HANDBOOK

of

CHEMISTRY

and

PHYSICS

TWENTY FIRST

EDITION

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HANDBOOK
OF
CHEMISTRY AND PHYSICS

A READY-REFERENCE BOOK OF CHEMICAL AND PHYSICAL DATA

TWENTY-FIRST EDITION

EDITOR IN CHIEF

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PREFACE

THE Handbook of Chemistry and Physics, continuing the policy of the past, is being revised at frequent intervals.

The general features and scheme of arrangement, which have received extensive endorsement in former editions have been retained. The aim throughout has been to present in condensed form as large an amount of accurate, reliable and up-to-date information in the fields of chemistry and physics as was consistent with convenience in form and the possibility of wide utility and distribution. A very large proportion of the tables have been compiled especially for the Handbook from various authoritative collections of data and from the current journals.

Since the beginning special consideration has been given to the requests and suggestions of those who have used former editions. In this way it has been hoped to develop the book along lines most acceptable to those interested in a volume of this type. Suggestions and contributions are received each year from many eminent chemists and physicists including members of the teaching profession and those engaged in industrial work. We believe this coöperation to have been of very great value in the growth and development of the work.

An attempt has been made to include material on all branches of chemistry and physics and the closely allied sciences, which would be likely to find any extended use. On the other hand, in order to retain the convenience of moderate dimensions and at the same time allow for natural growth due to the extension of knowledge in these sciences, and logical additions along lines already developed, it has seemed necessary to exclude types of material of use only in certain highly specialized lines of work.

Chemistry and physics, always closely related sciences, have been brought into much more intimate relations by the more recent developments of research. To an increasing extent the student of either science should have a knowledge of the other. It would seem that there should be a large field for a single volume containing the constants and formulæ of the two sciences together with mathematical and conversion tables adequate for

accurate computation. The generous response which the previous editions have met indicates that the volumes have been found useful and it is with the hope of even more completely meeting the needs of the chemists and physicists of the English-speaking world that succeeding editions are offered.

CHEMICAL RUBBER PUBLISHING CO.

CLEVELAND, OHIO

PREFACE TO THE TWENTY-FIRST EDITION

The Twenty-First Edition of the Handbook of Chemistry and Physics represents an increase in number of pages over the preceding edition of only 64. There are, however, over 175 pages of new composition entailed by complete revision of several important tables.

The mathematical section presents several new features. The numerical table of former editions has been replaced by a new and improved form. It now appears in two parts, the first of which gives the reciprocals and the circumference and the area of circles. The second part is devoted wholly to squares, cubes and roots, and all values are given to at least seven significant figures. The square roots of $10n$ and the cube roots of $10n$ and of $100n$ are included.

A table of haversines and considerable material on statistics have been added, and the order of arrangement altered so as to place the four- and five-place logarithm tables at the front of the volume.

The collection of laboratory arts and recipes has been completely revised and enlarged by material sent in by a large number of contributors in charge of or associated with educational or commercial laboratories.

The photographic section has been much enlarged and includes a large variety of new formulae and a completely revised table of plate and film speeds given in the Scheiner and in the Weston systems.

The increasing availability and widespread utilization of commercial plastics makes particularly appropriate the new and unusually complete collection of data for this class of material. The table occupies 17 pages and covers a very wide range of properties.

PREFACE TO THE TWENTY-FIRST EDITION

A revised table of isotopes brings up to date the information in this rapidly changing field.

Increased convenience in the reduction of gas volume to standard conditions will result from the use of the new special table giving both the factors and their logarithms for such reductions.

Several other small tables have been added and a large number of minor changes and partial revisions have been made.

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The Publishers and Editor will be grateful to readers of this Handbook who will call their attention to errors which may be discovered. Suggestions for improvement are also welcome.
CHEMICAL RUBBER PUBLISHING COMPANY

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LIGHT

QUANTITIES AND UNITS

Sodium Hydroxide or Potassium Hydroxide.—Vinegar, lemon juice, orange juice, oil, milk.

Sulfuric Acid.——Same as for hydrochloric acid with the addition of soap or oil.

Sulfurous Acid or Sulfur Dioxide.—Mustard plaster on chest; narcotics, expectorants.

Wood Alcohol (Methyl Alcohol or Methanol).–Emetic or wash out stomach (stomach tube) with a solution of 10 grains sodium citrate per ounce of water. Give milk, white of egg or flour in water; purgative of magnesium sulfate (15 grams); stimulate and combat collapse. In case of cardiac or pulmonary failure use artificial respiration. Physicians may administer atropine, digitalin or strychnine as stimulants; to cause perspiration and elimination of the poison use 0.1 grain of pilocarpine hydrochloride.

BURNS AND SCALDS

Exclude air by thin paste of starch, flour, or baking soda. Ordinary oils such as vaseline, olive or castor oil, lard or cream may also be used. Lime water mixed with an equal part of raw linseed oil makes an excellent dressing. An especially valuable material for all burns is picric acid gauze which may be applied in the form of a compress.

After treatment with any of the above materials, cover with a cloth or with cotton and hold in place with a light bandage.

Apply a freshly prepared 5% tannic acid solution. Place several layers of sterile gauze over the burned area, saturate with the tannic acid solution and bandage loosely.

ACID AND ALKALI BURNS

With either, wash off as quickly as possible with a large quantity of water. Water from a tap may be allowed to flow over burns.

Acids

While the injury is being washed, have procured lime water or lime water and raw linseed oil mixed together in equal proportions or a mixture of baking soda and water or soap suds and apply freely. For acid in the eye wash as quickly as possible with water and then with lime water.

Alkalis

Wash with a large quantity of water as for acid burns. Neutralize with weak vinegar, hard cider or lemon juice. For lime or other strong alkali burns in the eye wash with weak solution of vinegar or with olive oil or a saturated solution of boric acid.

FIRE PRECAUTIONS AND CHEMICAL HAZARDS

Acetone.—Dilute with a spray of water to avoid spread of burning liquid. Use suitable gas mask.

Alcohol.—See under acetone.

Ammonia.—Use water and dilute acid. Use suitable gas mask.

Benzol or Benzene.—Use water to cool containers which are endangered; extinguish flame with sand, earth, fire-foam or carbon tetrachloride fire extinguishers. Use suitable gas mask.

Calcium Carbide.—Do not use water as this generates acetylene, an inflammable and explosive gas; cut off electric current to avoid ignition of gas. Remove containers to a dry place. Use gas mask.

Carbon Disulfide.—Use water to cool containers which are endangered; extinguish blaze with sand, earth, fire-foam or carbon tetrachloride fire extinguishers. Use suitable gas mask.

Carbon Tetrachloride.—Do not use a fire extinguisher filled with carbon tetrachloride (pyrene or carbona) on flames caused by an electrical short circuit in a confined space; the carbon tetrachloride may be decomposed into toxic gases.

Celluloid.—Use large volumes of water and sand. The smoke contains oxides of nitrogen which are injurious. Use suitable gas mask.

Chlorine.—Spray with water. The pungent nature of the gas makes the use of a gas mask imperative.

Collodion.—See under carbon disulfide.

Ether.—See under carbon disulfide.

Gasoline.—See under carbon disulfide.

Hydrochloric Acid.—Use large volumes of water also chalk or soda. Use gas mask.

Hydrocyanic or Prussic Acid.—Suitable gas mask is essential because of the extremely poisonous nature of the vapors. Provide ventilation.

Lacquer Solvents.—See under carbon disulfide.

Magnesium.—Do not use water. Use sand or earth to extinguish flames. Remove containers to a dry place.

Nitric Acid and Oxides of Nitrogen.—Use large volumes of water. Do not use sand or earth. Use gas mask.

Potassium.—Do not use water. Remove containers to a dry place. Extinguish flames with sand or earth. For storage, potassium is kept immersed in petroleum.

Potassium Hydroxide.—Use large volumes of water or dilute acids.

Phosphorus.—Use water and wet sand. Use gas mask. For storage, white phosphorus must be kept immersed in water. Red phosphorus is less dangerous.

Sodium.—See under potassium.

Sodium Hydroxide.—See under potassium hydroxide.

Sulfur.—Extinguish with water or sand. Use gas mask.

Sulfuric Acid.—See under hydrochloric acid.

Turpentine.—See under acetone.

MATHEMATICAL TABLES

USE OF MATHEMATICAL TABLES

For a complete discussion of the principles and use of mathematical tables, textbooks on the subject should be consulted. The following brief statements are intended to give only sufficient information to make possible the intelligent use of the tables, omitting for the most part any attempt at treating the theory and principles.

Exponential Method of Expressing Numbers—For convenience in writing and manipulation, numbers are often expressed as factors of appropriate powers of 10. The following examples will illustrate:

2,380,000,000.	may be written	2.38×10^9
238.	may be written	2.38×10^2
.238	may be written	2.38×10^{-1}
.000000238	may be written	2.38×10^{-7}

Logarithms—The logarithm of a number is the exponent of that power to which another number, the base, must be raised to give the number first named. Any positive number greater than 1 might serve as a base. Two have been selected, yielding two systems of logarithms. One base, 2.718 . . . . usually indicated by the letter e, gives rise to a system of logarithms convenient in higher mathematics. These are called natural, Napierian, or hyperbolic logarithms. Reference will be made to their use in a subsequent paragraph.

The other base used is 10, giving logarithms particularly adapted to use in computation, called common or Briggian logarithms. Tables of logarithms given without designation are invariably of this latter type.

Since most numbers are incommensurable powers of ten, a common logarithm, in general, consists of an integer which is called the characteristic and an endless decimal, the mantissa.

It is to be observed that the common logarithms of all numbers expressed by the same figures in the same order with the decimal point in different positions have different characteristics but the same mantissa. To illustrate:—if the decimal point stand after the first figure of a number, counting from the left, the characteristic is 0; if after two figures, it is 1; if after three figures, it is 2, and so forth. If the decimal point stand before the first significant figure the characteristic is -1, usually written $\bar{1}$; if there is one zero between the decimal point and the first significant figure it is $\bar{2}$ and so on. For example: $\log 256 = 2.40824$, $\log 2.56 = 0.40824$, $\log 0.256 = \bar{1}.40824$, $\log 0.00256 = \bar{3}.40824$. The two latter are often written $\log 0.256 = 9.40824 - 10$, $\log 0.00256 = 7.40824 - 10$.

A method of determining characteristics of logarithms is to write the number with one figure to the left of the decimal point multiplied by the appropriate power of 10. The characteristic is then the exponent used. For example:

$$256{,}000{,}000 = 2.56 \times 10^{8} \quad \log = 8.40824$$
$$0.000000256 = 2.56 \times 10^{-7} \quad \log = \bar{7}.40824 \text{ or } 3.40824-10$$

Inasmuch as the characteristic may be determined by inspection the mantissas only are given in tables of common logarithms.

To find the logarithm of a number:

For a number of four figures, take out the tabular mantissa on a line with the first three figures of the number and under its fourth figure. The characteristic is determined as previously explained.

For a number of less than four figures, supply zeros to make a four figure number and take the value of the mantissa from the tables as before. For example: log 2 = log 2.000 = 0.30103.

For a number of more than four figures, take the tabular value of the mantissa for the first four figures; find the difference between this mantissa and the next greater tabular mantissa and multiply the difference so found by the remaining figures of the number as a decimal and add the product to the mantissa of the first four figures. For example: to find log 46.762.

$$\log 46.76 = 1.66987$$

Tabular difference between this mantissa and that for 4677 is .00010.

$$\begin{aligned} \therefore \log 46.762 &= 1.66987 + .2 \times .00010 \\ &= 1.66987 + .00002 \\ &= 1.66989 \end{aligned}$$

To find the number corresponding to a given logarithm:

If the mantissa is found exactly in the table, join the figure at the top which is directly above the given mantissa to the three figures on the line at the left and place the decimal point according to the characteristic of the logarithm. For example, $\log^{-1}$ (antilogarithm) 3.39967 = 2510.

If the mantissa is not found exactly in the table it is necessary to interpolate. For example, $\log^{-1} 3.40028 = 2513. + {}^{9}/_{18} = 2513.5$.

The column of proportional parts at the right of each page of the table shows, under the heading of the various tabular differences, the parts of these differences which correspond to the digits from 1 to 9 in the fifth place. This makes it possible to take out a logarithm for a five figure number or to find an antilogarithm of the same number of significant figures with increased facility, usually by inspection.

The following formulae express the relations on which the use of logarithms is based:

$$\log ab = \log a + \log b$$

$$\log \frac{a}{b} = \log a - \log b$$

$$\log a^n = n \times \log a$$

$$\log \sqrt[n]{a} = \frac{\log a}{n}.$$

The following examples will serve as illustrations:

1. $52600 \times 0.00381 \times 2.74 = 549.1$

$$\begin{aligned} \log 52600 &= 4.72099 \\ \log 0.00381 &= \bar{3}.58092 \\ \log 2.74 &= 0.43775 \\ \hline \text{Sum:} &= 2.73966 \\ \text{Antilogarithm} &= 549.1 \end{aligned}$$

The sum is the logarithm of the product, the mantissa of which is 73966. On looking up this mantissa in the logarithm tables we see that it corresponds to the digits 5491. The characteristic is 2, hence there are three figures before the decimal point. The number corresponding to the logarithm, called the antilogarithm, is 549.1.

2. $0.00123 \div 52.7 = 0.00002334$ An Alternative method:

log 0.00123	$= \bar{3}.08991$	log 0.00123	$= 7.08991 - 10$
log 52.7	$= 1.72181$	log 52.7	$= 1.72181$
Subtracting	$\bar{5}.36810$		$5.36810 - 10$
Antilog	0.00002334		

The characteristic $\bar{5}$ (5. −10) shows four zeros after the decimal point before the first significant figure.

3. $\dfrac{273 \times 780}{292 \times 760} \times 15 \times 0.09 = 1.295$

log 273	= 2.43616	log 292	= 2.46538
log 780	= 2.89209	log 760	= 2.88081
log 15	= 1.17609	log denominator	= 5.34619
log 0.09	$= \bar{2}.95424$		
log sum	= 5.45858		

$$\begin{aligned} \text{log numerator} &= 5.45858 \\ \text{log denominator} &= 5.34619 \\ \hline \text{subtracting} &= 0.11239 \\ \text{antilogarithm} &= 1.295 \end{aligned}$$

As division may be accomplished by multiplying by the reciprocal of a number, the above may be considerably simplified. The logarithm of the reciprocal of a number, called the cologarithm, is readily obtained from the table by subtracting the logarithm of the number from zero. This may readily be read off from the table of mantissas. Change the sign of the characteristic algebraically adding to it -1, then mentally subtract each figure of the mantissa from 9 proceeding from left to right, the last figure being subtracted from 10. The example then is:

$$
\begin{array}{lrl}
\log & 273 & = 2.43616 \\
\log & 780 & = 2.89209 \\
\log & 15 & = 1.17609 \\
\log & 0.09 & = \bar{2}.95424 \\
\text{colog} & 292 & = \bar{3}.53462 \\
\text{colog} & 760 & = \bar{3}.11919 \\
\hline
 & & \ 0.11239
\end{array}
$$

4. $(0.00098)^4 = 9.224 \times 10^{-13}$

$$
\begin{array}{lrl}
\log 0.00098 & = \bar{4}.99123 & \\
 & 4 & \\
\hline
 & 3.96492 & (a) \\
\bar{4} \times 4 & \overline{16}. & (b) \\
\hline
\log (0.00098)^4 = & \overline{13}.96492 & \\
\text{antilog} = 9.224 \times 10^{-13} & & (c)
\end{array}
$$

An alternative method:

$$
\begin{array}{rl}
\log 0.00098 = & 6.99123-10 \\
 & 4 \\
\hline
 & 27.96492-40 \\
\text{or} & 7.96492-20 \\
\text{or} & \overline{13}.96492 \\
\text{antilog} = & 9.224 \times 10^{-13}
\end{array}
$$

In the above it will be noted that the mantissa is always positive hence the multiplication of the mantissa shown at (a) while (b) shows the multiplication of the characteristic. (c) is the algebraic sum.

5. $\sqrt[5]{492} = 3.455$

$\log 492 = 2.69197$

Dividing the logarithm by 5 gives as the logarithm of the root 0.53839 the antilogarithm of which is 3.455 both characteristic and mantissa being positive. When the characteristic is negative and not evenly divisible by the root to be taken a modification of the logarithm is necessary.

6. $\sqrt[3]{0.000372} =$

$$
\begin{array}{rll}
\log 3.72 \times 10^{-4} = & \bar{4}.57054 & (a) \\
= & 26.57054-30 & (b)
\end{array}
$$

dividing (b) by 3 gives $8.85685-10$ which may be written

$\bar{2}.85685$ and is the logarithm of the root sought, the antilogarithm of which is 0.07192.

7. $0.000372^{1.2} = 0.000076674$

$$
\begin{aligned}
\log 0.000372 &= \bar{4}.57054 \\
&\text{or } 6.57054-10 \\
&\qquad\qquad 1.2 \\
\hline
&\quad 7.88465-12 \\
\text{antilogarithm} &\ 0.000076674
\end{aligned}
$$

Four-Place Logarithms—This short table on two facing pages makes possible logarithmic computation precise to four significant figures, (three without interpolation). The mantissa is given complete and the proportional parts indicated for each line.

Four-Place Antilogarithms—Some computers prefer to use separate tables for determining antilogarithms; the table being entered from the margins with the logarithm and the number being found in the body of the table. Such a table is given to accompany the four-place logarithms.

Five-Place Logarithms—For computation involving five significant figures, (four without interpolation) the five-place table will be adequate. Since the first two figures will be the same for several lines of the table they are given in the first line only. The point at which these first two figures change is indicated by an asterisk. While space does not permit the proportional parts for each line, tables will be found for each tabular difference.

The supplementary table following the five-place logarithms, giving seven-place logarithms for numbers of five significant figures from 10,000 to 12,000 will be found convenient to increase precision and avoid the inconvenience of interpolation where the differences are large.

Logarithms of the Trigonometric Functions—Logarithms of the functions are given for each minute from 0-360°.

The quantity -10 is to be appended to all logarithms of the sine and cosine, to logarithms of the tangent from 0-45° and of the cotangent from 45-90°.

With degrees indicated at either side of the top of the page use the column headings at the top. With degrees stated at the bottom of the page use the column designations at the bottom.

With degrees at the left (top or bottom) use the minute column at the left, and with degrees on the right side of the page use the minute column at the right.

To illustrate the proper employment of headings for angles in the four quadrants—

log sin 6° 24′ = 9.04715 − 10	log sin 186° 24′ = 9.04715 − 10
log sin 83° 15′ = 9.99698 − 10	log sin 263° 15′ = 9.99698 − 10
log cos 96° 41′ = 9.06589 − 10	log cos 276° 41′ = 9.06589 − 10
log cos 173° 49′ = 9.99747 − 10	log cos 353° 49′ = 9.99747 − 10

For the accurate determination of values where the tabular differences are large, the values of CS and CT are given. The following equations indicate their use.

To find the logarithm of the functions of an angle:

For angles 0–3°	For angles 87–90°
$\log\sin\theta = \log\theta'' - CS$	$\log\cos\theta = \log(90° - \theta)'' - CS$
$\log\tan\theta = \log\theta'' - CT$	$\log\cot\theta = \log(90° - \theta)'' - CT$
$\log\cot\theta = \text{colog}\tan\theta$	$\log\tan\theta = \text{colog}\cot\theta$

To find the angle:

For angles 0–3°	For angles 87–90°
$\log\theta'' = \log\sin\theta + CS$	$\log(90° - \theta)'' = \log\cos\theta + CS$
$\log\theta'' = \log\tan\theta + CT$	$\log(90° - \theta)'' = \log\cot\theta + CT$

In the above expressions, θ'' and $(90° - \theta)''$ are used to indicate the value of the angles expressed in seconds. The values in the body of the table are the cologarithms and should be used as indicated above.

The values of the logarithms S and T are also given in a separate table. For these the following relations hold:

To find the functions of an angle.

$\log\sin\theta = \log\theta'' + S$	$\log\cos\theta = \log(90° - \theta)'' + S$
$\log\tan\theta = \log\theta'' + T$	$\log\cot\theta = \log(90° - \theta)'' + T$

To find the angle.

$\log\theta'' = \log\sin\theta - S$	$\log(90° - \theta)'' = \log\cos\theta - S$
$\log\theta'' = \log\tan\theta - T$	$\log(90° - \theta)'' = \log\cot\theta - T$

Where the values of CS and CT are given, the angles expressed in seconds are given in the supplementary column at the left.

The tabular differences are given under the headings "d" and "c.d.", the latter referring to the common difference for the tangent and cotangent. Tables of proportional parts ("P.P.") facilitate interpolation. At the bottom of each column will be found special proportional parts between the tabular differences for the tangent or cotangent and those for the sine or cosine. These are useful when one function is to be obtained directly from the other without determining the angle.

For example, suppose log tan θ is given as 9.67644 and log cos θ is required. The difference between the given logarithm and that given in the table, 9.67622 (opposite 25° 23′), is 22.

The tabular differences of the two logarithmic functions at this place are 32 and 6. In the proportional table for $\frac{6}{32}$, 22 corresponds to 4; this, subtracted from the tabular logarithmic cosine 9.95591, gives the required log cos θ = 9.95587.

The symbols $\bar{5}$ and $\dot{5}$ are used to indicate how the terminal 5 has been derived. For example, the logarithm 8.8307$\bar{5}$ is more fully given as 8.8307495 while the value 9.4082$\dot{5}$ is derived from 9.4082539.

Natural Trigonometric Functions—Values of the natural trigonometric functions of angles are given for each minute from 0–360°.

For degrees indicated at the top of the page use the column headings at the top. For degrees indicated at the bottom use the column indications at the bottom.

With degrees at the left of each block (top or bottom), use the minute column at the left and with degrees at the right of each block use the minute column at the right.

Natural Functions and their Logarithms are given for angles in degrees and tenths from 0 to 90 degrees.

Natural Functions and their Logarithms are given for angles in radians and hundredths, from 0 to 2 radians.

Haversines—Values of $(1 - \cos\theta)/2$ for angles between 0 and 180° are given to four significant figures. The four-place mantissas of the logarithms of the haversines are also given. The correct characteristic must be provided in each case.

The listed values of the haversines were derived from values which were computed to seven significant figures. The logarithms were independently derived from the more exact values of the haversines and are, therefore, in many cases not the exact value of the logarithm of the haversine as listed. This is notably true at the beginning of the table where the logarithm can be given with more exactness than the function.

Natural Logarithms—The natural logarithms of numbers are presented in a group of tables. To find logarithms not included in the tables, the following method is used:

To find the logarithm of a number which is $\frac{1}{10}$ or 10 times etc. a number whose logarithm is given, subtract from or add to the given logarithm the logarithm of 10.

$$\text{Thus } \log 1.6 = \log 16 - \log 10$$
$$\log 160 = \log 16 + \log 10 \text{ etc.}$$

Table **A** gives logarithms of numbers from 0.00 to 0.99. −10 should be appended to each. For instance: $\log_e 0.48 = 9.266 - 10$

Table **B** gives logarithms of numbers from 1.00 to 10.09. For example: $\log_e 4.86 = 1.58104$

Table **C** gives logarithms of numbers from 10 to 99. For example: $\log_e 48 = 3.87120$

Table **D** gives logarithms of numbers from 100 to 1109. For example: $\log_e 486 = 6.18621$

Exponential Functions—Values of e^x, $\log e^x$ and e^{-x} where e is the base of the natural system of logarithms 2.71828 . . . and x has values from 0 to 10. Facilitating the solution of exponential equations, these tables also serve as a table of natural or Naperian antilogarithms. For instance if the logarithm or exponent $x = 3.26$ the corresponding number or value of e^x is 26.050. Its reciprocal e^{-x} is .038388.

Hyperbolic Functions—The table gives the values and logarithms of the hyperbolic sine x, cosine x, tangent x and cotangent x for values of x from 0 to 5.

Degrees-Radians—This table gives the value in radians to five significant figures; for each 10 minutes from 0° 0′ to 90° 0′; for each degree from 90 to 180; for each 10 degrees from 180 to 480. Values are also given for each minute from 0–60′ and for each second from 0–60″.

Tables are also provided to facilitate changing from degrees and decimal fractions to radians, from decimal fractions of a degree to minutes and seconds and the reverse operations.

Numerical Tables—The first section gives the reciprocals of numbers from 0 to 1000 and circumferences and areas of circles with diameters having these values. Reciprocals and circumferences for values not listed can be obtained by an appropriate shift of the decimal point.

The second section is devoted to squares, cubes and roots. The squares and cubes from 1 to 1000 are given exactly. The roots are given to seven significant figures. Since the square roots of $10n$ are given, values of the square roots from 1 to 10,000 may be found directly. For the square roots of numbers below and above this range, use may be made of the following relations: $\sqrt{100n} = 10\sqrt{n}$; $\sqrt{1000n} = 10\sqrt{10n}$; $\sqrt{\frac{1}{10}n} = \frac{1}{10}\sqrt{10n}$; $\sqrt{\frac{1}{100}n} = \frac{1}{10}\sqrt{n}$; $\sqrt{\frac{1}{1000}n} = \frac{1}{100}\sqrt{10n}$. For example, the square root of 0.268 may be found by using the form, $\sqrt{0.268} = \frac{1}{100}\sqrt{10 \times 268}$. The tabular value for the square root of $10n$ for 268 is 51.76872. Hence, the desired root is 0.5176872.

Values of cube roots for all numbers from 1 to 100,000 will be found directly in the table. Cube roots for numbers above or below this range will be found from the following relations: $\sqrt[3]{1000n} = 10\sqrt[3]{n}$; $\sqrt[3]{10{,}000n} = 10\sqrt[3]{10n}$; $\sqrt[3]{100{,}000n} = 10\sqrt[3]{100n}$; $\sqrt[3]{\frac{1}{10}n} = \frac{1}{10}\sqrt[3]{100n}$; $\sqrt[3]{\frac{1}{100}n} = \frac{1}{10}\sqrt[3]{10n}$; $\sqrt[3]{\frac{1}{1000}n} = \frac{1}{10}\sqrt[3]{n}$. For example, the cube root of 731,000 may be found

by using the form, $\sqrt[3]{731.000} = 10\sqrt[3]{731}$. The tabular value of the root for 731 is 9.008223. The desired root is, therefore, 90.08223.

Powers of Numbers—This table is given to supplement the values of squares and cubes of numbers found in the preceding numerical table. The larger numbers are expressed exponentially to at least seven significant figures. The approximate value written as a whole number may be obtained by shifting the decimal point to the right by the number of places indicated in the exponent of 10 shown at the head of each group of values. For example: the approximate value of 33^8 is found in the table as 14.064086×10^{11}. Written as a whole number it is 1,406,408,600,000.

Factorials and their Logarithms—The product $n \times (n - 1) \times (n - 2) \times \cdots \times 1$ is called factorial n, expressed as $n!$ or $\underline{|n}$. For example: factorial $5 = 5 \times 4 \times 3 \times 2 \times 1 = 120$. Factorials are very often met with in series. For purposes of computation in such cases the table giving the values of the factorials and of their logarithms for numbers from 1 to 100 is provided. The values of the factorials are expressed exponentially to 5 significant figures.

A brief table of exact values and reciprocals of factorials is to be found on page 140.

Factors for Computing Probable Errors—The probable error of a series of n measures $a_1, a_2, a_3 \ldots a_n$, the mean of which is m, is given by the expression,

$$e = \frac{0.6745}{\sqrt{n-1}}\sqrt{(m - a_1)^2 + (m - a_2)^2 + \cdots (m - a_n)^2}$$

The probable error of the mean is,

$$E = \frac{0.6745}{\sqrt{n(n-1)}}\sqrt{(m - a_1)^2 + (m - a_2)^2 + \cdots (m - a_n)^2}$$

The following approximate equations are convenient forms for computation,

$$e = 0.8453\frac{\Sigma d}{\sqrt{n(n-1)}}$$

$$E = 0.8453\frac{\Sigma d}{n\sqrt{n-1}}$$

The symbol Σd represents the arithmetical sum of the deviations.

For convenience in computing the probable error the value of several of the factors involved is given for values of n from 2 to 100.

Probability of Occurrence of Deviations—The significance of deviations is indicated by this table. The probability of occurrence of deviations as great as or greater than any specific value is given for various ratios of deviation to probable error and also with respect to the standard deviation σ. The probability of occurrence is stated in per cent or chances in 100. The odds against occurrence are also stated. The probable error is $0.6745 \times (\sigma)$.

Areas, Ordinates and Derivatives of the Normal Curve of Error—If, for a large number of observations, the frequency y, of the occurrence of an error of magnitude t be plotted, a curve results whose equation may be written,

$$y = \frac{1}{\sqrt{2\pi}} e^{-t^2/2}$$

The area, ordinates and derivatives for this curve given in the table are useful in the treatment of observational data. A text on statistical methods should be consulted for a complete explanation.

Factors and Primes—The table presents the prime factors of *all* factorable numbers and the logarithms of all prime numbers from 1 to 2000.

Interest Tables—The equations involved in the computation and use of the interest tables are collected at the beginning of this section. For further explanation the reader is referred to a textbook of the mathematics of finance or investment. A much more complete set of interest tables is to be found in "Tables of Applied Mathematics in Finance, Insurance, Statistics," edited by James W. Glover.

FOUR-PLACE

N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
											Proportional Parts								
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	*4	8	12	17	21	25	29	33	[illegible]
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	[illegible]
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	*3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

* Interpolation in this section of the table is inaccurate.

LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

ANTILOGARITHMS

	0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5	6	7	8	9
.00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	1	2	2	2
.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2
.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	2	2	2
.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1	1	2	2	2
.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1	2	2	2	2
.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1	2	2	2	2
.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1	2	2	2	2
.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1	2	2	2	2
.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	2	2	2	3
.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	2	2	2	3
.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	2	2	2	3
.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	2	2	2	2	3
.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	2	2	2	2	3
.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	2	2	2	3	3
.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	2	2	2	3	3
.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	2	2	2	3	3
.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	2	2	2	3	3
.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	2	2	2	3	3
.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	2	2	2	3	3
.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	2	2	3	3	3
.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	2	2	3	3	3
.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	2	2	2	3	3	3
.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	2	2	2	3	3	3
.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	2	2	2	3	3	4
.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	2	2	2	3	3	4
.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	2	2	2	3	3	4
.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	2	2	3	3	3	4
.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	2	2	3	3	3	4
.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	2	2	3	3	4	4
.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	2	2	3	3	4	4
.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2	3	3	4	4
.31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2	3	3	4	4
.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2	3	3	4	4
.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2	3	3	4	4
.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3	3	4	4	5
35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3	3	4	4	5
.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3	3	4	4	5
.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	5	5
.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	5
.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	5
42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	6
43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	6
.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	6
.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3	4	5	5	6
46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3	4	5	5	6
.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3	4	5	5	6
.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	4	4	5	6	6
.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4	4	5	6	6
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

ANTILOGARITHMS

											Proportional Parts								
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	6	7
.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	2	2	3	4	5	5	6	7
.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	2	2	3	4	5	5	6	7
.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4	5	6	6	7
.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4	5	6	6	7
.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4	5	6	7	7
.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	3	3	4	5	6	7	8
.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4	5	6	7	8
.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	4	4	5	6	7	8
.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5	5	6	7	8
.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5	6	6	7	8
.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5	6	7	8	9
.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	2	3	4	5	6	7	8	9
.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5	6	7	8	9
.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	2	3	4	5	6	7	8	9
.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5	6	7	8	9
.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5	6	7	9	10
.67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	2	3	4	5	7	8	9	10
.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	2	3	4	6	7	8	9	10
.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6	7	8	9	10
.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11
.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6	8	9	10	11
.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6	8	9	10	12
.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7	8	9	10	12
.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7	8	9	11	12
.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7	8	10	11	12
.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7	8	10	11	13
.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7	9	10	11	13
.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7	9	10	12	13
.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8	9	11	12	14
.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8	9	11	12	14
.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8	9	11	13	14
.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	6	8	10	11	13	15
.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8	10	12	13	15
.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8	10	12	13	15
.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	3	5	7	9	10	12	14	16
.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9	11	12	14	16
.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	5	7	9	11	13	14	16
.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	13	15	17
.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	8	11	13	15	17	19
.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11	14	16	18	20
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

FIVE-PLACE LOGARITHMS

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts			
100	00 000	043	087	130	173	217	260	303	346	389		**44**	**43**	**42**
101	432	475	518	561	604	647	689	732	775	817	1	4,4	4,3	4,2
102	860	903	945	988	*030	*072	*115	*157	*199	*242	2	8,8	8,6	8,4
103	01 284	326	368	410	452	494	536	578	620	662	3	13,2	12,9	12,6
104	703	745	787	828	870	912	953	995	*036	*078	4	17,6	17,2	16,8
105	02 119	160	202	243	284	325	366	407	449	490	5	22,0	21,5	21,0
106	531	572	612	653	694	735	776	816	857	898	6	26,4	25,8	25,2
107	938	979	*019	*060	*100	*141	*181	*222	*262	*302	7	30,8	30,1	29,4
108	03 342	383	423	463	503	543	583	623	663	703	8	35,2	34,4	33,6
109	743	782	822	862	902	941	981	*021	*060	*100	9	39,6	38,7	37,8
110	04 139	179	218	258	297	336	376	415	454	493		**41**	**40**	**39**
111	532	571	610	650	689	727	766	805	844	883	1	4,1	4,0	3,9
112	922	961	999	*038	*077	*115	*154	*192	*231	*269	2	8,2	8,0	7,8
113	05 308	346	385	423	461	500	538	576	614	652	3	12,3	12,0	11,7
114	690	729	767	805	843	881	918	956	994	*032	4	16,4	16,0	15,6
115	06 070	108	145	183	221	258	296	333	371	408	5	20,5	20,0	19,5
116	446	483	521	558	595	633	670	707	744	781	6	24,6	24,0	23,4
117	819	856	893	930	967	*004	*041	*078	*115	*151	7	28,7	28,0	27,3
118	07 188	225	262	298	335	372	408	445	482	518	8	32,8	32,0	31,2
119	555	591	628	664	700	737	773	809	846	882	9	36,9	36,0	35,1
120	918	954	990	*027	*063	*099	*135	*171	*207	*243		**38**	**37**	**36**
121	08 279	314	350	386	422	458	493	529	565	600	1	3,8	3,7	3,6
122	636	672	707	743	778	814	849	884	920	955	2	7,6	7,4	7,2
123	991	*026	*061	*096	*132	*167	*202	*237	*272	*307	3	11,4	11,1	10,8
124	09 342	377	412	447	482	517	552	587	621	656	4	15,2	14,8	14,4
125	691	726	760	795	830	864	899	934	968	*003	5	19,0	18,5	18,0
126	10 037	072	106	140	175	209	243	278	312	346	6	22,8	22,2	21,6
127	380	415	449	483	517	551	585	619	653	687	7	26,6	25,9	25,2
128	721	755	789	823	857	890	924	958	992	*025	8	30,4	29,6	28,8
129	11 059	093	126	160	193	227	261	294	327	361	9	34,2	33,3	32,4
130	394	428	461	494	528	561	594	628	661	694		**35**	**34**	**33**
131	727	760	793	826	860	893	926	959	992	*024	1	3,5	3,4	3,3
132	12 057	090	123	156	189	222	254	287	320	352	2	7,0	6,8	6,6
133	385	418	450	483	516	548	581	613	646	678	3	10,5	10,2	9,9
134	710	743	775	808	840	872	905	937	969	*001	4	14,0	13,6	13,2
135	13 033	066	098	130	162	194	226	258	290	322	5	17,5	17,0	16,5
136	354	386	418	450	481	513	545	577	609	640	6	21,0	20,4	19,8
137	672	704	735	767	799	830	862	893	925	956	7	24,5	23,8	23,1
138	988	*019	*051	*082	*114	*145	*176	*208	*239	*270	8	28,0	27,2	26,4
139	14 301	333	364	395	426	457	489	520	551	582	9	31,5	30,6	29,7
140	613	644	675	706	737	768	799	829	860	891		**32**	**31**	**30**
141	922	953	983	*014	*045	*076	*106	*137	*168	*198	1	3,2	3,1	3,0
142	15 229	259	290	320	351	381	412	442	473	503	2	6,4	6,2	6,0
143	534	564	594	625	655	685	715	746	776	806	3	9,6	9,3	9,0
144	836	866	897	927	957	987	*017	*047	*077	*107	4	12,8	12,4	12,0
145	16 137	167	197	227	256	286	316	346	376	406	5	16,0	15,5	15,0
146	435	465	495	524	554	584	613	643	673	702	6	19,2	18,6	18,0
147	732	761	791	820	850	879	909	938	967	997	7	22,4	21,7	21,0
148	17 026	056	085	114	143	173	202	231	260	289	8	25,6	24,8	24,0
149	319	348	377	406	435	464	493	522	551	580	9	28,8	27,9	27,0
150	609	638	667	696	725	754	782	811	840	869				
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts			

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts		
150	17 609	638	667	696	725	754	782	811	840	869		**29**	**28**
151	898	926	955	984	*013	*041	*070	*099	*127	*156	1	2,9	2,8
152	18 184	213	241	270	298	327	355	384	412	441	2	5,8	5,6
153	469	498	526	554	583	611	639	667	696	724	3	8,7	8,4
154	752	780	808	837	865	893	921	949	977	*005	4	11,6	11,2
155	19 033	061	089	117	145	173	201	229	257	285	5	14,5	14,0
156	312	340	368	396	424	451	479	507	535	562	6	17,4	16,8
157	590	618	645	673	700	728	756	783	811	838	7	20,3	19,6
158	866	893	921	948	976	*003	*030	*058	*085	*112	8	23,2	22,4
159	20 140	167	194	222	249	276	303	330	358	385	9	26,1	25,2
160	412	439	466	493	520	548	575	602	629	656		**27**	**26**
161	683	710	737	763	790	817	844	871	898	925	1	2,7	2,6
162	952	978	*005	*032	*059	*085	*112	*139	*165	*192	2	5,4	5,2
163	21 219	245	272	299	325	352	378	405	431	458	3	8,1	7,8
164	484	511	537	564	590	617	643	669	696	722	4	10,8	10,4
165	748	775	801	827	854	880	906	932	958	985	5	13,5	13,0
166	22 011	037	063	089	115	141	167	194	220	246	6	16,2	15,6
167	272	298	324	350	376	401	427	453	479	505	7	18,9	18,2
168	531	557	583	608	634	660	686	712	737	763	8	21,6	20,8
169	789	814	840	866	891	917	943	968	994	*019	9	24,3	23,4
170	23 045	070	096	121	147	172	198	223	249	274		**25**	
171	300	325	350	376	401	426	452	477	502	528	1	2,5	
172	553	578	603	629	654	679	704	729	754	779	2	5,0	
173	805	830	855	880	905	930	955	980	*005	*030	3	7,5	
174	24 055	080	105	130	155	180	204	229	254	279	4	10,0	
175	304	329	353	378	403	428	452	477	502	527	5	12,5	
176	551	576	601	625	650	674	699	724	748	773	6	15,0	
177	797	822	846	871	895	920	944	969	993	*018	7	17,5	
178	25 042	066	091	115	139	164	188	212	237	261	8	20,0	
179	285	310	334	358	382	406	431	455	479	503	9	22,5	
180	527	551	575	600	624	648	672	696	720	744		**24**	**23**
181	768	792	816	840	864	888	912	935	959	983	1	2,4	2,3
182	26 007	031	055	079	102	126	150	174	198	221	2	4,8	4,6
183	245	269	293	316	340	364	387	411	435	458	3	7,2	6,9
184	482	505	529	553	576	600	623	647	670	694	4	9,6	9,2
185	717	741	764	788	811	834	858	881	905	928	5	12,0	11,5
186	951	975	998	*021	*045	*068	*091	*114	*138	*161	6	14,4	13,8
187	27 184	207	231	254	277	300	323	346	370	393	7	16,8	16,1
188	416	439	462	485	508	531	554	577	600	623	8	19,2	18,4
189	646	669	692	715	738	761	784	807	830	852	9	21,6	20,7
190	875	898	921	944	967	989	*012	*035	*058	*081		**22**	**21**
191	28 103	126	149	171	194	217	240	262	285	307	1	2,2	2,1
192	330	353	375	398	421	443	466	488	511	533	2	4,4	4,2
193	556	578	601	623	646	668	691	713	735	758	3	6,6	6,3
194	780	803	825	847	870	892	914	937	959	981	4	8,8	8,4
195	29 003	026	048	070	092	115	137	159	181	203	5	11,0	10,5
196	226	248	270	292	314	336	358	380	403	425	6	13,2	12,6
197	447	469	491	513	535	557	579	601	623	645	7	15,4	14,7
198	667	688	710	732	754	776	798	820	842	863	8	17,6	16,8
199	885	907	929	951	973	994	*016	*038	*060	*081	9	19,8	18,9
200	30 103	125	146	168	190	211	233	255	276	298			
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts		

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts		
200	30 103	125	146	168	190	211	233	255	276	298		**22**	**21**
201	320	341	363	384	406	428	449	471	492	514	1	2,2	2,1
202	535	557	578	600	621	643	664	685	707	728	2	4,4	4,2
203	750	771	792	814	835	856	878	899	920	942	3	6,6	6,3
204	963	984	*006	*027	*048	*069	*091	*112	*133	*154	4	8,8	8,4
205	31 175	197	218	239	260	281	302	323	345	366	5	11,0	10,5
206	387	408	429	450	471	492	513	534	555	576	6	13,2	12,6
207	597	618	639	660	681	702	723	744	765	785	7	15,4	14,7
208	806	827	848	869	890	911	931	952	973	994	8	17,6	16,8
209	32 015	035	056	077	098	118	139	160	181	201	9	19,8	18,9
210	222	243	263	284	305	325	346	366	387	408		**20**	
211	428	449	469	490	510	531	552	572	593	613	1	2,0	
212	634	654	675	695	715	736	756	777	797	818	2	4,0	
213	838	858	879	899	919	940	960	980	*001	*021	3	6,0	
214	33 041	062	082	102	122	143	163	183	203	224	4	8,0	
215	244	264	284	304	325	345	365	385	405	425	5	10,0	
216	445	465	486	506	526	546	566	586	606	626	6	12,0	
217	646	666	686	706	726	746	766	786	806	826	7	14,0	
218	846	866	885	905	925	945	965	985	*005	*025	8	16,0	
219	34 044	064	084	104	124	143	163	183	203	223	9	18,0	
220	242	262	282	301	321	341	361	380	400	420		**19**	
221	439	459	479	498	518	537	557	577	596	616	1	1,9	
222	635	655	674	694	713	733	753	772	792	811	2	3,8	
223	830	850	869	889	908	928	947	967	986	*005	3	5,7	
224	35 025	044	064	083	102	122	141	160	180	199	4	7,6	
225	218	238	257	276	295	315	334	353	372	392	5	9,5	
226	411	430	449	468	488	507	526	545	564	583	6	11,4	
227	603	622	641	660	679	698	717	736	755	774	7	13,3	
228	793	813	832	851	870	889	908	927	946	965	8	15,2	
229	984	*003	*021	*040	*059	*078	*097	*116	*135	*154	9	17,1	
230	36 173	192	211	229	248	267	286	305	324	342		**18**	
231	361	380	399	418	436	455	474	493	511	530	1	1,8	
232	549	568	586	605	624	642	661	680	698	717	2	3,6	
233	736	754	773	791	810	829	847	866	884	903	3	5,4	
234	922	940	959	977	996	*014	*033	*051	*070	*088	4	7,2	
235	37 107	125	144	162	181	199	218	236	254	273	5	9,0	
236	291	310	328	346	365	383	401	420	438	457	6	10,8	
237	475	493	511	530	548	566	585	603	621	639	7	12,6	
238	658	676	694	712	731	749	767	785	803	822	8	14,4	
239	840	858	876	894	912	931	949	967	985	*003	9	16,2	
240	38 021	039	057	075	093	112	130	148	166	184		**17**	
241	202	220	238	256	274	292	310	328	346	364	1	1,7	
242	382	399	417	435	453	471	489	507	525	543	2	3,4	
243	561	578	596	614	632	650	668	686	703	721	3	5,1	
244	739	757	775	792	810	828	846	863	881	899	4	6,8	
245	917	934	952	970	987	*005	*023	*041	*058	*076	5	8,5	
246	39 094	111	129	146	164	182	199	217	235	252	6	10,2	
247	270	287	305	322	340	358	375	393	410	428	7	11,9	
248	445	463	480	498	515	533	550	568	585	602	8	13,6	
249	620	637	655	672	690	707	724	742	759	777	9	15,3	
250	794	811	829	846	863	881	898	915	933	950			

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9	Proportional parts	
250	39	794	811	829	846	863	881	898	915	933	950		18
251		967	985	*002	*019	*037	*054	*071	*088	*106	*123	1	1,8
252	40	140	157	175	192	209	226	243	261	278	295	2	3,6
253		312	329	346	364	381	398	415	432	449	466	3	5,4
254		483	500	518	535	552	569	586	603	620	637	4	7,2
255		654	671	688	705	722	739	756	773	790	807	5	9,0
256		824	841	858	875	892	909	926	943	960	976	6	10,8
257		993	*010	*027	*044	*061	*078	*095	*111	*128	*145	7	12,6
258	41	162	179	196	212	229	246	263	280	296	313	8	14,4
259		330	347	363	380	397	414	430	447	464	481	9	16,2
260		497	514	531	547	564	581	597	614	631	647		17
261		664	681	697	714	731	747	764	780	797	814	1	1,7
262		830	847	863	880	896	913	929	946	963	979	2	3,4
263		996	*012	*029	*045	*062	*078	*095	*111	*127	*144	3	5,1
264	42	160	177	193	210	226	243	259	275	292	308	4	6,8
265		325	341	357	374	390	406	423	439	455	472	5	8,5
266		488	504	521	537	553	570	586	602	619	635	6	10,2
267		651	667	684	700	716	732	749	765	781	797	7	11,9
268		813	830	846	862	878	894	911	927	943	959	8	13,6
269		975	991	*008	*024	*040	*056	*072	*088	*104	*120	9	15,3
270	43	136	152	169	185	201	217	233	249	265	281		16
271		297	313	329	345	361	377	393	409	425	441	1	1,6
272		457	473	489	505	521	537	553	569	584	600	2	3,2
273		616	632	648	664	680	696	712	727	743	759	3	4,8
274		775	791	807	823	838	854	870	886	902	917	4	6,4
275		933	949	965	981	996	*012	*028	*044	*059	*075	5	8,0
276	44	091	107	122	138	154	170	185	201	217	232	6	9,6
277		248	264	279	295	311	326	342	358	373	389	7	11,2
278		404	420	436	451	467	483	498	514	529	545	8	12,8
279		560	576	592	607	623	638	654	669	685	700	9	14,4
280		716	731	747	762	778	793	809	824	840	855		15
281		871	886	902	917	932	948	963	979	994	*010	1	1,5
282	45	025	040	056	071	086	102	117	133	148	163	2	3,0
283		179	194	209	225	240	255	271	286	301	317	3	4,5
284		332	347	362	378	393	408	423	439	454	469	4	6,0
285		484	500	515	530	545	561	576	591	606	621	5	7,5
286		637	652	667	682	697	712	728	743	758	773	6	9,0
287		788	803	818	834	849	864	879	894	909	924	7	10,5
288		939	954	969	984	*000	*015	*030	*045	*060	*075	8	12,0
289	46	090	105	120	135	150	165	180	195	210	225	9	13,5
290		240	255	270	285	300	315	330	345	359	374		14
291		389	404	419	434	449	464	479	494	509	523	1	1,4
292		538	553	568	583	598	613	627	642	657	672	2	2,8
293		687	702	716	731	746	761	776	790	805	820	3	4,2
294		835	850	864	879	894	909	923	938	953	967	4	5,6
295		982	997	*012	*026	*041	*056	*070	*085	*100	*114	5	7,0
296	47	129	144	159	173	188	202	217	232	246	261	6	8,4
297		276	290	305	319	334	349	363	378	392	407	7	9,8
298		422	436	451	465	480	494	509	524	538	553	8	11,2
299		567	582	596	611	625	640	654	669	683	698	9	12,6
300		712	727	741	756	770	784	799	813	828	842		
N.		0	1	2	3	4	5	6	7	8	9	Proportional parts	

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9
300	47	712	727	741	756	770	784	799	813	828	842
301		857	871	885	900	914	929	943	958	972	986
302	48	001	015	029	044	058	073	087	101	116	130
303		144	159	173	187	202	216	230	244	259	273
304		287	302	316	330	344	359	373	387	401	416
305		430	444	458	473	487	501	515	530	544	558
306		572	586	601	615	629	643	657	671	686	700
307		714	728	742	756	770	785	799	813	827	841
308		855	869	883	897	911	926	940	954	968	982
309		996	*010	*024	*038	*052	*066	*080	*094	*108	*122
310	49	136	150	164	178	192	206	220	234	248	262
311		276	290	304	318	332	346	360	374	388	402
312		415	429	443	457	471	485	499	513	527	541
313		554	568	582	596	610	624	638	651	665	679
314		693	707	721	734	748	762	776	790	803	817
315		831	845	859	872	886	900	914	927	941	955
316		969	982	996	*010	*024	*037	*051	*065	*079	*092
317	50	106	120	133	147	161	174	188	202	215	229
318		243	256	270	284	297	311	325	338	352	365
319		379	393	406	420	433	447	461	474	488	501
320		515	529	542	556	569	583	596	610	623	637
321		651	664	678	691	705	718	732	745	759	772
322		786	799	813	826	840	853	866	880	893	907
323		920	934	947	961	974	987	*001	*014	*028	*041
324	51	055	068	081	095	108	121	135	148	162	175
325		188	202	215	228	242	255	268	282	295	308
326		322	335	348	362	375	388	402	415	428	441
327		455	468	481	495	508	521	534	548	561	574
328		587	601	614	627	640	654	667	680	693	706
329		720	733	746	759	772	786	799	812	825	838
330		851	865	878	891	904	917	930	943	957	970
331		983	996	*009	*022	*035	*048	*061	*075	*088	*101
332	52	114	127	140	153	166	179	192	205	218	231
333		244	257	270	284	297	310	323	336	349	362
334		375	388	401	414	427	440	453	466	479	492
335		504	517	530	543	556	569	582	595	608	621
336		634	647	660	673	686	699	711	724	737	750
337		763	776	789	802	815	827	840	853	866	879
338		892	905	917	930	943	956	969	982	994	*007
339	53	020	033	046	058	071	084	097	110	122	135
340		148	161	173	186	199	212	224	237	250	263
341		275	288	301	314	326	339	352	364	377	390
342		403	415	428	441	453	466	479	491	504	517
343		529	542	555	567	580	593	605	618	631	643
344		656	668	681	694	706	719	732	744	757	769
345		782	794	807	820	832	845	857	870	882	895
346		908	920	933	945	958	970	983	995	*008	*020
347	54	033	045	058	070	083	095	108	120	133	145
348		158	170	183	195	208	220	233	245	258	270
349		283	295	307	320	332	345	357	370	382	394
350		407	419	432	444	456	469	481	494	506	518
N.		0	1	2	3	4	5	6	7	8	9

Proportional parts

	15	**14**	**13**	**12**
1	1,5	1,4	1,3	1,2
2	3,0	2,8	2,6	2,4
3	4,5	4,2	3,9	3,6
4	6,0	5,6	5,2	4,8
5	7,5	7,0	6,5	6,0
6	9,0	8,4	7,8	7,2
7	10,5	9,8	9,1	8,4
8	12,0	11,2	10,4	9,6
9	13,5	12,6	11,7	10,8

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
350	54 407	419	432	444	456	469	481	494	506	518
351	531	543	555	568	580	593	605	617	630	642
352	654	667	679	691	704	716	728	741	753	765
353	777	790	802	814	827	839	851	864	876	888
354	900	913	925	937	949	962	974	986	998	*011
355	55 023	035	047	060	072	084	096	108	121	133
356	145	157	169	182	194	206	218	230	242	255
357	267	279	291	303	315	328	340	352	364	376
358	388	400	413	425	437	449	461	473	485	497
359	509	522	534	546	558	570	582	594	606	618
360	630	642	654	666	678	691	703	715	727	739
361	751	763	775	787	799	811	823	835	847	859
362	871	883	895	907	919	931	943	955	967	979
363	991	*003	*015	*027	*038	*050	*062	*074	*086	*098
364	56 110	122	134	146	158	170	182	194	205	217
365	229	241	253	265	277	289	301	312	324	336
366	348	360	372	384	396	407	419	431	443	455
367	467	478	490	502	514	526	538	549	561	573
368	585	597	608	620	632	644	656	667	679	691
369	703	714	726	738	750	761	773	785	797	808
370	820	832	844	855	867	879	891	902	914	926
371	937	949	961	972	984	996	*008	*019	*031	*043
372	57 054	066	078	089	101	113	124	136	148	159
373	171	183	194	206	217	229	241	252	264	276
374	287	299	310	322	334	345	357	368	380	392
375	403	415	426	438	449	461	473	484	496	507
376	519	530	542	553	565	576	588	600	611	623
377	634	646	657	669	680	692	703	715	726	738
378	749	761	772	784	795	807	818	830	841	852
379	864	875	887	898	910	921	933	944	955	967
380	978	990	*001	*013	*024	*035	*047	*058	*070	*081
381	58 092	104	115	127	138	149	161	172	184	195
382	206	218	229	240	252	263	274	286	297	309
383	320	331	343	354	365	377	388	399	410	422
384	433	444	456	467	478	490	501	512	524	535
385	546	557	569	580	591	602	614	625	636	647
386	659	670	681	692	704	715	726	737	749	760
387	771	782	794	805	816	827	838	850	861	872
388	883	894	906	917	928	939	950	961	973	984
389	995	*006	*017	*028	*040	*051	*062	*073	*084	*095
390	59 106	118	129	140	151	162	173	184	195	207
391	218	229	240	251	262	273	284	295	306	318
392	329	340	351	362	373	384	395	406	417	428
393	439	450	461	472	483	494	506	517	528	539
394	550	561	572	583	594	605	616	627	638	649
395	660	671	682	693	704	715	726	737	748	759
396	770	780	791	802	813	824	835	846	857	868
397	879	890	901	912	923	934	945	956	966	977
398	988	999	*010	*021	*032	*043	*054	*065	*076	*086
399	60 097	108	119	130	141	152	163	173	184	195
400	206	217	228	239	249	260	271	282	293	304
N.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	13	12	11	10
1	1,3	1,2	1,1	1,0
2	2,6	2,4	2,2	2,0
3	3,9	3,6	3,3	3,0
4	5,2	4,8	4,4	4,0
5	6,5	6,0	5,5	5,0
6	7,8	7,2	6,6	6,0
7	9,1	8,4	7,7	7,0
8	10,4	9,6	8,8	8,0
9	11,7	10,8	9,9	9,0

Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
400	60 206	217	228	239	249	260	271	282	293	304
401	314	325	336	347	358	369	379	390	401	412
402	423	433	444	455	466	477	487	498	509	520
403	531	541	552	563	574	584	595	606	617	627
404	638	649	660	670	681	692	703	713	724	735
405	746	756	767	778	788	799	810	821	831	842
406	853	863	874	885	895	906	917	927	938	949
407	959	970	981	991	*002	*013	*023	*034	*045	*055
408	61 066	077	087	098	109	119	130	140	151	162
409	172	183	194	204	215	225	236	247	257	268
410	278	289	300	310	321	331	342	352	363	374
411	384	395	405	416	426	437	448	458	469	479
412	490	500	511	521	532	542	553	563	574	584
413	595	606	616	627	637	648	658	669	679	690
414	700	711	721	731	742	752	763	773	784	794
415	805	815	826	836	847	857	868	878	888	899
416	909	920	930	941	951	962	972	982	993	*003
417	62 014	024	034	045	055	066	076	086	097	107
418	118	128	138	149	159	170	180	190	201	211
419	221	232	242	252	263	273	284	294	304	315
420	325	335	346	356	366	377	387	397	408	418
421	428	439	449	459	469	480	490	500	511	521
422	531	542	552	562	572	583	593	603	613	624
423	634	644	655	665	675	685	696	706	716	726
424	737	747	757	767	778	788	798	808	818	829
425	839	849	859	870	880	890	900	910	921	931
426	941	951	961	972	982	992	*002	*012	*022	*033
427	63 043	053	063	073	083	094	104	114	124	134
428	144	155	165	175	185	195	205	215	225	236
429	246	256	266	276	286	296	306	317	327	337
430	347	357	367	377	387	397	407	417	428	438
431	448	458	468	478	488	498	508	518	528	538
432	548	558	568	579	589	599	609	619	629	639
433	649	659	669	679	689	699	709	719	729	739
434	749	759	769	779	789	799	809	819	829	839
435	849	859	869	879	889	899	909	919	929	939
436	949	959	969	979	988	998	*008	*018	*028	*038
437	64 048	058	068	078	088	098	108	118	128	137
438	147	157	167	177	187	197	207	217	227	237
439	246	256	266	276	286	296	306	316	326	335
440	345	355	365	375	385	395	404	414	424	434
441	444	454	464	473	483	493	503	513	523	532
442	542	552	562	572	582	591	601	611	621	631
443	640	650	660	670	680	689	699	709	719	729
444	738	748	758	768	777	787	797	807	816	826
445	836	846	856	865	875	885	895	904	914	924
446	933	943	953	963	972	982	992	*002	*011	*021
447	65 031	040	050	060	070	079	089	099	108	118
448	128	137	147	157	167	176	186	196	205	215
449	225	234	244	254	263	273	283	292	302	312
450	321	331	341	350	360	369	379	389	398	408
N.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	11
1	1.1
2	2.2
3	3.3
4	4.4
5	5.5
6	6.6
7	7.7
8	8.8
9	9.9

	10
1	1.0
2	2.0
3	3.0
4	4.0
5	5.0
6	6.0
7	7.0
8	8.0
9	9.0

	9
1	0.9
2	1.8
3	2.7
4	3.6
5	4.5
6	5.4
7	6.3
8	7.2
9	8.1

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9
450	65	321	331	341	350	360	369	379	389	398	408
451		418	427	437	447	456	466	475	485	495	504
452		514	523	533	543	552	562	571	581	591	600
453		610	619	629	639	648	658	667	677	686	696
454		706	715	725	734	744	753	763	772	782	792
455		801	811	820	830	839	849	858	868	877	887
456		896	906	916	925	935	944	954	963	973	982
457		992	*001	*011	*020	*030	*039	*049	*058	*068	*077
458	66	087	096	106	115	124	134	143	153	162	172
459		181	191	200	210	219	229	238	247	257	266
460		276	285	295	304	314	323	332	342	351	361
461		370	380	389	398	408	417	427	436	445	455
462		464	474	483	492	502	511	521	530	539	549
463		558	567	577	586	596	605	614	624	633	642
464		652	661	671	680	689	699	708	717	727	736
465		745	755	764	773	783	792	801	811	820	829
466		839	848	857	867	876	885	894	904	913	922
467		932	941	950	960	969	978	987	997	*006	*015
468	67	025	034	043	052	062	071	080	089	099	108
469		117	127	136	145	154	164	173	182	191	201
470		210	219	228	237	247	256	265	274	284	293
471		302	311	321	330	339	348	357	367	376	385
472		394	403	413	422	431	440	449	459	468	477
473		486	495	504	514	523	532	541	550	560	569
474		578	587	596	605	614	624	633	642	651	660
475		669	679	688	697	706	715	724	733	742	752
476		761	770	779	788	797	806	815	825	834	843
477		852	861	870	879	888	897	906	916	925	934
478		943	952	961	970	979	988	997	*006	*015	*024
479	68	034	043	052	061	070	079	088	097	106	115
480		124	133	142	151	160	169	178	187	196	205
481		215	224	233	242	251	260	269	278	287	296
482		305	314	323	332	341	350	359	368	377	386
483		395	404	413	422	431	440	449	458	467	476
484		485	494	502	511	520	529	538	547	556	565
485		574	583	592	601	610	619	628	637	646	655
486		664	673	681	690	699	708	717	726	735	744
487		753	762	771	780	789	797	806	815	824	833
488		842	851	860	869	878	886	895	904	913	922
489		931	940	949	958	966	975	984	993	*002	*011
490	69	020	028	037	046	055	064	073	082	090	099
491		108	117	126	135	144	152	161	170	179	188
492		197	205	214	223	232	241	249	258	267	276
493		285	294	302	311	320	329	338	346	355	364
494		373	381	390	399	408	417	425	434	443	452
495		461	469	478	487	496	504	513	522	531	539
496		548	557	566	574	583	592	601	609	618	627
497		636	644	653	662	671	679	688	697	705	714
498		723	732	740	749	758	767	775	784	793	801
499		810	819	827	836	845	854	862	871	880	888
500		897	906	914	923	932	940	949	958	966	975
N.		0	1	2	3	4	5	6	7	8	9

Proportional parts

	10
1	1.0
2	2.0
3	3.0
4	4.0
5	5.0
6	6.0
7	7.0
8	8.0
9	9.0

	9
1	0.9
2	1.8
3	2.7
4	3.6
5	4.5
6	5.4
7	6.3
8	7.2
9	8.1

	8
1	0.8
2	1.6
3	2.4
4	3.2
5	4.0
6	4.8
7	5.6
8	6.4
9	7.2

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9
500	69	897	906	914	923	932	940	949	958	966	975
501		984	992	*001	*010	*018	*027	*036	*044	*053	*062
502	70	070	079	088	096	105	114	122	131	140	148
503		157	165	174	183	191	200	209	217	226	234
504		243	252	260	269	278	286	295	303	312	321
505		329	338	346	355	364	372	381	389	398	406
506		415	424	432	441	449	458	467	475	484	492
507		501	509	518	526	535	544	552	561	569	578
508		586	595	603	612	621	629	638	646	655	663
509		672	680	689	697	706	714	723	731	740	749
510		757	766	774	783	791	800	808	817	825	834
511		842	851	859	868	876	885	893	902	910	919
512		927	935	944	952	961	969	978	986	995	*003
513	71	012	020	029	037	046	054	063	071	079	088
514		096	105	113	122	130	139	147	155	164	172
515		181	189	198	206	214	223	231	240	248	257
516		265	273	282	290	299	307	315	324	332	341
517		349	357	366	374	383	391	399	408	416	425
518		433	441	450	458	466	475	483	492	500	508
519		517	525	533	542	550	559	567	575	584	592
520		600	609	617	625	634	642	650	659	667	675
521		684	692	700	709	717	725	734	742	750	759
522		767	775	784	792	800	809	817	825	834	842
523		850	858	867	875	883	892	900	908	917	925
524		933	941	950	958	966	975	983	991	999	*008
525	72	016	024	032	041	049	057	066	074	082	090
526		099	107	115	123	132	140	148	156	165	173
527		181	189	198	206	214	222	230	239	247	255
528		263	272	280	288	296	304	313	321	329	337
529		346	354	362	370	378	387	395	403	411	419
530		428	436	444	452	460	469	477	485	493	501
531		509	518	526	534	542	550	558	567	575	583
532		591	599	607	616	624	632	640	648	656	665
533		673	681	689	697	705	713	722	730	738	746
534		754	762	770	779	787	795	803	811	819	827
535		835	843	852	860	868	876	884	892	900	908
536		916	925	933	941	949	957	965	973	981	989
537		997	*006	*014	*022	*030	*038	*046	*054	*062	*070
538	73	078	086	094	102	111	119	127	135	143	151
539		159	167	175	183	191	199	207	215	223	231
540		239	247	255	263	272	280	288	296	304	312
541		320	328	336	344	352	360	368	376	384	392
542		400	408	416	424	432	440	448	456	464	472
543		480	488	496	504	512	520	528	536	544	552
544		560	568	576	584	592	600	608	616	624	632
545		640	648	656	664	672	679	687	695	703	711
546		719	727	735	743	751	759	767	775	783	791
547		799	807	815	823	830	838	846	854	862	870
548		878	886	894	902	910	918	926	933	941	949
549		957	965	973	981	989	997	*005	*013	*020	*028
550	74	036	044	052	060	068	076	084	092	099	107
N.		0	1	2	3	4	5	6	7	8	9

Proportional parts

	9	8	7
1	0.9	0.8	0.7
2	1.8	1.6	1.4
3	2.7	2.4	2.1
4	3.6	3.2	2.8
5	4.5	4.0	3.5
6	5.4	4.8	4.2
7	6.3	5.6	4.9
8	7.2	6.4	5.6
9	8.1	7.2	6.3

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
550	74 036	044	052	060	068	076	084	092	099	107	
551	115	123	131	139	147	155	162	170	178	186	
552	194	202	210	218	225	233	241	249	257	265	
553	273	280	288	296	304	312	320	327	335	343	
554	351	359	367	374	382	390	398	406	414	421	
555	429	437	445	453	461	468	476	484	492	500	
556	507	515	523	531	539	547	554	562	570	578	
557	586	593	601	609	617	624	632	640	648	656	
558	663	671	679	687	695	702	710	718	726	733	
559	741	749	757	764	772	780	788	796	803	811	
560	819	827	834	842	850	858	865	873	881	889	8
561	896	904	912	920	927	935	943	950	958	966	1 0.8
562	974	981	989	997	*005	*012	*020	*028	*035	*043	2 1.6
563	75 051	059	066	074	082	089	097	105	113	120	3 2.4
564	128	136	143	151	159	166	174	182	189	197	4 3.2
565	205	213	220	228	236	243	251	259	266	274	5 4.0
566	282	289	297	305	312	320	328	335	343	351	6 4.8
567	358	366	374	381	389	397	404	412	420	427	7 5.6
568	435	442	450	458	465	473	481	488	496	504	8 6.4
569	511	519	526	534	542	549	557	565	572	580	9 7.2
570	587	595	603	610	618	626	633	641	648	656	
571	664	671	679	686	694	702	709	717	724	732	
572	740	747	755	762	770	778	785	793	800	808	
573	815	823	831	838	846	853	861	868	876	884	
574	891	899	906	914	921	929	937	944	952	959	
575	967	974	982	989	997	*005	*012	*020	*027	*035	
576	76 042	050	057	065	072	080	087	095	103	110	
577	118	125	133	140	148	155	163	170	178	185	
578	193	200	208	215	223	230	238	245	253	260	
579	268	275	283	290	298	305	313	320	328	335	
580	343	350	358	365	373	380	388	395	403	410	7
581	418	425	433	440	448	455	462	470	477	485	1 0.7
582	492	500	507	515	522	530	537	545	552	559	2 1.4
583	567	574	582	589	597	604	612	619	626	634	3 2.1
584	641	649	656	664	671	678	686	693	701	708	4 2.8
585	716	723	730	738	745	753	760	768	775	782	5 3.5
586	790	797	805	812	819	827	834	842	849	856	6 4.2
587	864	871	879	886	893	901	908	916	923	930	7 4.9
588	938	945	953	960	967	975	982	989	997	*004	8 5.6
589	77 012	019	026	034	041	048	056	063	070	078	9 6.3
590	085	093	100	107	115	122	129	137	144	151	
591	159	166	173	181	188	195	203	210	217	225	
592	232	240	247	254	262	269	276	283	291	298	
593	305	313	320	327	335	342	349	357	364	371	
594	379	386	393	401	408	415	422	430	437	444	
595	452	459	466	474	481	488	495	503	510	517	
596	525	532	539	546	554	561	568	576	583	590	
597	597	605	612	619	627	634	641	648	656	663	
598	670	677	685	692	699	706	714	721	728	735	
599	743	750	757	764	772	779	786	793	801	808	
600	815	822	830	837	844	851	859	866	873	880	

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
600	77 815	822	830	837	844	851	859	866	873	880
601	887	895	902	909	916	924	931	938	945	952
602	960	967	974	981	988	996	*003	*010	*017	*025
603	78 032	039	046	053	061	068	075	082	089	097
604	104	111	118	125	132	140	147	154	161	168
605	176	183	190	197	204	211	219	226	233	240
606	247	254	262	269	276	283	290	297	305	312
607	319	326	333	340	347	355	362	369	376	383
608	390	398	405	412	419	426	433	440	447	455
609	462	469	476	483	490	497	504	512	519	526
610	533	540	547	554	561	569	576	583	590	597
611	604	611	618	625	633	640	647	654	661	668
612	675	682	689	696	704	711	718	725	732	739
613	746	753	760	767	774	781	789	796	803	810
614	817	824	831	838	845	852	859	866	873	880
615	888	895	902	909	916	923	930	937	944	951
616	958	965	972	979	986	993	*000	*007	*014	*021
617	79 029	036	043	050	057	064	071	078	085	092
618	099	106	113	120	127	134	141	148	155	162
619	169	176	183	190	197	204	211	218	225	232
620	239	246	253	260	267	274	281	288	295	302
621	309	316	323	330	337	344	351	358	365	372
622	379	386	393	400	407	414	421	428	435	442
623	449	456	463	470	477	484	491	498	505	511
624	518	525	532	539	546	553	560	567	574	581
625	588	595	602	609	616	623	630	637	644	650
626	657	664	671	678	685	692	699	706	713	720
627	727	734	741	748	754	761	768	775	782	789
628	796	803	810	817	824	831	837	844	851	858
629	865	872	879	886	893	900	906	913	920	927
630	934	941	948	955	962	969	975	982	989	996
631	80 003	010	017	024	030	037	044	051	058	065
632	072	079	085	092	099	106	113	120	127	134
633	140	147	154	161	168	175	182	188	195	202
634	209	216	223	229	236	243	250	257	264	271
635	277	284	291	298	305	312	318	325	332	339
636	346	353	359	366	373	380	387	393	400	407
637	414	421	428	434	441	448	455	462	468	475
638	482	489	496	502	509	516	523	530	536	543
639	550	557	564	570	577	584	591	598	604	611
640	618	625	632	638	645	652	659	665	672	679
641	686	693	699	706	713	720	726	733	740	747
642	754	760	767	774	781	787	794	801	808	814
643	821	828	835	841	848	855	862	868	875	882
644	889	895	902	909	916	922	929	936	943	949
645	956	963	969	976	983	990	996	*003	*010	*017
646	81 023	030	037	043	050	057	064	070	077	084
647	090	097	104	111	117	124	131	137	144	151
648	158	164	171	178	184	191	198	204	211	218
649	224	231	238	245	251	258	265	271	278	285
650	291	298	305	311	318	325	331	338	345	351
N.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	8	7	6
1	0.8	0.7	0.6
2	1.6	1.4	1.2
3	2.4	2.1	1.8
4	3.2	2.8	2.4
5	4.0	3.5	3.0
6	4.8	4.2	3.6
7	5.6	4.9	4.2
8	6.4	5.6	4.8
9	7.2	6.3	5.4

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9	Proportional parts
650	81	291	298	305	311	318	325	331	338	345	351	
651		358	365	371	378	385	391	398	405	411	418	
652		425	431	438	445	451	458	465	471	478	485	
653		491	498	505	511	518	525	531	538	544	551	
654		558	564	571	578	584	591	598	604	611	617	
655		624	631	637	644	651	657	664	671	677	684	
656		690	697	704	710	717	723	730	737	743	750	
657		757	763	770	776	783	790	796	803	809	816	
658		823	829	836	842	849	856	862	869	875	882	
659		889	895	902	908	915	921	928	935	941	948	
660		954	961	968	974	981	987	994	*000	*007	*014	**7**
661	82	020	027	033	040	046	053	060	066	073	079	1 | 0.7
662		086	092	099	105	112	119	125	132	138	145	2 | 1.4
663		151	158	164	171	178	184	191	197	204	210	3 | 2.1
664		217	223	230	236	243	249	256	263	269	276	4 | 2.8
665		282	289	295	302	308	315	321	328	334	341	5 | 3.5
666		347	354	360	367	373	380	387	393	400	406	6 | 4.2
667		413	419	426	432	439	445	452	458	465	471	7 | 4.9
668		478	484	491	497	504	510	517	523	530	536	8 | 5.6
669		543	549	556	562	569	575	582	588	595	601	9 | 6.3
670		607	614	620	627	633	640	646	653	659	666	
671		672	679	685	692	698	705	711	718	724	730	
672		737	743	750	756	763	769	776	782	789	795	
673		802	808	814	821	827	834	840	847	853	860	
674		866	872	879	885	892	898	905	911	918	924	
675		930	937	943	950	956	963	969	975	982	988	
676		995	*001	*008	*014	*020	*027	*033	*040	*046	*052	
677	83	059	065	072	078	085	091	097	104	110	117	
678		123	129	136	142	149	155	161	168	174	181	
679		187	193	200	206	213	219	225	232	238	245	
680		251	257	264	270	276	283	289	296	302	308	**6**
681		315	321	327	334	340	347	353	359	366	372	1 | 0.6
682		378	385	391	398	404	410	417	423	429	436	2 | 1.2
683		442	448	455	461	467	474	480	487	493	499	3 | 1.8
684		506	512	518	525	531	537	544	550	556	563	4 | 2.4
685		569	575	582	588	594	601	607	613	620	626	5 | 3.0
686		632	639	645	651	658	664	670	677	683	689	6 | 3.6
687		696	702	708	715	721	727	734	740	746	753	7 | 4.2
688		759	765	771	778	784	790	797	803	809	816	8 | 4.8
689		822	828	835	841	847	853	860	866	872	879	9 | 5.4
690		885	891	897	904	910	916	923	929	935	942	
691		948	954	960	967	973	979	985	992	998	*004	
692	84	011	017	023	029	036	042	048	055	061	067	
693		073	080	086	092	098	105	111	117	123	130	
694		136	142	148	155	161	167	173	180	186	192	
695		198	205	211	217	223	230	236	242	248	255	
696		261	267	273	280	286	292	298	305	311	317	
697		323	330	336	342	348	354	361	367	373	379	
698		386	392	398	404	410	417	423	429	435	442	
699		448	454	460	466	473	479	485	491	497	504	
700		510	516	522	528	535	541	547	553	559	566	
N.		0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
700	84 510	516	522	528	535	541	547	553	559	566
701	572	578	584	590	597	603	609	615	621	628
702	634	640	646	652	658	665	671	677	683	689
703	696	702	708	714	720	726	733	739	745	751
704	757	763	770	776	782	788	794	800	807	813
705	819	825	831	837	844	850	856	862	868	874
706	880	887	893	899	905	911	917	924	930	936
707	942	948	954	960	967	973	979	985	991	997
708	85 003	009	016	022	028	034	040	046	052	058
709	065	071	077	083	089	095	101	107	114	120
710	126	132	138	144	150	156	163	169	175	181
711	187	193	199	205	211	217	224	230	236	242
712	248	254	260	266	272	278	285	291	297	303
713	309	315	321	327	333	339	345	352	358	364
714	370	376	382	388	394	400	406	412	418	425
715	431	437	443	449	455	461	467	473	479	485
716	491	497	503	509	516	522	528	534	540	546
717	552	558	564	570	576	582	588	594	600	606
718	612	618	625	631	637	643	649	655	661	667
719	673	679	685	691	697	703	709	715	721	727
720	733	739	745	751	757	763	769	775	781	788
721	794	800	806	812	818	824	830	836	842	848
722	854	860	866	872	878	884	890	896	902	908
723	914	920	926	932	938	944	950	956	962	968
724	974	980	986	992	998	*004	*010	*016	*022	*028
725	86 034	040	046	052	058	064	070	076	082	088
726	094	100	106	112	118	124	130	136	141	147
727	153	159	165	171	177	183	189	195	201	207
728	213	219	225	231	237	243	249	255	261	267
729	273	279	285	291	297	303	308	314	320	326
730	332	338	344	350	356	362	368	374	380	386
731	392	398	404	410	415	421	427	433	439	445
732	451	457	463	469	475	481	487	493	499	504
733	510	516	522	528	534	540	546	552	558	564
734	570	576	581	587	593	599	605	611	617	623
735	629	635	641	646	652	658	664	670	676	682
736	688	694	700	705	711	717	723	729	735	741
737	747	753	759	764	770	776	782	788	794	800
738	806	812	817	823	829	835	841	847	853	859
739	864	870	876	882	888	894	900	906	911	917
740	923	929	935	941	947	953	958	964	970	976
741	982	988	994	999	*005	*011	*017	*023	*029	*035
742	87 040	046	052	058	064	070	075	081	087	093
743	099	105	111	116	122	128	134	140	146	151
744	157	163	169	175	181	186	192	198	204	210
745	216	221	227	233	239	245	251	256	262	268
746	274	280	286	291	297	303	309	315	320	326
747	332	338	344	349	355	361	367	373	379	384
748	390	396	402	408	413	419	425	431	437	442
749	448	454	460	466	471	477	483	489	495	500
750	506	512	518	523	529	535	541	547	552	558
N.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	7	6	5
1	0.7	0.6	0.5
2	1.4	1.2	1.0
3	2.1	1.8	1.5
4	2.8	2.4	2.0
5	3.5	3.0	2.5
6	4.2	3.6	3.0
7	4.9	4.2	3.5
8	5.6	4.8	4.0
9	6.3	5.4	4.5

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
750	87 506	512	518	523	529	535	541	547	552	558	
751	564	570	576	581	587	593	599	604	610	616	
752	622	628	633	639	645	651	656	662	668	674	
753	679	685	691	697	703	708	714	720	726	731	
754	737	743	749	754	760	766	772	777	783	789	
755	795	800	806	812	818	823	829	835	841	846	
756	852	858	864	869	875	881	887	892	898	904	
757	910	915	921	927	933	938	944	950	955	961	
758	967	973	978	984	990	996	*001	*007	*013	*018	
759	88 024	030	036	041	047	053	058	064	070	076	
760	081	087	093	098	104	110	116	121	127	133	**6**
761	138	144	150	156	161	167	173	178	184	190	1 | 0.6
762	195	201	207	213	218	224	230	235	241	247	2 | 1.2
763	252	258	264	270	275	281	287	292	298	304	3 | 1.8
764	309	315	321	326	332	338	343	349	355	360	4 | 2.4
765	366	372	377	383	389	395	400	406	412	417	5 | 3.0
766	423	429	434	440	446	451	457	463	468	474	6 | 3.6
767	480	485	491	497	502	508	513	519	525	530	7 | 4.2
768	536	542	547	553	559	564	570	576	581	587	8 | 4.8
769	593	598	604	610	615	621	627	632	638	643	9 | 5.4
770	649	655	660	666	672	677	683	689	694	700	
771	705	711	717	722	728	734	739	745	750	756	
772	762	767	773	779	784	790	795	801	807	812	
773	818	824	829	835	840	846	852	857	863	868	
774	874	880	885	891	897	902	908	913	919	925	
775	930	936	941	947	953	958	964	969	975	981	
776	986	992	997	*003	*009	*014	*020	*025	*031	*037	
777	89 042	048	053	059	064	070	076	081	087	092	
778	098	104	109	115	120	126	131	137	143	148	
779	154	159	165	170	176	182	187	193	198	204	
780	209	215	221	226	232	237	243	248	254	260	**5**
781	265	271	276	282	287	293	298	304	310	315	1 | 0.5
782	321	326	332	337	343	348	354	360	365	371	2 | 1.0
783	376	382	387	393	398	404	409	415	421	426	3 | 1.5
784	432	437	443	448	454	459	465	470	476	481	4 | 2.0
785	487	492	498	504	509	515	520	526	531	537	5 | 2.5
786	542	548	553	559	564	570	575	581	586	592	6 | 3.0
787	597	603	609	614	620	625	631	636	642	647	7 | 3.5
788	653	658	664	669	675	680	686	691	697	702	8 | 4.0
789	708	713	719	724	730	735	741	746	752	757	9 | 4.5
790	763	768	774	779	785	790	796	801	807	812	
791	818	823	829	834	840	845	851	856	862	867	
792	873	878	883	889	894	900	905	911	916	922	
793	927	933	938	944	949	955	960	966	971	977	
794	982	988	993	998	*004	*009	*015	*020	*026	*031	
795	90 037	042	048	053	059	064	069	075	080	086	
796	091	097	102	108	113	119	124	129	135	140	
797	146	151	157	162	168	173	179	184	189	195	
798	200	206	211	217	222	227	233	238	244	249	
799	255	260	266	271	276	282	287	293	298	304	
800	309	314	320	325	331	336	342	347	352	358	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
800	90 309	314	320	325	331	336	342	347	352	358	
801	363	369	374	380	385	390	396	401	407	412	
802	417	423	428	434	439	445	450	455	461	466	
803	472	477	482	488	493	499	504	509	515	520	
804	526	531	536	542	547	553	558	563	569	574	
805	580	585	590	596	601	607	612	617	623	628	
806	634	639	644	650	655	660	666	671	677	682	
807	687	693	698	703	709	714	720	725	730	736	
808	741	747	752	757	763	768	773	779	784	789	
809	795	800	806	811	816	822	827	832	838	843	
810	849	854	859	865	870	875	881	886	891	897	**6**
811	902	907	913	918	924	929	934	940	945	950	1 | 0.6
812	956	961	966	972	977	982	988	993	998	*004	2 | 1.2
813	91 009	014	020	025	030	036	041	046	052	057	3 | 1.8
814	062	068	073	078	084	089	094	100	105	110	4 | 2.4
815	116	121	126	132	137	142	148	153	158	164	5 | 3.0
816	169	174	180	185	190	196	201	206	212	217	6 | 3.6
817	222	228	233	238	243	249	254	259	265	270	7 | 4.2
818	275	281	286	291	297	302	307	312	318	323	8 | 4.8
819	328	334	339	344	350	355	360	365	371	376	9 | 5.4
820	381	387	392	397	403	408	413	418	424	429	
821	434	440	445	450	455	461	466	471	477	482	
822	487	492	498	503	508	514	519	524	529	535	
823	540	545	551	556	561	566	572	577	582	587	
824	593	598	603	609	614	619	624	630	635	640	
825	645	651	656	661	666	672	677	682	687	693	
826	698	703	709	714	719	724	730	735	740	745	
827	751	756	761	766	772	777	782	787	793	798	
828	803	808	814	819	824	829	834	840	845	850	
829	855	861	866	871	876	882	887	892	897	903	
830	908	913	918	924	929	934	939	944	950	955	**5**
831	960	965	971	976	981	986	991	997	*002	*007	1 | 0.5
832	92 012	018	023	028	033	038	044	049	054	059	2 | 1.0
833	065	070	075	080	085	091	096	101	106	111	3 | 1.5
834	117	122	127	132	137	143	148	153	158	163	4 | 2.0
835	169	174	179	184	189	195	200	205	210	215	5 | 2.5
836	221	226	231	236	241	247	252	257	262	267	6 | 3.0
837	273	278	283	288	293	298	304	309	314	319	7 | 3.5
838	324	330	335	340	345	350	355	361	366	371	8 | 4.0
839	376	381	387	392	397	402	407	412	418	423	9 | 4.5
840	428	433	438	443	449	454	459	464	469	474	
841	480	485	490	495	500	505	511	516	521	526	
842	531	536	542	547	552	557	562	567	572	578	
843	583	588	593	598	603	609	614	619	624	629	
844	634	639	645	650	655	660	665	670	675	681	
845	686	691	696	701	706	711	716	722	727	732	
846	737	742	747	752	758	763	768	773	778	783	
847	788	793	799	804	809	814	819	824	829	834	
848	840	845	850	855	860	865	870	875	881	886	
849	891	896	901	906	911	916	921	927	932	937	
850	942	947	952	957	962	967	973	978	983	988	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9
850	92	942	947	952	957	962	967	973	978	983	988
851		993	998	*003	*008	*013	*018	*024	*029	*034	*039
852	93	044	049	054	059	064	069	075	080	085	090
853		095	100	105	110	115	120	125	131	136	141
854		146	151	156	161	166	171	176	181	186	192
855		197	202	207	212	217	222	227	232	237	242
856		247	252	258	263	268	273	278	283	288	293
857		298	303	308	313	318	323	328	334	339	344
858		349	354	359	364	369	374	379	384	389	394
859		399	404	409	414	420	425	430	435	440	445
860		450	455	460	465	470	475	480	485	490	495
861		500	505	510	515	520	526	531	536	541	546
862		551	556	561	566	571	576	581	586	591	596
863		601	606	611	616	621	626	631	636	641	646
864		651	656	661	666	671	676	682	687	692	697
865		702	707	712	717	722	727	732	737	742	747
866		752	757	762	767	772	777	782	787	792	797
867		802	807	812	817	822	827	832	837	842	847
868		852	857	862	867	872	877	882	887	892	897
869		902	907	912	917	922	927	932	937	942	947
870		952	957	962	967	972	977	982	987	992	997
871	94	002	007	012	017	022	027	032	037	042	047
872		052	057	062	067	072	077	082	086	091	096
873		101	106	111	116	121	126	131	136	141	146
874		151	156	161	166	171	176	181	186	191	196
875		201	206	211	216	221	226	231	236	240	245
876		250	255	260	265	270	275	280	285	290	295
877		300	305	310	315	320	325	330	335	340	345
878		349	354	359	364	369	374	379	384	389	394
879		399	404	409	414	419	424	429	433	438	443
880		448	453	458	463	468	473	478	483	488	493
881		498	503	507	512	517	522	527	532	537	542
882		547	552	557	562	567	571	576	581	586	591
883		596	601	606	611	616	621	626	630	635	640
884		645	650	655	660	665	670	675	680	685	689
885		694	699	704	709	714	719	724	729	734	738
886		743	748	753	758	763	768	773	778	783	787
887		792	797	802	807	812	817	822	827	832	836
888		841	846	851	856	861	866	871	876	880	885
889		890	895	900	905	910	915	919	924	929	934
890		939	944	949	954	959	963	968	973	978	983
891		988	993	998	*002	*007	*012	*017	*022	*027	*032
892	95	036	041	046	051	056	061	066	071	075	080
893		085	090	095	100	105	109	114	119	124	129
894		134	139	143	148	153	158	163	168	173	177
895		182	187	192	197	202	207	211	216	221	226
896		231	236	240	245	250	255	260	265	270	274
897		279	284	289	294	299	303	308	313	318	323
898		328	332	337	342	347	352	357	361	366	371
899		376	381	386	390	395	400	405	410	415	419
900		424	429	434	439	444	448	453	458	463	468
N.		0	1	2	3	4	5	6	7	8	9

Proportional parts

	6	5	4
1	0.6	0.5	0.4
2	1.2	1.0	0.8
3	1.8	1.5	1.2
4	2.4	2.0	1.6
5	3.0	2.5	2.0
6	3.6	3.0	2.4
7	4.2	3.5	2.8
8	4.8	4.0	3.2
9	5.4	4.5	3.6

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
900	95 424	429	434	439	444	448	453	458	463	468	
901	472	477	482	487	492	497	501	506	511	516	
902	521	525	530	535	540	545	550	554	559	564	
903	569	574	578	583	588	593	598	602	607	612	
904	617	622	626	631	636	641	646	650	655	660	
905	665	670	674	679	684	689	694	698	703	708	
906	713	718	722	727	732	737	742	746	751	756	
907	761	766	770	775	780	785	789	794	799	804	
908	809	813	818	823	828	832	837	842	847	852	
909	856	861	866	871	875	880	885	890	895	899	
910	904	909	914	918	923	928	933	938	942	947	**5**
911	952	957	961	966	971	976	980	985	990	995	1 | 0.5
912	999	*004	*009	*014	*019	*023	*028	*033	*038	*042	2 | 1.0
913	96 047	052	057	061	066	071	076	080	085	090	3 | 1.5
914	095	099	104	109	114	118	123	128	133	137	4 | 2.0
915	142	147	152	156	161	166	171	175	180	185	5 | 2.5
916	190	194	199	204	209	213	218	223	227	232	6 | 3.0
917	237	242	246	251	256	261	265	270	275	280	7 | 3.5
918	284	289	294	298	303	308	313	317	322	327	8 | 4.0
919	332	336	341	346	350	355	360	365	369	374	9 | 4.5
920	379	384	388	393	398	402	407	412	417	421	
921	426	431	435	440	445	450	454	459	464	468	
922	473	478	483	487	492	497	501	506	511	515	
923	520	525	530	534	539	544	548	553	558	562	
924	567	572	577	581	586	591	595	600	605	609	
925	614	619	624	628	633	638	642	647	652	656	
926	661	666	670	675	680	685	689	694	699	703	
927	708	713	717	722	727	731	736	741	745	750	
928	755	759	764	769	774	778	783	788	792	797	
929	802	806	811	816	820	825	830	834	839	844	
930	848	853	858	862	867	872	876	881	886	890	**4**
931	895	900	904	909	914	918	923	928	932	937	1 | 0.4
932	942	946	951	956	960	965	970	974	979	984	2 | 0.8
933	988	993	997	*002	*007	*011	*016	*021	*025	*030	3 | 1.2
934	97 035	039	044	049	053	058	063	067	072	077	4 | 1.6
935	081	086	090	095	100	104	109	114	118	123	5 | 2.0
936	128	132	137	142	146	151	155	160	165	169	6 | 2.4
937	174	179	183	188	192	197	202	206	211	216	7 | 2.8
938	220	225	230	234	239	243	248	253	257	262	8 | 3.2
939	267	271	276	280	285	290	294	299	304	308	9 | 3.6
940	313	317	322	327	331	336	340	345	350	354	
941	359	364	368	373	377	382	387	391	396	400	
942	405	410	414	419	424	428	433	437	442	447	
943	451	456	460	465	470	474	479	483	488	493	
944	497	502	506	511	516	520	525	529	534	539	
945	543	548	552	557	562	566	571	575	580	585	
946	589	594	598	603	607	612	617	621	626	630	
947	635	640	644	649	653	658	663	667	672	676	
948	681	685	690	695	699	704	708	713	717	722	
949	727	731	736	740	745	749	754	759	763	768	
950	772	777	782	786	791	795	800	804	809	813	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
950	97 772	777	782	786	791	795	800	804	809	813	
951	818	823	827	832	836	841	845	850	855	859	
952	864	868	873	877	882	886	891	896	900	905	
953	909	914	918	923	928	932	937	941	946	950	
954	955	959	964	968	973	978	982	987	991	996	
955	98 000	005	009	014	019	023	028	032	037	041	
956	046	050	055	059	064	068	073	078	082	087	
957	091	096	100	105	109	114	118	123	127	132	
958	137	141	146	150	155	159	164	168	173	177	
959	182	186	191	195	200	204	209	214	218	223	
960	227	232	236	241	245	250	254	259	263	268	**5**
961	272	277	281	286	290	295	299	304	308	313	1 | 0.5
962	318	322	327	331	336	340	345	349	354	358	2 | 1.0
963	363	367	372	376	381	385	390	394	399	403	3 | 1.5
964	408	412	417	421	426	430	435	439	444	448	4 | 2.0
965	453	457	462	466	471	475	480	484	489	493	5 | 2.5
966	498	502	507	511	516	520	525	529	534	538	6 | 3.0
967	543	547	552	556	561	565	570	574	579	583	7 | 3.5
968	588	592	597	601	605	610	614	619	623	628	8 | 4.0
969	632	637	641	646	650	655	659	664	668	673	9 | 4.5
970	677	682	686	691	695	700	704	709	713	717	
971	722	726	731	735	740	744	749	753	758	762	
972	767	771	776	780	784	789	793	798	802	807	
973	811	816	820	825	829	834	838	843	847	851	
974	856	860	865	869	874	878	883	887	892	896	
975	900	905	909	914	918	923	927	932	936	941	
976	945	949	954	958	963	967	972	976	981	985	
977	989	994	998	*003	*007	*012	*016	*021	*025	*029	
978	99 034	038	043	047	052	056	061	065	069	074	
979	078	083	087	092	096	100	105	109	114	118	
980	123	127	131	136	140	145	149	154	158	162	**4**
981	167	171	176	180	185	189	193	198	202	207	1 | 0.4
982	211	216	220	224	229	233	238	242	247	251	2 | 0.8
983	255	260	264	269	273	277	282	286	291	295	3 | 1.2
984	300	304	308	313	317	322	326	330	335	339	4 | 1.6
985	344	348	352	357	361	366	370	374	379	383	5 | 2.0
986	388	392	396	401	405	410	414	419	423	427	6 | 2.4
987	432	436	441	445	449	454	458	463	467	471	7 | 2.8
988	476	480	484	489	493	498	502	506	511	515	8 | 3.2
989	520	524	528	533	537	542	546	550	555	559	9 | 3.6
990	564	568	572	577	581	585	590	594	599	603	
991	607	612	616	621	625	629	634	638	642	647	
992	651	656	660	664	669	673	677	682	686	691	
993	695	699	704	708	712	717	721	726	730	734	
994	739	743	747	752	756	760	765	769	774	778	
995	782	787	791	795	800	804	808	813	817	822	
996	826	830	835	839	843	848	852	856	861	865	
997	870	874	878	883	887	891	896	900	904	909	
998	913	917	922	926	930	935	939	944	948	952	
999	957	961	965	970	974	978	983	987	991	996	
1000	00 000	004	009	013	017	022	026	030	035	039	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	d.
1000	000 0000	0434	0869	1303	1737	2171	2605	3039	3473	3907	434
1001	4341	4775	5208	5642	6076	6510	6943	7377	7810	8244	434
1002	8677	9111	9544	9977	*0411	*0844	*1277	*1710	*2143	*2576	433
1003	001 3009	3442	3875	4308	4741	5174	5607	6039	6472	6905	433
1004	7337	7770	8202	8635	9067	9499	9932	*0364	*0796	*1228	432
1005	002 1661	2093	2525	2957	3389	3821	4253	4685	5116	5548	432
1006	5980	6411	6843	7275	7706	8138	8569	9001	9432	9863	431
1007	003 0295	0726	1157	1588	2019	2451	2882	3313	3744	4174	431
1008	4605	5036	5467	5898	6328	6759	7190	7620	8051	8481	431
1009	8912	9342	9772	*0203	*0633	*1063	*1493	*1924	*2354	*2784	430
1010	004 3214	3644	4074	4504	4933	5363	5793	6223	6652	7082	430
1011	7512	7941	8371	8800	9229	9659	*0088	*0517	*0947	*1376	429
1012	005 1805	2234	2663	3092	3521	3950	4379	4808	5237	5666	429
1013	6094	6523	6952	7380	7809	8238	8666	9094	9523	9951	429
1014	006 0380	0808	1236	1664	2092	2521	2949	3377	3805	4233	428
1015	4660	5088	5516	5944	6372	6799	7227	7655	8082	8510	428
1016	8937	9365	9792	*0219	*0647	*1074	*1501	*1923	*2355	*2782	427
1017	007 3210	3637	4064	4490	4917	5344	5771	6198	6624	7051	427
1018	7478	7904	8331	8757	9184	9610	*0037	*0463	*0889	*1316	426
1019	008 1742	2168	2594	3020	3446	3872	4298	4724	5150	5576	426
1020	6002	6427	6853	7279	7704.	8130	8556	8981	9407	9832	426
1021	009 0257	0683	1108	1533	1959	2384	2809	3234	3659	4084	425
1022	4509	4934	5359	5784	6208	6633	7058	7483	7907	8332	425
1023	8756	9181	9605	*0030	*0454	*0878	*1303	*1727	*2151	*2575	424
1024	010 3000	3424	3848	4272	4696	5120	5544	5967	6391	6815	424
1025	7239	7662	8086	8510	8933	9357	9780	*0204	*0627	*1050	424
1026	011 1474	1897	2320	2743	3166	3590	4013	4436	4859	5282	423
1027	5704	6127	6550	6973	7396	7818	8241	8664	9086	9509	423
1028	9931	*0354	*0776	*1198	*1621	*2043	*2465	*2887	*3310	*3732	422
1029	012 4154	4576	4998	5420	5842	6264	6685	7107	7529	7951	422
1030	8372	8794	9215	9637	*0059	*0480	*0901	*1323	*1744	*2165	422
1031	013 2587	3008	3429	3850	4271	4692	5113	5534	5955	6376	421
1032	6797	7218	7639	8059	8480	8901	9321	9742	*0162	*0583	421
1033	014 1003	1424	1844	2264	2685	3105	3525	3945	4365	4785	420
1034	5205	5625	6045	6465	6885	7305	7725	8144	8564	8984	420
1035	9403	9823	*0243	*0662	*1082	*1501	*1920	*2340	*2759	*3178	420
1036	015 3598	4017	4436	4855	5274	5693	6112	6531	6950	7369	419
1037	7788	8206	8625	9044	9462	9881	*0300	*0718	*1137	*1555	419
1038	016 1974	2392	2810	3229	3647	4065	4483	4901	5319	5737	418
1039	6155	6573	6991	7409	7827	8245	8663	9080	9498	9916	418
1040	017 0333	0751	1168	1586	2003	2421	2838	3256	3673	4090	417
1041	4507	4924	5342	5759	6176	6593	7010	7427	7844	8260	417
1042	8677	9094	9511	9927	*0344	*0761	*1177	*1594	*2010	*2427	417
1043	018 2843	3259	3676	4092	4508	4925	5341	5757	6173	6589	416
1044	7005	7421	7837	8253	8669	9084	9500	9916	*0332	*0747	416
1045	019 1163	1578	1994	2410	2825	3240	3656	4071	4486	4902	415
1046	5317	5732	6147	6562	6977	7392	7807	8222	8637	9052	415
1047	9467	9882	*0296	*0711	*1126	*1540	*1955	*2369	*2784	*3198	415
1048	020 3613	4027	4442	4856	5270	5684	6099	6513	6927	7341	414
1049	7755	8169	8583	8997	9411	9824	*0238	*0652	*1066	*1479	414
1050	021 1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
N.	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	d.
1050	021 1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
1051	6027	6440	6854	7267	7680	8093	8506	8919	9332	9745	413
1052	022 0157	0570	0983	1396	1808	2221	2634	3046	3459	3871	413
1053	4284	4696	5109	5521	5933	6345	6758	7170	7582	7994	412
1054	8406	8818	9230	9642	*0054	*0466	*0878	*1289	*1701	*2113	412
1055	023 2525	2936	3348	3759	4171	4582	4994	5405	5817	6228	411
1056	6639	7050	7462	7873	8284	8695	9106	9517	9928	*0339	411
1057	024 0750	1161	1572	1982	2393	2804	3214	3625	4036	4446	411
1058	4857	5267	5678	6088	6498	6909	7319	7729	8139	8549	410
1059	8960	9370	9780	*0190	*0600	*1010	*1419	*1829	*2239	*2649	410
1060	025 3059	3468	3878	4288	4697	5107	5516	5926	6335	6744	410
1061	7154	7563	7972	8382	8791	9200	9609	*0018	*0427	*0836	409
1062	026 1245	1654	2063	2472	2881	3289	3698	4107	4515	4924	409
1063	5333	5741	6150	6558	6967	7375	7783	8192	8600	9008	408
1064	9416	9824	*0233	*0641	*1049	*1457	*1865	*2273	*2680	*3088	408
1065	027 3496	3904	4312	4719	5127	5535	5942	6350	6757	7165	408
1066	7572	7979	8387	8794	9201	9609	*0016	*0423	*0830	*1237	407
1067	028 1644	2051	2458	2865	3272	3679	4086	4492	4899	5306	407
1068	5713	6119	6526	6932	7339	7745	8152	8558	8964	9371	406
1069	9777	*0183	*0590	*0996	*1402	*1808	*2214	*2620	*3026	*3432	406
1070	029 3838	4244	4649	5055	5461	5867	6272	6678	7084	7489	406
1071	7895	8300	8706	9111	9516	9922	*0327	*0732	*1138	*1543	405
1072	030 1948	2353	2758	3163	3568	3973	4378	4783	5188	5592	405
1073	5997	6402	6807	7211	7616	8020	8425	8830	9234	9638	405
1074	031 0043	0447	0851	1256	1660	2064	2468	2872	3277	3681	404
1075	4085	4489	4893	5296	5700	6104	6508	6912	7315	7719	404
1076	8123	8526	8930	9333	9737	*0140	*0544	*0947	*1350	*1754	403
1077	032 2157	2560	2963	3367	3770	4173	4576	4979	5382	5785	403
1078	6188	6590	6993	7396	7799	8201	8604	9007	9409	9812	403
1079	033 0214	0617	1019	1422	1824	2226	2629	3031	3433	3835	402
1080	4238	4640	5042	5444	5846	6248	6650	7052	7453	7855	402
1081	8257	8659	9060	9462	9864	*0265	*0667	*1068	*1470	*1871	402
1082	034 2273	2674	3075	3477	3878	4279	4680	5081	5482	5884	401
1083	6285	6686	7087	7487	7888	8289	8690	9091	9491	9892	401
1084	035 0293	0693	1094	1495	1895	2296	2696	3096	3497	3897	400
1085	4297	4698	5098	5498	5898	6298	6698	7098	7498	7898	400
1086	8298	8698	9098	9498	9898	*0297	*0697	*1097	*1496	*1896	400
1087	036 2295	2695	3094	3494	3893	4293	4692	5091	5491	5890	399
1088	6289	6688	7087	7486	7885	8284	8683	9082	9481	9880	399
1089	037 0279	0678	1076	1475	1874	2272	2671	3070	3468	3867	399
1090	4265	4663	5062	5460	5858	6257	6655	7053	7451	7849	398
1091	8248	8646	9044	9442	9839	*0237	*0635	*1033	*1431	*1829	398
1092	038 2226	2624	3022	3419	3817	4214	4612	5009	5407	5804	398
1093	6202	6599	6996	7393	7791	8188	8585	8982	9379	9776	397
1094	039 0173	0570	0967	1364	1761	2158	2554	2951	3348	3745	397
1095	4141	4538	4934	5331	5727	6124	6520	6917	7313	7709	397
1096	8106	8502	8898	9294	9690	*0086	*0482	*0878	*1274	*1670	396
1097	040 2066	2462	2858	3254	3650	4045	4441	4837	5232	5628	396
1098	6023	6419	6814	7210	7605	8001	8396	8791	9187	9582	395
1099	9977	*0372	*0767	*1162	*1557	*1952	*2347	*2742	*3137	*3532	395
1100	041 3927	4322	4716	5111	5506	5900	6295	6690	7084	7479	395
N.	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS—(Continued)

N	0	1	2	3	4	5	6	7	8	9	d.
1100	041 3927	4322	4716	5111	5506	5900	6295	6690	7084	7479	395
1101	7873	8268	8662	9056	9451	9845	*0239	*0633	*1028	*1422	394
1102	042 1816	2210	2604	2998	3392	3786	4180	4574	4968	5361	394
1103	5755	6149	6543	6936	7330	7723	8117	8510	8904	9297	394
1104	9691	*0084	*0477	*0871	*1264	*1657	*2050	*2444	*2837	*3230	393
1105	043 3623	4016	4409	4802	5195	5587	5980	6373	6766	7159	393
1106	7551	7944	8337	8729	9122	9514	9907	*0299	*0692	*1084	393
1107	044 1476	1869	2261	2653	3045	3437	3829	4222	4614	5006	392
1108	5398	5790	6181	6573	6965	7357	7749	8140	8532	8924	392
1109	9315	9707	*0099	*0490	*0882	*1273	*1664	*2056	*2447	*2839	392
1110	045 3230	3621	4012	4403	4795	5186	5577	5968	6359	6750	391
1111	7141	7531	7922	8313	8704	9095	9485	9876	*0267	*0657	391
1112	046 1048	1438	1829	2219	2610	3000	3391	3781	4171	4561	390
1113	4952	5342	5732	6122	6512	6902	7292	7682	8072	8462	390
1114	8852	9242	9632	*0021	*0411	*0801	*1190	*1580	*1970	*2359	390
1115	047 2749	3138	3528	3917	4306	4696	5085	5474	5864	6253	389
1116	6642	7031	7420	7809	8198	8587	8976	9365	9754	*0143	389
1117	048 0532	0921	1309	1698	2087	2475	2864	3253	3641	4030	389
1118	4418	4806	5195	5583	5972	6360	6748	7136	7525	7913	388
1119	8301	8689	9077	9465	9853	*0241	*0629	*1017	*1405	*1792	388
1120	049 2180	2568	2956	3343	3731	4119	4506	4894	5281	5669	388
1121	6056	6444	6831	7218	7606	7993	8380	8767	9154	9541	387
1122	9929	*0316	*0703	*1090	*1477	*1863	*2250	*2637	*3024	*3411	387
1123	050 3798	4184	4571	4958	5344	5731	6117	6504	6890	7277	387
1124	7663	8049	8436	8822	9208	9595	9981	*0367	*0753	*1139	386
1125	051 1525	1911	2297	2683	3069	3455	3841	4227	4612	4998	386
1126	5384	5770	6155	6541	6926	7312	7697	8083	8468	8854	386
1127	9239	9624	*0010	*0395	*0780	*1166	*1551	*1936	*2321	*2706	385
1128	052 3091	3476	3861	4246	4631	5016	5400	5785	6170	6555	385
1129	6939	7324	7709	8093	8478	8862	9247	9631	*0016	*0400	385
1130	053 0784	1169	1553	1937	2321	2706	3090	3474	3858	4242	384
1131	4626	5010	5394	5778	6162	6546	6929	7313	7697	8081	384
1132	8464	8848	9232	9615	9999	*0382	*0766	*1149	*1532	*1916	384
1133	054 2299	2682	3066	3449	3832	4215	4598	4981	5365	5748	383
1134	6131	6514	6896	7279	7662	8045	8428	8811	9193	9576	383
1135	9959	*0341	*0724	*1106	*1489	*1871	*2254	*2636	*3019	*3401	382
1136	055 3783	4166	4548	4930	5312	5694	6077	6459	6841	7223	382
1137	7605	7987	8369	8750	9132	9514	9896	*0278	*0659	*1041	382
1138	056 1423	1804	2186	2567	2949	3330	3712	4093	4475	4856	381
1139	5237	5619	6000	6381	6762	7143	7524	7905	8287	8668	381
1140	9049	9429	9810	*0191	*0572	*0953	*1334	*1714	*2095	*2476	381
1141	057 2856	3237	3618	3998	4379	4759	5140	5520	5900	6281	381
1142	6661	7041	7422	7802	8182	8562	8942	9322	9702	*0082	380
1143	058 0462	0842	1222	1602	1982	2362	2741	3121	3501	3881	380
1144	4260	4640	5019	5399	5778	6158	6537	6917	7296	7676	380
1145	8055	8434	8813	9193	9572	9951	*0330	*0709	*1088	*1467	379
1146	059 1846	2225	2604	2983	3362	3741	4119	4498	4877	5256	379
1147	5634	6013	6391	6770	7148	7527	7905	8284	8662	9041	379
1148	9419	9797	*0175	*0554	*0932	*1310	*1688	*2066	*2444	*2822	378
1149	060 3200	3578	3956	4334	4712	5090	5468	5845	6223	6601	378
1150	6978	7356	7734	8111	8489	8866	9244	9621	9999	*0376	378
N	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS—(Continued)

N	0	1	2	3	4	5	6	7	8	9	d.
1150	060 6978	7356	7734	8111	8489	8866	9244	9621	9999	*0376	378
1151	061 0753	1131	1508	1885	2262	2639	3017	3394	3771	4148	377
1152	4525	4902	5279	5656	6032	6409	6786	7163	7540	7916	377
1153	8293	8670	9046	9423	9799	*0176	*0552	*0929	*1305	*1682	377
1154	062 2058	2434	2811	3187	3563	3939	4316	4692	5068	5444	376
1155	5820	6196	6572	6948	7324	7699	8075	8451	8827	9203	376
1156	9578	9954	*0330	*0705	*1081	*1456	*1832	*2207	*2583	*2958	376
1157	063 3334	3709	4084	4460	4835	5210	5585	5960	6335	6711	375
1158	7086	7461	7836	8211	8585	8960	9335	9710	*0085	*0460	375
1159	064 0834	1209	1584	1958	2333	2708	3082	3457	3831	4205	375
1160	4580	4954	5329	5703	6077	6451	6826	7200	7574	7948	374
1161	8322	8696	9070	9444	9818	*0192	*0566	*0940	*1314	*1688	374
1162	065 2061	2435	2809	3182	3556	3930	4303	4677	5050	5424	374
1163	5797	6171	6544	6917	7291	7664	8037	8410	8784	9157	373
1164	9530	9903	*0276	*0649	*1022	*1395	*1768	*2141	*2514	*2886	373
1165	066 3259	3632	4005	4377	4750	5123	5495	5868	6241	6613	373
1166	6986	7358	7730	8103	8475	8847	9220	9592	9964	*0336	372
1167	067 0709	1081	1453	1825	2197	2569	2941	3313	3685	4057	372
1168	4428	4800	5172	5544	5915	6287	6659	7030	7402	7774	372
1169	8145	8517	8888	9259	9631	*0002	*0374	*0745	*1116	*1487	371
1170	068 1859	2230	2601	2972	3343	3714	4085	4456	4827	5198	371
1171	5569	5940	6311	6681	7052	7423	7794	8164	8535	8906	371
1172	9276	9647	*0017	*0388	*0758	*1129	*1499	*1869	*2240	*2610	370
1173	069 2980	3350	3721	4091	4461	4831	5201	5571	5941	6311	370
1174	6681	7051	7421	7791	8160	8530	8900	9270	9639	*0009	370
1175	070 0379	0748	1118	1487	1857	2226	2596	2965	3335	3704	369
1176	4073	4442	4812	5181	5550	5919	6288	6658	7027	7396	369
1177	7765	8134	8503	8871	9240	9609	9978	*0347	*0715	*1084	369
1178	071 1453	1822	2190	2559	2927	3296	3664	4033	4401	4770	369
1179	5138	5506	5875	6243	6611	6979	7348	7716	8084	8452	368
1180	8820	9188	9556	9924	*0292	*0660	*1028	*1396	*1763	*2131	368
1181	072 2499	2867	3234	3602	3970	4337	4705	5072	5440	5807	368
1182	6175	6542	6910	7277	7644	8011	8379	8746	9113	9480	367
1183	9847	*0215	*0582	*0949	*1316	*1683	*2050	*2416	*2783	*3150	367
1184	073 3517	3884	4251	4617	4984	5351	5717	6084	6450	6817	367
1185	7184	7550	7916	8283	8649	9016	9382	9748	*0114	*0481	366
1186	074 0847	1213	1579	1945	2311	2677	3043	3409	3775	4141	366
1187	4507	4873	5239	5605	5970	6336	6702	7068	7433	7799	366
1188	8164	8530	8895	9261	9626	9992	*0357	*0723	*1088	*1453	365
1189	075 1819	2184	2549	2914	3279	3644	4010	4375	4740	5105	365
1190	5470	5835	6199	6564	6929	7294	7659	8024	8388	8753	365
1191	9118	9482	9847	*0211	*0576	*0940	*1305	*1669	*2034	*2398	364
1192	076 2763	3127	3491	3855	4220	4584	4948	5312	5676	6040	364
1193	6404	6768	7132	7496	7860	8224	8588	8952	9316	9680	364
1194	077 0043	0407	0771	1134	1498	1862	2225	2589	2952	3316	364
1195	3679	4042	4406	4769	5133	5496	5859	6222	6585	6949	363
1196	7312	7675	8038	8401	8764	9127	9490	9853	*0216	*0579	363
1197	078 0942	1304	1667	2030	2393	2755	3118	3480	3843	4206	363
1198	4568	4931	5293	5656	6018	6380	6743	7105	7467	7830	362
1199	8192	8554	8916	9278	9640	*0003	*0365	*0727	*1089	*1451	362
1200	079 1812	2174	2536	2898	3260	3622	3983	4345	4707	5068	362
N	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS OF THE TRIGONOMETRIC FUNCTIONS

Logarithms of the functions are given for each minute from 0-360°.

The quantity −10 is to be appended to all logarithms of the sine and cosine, to logarithms of the tangent from 0-45° and of the cotangent from 45-90°.

With degrees indicated at either side of the top of the page use the column headings at the top. With degrees stated at the bottom of the page use the column designations at the bottom.

With degrees at the left (top or bottom) use the minute column at the left, and with degrees on the right side of the page use the minute column at the right.

The method of determining the functions of small angles by the auxiliary quantities S and T is given in the section explaining the use of the mathematical tables at the front of the volume.

Min.	Values of S, −10 to be appended					Values of T, −10 to be appended					Sec.
	0°	1°	2°	3°	4°	0°	1°	2°	3°	4°	
0′	4.68 558	555	549	538	522	4.68 558	562	575	597	628	0″
1	558	555	549	537	522	558	562	575	598	629	60
2	558	555	548	537	522	558	562	576	598	629	120
3	558	555	548	537	521	558	562	576	599	630	180
4	558	555	548	537	521	558	563	576	599	631	240
5	558	555	548	537	521	558	563	577	599	631	300
6	558	555	548	536	520	558	563	577	600	632	360
7	558	555	548	536	520	558	563	577	600	632	420
8	557	555	548	536	520	558	563	578	601	633	480
9	557	555	547	536	520	558	563	578	601	634	540
10	4.68 557	555	547	535	519	4.68 558	564	578	602	634	600
11	557	554	547	535	519	558	564	579	602	635	660
12	557	554	547	535	519	558	564	579	603	635	720
13	557	554	547	535	518	558	564	579	603	636	780
14	557	554	547	534	518	558	564	580	604	637	840
15	557	554	546	534	518	558	564	580	604	637	900
16	557	554	546	534	517	558	565	580	605	638	960
17	557	554	546	534	517	558	565	581	605	639	1020
18	557	554	546	534	517	558	565	581	606	639	1080
19	557	554	546	533	516	558	565	581	606	640	1140
20	4.68 557	554	546	533	516	4.68 558	565	582	607	640	1200
21	557	554	545	533	516	558	566	582	607	641	1260
22	557	553	545	533	515	558	566	582	608	642	1320
23	557	553	545	532	515	558	566	583	608	642	1380
24	557	553	545	532	515	558	566	583	609	643	1440
25	557	553	545	532	515	558	566	583	609	644	1500
26	557	553	544	532	514	558	567	584	610	644	1560
27	557	553	544	531	514	558	567	584	610	645	1620
28	557	553	544	531	514	558	567	584	611	646	1680
29	557	553	544	531	513	559	567	585	611	646	1740
30	4.68 557	553	544	531	513	4.68 559	567	585	612	647	1800
31	557	552	544	530	513	559	568	585	612	648	1860
32	557	552	543	530	512	559	568	586	613	648	1920
33	557	552	543	530	512	559	568	586	613	649	1980
34	557	552	543	529	512	559	568	587	614	650	2040
35	557	552	543	529	511	559	569	587	614	650	2100
36	557	552	543	529	511	559	569	587	615	651	2160
37	557	552	542	529	511	559	569	588	615	652	2220
38	557	552	542	528	510	559	569	588	616	652	2280
39	557	552	542	528	510	559	570	589	616	653	2340
40	4.68 557	551	542	528	510	4.68 559	570	589	617	654	2400
41	557	551	542	528	509	560	570	589	617	654	2460
42	556	551	541	527	509	560	570	590	618	655	2520
43	556	551	541	527	508	560	571	590	619	656	2580
44	556	551	541	527	508	560	571	591	619	656	2640
45	556	551	541	527	508	560	571	591	620	657	2700
46	556	551	541	526	507	560	571	591	620	658	2760
47	556	551	540	526	507	560	572	592	621	659	2820
48	556	550	540	526	507	560	572	592	621	659	2880
49	556	550	540	525	506	560	572	593	622	660	2940
50	4.68 556	550	540	525	506	4.68 561	572	593	622	661	3000
51	556	550	540	525	506	561	573	593	623	661	3060
52	556	550	539	525	505	561	573	594	624	662	3120
53	556	550	539	524	505	561	573	594	624	663	3180
54	556	550	539	524	505	561	573	595	625	664	3240
55	556	549	539	524	504	561	574	595	625	664	3300
56	556	549	539	523	504	561	574	596	626	665	3360
57	556	549	538	523	503	562	574	596	626	666	3420
58	555	549	538	523	503	562	575	596	627	667	3480
59	555	549	538	523	503	562	575	597	628	667	3540
60	4.68 555	549	538	522	502	4.68 562	575	597	628	668	3600

0° (180°) (359°) **179°**

"	'	L. Sin	d.	C. S.	C. T.	L. Tan.	c.d.	L. Cot.	L. Cos.	'
0	**0**	—		—	—	—		—	0.00 000	**60**
60	1	6.46 373	30103	5.31 443	5.31 443	6.46 373	30103	3.53 627	0.00 000	59
120	2	6.76 476	17609	5.31 443	5.31 443	6.76 476	17609	3.23 524	0.00 000	58
180	3	6.94 085	12494	5.31 443	5.31 443	6.94 085	12494	3.05 915	0.00 000	57
240	4	7.06 579	9691	5.31 443	5.31 442	7.06 579	9691	2.93 421	0.00 000	56
300	5	7.16 270	7918	5.31 443	5.31 442	7.16 270	7918	2.83 730	0.00 000	55
360	6	7.24 188	6694	5.31 443	5.31 442	7.24 188	6694	2.75 812	0.00 000	54
420	7	7.30 882	5800	5.31 443	5.31 442	7.30 882	5800	2.69 118	0.00 000	53
480	8	7.36 682	5115	5.31 443	5.31 442	7.36 682	5115	2.63 318	0.00 000	52
540	9	7.41 797	4576	5.31 443	5.31 442	7.41 797	4576	2.58 203	0.00 000	51
600	**10**	7.46 373	4139	5.31 443	5.31 442	7.46 373	4139	2.53 627	0.00 000	**50**
660	11	7.50 512	3779	5.31 443	5.31 442	7.50 512	3779	2.49 488	0.00 000	49
720	12	7.54 291	3476	5.31 443	5.31 442	7.54 291	3476	2.45 709	0.00 000	48
780	13	7.57 767	3218	5.31 443	5.31 442	7.57 767	3219	2.42 233	0.00 000	47
840	14	7.60 985	2997	5.31 443	5.31 442	7.60 986	2996	2.39 014	0.00 000	46
900	15	7.63 982	2802	5.31 443	5.31 442	7.63 982	2803	2.36 018	0.00 000	45
960	16	7.66 784	2633	5.31 443	5.31 442	7.66 785	2633	2.33 215	0.00 000	44
1020	17	7.69 417	2483	5.31 443	5.31 442	7.69 418	2482	2.30 582	9.99 999	43
1080	18	7.71 900	2348	5.31 443	5.31 442	7.71 900	2348	2.28 100	9.99 999	42
1140	19	7.74 248	2227	5.31 443	5.31 442	7.74 248	2228	2.25 752	9.99 999	41
1200	**20**	7.76 475	2119	5.31 443	5.31 442	7.76 476	2119	2.23 524	9.99 999	**40**
1260	21	7.78 594	2021	5.31 443	5.31 442	7.78 595	2020	2.21 405	9.99 999	39
1320	22	7.80 615	1930	5.31 443	5.31 442	7.80 615	1931	2.19 385	9.99 999	38
1380	23	7.82 545	1848	5.31 443	5.31 442	7.82 546	1848	2.17 454	9.99 999	37
1440	24	7.84 393	1773	5.31 443	5.31 442	7.84 394	1773	2.15 606	9.99 999	36
1500	25	7.86 166	1704	5.31 443	5.31 442	7.86 167	1704	2.13 833	9.99 999	35
1560	26	7.87 870	1639	5.31 443	5.31 442	7.87 871	1639	2.12 129	9.99 999	34
1620	27	7.89 509	1579	5.31 443	5.31 442	7.89 510	1579	2.10 490	9.99 999	33
1680	28	7.91 088	1524	5.31 443	5.31 442	7.91 089	1524	2.08 911	9.99 999	32
1740	29	7.92 612	1472	5.31 443	5.31 441	7.92 613	1473	2.07 387	9.99 998	31
1800	**30**	7.94 084	1424	5.31 443	5.31 441	7.94 086	1424	2.05 914	9.99 998	**30**
1860	31	7.95 508	1379	5.31 443	5.31 441	7.95 510	1379	2.04 490	9.99 998	29
1920	32	7.96 887	1336	5.31 443	5.31 441	7.96 889	1336	2.03 111	9.99 998	28
1980	33	7.98 223	1297	5.31 443	5.31 441	7.98 225	1297	2.01 775	9.99 998	27
2040	34	7.99 520	1259	5.31 443	5.31 441	7.99 522	1259	2.00 478	9.99 998	26
2100	35	8.00 779	1223	5.31 443	5.31 441	8.00 781	1223	1.99 219	9.99 998	25
2160	36	8.02 002	1190	5.31 443	5.31 441	8.02 004	1190	1.97 996	9.99 998	24
2220	37	8.03 192	1158	5.31 443	5.31 441	8.03 194	1159	1.96 806	9.99 997	23
2280	38	8.04 350	1128	5.31 443	5.31 441	8.04 353	1128	1.95 647	9.99 997	22
2340	39	8.05 478	1100	5.31 443	5.31 441	8.05 481	1100	1.94 519	9.99 997	21
2400	**40**	8.06 578	1072	5.31 443	5.31 441	8.06 581	1072	1.93 419	9.99 997	**20**
2460	41	8.07 650	1046	5.31 444	5.31 440	8.07 653	1047	1.92 347	9.99 997	19
2520	42	8.08 696	1022	5.31 444	5.31 440	8.08 700	1022	1.91 300	9.99 997	18
2580	43	8.09 718	999	5.31 444	5.31 440	8.09 722	998	1.90 278	9.99 997	17
2640	44	8.10 717	976	5.31 444	5.31 440	8.10 720	976	1.89 280	9.99 996	16
2700	45	8.11 693	954	5.31 444	5.31 440	8.11 696	955	1.88 304	9.99 996	15
2760	46	8.12 647	934	5.31 444	5.31 440	8.12 651	934	1.87 349	9.99 996	14
2820	47	8.13 581	914	5.31 444	5.31 440	8.13 585	915	1.86 415	9.99 996	13
2880	48	8.14 495	896	5.31 444	5.31 440	8.14 500	895	1.85 500	9.99 996	12
2940	49	8.15 391	877	5.31 444	5.31 440	8.15 395	878	1.84 605	9.99 996	11
3000	**50**	8.16 268	860	5.31 444	5.31 439	8.16 273	860	1.83 727	9.99 995	**10**
3060	51	8.17 128	843	5.31 444	5.31 439	8.17 133	843	1.82 867	9.99 995	9
3120	52	8.17 971	827	5.31 444	5.31 439	8.17 976	828	1.82 024	9.99 995	8
3180	53	8.18 798	812	5.31 444	5.31 439	8.18 804	812	1.81 196	9.99 995	7
3240	54	8.19 610	797	5.31 444	5.31 439	8.19 616	797	1.80 384	9.99 995	6
3300	55	8.20 407	782	5.31 444	5.31 439	8.20 413	782	1.79 587	9.99 994	5
3360	56	8.21 189	769	5.31 444	5.31 439	8.21 195	769	1.78 805	9.99 994	4
3420	57	8.21 958	755	5.31 445	5.31 439	8.21 964	756	1.78 036	9.99 994	3
3480	58	8.22 713	743	5.31 445	5.31 438	8.22 720	742	1.77 280	9.99 994	2
3540	59	8.23 456	730	5.31 445	5.31 438	8.23 462	730	1.76 538	9.99 994	1
3600	**60**	8.24 186		5.31 445	5.31 438	8.24 192		1.75 808	9.99 993	**0**
	'	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	'

90° (270°) (269°) **89°**

1° (181°) (358°) **178°**

"	'	L. Sin.	d.	C. S.	C. T.	L. Tan.	c.d.	L. Cot.	L. Cos.	'
3600	**0**	8.24 186	717	5.31 445	5.31 438	8.24 192	718	1.75 808	9.99 993	**60**
3660	1	8.24 903	706	5.31 445	5.31 438	8.24 910	706	1.75 090	9.99 993	59
3720	2	8.25 609	695	5.31 445	5.31 438	8.25 616	696	1.74 384	9.99 993	58
3780	3	8.26 304	684	5.31 445	5.31 438	8.26 312	684	1.73 688	9.99 993	57
3840	4	8.26 988	673	5.31 445	5.31 437	8.26 996	673	1.73 004	9.99 992	56
3900	5	8.27 661	663	5.31 445	5.31 437	8.27 669	663	1.72 331	9.99 992	55
3960	6	8.28 324	653	5.31 445	5.31 437	8.28 332	654	1.71 668	9.99 992	54
4020	7	8.28 977	644	5.31 445	5.31 437	8.28 986	643	1.71 014	9.99 992	53
4080	8	8.29 621	634	5.31 445	5.31 437	8.29 629	634	1.70 371	9.99 992	52
4140	9	8.30 255	624	5.31 445	5.31 437	8.30 263	625	1.69 737	9.99 991	51
4200	**10**	8.30 879	616	5.31 446	5.31 437	8.30 888	617	1.69 112	9.99 991	**50**
4260	11	8.31 495	608	5.31 446	5.31 436	8.31 505	607	1.68 495	9.99 991	49
4320	12	8.32 103	599	5.31 446	5.31 436	8.32 112	599	1.67 888	9.99 990	48
4380	13	8.32 702	590	5.31 446	5.31 436	8.32 711	591	1.67 289	9.99 990	47
4440	14	8.33 292	583	5.31 446	5.31 436	8.33 302	584	1.66 698	9.99 990	46
4500	15	8.33 875	575	5.31 446	5.31 436	8.33 886	575	1.66 114	9.99 990	45
4560	16	8.34 450	568	5.31 446	5.31 435	8.34 461	568	1.65 539	9.99 989	44
4620	17	8.35 018	560	5.31 446	5.31 435	8.35 029	561	1.64 971	9.99 989	43
4680	18	8.35 578	553	5.31 446	5.31 435	8.35 590	553	1.64 410	9.99 989	42
4740	19	8.36 131	547	5.31 446	5.31 435	8.36 143	546	1.63 857	9.99 989	41
4800	**20**	8.36 678	539	5.31 446	5.31 435	8.36 689	540	1.63 311	9.99 988	**40**
4860	21	8.37 217	533	5.31 447	5.31 434	8.37 229	533	1.62 771	9.99 988	39
4920	22	8.37 750	526	5.31 447	5.31 434	8.37 762	527	1.62 238	9.99 988	38
4980	23	8.38 276	520	5.31 447	5.31 434	8.38 289	520	1.61 711	9.99 987	37
5040	24	8.38 796	514	5.31 447	5.31 434	8.38 809	514	1.61 191	9.99 987	36
5100	25	8.39 310	508	5.31 447	5.31 434	8.39 323	509	1.60 677	9.99 987	35
5160	26	8.39 818	502	5.31 447	5.31 433	8.39 832	502	1.60 168	9.99 986	34
5220	27	8.40 320	496	5.31 447	5.31 433	8.40 334	496	1.59 666	9.99 986	33
5280	28	8.40 816	491	5.31 447	5.31 433	8.40 830	491	1.59 170	9.99 986	32
5340	29	8.41 307	485	5.31 447	5.31 433	8.41 321	486	1.58 679	9.99 985	31
5400	**30**	8.41 792	480	5.31 447	5.31 433	8.41 807	480	1.58 193	9.99 985	**30**
5460	31	8.42 272	474	5.31 448	5.31 432	8.42 287	475	1.57 713	9.99 985	29
5520	32	8.42 746	470	5.31 448	5.31 432	8.42 762	470	1.57 238	9.99 984	28
5580	33	8.43 216	464	5.31 448	5.31 432	8.43 232	464	1.56 768	9.99 984	27
5640	34	8.43 680	459	5.31 448	5.31 432	8.43 696	460	1.56 304	9.99 984	26
5700	35	8.44 139	455	5.31 448	5.31 431	8.44 156	455	1.55 844	9.99 983	25
5760	36	8.44 594	450	5.31 448	5.31 431	8.44 611	450	1.55 389	9.99 983	24
5820	37	8.45 044	445	5.31 448	5.31 431	8.45 061	446	1.54 939	9.99 983	23
5880	38	8.45 489	441	5.31 448	5.31 431	8.45 507	441	1.54 493	9.99 982	22
5940	39	8.45 930	436	5.31 449	5.31 431	8.45 948	437	1.54 052	9.99 982	21
6000	**40**	8.46 366	433	5.31 449	5.31 430	8.46 385	432	1.53 615	9.99 982	**20**
6060	41	8.46 799	427	5.31 449	5.31 430	8.46 817	428	1.53 183	9.99 981	19
6120	42	8.47 226	424	5.31 449	5.31 430	8.47 245	424	1.52 755	9.99 981	18
6180	43	8.47 650	419	5.31 449	5.31 430	8.47 669	420	1.52 331	9.99 981	17
6240	44	8.48 069	416	5.31 449	5.31 429	8.48 089	416	1.51 911	9.99 980	16
6300	45	8.48 485	411	5.31 449	5.31 429	8.48 505	412	1.51 495	9.99 980	15
6360	46	8.48 896	408	5.31 449	5.31 429	8.48 917	408	1.51 083	9.99 979	14
6420	47	8.49 304	404	5.31 450	5.31 428	8.49 325	404	1.50 675	9.99 979	13
6480	48	8.49 708	400	5.31 450	5.31 428	8.49 729	401	1.50 271	9.99 979	12
6540	49	8.50 108	396	5.31 450	5.31 428	8.50 130	397	1.49 870	9.99 978	11
6600	**50**	8.50 504	393	5.31 450	5.31 428	8.50 527	393	1.49 473	9.99 978	**10**
6660	51	8.50 897	390	5.31 450	5.31 427	8.50 920	390	1.49 080	9.99 977	9
6720	52	8.51 287	386	5.31 450	5.31 427	8.51 310	386	1.48 690	9.99 977	8
6780	53	8.51 673	382	5.31 450	5.31 427	8.51 696	383	1.48 304	9.99 977	7
6840	54	8.52 055	379	5.31 450	5.31 427	8.52 079	380	1.47 921	9.99 976	6
6900	55	8.52 434	376	5.31 451	5.31 426	8.52 459	376	1.47 541	9.99 976	5
6960	56	8.52 810	373	5.31 451	5.31 426	8.52 835	373	1.47 165	9.99 975	4
7020	57	8.53 183	369	5.31 451	5.31 426	8.53 208	370	1.46 792	9.99 975	3
7080	58	8.53 552	367	5.31 451	5.31 425	8.53 578	367	1.46 422	9.99 974	2
7140	59	8.53 919	363	5.31 451	5.31 425	8.53 945	363	1.46 055	9.99 974	1
7200	**60**	8.54 282		5.31 451	5.31 425	8.54 308		1.45 692	9.99 974	**0**
	'	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	'

91° (271°) (268°) **88°**

2° (182°) (357°) **177°**

"	'	L. Sin.	d.	C. S.	C. T.	L. Tan.	c.d.	L. Cot.	L. Cos.	'
7200	0	8.54 282	360	5.31 451	5.31 425	8.54 308	361	1.45 692	9.99 974	60
7260	1	8.54 642	357	5.31 451	5.31 425	8.54 669	358	1.45 331	9.99 973	59
7320	2	8.54 999	355	5.31 452	5.31 424	8.55 027	355	1.44 973	9.99 973	58
7380	3	8.55 354	351	5.31 452	5.31 424	8.55 382	352	1.44 618	9.99 972	57
7440	4	8.55 705	349	5.31 452	5.31 424	8.55 734	349	1.44 266	9.99 972	56
7500	5	8.56 054	346	5.31 452	5.31 423	8.56 083	346	1.43 917	9.99 971	55
7560	6	8.56 400	343	5.31 452	5.31 423	8.56 429	344	1.43 571	9.99 971	54
7620	7	8.56 743	341	5.31 452	5.31 423	8.56 773	341	1.43 227	9.99 970	53
7680	8	8.57 084	337	5.31 453	5.31 422	8.57 114	338	1.42 886	9.99 970	52
7740	9	8.57 421	336	5.31 453	5.31 422	8.57 452	336	1.42 548	9.99 969	51
7800	10	8.57 757	332	5.31 453	5.31 422	8.57 788	333	1.42 212	9.99 969	50
7860	11	8.58 089	330	5.31 453	5.31 421	8.58 121	330	1.41 879	9.99 968	49
7920	12	8.58 419	328	5.31 453	5.31 421	8.58 451	328	1.41 549	9.99 968	48
7980	13	8.58 747	325	5.31 453	5.31 421	8.58 779	326	1.41 221	9.99 967	47
8040	14	8.59 072	323	5.31 454	5.31 421	8.59 105	323	1.40 895	9.99 967	46
8100	15	8.59 395	320	5.31 454	5.31 420	8.59 428	321	1.40 572	9.99 967	45
8160	16	8.59 715	318	5.31 454	5.31 420	8.59 749	319	1.40 251	9.99 966	44
8220	17	8.60 033	316	5.31 454	5.31 420	8.60 068	316	1.39 932	9.99 966	43
8280	18	8.60 349	313	5.31 454	5.31 419	8.60 384	314	1.39 616	9.99 965	42
8340	19	8.60 662	311	5.31 454	5.31 419	8.60 698	311	1.39 302	9.99 964	41
8400	20	8.60 973	309	5.31 455	5.31 418	8.61 009	310	1.38 991	9.99 964	40
8460	21	8.61 282	307	5.31 455	5.31 418	8.61 319	307	1.38 681	9.99 963	39
8520	22	8.61 589	305	5.31 455	5.31 418	8.61 626	305	1.38 374	9.99 963	38
8580	23	8.61 894	302	5.31 455	5.31 417	8.61 931	303	1.38 069	9.99 962	37
8640	24	8.62 196	301	5.31 455	5.31 417	8.62 234	301	1.37 766	9.99 962	36
8700	25	8.62 497	298	5.31 455	5.31 417	8.62 535	299	1.37 465	9.99 961	35
8760	26	8.62 795	296	5.31 456	5.31 416	8.62 834	297	1.37 166	9.99 961	34
8820	27	8.63 091	294	5.31 456	5.31 416	8.63 131	295	1.36 869	9.99 960	33
8880	28	8.63 385	293	5.31 456	5.31 416	8.63 426	292	1.36 574	9.99 960	32
8940	29	8.63 678	290	5.31 456	5.31 415	8.63 718	291	1.36 282	9.99 959	31
9000	30	8.63 968	288	5.31 456	5.31 415	8.64 009	289	1.35 991	9.99 959	30
9060	31	8.64 256	287	5.31 456	5.31 415	8.64 298	287	1.35 702	9.99 958	29
9120	32	8.64 543	284	5.31 457	5.31 414	8.64 585	285	1.35 415	9.99 958	28
9180	33	8.64 827	283	5.31 457	5.31 414	8.64 870	284	1.35 130	9.99 957	27
9240	34	8.65 110	281	5.31 457	5.31 413	8.65 154	281	1.34 846	9.99 956	26
9300	35	8.65 391	279	5.31 457	5.31 413	8.65 435	280	1.34 565	9.99 956	25
9360	36	8.65 670	277	5.31 457	5.31 413	8.65 715	278	1.34 285	9.99 955	24
9420	37	8.65 947	276	5.31 458	5.31 412	8.65 993	276	1.34 007	9.99 955	23
9480	38	8.66 223	274	5.31 458	5.31 412	8.66 269	274	1.33 731	9.99 954	22
9540	39	8.66 497	272	5.31 458	5.31 412	8.66 543	273	1.33 457	9.99 954	21
9600	40	8.66 769	270	5.31 458	5.31 411	8.66 816	271	1.33 184	9.99 953	20
9660	41	8.67 039	269	5.31 458	5.31 411	8.67 087	269	1.32 913	9.99 952	19
9720	42	8.67 308	267	5.31 459	5.31 410	8.67 356	268	1.32 644	9.99 952	18
9780	43	8.67 575	266	5.31 459	5.31 410	8.67 624	266	1.32 376	9.99 951	17
9840	44	8.67 841	263	5.31 459	5.31 410	8.67 890	264	1.32 110	9.99 951	16
9900	45	8.68 104	263	5.31 459	5.31 409	8.68 154	263	1.31 846	9.99 950	15
9960	46	8.68 367	260	5.31 459	5.31 409	8.68 417	261	1.31 583	9.99 949	14
10020	47	8.68 627	259	5.31 460	5.31 408	8.68 678	260	1.31 322	9.99 949	13
10080	48	8.68 886	258	5.31 460	5.31 408	8.68 938	258	1.31 062	9.99 948	12
10140	49	8.69 144	256	5.31 460	5.31 408	8.69 196	257	1.30 804	9.99 948	11
10200	50	8.69 400	254	5.31 460	5.31 407	8.69 453	255	1.30 547	9.99 947	10
10260	51	8.69 654	253	5.31 460	5.31 407	8.69 708	254	1.30 292	9.99 946	9
10320	52	8.69 907	252	5.31 461	5.31 406	8.69 962	252	1.30 038	9.99 946	8
10380	53	8.70 159	250	5.31 461	5.31 406	8.70 214	251	1.29 786	9.99 945	7
10440	54	8.70 409	249	5.31 461	5.31 405	8.70 465	249	1.29 535	9.99 944	6
10500	55	8.70 658	247	5.31 461	5.21 405	8.70 714	248	1.29 286	9.99 944	5
10560	56	8.70 905	246	5.31 461	5.31 405	8.70 962	246	1.29 038	9.99 943	4
10620	57	8.71 151	244	5.31 462	5.31 404	8.71 208	245	1.28 792	9.99 942	3
10680	58	8.71 395	243	5.31 462	5.31 404	8.71 453	244	1.28 547	9.99 942	2
10740	59	8.71 638	242	5.31 462	5.31 403	8.71 697	243	1.28 303	9.99 941	1
10800	60	8.71 880		5.31 462	5.31 403	8.71 940		1.28 060	9.99 940	0
	'	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	'

92° (272°) (267°) **87°**

3° (183°) (356°) **176°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	8.71 880	240	8.71 940	241	1.28 060	9.99 940	**60**
1	8.72 120	239	8.72 181	239	1.27 819	9.99 940	59
2	8.72 359	238	8.72 420	239	1.27 580	9.99 939	58
3	8.72 597	237	8.72 659	237	1.27 341	9.99 938	57
4	8.72 834	235	8.72 896	236	1.27 104	9.99 938	56
5	8.73 069	234	8.73 132	234	1.26 868	9.99 937	55
6	8.73 303	232	8.73 366	234	1.26 634	9.99 936	54
7	8.73 535	232	8.73 600	232	1.26 400	9.99 936	53
8	8.73 767	230	8.73 832	231	1.26 168	9.99 935	52
9	8.73 997	229	8.74 063	229	1.25 937	9.99 934	51
10	8.74 226	228	8.74 292	229	1.25 708	9.99 934	**50**
11	8.74 454	226	8.74 521	227	1.25 479	9.99 933	49
12	8.74 680	226	8.74 748	226	1.25 252	9.99 932	48
13	8.74 906	224	8.74 974	225	1.25 026	9.99 932	47
14	8.75 130	223	8.75 199	224	1.24 801	9.99 931	46
15	8.75 353	222	8.75 423	222	1.24 577	9.99 930	45
16	8.75 575	220	8.75 645	222	1.24 355	9.99 929	44
17	8.75 795	220	8.75 867	220	1.24 133	9.99 929	43
18	8.76 015	219	8.76 087	219	1.23 913	9.99 928	42
19	8.76 234	217	8.76 306	219	1.23 694	9.99 927	41
20	8.76 451	216	8.76 525	217	1.23 475	9.99 926	**40**
21	8.76 667	216	8.76 742	216	1.23 258	9.99 926	39
22	8.76 883	214	8.76 958	215	1.23 042	9.99 925	38
23	8.77 097	213	8.77 173	214	1.22 827	9.99 924	37
24	8.77 310	212	8.77 387	213	1.22 613	9.99 923	36
25	8.77 522	211	8.77 600	211	1.22 400	9.99 923	35
26	8.77 733	210	8.77 811	211	1.22 189	9.99 922	34
27	8.77 943	209	8.78 022	210	1.21 978	9.99 921	33
28	8.78 152	208	8.78 232	209	1.21 768	9.99 920	32
29	8.78 360	208	8.78 441	208	1.21 559	9.99 920	31
30	8.78 568	206	8.78 649	206	1.21 351	9.99 919	**30**
31	8.78 774	205	8.78 855	206	1.21 145	9.99 918	29
32	8.78 979	204	8.79 061	205	1.20 939	9.99 917	28
33	8.79 183	203	8.79 266	204	1.20 734	9.99 917	27
34	8.79 386	202	8.79 470	203	1.20 530	9.99 916	26
35	8.79 588	201	8.79 673	202	1.20 327	9.99 915	25
36	8.79 789	201	8.79 875	201	1.20 125	9.99 914	24
37	8.79 990	199	8.80 076	201	1.19 924	9.99 913	23
38	8.80 189	199	8.80 277	199	1.19 723	9.99 913	22
39	8.80 388	197	8.80 476	198	1.19 524	9.99 912	21
40	8.80 585	197	8.80 674	198	1.19 326	9.99 911	**20**
41	8.80 782	196	8.80 872	196	1.19 128	9.99 910	19
42	8.80 978	195	8.81 068	196	1.18 932	9.99 909	18
43	8.81 173	194	8.81 264	195	1.18 736	9.99 909	17
44	8.81 367	193	8.81 459	194	1.18 541	9.99 908	16
45	8.81 560	192	8.81 653	193	1.18 347	9.99 907	15
46	8.81 752	192	8.81 846	192	1.18 154	9.99 906	14
47	8.81 944	190	8.82 038	192	1.17 962	9.99 905	13
48	8.82 134	190	8.82 230	190	1.17 770	9.99 904	12
49	8.82 324	189	8.82 420	190	1.17 580	9.99 904	11
50	8.82 513	188	8.82 610	189	1.17 390	9.99 903	**10**
51	8.82 701	187	8.82 799	188	1.17 201	9.99 902	9
52	8.82 888	187	8.82 987	188	1.17 013	9.99 901	8
53	8.83 075	186	8.83 175	186	1.16 825	9.99 900	7
54	8.83 261	185	8.83 361	186	1.16 639	9.99 899	6
55	8.83 446	184	8.83 547	185	1.16 453	9.99 898	5
56	8.83 630	183	8.83 732	184	1.16 268	9.99 898	4
57	8.83 813	183	8.83 916	184	1.16 084	9.99 897	3
58	8.83 996	181	8.84 100	182	1.15 900	9.99 896	2
59	8.84 177	181	8.84 282	182	1.15 718	9.99 895	1
60	8.84 358		8.84 464		1.15 536	9.99 894	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P. P.

″	241	239	237	235	234
1	4.0	4.0	4.0	3.9	3.9
2	8.0	8.0	7.9	7.8	7.8
3	12.0	12.0	11.8	11.8	11.7
4	16.1	15.9	15.8	15.7	15.6
5	20.1	19.9	19.8	19.6	19.5
6	24.1	23.9	23.7	23.5	23.4
7	28.1	27.9	27.6	27.4	27.3
8	32.1	31.9	31.6	31.3	31.2
9	36.2	35.8	35.6	35.2	35.1
″	**232**	**229**	**227**	**225**	**223**
1	3.9	3.8	3.8	3.8	3.7
2	7.7	7.6	7.6	7.5	7.4
3	11.6	11.4	11.4	11.2	11.2
4	15.5	15.3	15.1	15.0	14.9
5	19.3	19.1	18.9	18.8	18.6
6	23.2	22.9	22.7	22.5	22.3
7	27.1	26.7	26.5	26.2	26.0
8	30.9	30.5	30.3	30.0	29.7
9	34.8	34.4	34.0	33.8	33.4
″	**222**	**220**	**217**	**215**	**213**
1	3.7	3.7	3.6	3.6	3.6
2	7.4	7.3	7.2	7.2	7.1
3	11.1	11.0	10.8	10.8	10.6
4	14.8	14.7	14.5	14.3	14.2
5	18.5	18.3	18.1	17.9	17.8
6	22.2	22.0	21.7	21.5	21.3
7	25.9	25.7	25.3	25.1	24.8
8	29.6	29.3	28.9	28.7	28.4
9	33.3	33.0	32.6	32.2	32.0
″	**211**	**208**	**206**	**203**	**201**
1	3.5	3.5	3.4	3.4	3.4
2	7.0	6.9	6.9	6.8	6.7
3	10.6	10.4	10.3	10.2	10.0
4	14.1	13.9	13.7	13.5	13.4
5	17.6	17.3	17.2	16.9	16.8
6	21.1	20.8	20.6	20.3	20.1
7	24.6	24.3	24.0	23.7	23.4
8	28.1	27.7	27.5	27.1	26.8
9	31.6	31.2	30.9	30.4	30.2
″	**199**	**197**	**195**	**193**	**192**
1	3.3	3.3	3.2	3.2	3.2
2	6.6	6.6	6.5	6.4	6.4
3	10.0	9.8	9.8	9.6	9.6
4	13.3	13.1	13.0	12.9	12.8
5	16.6	16.4	16.2	16.1	16.0
6	19.9	19.7	19.5	19.3	19.2
7	23.2	23.0	22.8	22.5	22.4
8	26.5	26.3	26.0	25.7	25.6
9	29.8	29.6	29.2	29.0	28.8
″	**189**	**187**	**185**	**183**	**181**
1	3.2	3.1	3.1	3.0	3.0
2	6.3	6.2	6.2	6.1	6.0
3	9.4	9.4	9.2	9.2	9.0
4	12.6	12.5	12.3	12.2	12.1
5	15.8	15.6	15.4	15.2	15.1
6	18.9	18.7	18.5	18.3	18.1
7	22.0	21.8	21.6	21.4	21.1
8	25.2	24.9	24.7	24.4	24.1
9	28.4	28.0	27.8	27.4	27.2
10	31.5	31.2	30.8	30.5	30.2

P. P.

93° (273°) (266°) **86°**

4° (184°) (355°) **175°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	8.84 358	181	8.84 464	182	1.15 536	9.99 894	**60**
1	8.84 539	179	8.84 646	180	1.15 354	9.99 893	59
2	8.84 718	179	8.84 826	180	1.15 174	9.99 892	58
3	8.84 897	178	8.85 006	179	1.14 994	9.99 891	57
4	8.85 075	177	8.85 185	178	1.14 815	9.99 891	56
5	8.85 252	177	8.85 363	177	1.14 637	9.99 890	55
6	8.85 429	176	8.85 540	177	1.14 460	9.99 889	54
7	8.85 605	175	8.85 717	176	1.14 283	9.99 888	53
8	8.85 780	175	8.85 893	176	1.14 107	9.99 887	52
9	8.85 955	173	8.86 069	174	1.13 931	9.99 886	51
10	8.86 128	173	8.86 243	174	1.13 757	9.99 885	**50**
11	8.86 301	173	8.86 417	174	1.13 583	9.99 884	49
12	8.86 474	171	8.86 591	172	1.13 409	9.99 883	48
13	8.86 645	171	8.86 763	172	1.13 237	9.99 882	47
14	8.86 816	171	8.86 935	171	1.13 065	9.99 881	46
15	8.86 987	169	8.87 106	171	1.12 894	9.99 880	45
16	8.87 156	169	8.87 277	170	1.12 723	9.99 879	44
17	8.87 325	169	8.87 447	169	1.12 553	9.99 879	43
18	8.87 494	167	8.87 616	169	1.12 384	9.99 878	42
19	8.87 661	168	8.87 785	168	1.12 215	9.99 877	41
20	8.87 829	166	8.87 953	167	1.12 047	9.99 876	**40**
21	8.87 995	166	8.88 120	167	1.11 880	9.99 875	39
22	8.88 161	165	8.88 287	166	1.11 713	9.99 874	38
23	8.88 326	164	8.88 453	165	1.11 547	9.99 873	37
24	8.88 490	164	8.88 618	165	1.11 382	9.99 872	36
25	8.88 654	163	8.88 783	165	1.11 217	9.99 871	35
26	8.88 817	163	8.88 948	163	1.11 052	9.99 870	34
27	8.88 980	162	8.89 111	163	1.10 889	9.99 869	33
28	8.89 142	162	8.89 274	163	1.10 726	9.99 868	32
29	8.89 304	160	8.89 437	161	1.10 563	9.99 867	31
30	8.89 464	161	8.89 598	162	1.10 402	9.99 866	**30**
31	8.89 625	159	8.89 760	160	1.10 240	9.99 865	29
32	8.89 784	159	8.89 920	160	1.10 080	9.99 864	28
33	8.89 943	159	8.90 080	160	1.09 920	9.99 863	27
34	8.90 102	158	8.90 240	159	1.09 760	9.99 862	26
35	8.90 260	157	8.90 399	158	1.09 601	9.99 861	25
36	8.90 417	157	8.90 557	158	1.09 443	9.99 860	24
37	8.90 574	156	8.90 715	157	1.09 285	9.99 859	23
38	8.90 730	155	8.90 872	157	1.09 128	9.99 858	22
39	8.90 885	155	8.91 029	156	1.08 971	9.99 857	21
40	8.91 040	155	8.91 185	155	1.08 815	9.99 856	**20**
41	8.91 195	154	8.91 340	155	1.08 660	9.99 855	19
42	8.91 349	153	8.91 495	155	1.08 505	9.99 854	18
43	8.91 502	153	8.91 650	153	1.08 350	9.99 853	17
44	8.91 655	152	8.91 803	154	1.08 197	9.99 852	16
45	8.91 807	152	8.91 957	153	1.08 043	9.99 851	15
46	8.91 959	151	8.92 110	152	1.07 890	9.99 850	14
47	8.92 110	151	8.92 262	152	1.07 738	9.99 848	13
48	8.92 261	150	8.92 414	151	1.07 586	9.99 847	12
49	8.92 411	150	8.92 565	151	1.07 435	9.99 846	11
50	8.92 561	149	8.92 716	150	1.07 284	9.99 845	**10**
51	8.92 710	149	8.92 866	150	1.07 134	9.99 844	9
52	8.92 859	148	8.93 016	149	1.06 984	9.99 843	8
53	8.93 007	147	8.93 165	148	1.06 835	9.99 842	7
54	8.93 154	147	8.93 313	149	1.06 687	9.99 841	6
55	8.93 301	147	8.93 462	147	1.06 538	9.99 840	5
56	8.93 448	146	8.93 609	147	1.06 391	9.99 839	4
57	8.93 594	146	8.93 756	147	1.06 244	9.99 838	3
58	8.93 740	145	8.93 903	146	1.06 097	9.99 837	2
59	8.93 885	145	8.94 049	146	1.05 951	9.99 836	1
60	8.94 030		8.94 195		1.05 805	9.99 834	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P.P.

″	**182**	**181**	**179**	**178**	**177**
1	3.0	3.0	3.0	3.0	3.0
2	6.1	6.0	6.0	5.9	5.9
3	9.1	9.0	9.0	8.9	8.8
4	12.1	12.1	11.9	11.9	11.8
5	15.2	15.1	14.9	14.8	14.8
6	18.2	18.1	17.9	17.8	17.7
7	21.2	21.1	20.9	20.8	20.6
8	24.3	24.1	23.9	23.7	23.6
9	27.3	27.2	26.8	26.7	26.6
″	**176**	**175**	**174**	**173**	**172**
1	2.9	2.9	2.9	2.9	2.9
2	5.9	5.8	5.8	5.8	5.7
3	8.8	8.8	8.7	8.6	8.6
4	11.7	11.7	11.6	11.5	11.5
5	14.7	14.6	14.5	14.4	14.3
6	17.6	17.5	17.4	17.3	17.2
7	20.5	20.4	20.3	20.2	20.1
8	23.5	23.3	23.2	23.1	22.9
9	26.4	26.2	26.1	26.0	25.8
″	**171**	**170**	**169**	**168**	**167**
1	2.8	2.8	2.8	2.8	2.8
2	5.7	5.7	5.6	5.6	5.6
3	8.6	8.5	8.4	8.4	8.4
4	11.4	11.3	11.3	11.2	11.1
5	14.2	14.2	14.1	14.0	13.9
6	17.1	17.0	16.9	16.8	16.7
7	20.0	19.8	19.7	19.6	19.5
8	22.8	22.7	22.5	22.4	22.3
9	25.6	25.5	25.4	25.2	25.0
″	**166**	**165**	**164**	**163**	**162**
1	2.8	2.8	2.7	2.7	2.7
2	5.5	5.5	5.5	5.4	5.4
3	8.3	8.2	8.2	8.2	8.1
4	11.1	11.0	10.9	10.9	10.8
5	13.8	13.8	13.7	13.6	13.5
6	16.6	16.5	16.4	16.3	16.2
7	19.4	19.2	19.1	19.0	18.9
8	22.1	22.0	21.9	21.7	21.6
9	24.9	24.8	24.6	24.4	24.3
″	**161**	**160**	**159**	**158**	**157**
1	2.7	2.7	2.6	2.6	2.6
2	5.4	5.3	5.3	5.3	5.2
3	8.0	8.0	8.0	7.9	7.8
4	10.7	10.7	10.6	10.5	10.5
5	13.4	13.3	13.2	13.2	13.1
6	16.1	16.0	15.9	15.8	15.7
7	18.8	18.7	18.6	18.4	18.3
8	21.5	21.3	21.2	21.1	20.9
9	24.2	24.0	23.8	23.7	23.6
″	**156**	**155**	**154**	**153**	**152**
1	2.6	2.6	2.6	2.6	2.5
2	5.2	5.2	5.1	5.1	5.1
3	7.8	7.8	7.7	7.6	7.6
4	10.4	10.3	10.3	10.2	10.1
5	13.0	12.9	12.8	12.8	12.7
6	15.6	15.5	15.4	15.3	15.2
7	18.2	18.1	18.0	17.8	17.7
8	20.8	20.7	20.5	20.4	20.3
9	23.4	23.2	23.1	23.0	22.8
10	26.0	25.8	25.7	25.5	25.3

P.P.

94° (274°) (265°) **85°**

5° (185°) (354°) **174°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	8.94 030	144	8.94 195	145	1.05 805	9.99 834	**60**
1	8.94 174	143	8.94 340	145	1.05 660	9.99 833	59
2	8.94 317	144	8.94 485	145	1.05 515	9.99 832	58
3	8.94 461	142	8.94 630	143	1.05 370	9 99 831	57
4	8.94 603	143	8.94 773	144	1.05 227	9.99 830	56
5	8.94 746	141	8.94 917	143	1.05 083	9.99 829	55
6	8.94 887	142	8.95 060	142	1.04 940	9.99 828	54
7	8.95 029	141	8.95 202	142	1.04 798	9.99 827	53
8	8.95 170	140	8.95 344	142	1.04 656	9.99 825	52
9	8.95 310	140	8.95 486	141	1.04 514	9.99 824	51
10	8.95 450	139	8.95 627	140	1.04 373	9.99 823	**50**
11	8.95 589	139	8.95 767	141	1.04 233	9.99 822	49
12	8.95 728	139	8.95 908	139	1.04 092	9.99 821	48
13	8.95 867	138	8.96 047	140	1.03 953	9.99 820	47
14	8.96 005	138	8.96 187	138	1.03 813	9.99 819	46
15	8.96 143	137	8.96 325	139	1.03 675	9.99 817	45
16	8.96 280	137	8.96 464	138	1.03 536	9.99 816	44
17	8.96 417	136	8.96 602	137	1.03 398	9.99 815	43
18	8.96 553	136	8.96 739	138	1.03 261	9.99 814	42
19	8.96 689	136	8.96 877	136	1.03 123	9.99 813	41
20	8.96 825	135	8.97 013	137	1.02 987	9.99 812	**40**
21	8.96 960	135	8.97 150	135	1.02 850	9.99 810	39
22	8.97 095	134	8.97 285	136	1.02 715	9.99 809	38
23	8.97 229	134	8.97 421	135	1.02 579	9.99 808	37
24	8.97 363	133	8.97 556	135	1.02 444	9.99 807	36
25	8.97 496	133	8.97 691	134	1.02 309	9.99 806	35
26	8.97 629	133	8.97 825	134	1.02 175	9.99 804	34
27	8.97 762	132	8.97 959	133	1.02 041	9.99 803	33
28	8.97 894	132	8.98 092	133	1.01 908	9.99 802	32
29	8.98 026	131	8.98 225	133	1.01 775	9.99 801	31
30	8.98 157	131	8.98 358	132	1.01 642	9.99 800	**30**
31	8.98 288	131	8.98 490	132	1.01 510	9.99 798	29
32	8.98 419	130	8.98 622	131	1.01 378	9.99 797	28
33	8.98 549	130	8.98 753	131	1.01 247	9.99 796	27
34	8.98 679	129	8.98 884	131	1.01 116	9.99 795	26
35	8.98 808	129	8.99 015	130	1.00 985	9.99 793	25
36	8.98 937	129	8.99 145	130	1.00 855	9.99 792	24
37	8.99 066	128	8.99 275	130	1.00 725	9.99 791	23
38	8.99 194	128	8.99 405	129	1.00 595	9.99 790	22
39	8.99 322	128	8.99 534	128	1.00 466	9.99 788	21
40	8.99 450	127	8.99 662	129	1.00 338	9.99 787	**20**
41	8.99 577	127	8.99 791	128	1.00 209	9.99 786	19
42	8.99 704	126	8.99 919	127	1.00 081	9.99 785	18
43	8.99 830	126	9.00 046	128	0.99 954	9.99 783	17
44	8.99 956	126	9.00 174	127	0.99 826	9.99 782	16
45	9.00 082	125	9.00 301	126	0.99 699	9.99 781	15
46	9.00 207	125	9.00 427	126	0.99 573	9.99 780	14
47	9.00 332	124	9.00 553	126	0.99 447	9.99 778	13
48	9.00 456	125	9.00 679	126	0.99 321	9.99 777	12
49	9.00 581	123	9.00 805	125	0.99 195	9.99 776	11
50	9.00 704	124	9.00 930	125	0.99 070	9.99 775	**10**
51	9.00 828	123	9.01 055	124	0.98 945	9.99 773	9
52	9.00 951	123	9.01 179	124	0.98 821	9.99 772	8
53	9.01 074	122	9.01 303	124	0.98 697	9.99 771	7
54	9.01 196	122	9.01 427	123	0.98 573	9.99 769	6
55	9.01 318	122	9.01 550	123	0.98 450	9.99 768	5
56	9.01 440	121	9.01 673	123	0.98 327	9.99 767	4
57	9.01 561	121	9.01 796	122	0.98 204	9.99 765	3
58	9.01 682	121	9.01 918	122	0.98 082	9.99 764	2
59	9.01 803	120	9.02 040	122	0.97 960	9.99 763	1
60	9.01 923		9.02 162		0.97 838	9.99 761	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P.P.					
″	**151**	**149**	**148**	**147**	**146**
1	2.5	2.5	2.5	2.4	2.4
2	5.0	5.0	4.9	4.9	4.9
3	7.6	7.4	7.4	7.4	7.3
4	10.1	9.9	9.9	9.8	9.7
5	12.6	12.4	12.3	12.2	12.2
6	15.1	14.9	14.8	14.7	14.6
7	17.6	17.4	17.3	17.2	17.0
8	20.1	19.9	19.7	19.6	19.5
9	22.6	22.4	22.2	22.0	21.9
″	**145**	**144**	**143**	**142**	**141**
1	2.4	2.4	2.4	2.4	2.4
2	4.8	4.8	4.8	4.7	4.7
3	7.2	7.2	7.2	7.1	7.0
4	9.7	9.6	9.5	9.5	9.4
5	12.1	12.0	11.9	11.8	11.8
6	14.5	14.4	14.3	14.2	14.1
7	16.9	16.8	16.7	16.6	16.4
8	19.3	19.2	19.1	18.9	18.8
9	21.8	21.6	21.4	21.3	21.2
″	**140**	**139**	**138**	**137**	**136**
1	2.3	2.3	2.3	2.3	2.3
2	4.7	4.6	4.6	4.6	4.5
3	7.0	7.0	6.9	6.8	6.8
4	9.3	9.3	9.2	9.1	9.1
5	11.7	11.6	11.5	11.4	11.3
6	14.0	13.9	13.8	13.7	13.6
7	16.3	16.2	16.1	16.0	15.9
8	18.7	18.5	18.4	18.3	18.1
9	21.0	20.8	20.7	20.6	20.4
″	**135**	**134**	**133**	**132**	**131**
1	2.2	2.2	2.2	2.2	2.2
2	4.5	4.5	4.4	4.4	4.4
3	6.8	6.7	6.6	6.6	6.6
4	9.0	8.9	8.9	8.8	8.7
5	11.2	11.2	11.1	11.0	10.9
6	13.5	13.4	13.3	13.2	13.1
7	15.8	15.6	15.5	15.4	15.3
8	18.0	17.9	17.7	17.6	17.5
9	20.2	20.1	20.0	19.8	19.6
″	**130**	**129**	**128**	**127**	**126**
1	2.2	2.2	2.1	2.1	2.1
2	4.3	4.3	4.3	4.2	4.2
3	6.5	6.4	6.4	6.4	6.3
4	8.7	8.6	8.5	8.5	8.4
5	10.8	10.8	10.7	10.6	10.5
6	13.0	12.9	12.8	12.7	12.6
7	15.2	15.0	14.9	14.8	14.7
8	17.3	17.2	17.1	16.9	16.8
9	19.5	19.4	19.2	19.0	18.9
″	**125**	**124**	**123**	**122**	**121**
1	2.1	2.1	2.0	2.0	2.0
2	4.2	4.1	4.1	4.1	4.0
3	6.2	6.2	6.2	6.1	6.0
4	8.3	8.3	8.2	8.1	8.1
5	10.4	10.3	10.2	10.2	10.1
6	12.5	12.4	12.3	12.2	12.1
7	14.6	14.5	14.4	14.2	14.1
8	16.7	16.5	16.4	16.3	16.1
9	18.8	18.6	18.4	18.3	18.2
10	20.8	20.7	20.5	20.3	20.2

95° (275°) (264°) **84°**

6° (186°) (353°) **173°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	9.01 923	120	9.02 162	121	0.97 838	9.99 761	60
1	9.02 043	120	9.02 283	121	0.97 717	9.99 760	59
2	9.02 163	120	9.02 404	121	0.97 596	9.99 759	58
3	9.02 283	119	9.02 525	120	0.97 475	9.99 757	57
4	9.02 402	118	9.02 645	121	0.97 355	9.99 756	56
5	9.02 520	119	9.02 766	119	0.97 234	9.99 755	55
6	9.02 639	118	9.02 885	120	0.97 115	9.99 753	54
7	9.02 757	117	9.03 005	119	0.96 995	9.99 752	53
8	9.02 874	118	9.03 124	118	0.96 876	9.99 751	52
9	9.02 992	117	9.03 242	119	0.96 758	9.99 749	51
10	9.03 109	117	9.03 361	118	0.96 639	9.99 748	50
11	9.03 226	116	9.03 479	118	0.96 521	9.99 747	49
12	9.03 342	116	9.03 597	117	0.96 403	9.99 745	48
13	9.03 458	116	9.03 714	118	0.96 286	9.99 744	47
14	9.03 574	116	9.03 832	116	0.96 168	9.99 742	46
15	9.03 690	115	9.03 948	117	0.96 052	9.99 741	45
16	9.03 805	115	9.04 065	116	0.95 935	9.99 740	44
17	9.03 920	114	9.04 181	116	0.95 819	9.99 738	43
18	9.04 034	115	9.04 297	116	0.95 703	9.99 737	42
19	9.04 149	113	9.04 413	115	0.95 587	9.99 736	41
20	9.04 262	114	9.04 528	115	0.95 472	9.99 734	40
21	9.04 376	114	9.04 643	115	0.95 357	9.99 733	39
22	9.04 490	113	9.04 758	115	0.95 242	9.99 731	38
23	9.04 603	112	9.04 873	114	0.95 127	9.99 730	37
24	9.04 715	113	9.04 987	114	0.95 013	9.99 728	36
25	9.04 828	112	9.05 101	113	0.94 899	9.99 727	35
26	9.04 940	112	9.05 214	114	0.94 786	9.99 726	34
27	9.05 052	112	9.05 328	113	0.94 672	9.99 724	33
28	9.05 164	111	9.05 441	112	0.94 559	9.99 723	32
29	9.05 275	111	9.05 553	113	0.94 447	9.99 721	31
30	9.05 386	111	9.05 666	112	0.94 334	9.99 720	30
31	9.05 497	110	9.05 778	112	0.94 222	9.99 718	29
32	9.05 607	110	9.05 890	112	0.94 110	9.99 717	28
33	9.05 717	110	9.06 002	111	0.93 998	9.99 716	27
34	9.05 827	110	9.06 113	111	0.93 887	9.99 714	26
35	9.05 937	109	9.06 224	111	0.93 776	9.99 713	25
36	9.06 046	109	9.06 335	110	0.93 665	9.99 711	24
37	9.06 155	109	9.06 445	111	0.93 555	9.99 710	23
38	9.06 264	108	9.06 556	110	0.93 444	9.99 708	22
39	9.06 372	109	9.06 666	109	0.93 334	9.99 707	21
40	9.06 481	108	9.06 775	110	0.93 225	9.99 705	20
41	9.06 589	107	9.06 885	109	0.93 115	9.99 704	19
42	9.06 696	108	9.06 994	109	0.93 006	9.99 702	18
43	9.06 804	107	9.07 103	108	0.92 897	9.99 701	17
44	9.06 911	107	9.07 211	109	0.92 789	9.99 699	16
45	9.07 018	106	9.07 320	108	0.92 680	9.99 698	15
46	9.07 124	107	9.07 428	108	0.92 572	9.99 696	14
47	9.07 231	106	9.07 536	107	0.92 464	9.99 695	13
48	9.07 337	105	9.07 643	108	0.92 357	9.99 693	12
49	9.07 442	106	9.07 751	107	0.92 249	9.99 692	11
50	9.07 548	105	9.07 858	106	0.92 142	9.99 690	10
51	9.07 653	105	9.07 964	107	0.92 036	9.99 689	9
52	9.07 758	105	9.08 071	106	0.91 929	9.99 687	8
53	9.07 863	105	9.08 177	106	0.91 823	9.99 686	7
54	9.07 968	104	9.08 283	106	0.91 717	9.99 684	6
55	9.08 072	104	9.08 389	106	0.91 611	9.99 683	5
56	9.08 176	104	9.08 495	105	0.91 505	9.99 681	4
57	9.08 280	103	9.08 600	105	0.91 400	9.99 680	3
58	9.08 383	103	9.08 705	105	0.91 295	9.99 678	2
59	9.08 486	103	9.08 810	104	0.91 190	9.99 677	1
60	9.08 589		9.08 914		0.91 086	9.99 675	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P. P.

″	121	120	119	118
1	2.0	2.0	2.0	2.0
2	4.0	4.0	4.0	3.9
3	6.0	6.0	6.0	5.9
4	8.1	8.0	7.9	7.9
5	10.1	10.0	9.9	9.8
6	12.1	12.0	11.9	11.8
7	14.1	14.0	13.9	13.8
8	16.1	16.0	15.9	15.7
9	18.2	18.0	17.8	17.7
10	20.2	20.0	19.8	19.7
20	40.3	40.0	39.7	39.3
30	60.5	60.0	59.5	59.0
40	80.7	80.0	79.3	78.7
50	100.8	100.0	99.2	98.3
″	**117**	**116**	**115**	**114**
1	2.0	1.9	1.9	1.9
2	3.9	3.9	3.8	3.8
3	5.8	5.8	5.8	5.7
4	7.8	7.7	7.7	7.6
5	9.8	9.7	9.6	9.5
6	11.7	11.6	11.5	11.4
7	13.6	13.5	13.4	13.3
8	15.6	15.5	15.3	15.2
9	17.6	17.4	17.2	17.1
10	19.5	19.3	19.2	19.0
20	39.0	38.7	38.3	38.0
30	58.5	58.0	57.5	57.0
40	78.0	77.3	76.7	76.0
50	97.5	96.7	95.8	95.0
″	**113**	**112**	**111**	**110**
1	1.9	1.9	1.8	1.8
2	3.8	3.7	3.7	3.7
3	5.6	5.6	5.6	5.5
4	7.5	7.5	7.4	7.3
5	9.4	9.3	9.2	9.2
6	11.3	11.2	11.1	11.0
7	13.2	13.1	13.0	12.8
8	15.1	14.9	14.8	14.7
9	17.0	16.8	16.6	16.5
10	18.8	18.7	18.5	18.3
20	37.7	37.3	37.0	36.7
30	56.5	56.0	55.5	55.0
40	75.3	74.7	74.0	73.3
50	94.2	93.3	92.5	91.7
″	**109**	**108**	**107**	**106**
1	1.8	1.8	1.8	1.8
2	3.6	3.6	3.6	3.5
3	5.4	5.4	5.4	5.3
4	7.3	7.2	7.1	7.1
5	9.1	9.0	8.9	8.8
6	10.9	10.8	10.7	10.6
7	12.7	12.6	12.5	12.4
8	14.5	14.4	14.3	14.1
9	16.4	16.2	16.0	15.9
10	18.2	18.0	17.8	17.7
20	36.3	36.0	35.7	35.3
30	54.5	54.0	53.5	53.0
40	72.7	72.0	71.3	70.7
50	90.8	90.0	89.2	88.3

P. P.

96° (276°) (263°) **83°**

7° (187°) (352°) **172°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	9.08 589	103	9.08 914	105	0.91 086	9.99 675	**60**
1	9.08 692	103	9.09 019	104	0.90 981	9.99 674	59
2	9.08 795	102	9.09 123	104	0.90 877	9.99 672	58
3	9.08 897	102	9.09 227	103	0.90 773	9.99 670	57
4	9.08 999	102	9.09 330	104	0.90 670	9.99 669	56
5	9.09 101	101	9.09 434	103	0.90 566	9.99 667	55
6	9.09 202	102	9.09 537	103	0.90 463	9.99 666	54
7	9.09 304	101	9.09 640	102	0.90 360	9.99 664	53
8	9.09 405	101	9.09 742	103	0.90 258	9.99 663	52
9	9.09 506	100	9.09 845	102	0.90 155	9.99 661	51
10	9.09 606	101	9.09 947	102	0.90 053	9.99 659	**50**
11	9.09 707	100	9.10 049	101	0.89 951	9.99 658	49
12	9.09 807	100	9.10 150	102	0.89 850	9.99 656	48
13	9.09 907	99	9.10 252	101	0.89 748	9.99 655	47
14	9.10 006	100	9.10 353	101	0.89 647	9.99 653	46
15	9.10 106	99	9.10 454	101	0.89 546	9.99 651	45
16	9.10 205	99	9.10 555	101	0.89 445	9.99 650	44
17	9.10 304	98	9.10 656	100	0.89 344	9.99 648	43
18	9.10 402	99	9.10 756	100	0.89 244	9.99 647	42
19	9.10 501	98	9.10 856	100	0.89 144	9.99 645	41
20	9.10 599	98	9.10 956	100	0.89 044	9.99 643	**40**
21	9.10 697	98	9.11 056	99	0.88 944	9.99 642	39
22	9.10 795	98	9.11 155	99	0.88 845	9.99 640	38
23	9.10 893	97	9.11 254	99	0.88 746	9.99 638	37
24	9.10 990	97	9.11 353	99	0.88 647	9.99 637	36
25	9.11 087	97	9.11 452	99	0.88 548	9.99 635	35
26	9.11 184	97	9.11 551	98	0.88 449	9.99 633	34
27	9.11 281	96	9.11 649	98	0.88 351	9.99 632	33
28	9.11 377	97	9.11 747	98	0.88 253	9.99 630	32
29	9.11 474	96	9.11 845	98	0.88 155	9.99 629	31
30	9.11 570	96	9.11 943	97	0.88 057	9.99 627	**30**
31	9.11 666	95	9.12 040	98	0.87 960	9.99 625	29
32	9.11 761	96	9.12 138	97	0.87 862	9.99 624	28
33	9.11 857	95	9.12 235	97	0.87 765	9.99 622	27
34	9.11 952	95	9.12 332	96	0.87 668	9.99 620	26
35	9.12 047	95	9.12 428	97	0.87 572	9.99 618	25
36	9.12 142	94	9.12 525	96	0.87 475	9.99 617	24
37	9.12 236	95	9.12 621	96	0.87 379	9.99 615	23
38	9.12 331	94	9.12 717	96	0.87 283	9.99 613	22
39	9.12 425	94	9.12 813	96	0.87 187	9.99 612	21
40	9.12 519	93	9.12 909	95	0.87 091	9.99 610	**20**
41	9.12 612	94	9.13 004	95	0.86 996	9.99 608	19
42	9.12 706	93	9.13 099	95	0.86 901	9.99 607	18
43	9.12 799	93	9.13 194	95	0.86 806	9.99 605	17
44	9.12 892	93	9.13 289	95	0.86 711	9.99 603	16
45	9.12 985	93	9.13 384	94	0.86 616	9.99 601	15
46	9.13 078	93	9.13 478	95	0.86 522	9.99 600	14
47	9.13 171	92	9.13 573	94	0.86 427	9.99 598	13
48	9.13 263	92	9.13 667	94	0.86 333	9.99 596	12
49	9.13 355	92	9.13 761	93	0.86 239	9.99 595	11
50	9.13 447	92	9.13 854	94	0.86 146	9.99 593	**10**
51	9.13 539	91	9.13 948	93	0.86 052	9.99 591	9
52	9.13 630	92	9.14 041	93	0.85 959	9.99 589	8
53	9.13 722	91	9.14 134	93	0.85 866	9.99 588	7
54	9.13 813	91	9.14 227	93	0.85 773	9.99 586	6
55	9.13 904	90	9.14 320	92	0.85 680	9.99 584	5
56	9.13 994	91	9.14 412	92	0.85 588	9.99 582	4
57	9.14 085	90	9.14 504	93	0.85 496	9.99 581	3
58	9.14 175	91	9.14 597	91	0.85 403	9.99 579	2
59	9.14 266	90	9.14 688	92	0.85 312	9.99 577	1
60	9.14 356		9.14 780		0.85 220	9.99 575	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

″	P. P.			
″	**105**	**104**	**103**	**102**
1	1.8	1.7	1.7	1.7
2	3.5	3.5	3.4	3.4
3	5.2	5.2	5.2	5.1
4	7.0	6.9	6.9	6.8
5	8.8	8.7	8.6	8.5
6	10.5	10.4	10.3	10.2
7	12.2	12.1	12.0	11.9
8	14.0	13.9	13.7	13.6
9	15.8	15.6	15.4	15.3
10	17.5	17.3	17.2	17.0
20	35.0	34.7	34.3	34.0
30	52.5	52.0	51.5	51.0
40	70.0	69.3	68.7	68.0
50	87.5	86.7	85.8	85.0
″	**101**	**100**	**99**	**98**
1	1.7	1.7	1.6	1.6
2	3.4	3.3	3.3	3.3
3	5.0	5.0	5.0	4.9
4	6.7	6.7	6.6	6.5
5	8.4	8.3	8.2	8.2
6	10.1	10.0	9.9	9.8
7	11.8	11.7	11.6	11.4
8	13.5	13.3	13.2	13.1
9	15.2	15.0	14.8	14.7
10	16.8	16.7	16.5	16.3
20	33.7	33.3	33.0	32.7
30	50.5	50.0	49.5	49.0
40	67.3	66.7	66.0	65.3
50	84.2	83.3	82.5	81.7
″	**97**	**96**	**95**	**94**
1	1.6	1.6	1.6	1.6
2	3.2	3.2	3.2	3.1
3	4.8	4.8	4.8	4.7
4	6.5	6.4	6.3	6.3
5	8.1	8.0	7.9	7.8
6	9.7	9.6	9.5	9.4
7	11.3	11.2	11.1	11.0
8	12.9	12.8	12.7	12.5
9	14.6	14.4	14.2	14.1
10	16.2	16.0	15.8	15.7
20	32.3	32.0	31.7	31.3
30	48.5	48.0	47.5	47.0
40	64.7	64.0	63.3	62.7
50	80.8	80.0	79.2	78.3
″	**93**	**92**	**91**	**90**
1	1.6	1.5	1.5	1.5
2	3.1	3.1	3.0	3.0
3	4.6	4.6	4.6	4.5
4	6.2	6.1	6.1	6.0
5	7.8	7.7	7.6	7.5
6	9.3	9.2	9.1	9.0
7	10.8	10.7	10.6	10.5
8	12.4	12.3	12.1	12.0
9	14.0	13.8	13.6	13.5
10	15.5	15.3	15.2	15.0
20	31.0	30.7	30.3	30.0
30	46.5	46.0	45.5	45.0
40	62.0	61.3	60.7	60.0
50	77.5	76.7	75.8	75.0
	P. P.			

97° (277°) (262°) **82°**

8° (188°) (351°) **171°**

'	L. Sin.	d.	L. Tan.	c. d.	L. Cot.	L. Cos.	'
0	9.14 356	89	9.14 780	92	0.85 220	9.99 575	**60**
1	9.14 445	90	9.14 872	91	0.85 128	9.99 574	59
2	9.14 535	89	9.14 963	91	0.85 037	9.99 572	58
3	9.14 624	90	9.15 054	91	0.84 946	9.99 570	57
4	9.14 714	89	9.15 145	91	0.84 855	9.99 568	56
5	9.14 803	88	9.15 236	91	0.84 764	9.99 566	55
6	9.14 891	89	9.15 327	90	0.84 673	9.99 565	54
7	9.14 980	89	9.15 417	91	0.84 583	9.99 563	53
8	9.15 069	88	9.15 508	90	0.84 492	9.99 561	52
9	9.15 157	88	9.15 598	90	0.84 402	9.99 559	51
10	9.15 245	88	9.15 688	89	0.84 312	9.99 557	**50**
11	9.15 333	88	9.15 777	90	0.84 223	9.99 556	49
12	9.15 421	87	9.15 867	89	0.84 133	9.99 554	48
13	9.15 508	88	9.15 956	90	0.84 044	9.99 552	47
14	9.15 596	87	9.16 046	89	0.83 954	9.99 550	46
15	9.15 683	87	9.16 135	89	0.83 865	9.99 548	45
16	9.15 770	87	9.16 224	88	0.83 776	9.99 546	44
17	9.15 857	87	9.16 312	89	0.83 688	9.99 545	43
18	9.15 944	86	9.16 401	88	0.83 599	9.99 543	42
19	9.16 030	86	9.16 489	88	0.83 511	9.99 541	41
20	9.16 116	87	9.16 577	88	0.83 423	9.99 539	**40**
21	9.16 203	86	9.16 665	88	0.83 335	9.99 537	39
22	9.16 289	85	9.16 753	88	0.83 247	9.99 535	38
23	9.16 374	86	9.16 841	87	0.83 159	9.99 533	37
24	9.16 460	85	9.16 928	88	0.83 072	9.99 532	36
25	9.16 545	86	9.17 016	87	0.82 984	9.99 530	35
26	9.16 631	85	9.17 103	87	0.82 897	9.99 528	34
27	9.16 716	85	9.17 190	87	0.82 810	9.99 526	33
28	9.16 801	85	9.17 277	86	0.82 723	9.99 524	32
29	9.16 886	84	9.17 363	87	0.82 637	9.99 522	31
30	9.16 970	85	9.17 450	86	0.82 550	9.99 520	**30**
31	9.17 055	84	9.17 536	86	0.82 464	9.99 518	29
32	9.17 139	84	9.17 622	86	0.82 378	9.99 517	28
33	9.17 223	84	9.17 708	86	0.82 292	9.99 515	27
34	9.17 307	84	9.17 794	86	0.82 206	9.99 513	26
35	9.17 391	83	9.17 880	85	0.82 120	9.99 511	25
36	9.17 474	84	9.17 965	86	0.82 035	9.99 509	24
37	9.17 558	83	9.18 051	85	0.81 949	9.99 507	23
38	9.17 641	83	9.18 136	85	0.81 864	9.99 505	22
39	9.17 724	83	9.18 221	85	0.81 779	9.99 503	21
40	9.17 807	83	9.18 306	85	0.81 694	9.99 501	**20**
41	9.17 890	83	9.18 391	84	0.81 609	9.99 499	19
42	9.17 973	82	9.18 475	85	0.81 525	9.99 497	18
43	9.18 055	82	9.18 560	84	0.81 440	9.99 495	17
44	9.18 137	83	9.18 644	84	0.81 356	9.99 494	16
45	9.18 220	82	9.18 728	84	0.81 272	9.99 492	15
46	9.18 302	81	9.18 812	84	0.81 188	9.99 490	14
47	9.18 383	82	9.18 896	83	0.81 104	9.99 488	13
48	9.18 465	82	9.18 979	84	0.81 021	9.99 486	12
49	9.18 547	81	9.19 063	83	0.80 937	9.99 484	11
50	9.18 628	81	9.19 146	83	0.80 854	9.99 482	**10**
51	9.18 709	81	9.19 229	83	0.80 771	9.99 480	9
52	9.18 790	81	9.19 312	83	0.80 688	9.99 478	8
53	9.18 871	81	9.19 395	83	0.80 605	9.99 476	7
54	9.18 952	81	9.19 478	83	0.80 522	9.99 474	6
55	9.19 033	80	9.19 561	82	0.80 439	9.99 472	5
56	9.19 113	80	9.19 643	82	0.80 357	9.99 470	4
57	9.19 193	80	9.19 725	82	0.80 275	9.99 468	3
58	9.19 273	80	9.19 807	82	0.80 193	9.99 466	2
59	9.19 353	80	9.19 889	82	0.80 111	9.99 464	1
60	9.19 433		9.19 971		0.80 029	9.99 462	**0**
'	L. Cos.	d.	L. Cot.	c. d.	L. Tan.	L. Sin.	'

P. P.

"	**92**	**91**	**90**
1	1.5	1.5	1.5
2	3.1	3.0	3.0
3	4.6	4.6	4.5
4	6.1	6.1	6.0
5	7.7	7.6	7.5
6	9.2	9.1	9.0
7	10.7	10.6	10.5
8	12.3	12.1	12.0
9	13.8	13.6	13.5
10	15.3	15.2	15.0
20	30.7	30.3	30.0
30	46.0	45.5	45.0
40	61.3	60.7	60.0
50	76.7	75.8	75.0
"	**89**	**88**	**87**
1	1.5	1.5	1.4
2	3.0	2.9	2.9
3	4.4	4.4	4.4
4	5.9	5.9	5.8
5	7.4	7.3	7.2
6	8.9	8.8	8.7
7	10.4	10.3	10.2
8	11.9	11.7	11.6
9	13.4	13.2	13.0
10	14.8	14.7	14.5
20	29.7	29.3	29.0
30	44.5	44.0	43.5
40	59.3	58.7	58.0
50	74.2	73.3	72.5
"	**86**	**85**	**84**
1	1.4	1.4	1.4
2	2.9	2.8	2.8
3	4.3	4.2	4.2
4	5.7	5.7	5.6
5	7.2	7.1	7.0
6	8.6	8.5	8.4
7	10.0	9.9	9.8
8	11.5	11.3	11.2
9	12.9	12.8	12.6
10	14.3	14.2	14.0
20	28.7	28.3	28.0
30	43.0	42.5	42.0
40	57.3	56.7	56.0
50	71.7	70.8	70.0
"	**83**	**82**	**81**
1	1.4	1.4	1.4
2	2.8	2.7	2.7
3	4.2	4.1	4.0
4	5.5	5.5	5.4
5	6.9	6.8	6.8
6	8.3	8.2	8.1
7	9.7	9.6	9.4
8	11.1	10.9	10.8
9	12.4	12.3	12.2
10	13.8	13.7	13.5
20	27.7	27.3	27.0
30	41.5	41.0	40.5
30	55.3	54.7	54.0
50	69.2	68.3	67.5

P. P.

98° (278°) (261°) **81°**

9° (189°) (350°) **170°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	9.19 433	80	9.19 971	82	0.80 029	9.99 462	60
1	9.19 513	79	9.20 053	81	0.79 947	9.99 460	59
2	9.19 592	80	9.20 134	82	0.79 866	9.99 458	58
3	9.19 672	79	9.20 216	81	0.79 784	9.99 456	57
4	9.19 751	79	9.20 297	81	0.79 703	9.99 454	56
5	9.19 830	79	9.20 378	81	0.79 622	9.99 452	55
6	9.19 909	79	9.20 459	81	0.79 541	9.99 450	54
7	9.19 988	79	9.20 540	81	0.79 460	9.99 448	53
8	9.20 067	78	9.20 621	80	0.79 379	9.99 446	52
9	9.20 145	78	9.20 701	81	0.79 299	9.99 444	51
10	9.20 223	79	9.20 782	80	0.79 218	9.99 442	50
11	9.20 302	78	9.20 862	80	0.79 138	9.99 440	49
12	9.20 380	78	9.20 942	80	0.79 058	9.99 438	48
13	9.20 458	77	9.21 022	80	0.78 978	9.99 436	47
14	9.20 535	78	9.21 102	80	0.78 898	9.99 434	46
15	9.20 613	78	9.21 182	79	0.78 818	9.99 432	45
16	9.20 691	77	9.21 261	80	0.78 739	9.99 429	44
17	9.20 768	77	9.21 341	79	0.78 659	9.99 427	43
18	9.20 845	77	9.21 420	79	0.78 580	9.99 425	42
19	9.20 922	77	9.21 499	79	0.78 501	9.99 423	41
20	9.20 999	77	9.21 578	79	0.78 422	9.99 421	40
21	9.21 076	77	9.21 657	79	0.78 343	9.99 419	39
22	9.21 153	76	9.21 736	78	0.78 264	9.99 417	38
23	9.21 229	77	9.21 814	79	0.78 186	9.99 415	37
24	9.21 306	76	9.21 893	78	0.78 107	9.99 413	36
25	9.21 382	76	9.21 971	78	0.78 029	9.99 411	35
26	9.21 458	76	9.22 049	78	0.77 951	9.99 409	34
27	9.21 534	76	9.22 127	78	0.77 873	9.99 407	33
28	9.21 610	75	9.22 205	78	0.77 795	9.99 404	32
29	9.21 685	76	9.22 283	78	0.77 717	9.99 402	31
30	9.21 761	75	9.22 361	77	0.77 639	9.99 400	30
31	9.21 836	76	9.22 438	78	0.77 562	9.99 398	29
32	9.21 912	75	9.22 516	77	0.77 484	9.99 396	28
33	9.21 987	75	9.22 593	77	0.77 407	9.99 394	27
34	9.22 062	75	9.22 670	77	0.77 330	9.99 392	26
35	9.22 137	74	9.22 747	77	0.77 253	9.99 390	25
36	9.22 211	75	9.22 824	77	0.77 176	9.99 388	24
37	9.22 286	75	9.22 901	76	0.77 099	9.99 385	23
38	9.22 361	74	9.22 977	77	0.77 023	9.99 383	22
39	9.22 435	74	9.23 054	76	0.76 946	9.99 381	21
40	9.22 509	74	9.23 130	76	0.76 870	9.99 379	20
41	9.22 583	74	9.23 206	77	0.76 794	9.99 377	19
42	9.22 657	74	9.23 283	76	0.76 717	9.99 375	18
43	9.22 731	74	9.23 359	76	0.76 641	9.99 372	17
44	9.22 805	73	9.23 435	75	0.76 565	9.99 370	16
45	9.22 878	74	9.23 510	76	0.76 490	9.99 368	15
46	9.22 952	73	9.23 586	75	0.76 414	9.99 366	14
47	9.23 025	73	9.23 661	76	0.76 339	9.99 364	13
48	9.23 098	73	9.23 737	75	0.76 263	9.99 362	12
49	9.23 171	73	9.23 812	75	0.76 188	9.99 359	11
50	9.23 244	73	9.23 887	75	0.76 113	9.99 357	10
51	9.23 317	73	9.23 962	75	0.76 038	9.99 355	9
52	9.23 390	72	9.24 037	75	0.75 963	9.99 353	8
53	9.23 462	73	9.24 112	74	0.75 888	9.99 351	7
54	9.23 535	72	9.24 186	75	0.75 814	9.99 348	6
55	9.23 607	72	9.24 261	74	0.75 739	9.99 346	5
56	9.23 679	73	9.24 335	75	0.75 665	9.99 344	4
57	9.23 752	71	9.24 410	74	0.75 590	9.99 342	3
58	9.23 823	72	9.24 484	74	0.75 516	9.99 340	2
59	9.23 895	72	9.24 558	74	0.75 442	9.99 337	1
60	9.23 967		9.24 632		0.75 368	9.99 335	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P. P.

″	80	79	78	77
1	1.3	1.3	1.3	1.3
2	2.7	2.6	2.6	2.6
3	4.0	4.0	3.9	3.8
4	5.3	5.3	5.2	5.1
5	6.7	6.6	6.5	6.4
6	8.0	7.9	7.8	7.7
7	9.3	9.2	9.1	9.0
8	10.7	10.5	10.4	10.3
9	12.0	11.8	11.7	11.6
10	13.3	13.2	13.0	12.8
20	26.7	26.3	26.0	25.7
30	40.0	39.5	39.0	38.5
40	53.3	52.7	52.0	51.3
50	66.7	65.8	65.0	64.2

″	76	75	74	73
1	1.3	1.2	1.2	1.2
2	2.5	2.5	2.5	2.4
3	3.8	3.8	3.7	3.6
4	5.1	5.0	4.9	4.9
5	6.3	6.2	6.2	6.1
6	7.6	7.5	7.4	7.3
7	8.9	8.8	8.6	8.5
8	10.1	10.0	9.9	9.7
9	11.4	11.2	11.1	11.0
10	12.7	12.5	12.3	12.2
20	25.3	25.0	24.7	24.3
30	38.0	37.5	37.0	36.5
40	50.7	50.0	49.3	48.7
50	63.3	62.5	61.7	60.8

″	72	71	3	2
1	1.2	1.2	0.0	0.0
2	2.4	2.4	0.1	0.1
3	3.6	3.6	0.2	0.1
4	4.8	4.7	0.2	0.1
5	6.0	5.9	0.2	0.2
6	7.2	7.1	0.3	0.2
7	8.4	8.3	0.4	0.2
8	9.6	9.5	0.4	0.3
9	10.8	10.6	0.4	0.3
10	12.0	11.8	0.5	0.3
20	24.0	23.7	1.0	0.7
30	36.0	35.5	1.5	1.0
40	48.0	47.3	2.0	1.3
50	60.0	59.2	2.5	1.7

	$\frac{3}{79}$	$\frac{3}{78}$	$\frac{3}{77}$
0			
1	13.2	13.0	12.8
2	39.5	39.0	38.5
3	65.8	65.0	64.2

	$\frac{3}{76}$	$\frac{3}{75}$	$\frac{3}{74}$
0			
1	12.7	12.5	12.3
2	38.0	37.5	37.0
3	63.3	62.5	61.7

P. P.

99° (279°) (260°) **80°**

10° (190°) (349°) **169°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.23 967	72	9.24 632	74	0.75 368	9.99 335	2	**60**
1	9.24 039	71	9.24 706	73	0.75 294	9.99 333	2	59
2	9.24 110	71	9.24 779	74	0.75 221	9.99 331	3	58
3	9.24 181	72	9.24 853	73	0.75 147	9.99 328	2	57
4	9.24 253	71	9.24 926	74	0.75 074	9.99 326	2	56
5	9.24 324	71	9.25 000	73	0.75 000	9.99 324	2	55
6	9.24 395	71	9.25 073	73	0.74 927	9.99 322	3	54
7	9.24 466	70	9.25 146	73	0.74 854	9.99 319	2	53
8	9.24 536	71	9.25 219	73	0.74 781	9.99 317	2	52
9	9.24 607	70	9.25 292	73	0.74 708	9.99 315	2	51
10	9.24 677	71	9.25 365	72	0.74 635	9.99 313	3	**50**
11	9.24 748	70	9.25 437	73	0.74 563	9.99 310	2	49
12	9.24 818	70	9.25 510	72	0.74 490	9.99 308	2	48
13	9.24 888	70	9.25 582	73	0.74 418	9.99 306	2	47
14	9.24 958	70	9.25 655	72	0.74 345	9.99 304	3	46
15	9.25 028	70	9.25 727	72	0.74 273	9.99 301	2	45
16	9.25 098	70	9.25 799	72	0.74 201	9.99 299	2	44
17	9.25 168	69	9.25 871	72	0.74 129	9.99 297	3	43
18	9.25 237	70	9.25 943	72	0.74 057	9.99 294	2	42
19	9.25 307	69	9.26 015	71	0.73 985	9.99 292	2	41
20	9.25 376	69	9.26 086	72	0.73 914	9.99 290	2	**40**
21	9.25 445	69	9.26 158	71	0.73 842	9.99 288	3	39
22	9.25 514	69	9.26 229	72	0.73 771	9.99 285	2	38
23	9.25 583	69	9.26 301	71	0.73 699	9.99 283	2	37
24	9.25 652	69	9.26 372	71	0.73 628	9.99 281	3	36
25	9.25 721	69	9.26 443	71	0.73 557	9.99 278	2	35
26	9.25 790	68	9.26 514	71	0.73 486	9.99 276	2	34
27	9.25 858	69	9.26 585	70	0.73 415	9.99 274	3	33
28	9.25 927	68	9.26 655	71	0.73 345	9.99 271	2	32
29	9.25 995	68	9.26 726	71	0.73 274	9.99 269	2	31
30	9.26 063	68	9.26 797	70	0.73 203	9.99 267	3	**30**
31	9.26 131	68	9.26 867	70	0.73 133	9.99 264	2	29
32	9.26 199	68	9.26 937	71	0.73 063	9.99 262	2	28
33	9.26 267	68	9.27 008	70	0.72 992	9.99 260	3	27
34	9.26 335	68	9.27 078	70	0.72 922	9.99 257	2	26
35	9.26 403	67	9.27 148	70	0.72 852	9.99 255	3	25
36	9.26 470	68	9.27 218	70	0.72 782	9.99 252	2	24
37	9.26 538	67	9.27 288	69	0.72 712	9.99 250	2	23
38	9.26 605	67	9.27 357	70	0.72 643	9.99 248	3	22
39	9.26 672	67	9.27 427	69	0.72 573	9.99 245	2	21
40	9.26 739	67	9.27 496	70	0.72 504	9.99 243	2	**20**
41	9.26 806	67	9.27 566	69	0.72 434	9.99 241	3	19
42	9.26 873	67	9.27 635	69	0.72 365	9.99 238	2	18
43	9.26 940	67	9.27 704	69	0.72 296	9.99 236	3	17
44	9.27 007	66	9.27 773	69	0.72 227	9.99 233	2	16
45	9.27 073	67	9.27 842	69	0.72 158	9.99 231	2	15
46	9.27 140	66	9.27 911	69	0.72 089	9.99 229	3	14
47	9.27 206	67	9.27 980	69	0.72 020	9.99 226	2	13
48	9.27 273	66	9.28 049	68	0.71 951	9.99 224	3	12
49	9.27 339	66	9.28 117	69	0.71 883	9.99 221	2	11
50	9.27 405	66	9.28 186	68	0.71 814	9.99 219	2	**10**
51	9.27 471	66	9.28 254	69	0.71 746	9.99 217	3	9
52	9.27 537	65	9.28 323	68	0.71 677	9.99 214	2	8
53	9.27 602	66	9.28 391	68	0.71 609	9.99 212	3	7
54	9.27 668	66	9.28 459	68	0.71 541	9.99 209	2	6
55	9.27 734	65	9.28 527	68	0.71 473	9.99 207	3	5
56	9.27 799	65	9.28 595	67	0.71 405	9.99 204	2	4
57	9.27 864	66	9.28 662	68	0.71 338	9.99 202	2	3
58	9.27 930	65	9.28 730	68	0.71 270	9.99 200	3	2
59	9.27 995	65	9.28 798	67	0.71 202	9.99 197	2	1
60	9.28 060		9.28 865		0.71 135	9.99 195		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	74	73	72
1	1.2	1.2	1.2
2	2.5	2.4	2.4
3	3.7	3.6	3.6
4	4.9	4.9	4.8
5	6.2	6.1	6.0
6	7.4	7.3	7.2
7	8.6	8.5	8.4
8	9.9	9.7	9.6
9	11.1	11.0	10.8
10	12.3	12.2	12.0
20	24.7	24.3	24.0
30	37.0	36.5	36.0
40	49.3	48.7	48.0
50	61.7	60.8	60.0

″	71	70	69
1	1.2	1.2	1.2
2	2.4	2.3	2.3
3	3.6	3.5	3.4
4	4.7	4.7	4.6
5	5.9	5.8	5.8
6	7.1	7.0	6.9
7	8.3	8.2	8.0
8	9.5	9.3	9.2
9	10.6	10.5	10.4
10	11.8	11.7	11.5
20	23.7	23.3	23.0
30	35.5	35.0	34.5
40	47.3	46.7	46.0
50	59.2	58.3	57.5

″	68	67	66
1	1.1	1.1	1.1
2	2.3	2.2	2.2
3	3.4	3.4	3.3
4	4.5	4.5	4.4
5	5.7	5.6	5.5
6	6.8	6.7	6.6
7	7.9	7.8	7.7
8	9.1	8.9	8.8
9	10.2	10.0	9.9
10	11.3	11.2	11.0
20	22.7	22.3	22.0
30	34.0	33.5	33.0
40	45.3	44.7	44.0
50	56.7	55.8	55.0

	$\frac{3}{74}$	$\frac{3}{73}$	$\frac{3}{72}$
0	12.3	12.2	12.0
1	37.0	36.5	36.0
2	61.7	60.8	60.0
3			

	$\frac{3}{71}$	$\frac{3}{70}$	$\frac{3}{69}$	$\frac{3}{68}$
0	11.8	11.7	11.5	11.3
1	35.5	35.0	34.5	34.0
2	59.2	58.3	57.5	56.7
3				

P. P.

100° (280°) (259°) **79°**

11° (191°) (348°) **168°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.28 060	65	9.28 865	68	0.71 135	9.99 195	3	60
1	9.28 125	65	9.28 933	67	0.71 067	9.99 192	2	59
2	9.28 190	64	9.29 000	67	0.71 000	9.99 190	3	58
3	9.28 254	65	9.29 067	67	0.70 933	9.99 187	2	57
4	9.28 319	65	9.29 134	67	0.70 866	9.99 185	3	56
5	9.28 384	64	9.29 201	67	0.70 799	9.99 182	2	55
6	9.28 448	64	9.29 268	67	0.70 732	9.99 180	3	54
7	9.28 512	65	9.29 335	67	0.70 665	9.99 177	2	53
8	9.28 577	64	9.29 402	66	0.70 598	9.99 175	3	52
9	9.28 641	64	9.29 468	67	0.70 532	9.99 172	2	51
10	9.28 705	64	9.29 535	66	0.70 465	9.99 170	3	50
11	9.28 769	64	9.29 601	67	0.70 399	9.99 167	2	49
12	9.28 833	63	9.29 668	66	0.70 332	9.99 165	3	48
13	9.28 896	64	9.29 734	66	0.70 266	9.99 162	2	47
14	9.28 960	64	9.29 800	66	0.70 200	9.99 160	3	46
15	9.29 024	63	9.29 866	66	0.70 134	9.99 157	2	45
16	9.29 087	63	9.29 932	66	0.70 068	9.99 155	3	44
17	9.29 150	64	9.29 998	66	0.70 002	9.99 152	2	43
18	9.29 214	63	9.30 064	66	0.69 936	9.99 150	3	42
19	9.29 277	63	9.30 130	65	0.69 870	9.99 147	2	41
20	9.29 340	63	9.30 195	66	0.69 805	9.99 145	3	40
21	9.29 403	63	9.30 261	65	0.69 739	9.99 142	2	39
22	9.29 466	63	9.30 326	65	0.69 674	9.99 140	3	38
23	9.29 529	62	9.30 391	66	0.69 609	9.99 137	2	37
24	9.29 591	63	9.30 457	65	0.69 543	9.99 135	3	36
25	9.29 654	62	9.30 522	65	0.69 478	9.99 132	2	35
26	9.29 716	63	9.30 587	65	0.69 413	9.99 130	3	34
27	9.29 779	62	9.30 652	65	0.69 348	9.99 127	3	33
28	9.29 841	62	9.30 717	65	0.69 283	9.99 124	2	32
29	9.29 903	63	9.30 782	64	0.69 218	9.99 122	3	31
30	9.29 966	62	9.30 846	65	0.69 154	9.99 119	2	30
31	9.30 028	62	9.30 911	64	0.69 089	9.99 117	3	29
32	9.30 090	61	9.30 975	65	0.69 025	9.99 114	2	28
33	9.30 151	62	9.31 040	64	0.68 960	9.99 112	3	27
34	9.30 213	62	9.31 104	64	0.68 896	9.99 109	3	26
35	9.30 275	61	9.31 168	65	0.68 832	9.99 106	2	25
36	9.30 336	62	9.31 233	64	0.68 767	9.99 104	3	24
37	9.30 398	61	9.31 297	64	0.68 703	9.99 101	2	23
38	9.30 459	62	9.31 361	64	0.68 639	9.99 099	3	22
39	9.30 521	61	9.31 425	64	0.68 575	9.99 096	3	21
40	9.30 582	61	9.31 489	63	0.68 511	9.99 093	2	20
41	9.30 643	61	9.31 552	64	0.68 448	9.99 091	3	19
42	9.30 704	61	9.31 616	63	0.68 384	9.99 088	2	18
43	9.30 765	61	9.31 679	64	0.68 321	9.99 086	3	17
44	9.30 826	61	9.31 743	63	0.68 257	9.99 083	3	16
45	9.30 887	60	9.31 806	64	0.68 194	9.99 080	2	15
46	9.30 947	61	9.31 870	63	0.68 130	9.99 078	3	14
47	9.31 008	60	9.31 933	63	0.68 067	9.99 075	3	13
48	9.31 068	61	9.31 996	63	0.68 004	9.99 072	2	12
49	9.31 129	60	9.32 059	63	0.67 941	9.99 070	3	11
50	9.31 189	61	9.32 122	63	0.67 878	9.99 067	3	10
51	9.31 250	60	9.32 185	63	0.67 815	9.99 064	2	9
52	9.31 310	60	9.32 248	63	0.67 752	9.99 062	3	8
53	9.31 370	60	9.32 311	62	0.67 689	9.99 059	3	7
54	9.31 430	60	9.32 373	63	0.67 627	9.99 056	2	6
55	9.31 490	59	9.32 436	62	0.67 564	9.99 054	3	5
56	9.31 549	60	9.32 498	63	0.67 502	9.99 051	3	4
57	9.31 609	60	9.32 561	62	0.67 439	9.99 048	2	3
58	9.31 669	59	9.32 623	62	0.67 377	9.99 046	3	2
59	9.31 728	60	9.32 685	62	0.67 315	9.99 043	3	1
60	9.31 788		9.32 747		0.67 253	9.99 040		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	65	64	63
1	1.1	1.1	1.0
2	2.2	2.1	2.1
3	3.2	3.2	3.2
4	4.3	4.3	4.2
5	5.4	5.3	5.2
6	6.5	6.4	6.3
7	7.6	7.5	7.4
8	8.7	8.5	8.4
9	9.8	9.6	9.4
10	10.8	10.7	10.5
20	21.7	21.3	21.0
30	32.5	32.0	31.5
40	43.3	42.7	42.0
50	54.2	53.3	52.5
″	**62**	**61**	**60**
1	1.0	1.0	1.0
2	2.1	2.0	2.0
3	3.1	3.0	3.0
4	4.1	4.1	4.0
5	5.2	5.1	5.0
6	6.2	6.1	6.0
7	7.2	7.1	7.0
8	8.3	8.1	8.0
9	9.3	9.2	9.0
10	10.3	10.2	10.0
20	20.7	20.3	20.0
30	31.0	30.5	30.0
40	41.3	40.7	40.0
50	51.7	50.8	50.0
″	**59**	**3**	**2**
1	1.0	0.0	0.0
2	2.0	0.1	0.1
3	3.0	0.2	0.1
4	3.9	0.2	0.1
5	4.9	0.2	0.2
6	5.9	0.3	0.2
7	6.9	0.4	0.2
8	7.9	0.4	0.3
9	8.8	0.4	0.3
10	9.8	0.5	0.3
20	19.7	1.0	0.7
30	29.5	1.5	1.0
40	39.3	2.0	1.3
50	49.2	2.5	1.7

	$\frac{3}{67}$	$\frac{3}{66}$	$\frac{3}{65}$
0	11.2	11.0	10.8
1	33.5	33.0	32.5
2	55.8	55.0	54.2
3			
	$\frac{3}{64}$	$\frac{3}{63}$	$\frac{3}{62}$
0	10.7	10.5	10.3
1	32.0	31.5	31.0
2	53.3	52.5	51.7
3			

P. P.

101° (281°) (258°) **78°**

12° (192°) (347°) **167°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.31 788		9.32 747		0.67 253	9.99 040		60
1	9.31 847	59	9.32 810	63	0.67 190	9.99 038	2	59
2	9.31 907	60	9.32 872	62	0.67 128	9.99 035	3	58
3	9.31 966	59	9.32 933	61	0.67 067	9.99 032	3	57
4	9.32 025	59	9.32 995	62	0.67 005	9.99 030	2	56
5	9.32 084	59	9.33 057	62	0.66 943	9.99 027	3	55
6	9.32 143	59	9.33 119	62	0.66 881	9.99 024	3	54
7	9.32 202	59	9.33 180	61	0.66 820	9.99 022	2	53
8	9.32 261	59	9.33 242	62	0.66 758	9.99 019	3	52
9	9.32 319	58	9.33 303	61	0.66 697	9.99 016	3	51
10	9.32 378	59	9.33 365	62	0.66 635	9.99 013	3	50
11	9.32 437	59	9.33 426	61	0.66 574	9.99 011	2	49
12	9.32 495	58	9.33 487	61	0.66 513	9.99 008	3	48
13	9.32 553	58	9.33 548	61	0.66 452	9.99 005	3	47
14	9.32 612	59	9.33 609	61	0.66 391	9.99 002	3	46
15	9.32 670	58	9.33 670	61	0.66 330	9.99 000	2	45
16	9.32 728	58	9.33 731	61	0.66 269	9.98 997	3	44
17	9.32 786	58	9.33 792	61	0.66 208	9.98 994	3	43
18	9.32 844	58	9.33 853	61	0.66 147	9.98 991	3	42
19	9.32 902	58	9.33 913	60	0.66 087	9.98 989	2	41
20	9.32 960	58	9.33 974	61	0.66 026	9.98 986	3	40
21	9.33 018	58	9.34 034	60	0.65 966	9.98 983	3	39
22	9.33 075	57	9.34 095	61	0.65 905	9.98 980	3	38
23	9.33 133	58	9.34 155	60	0.65 845	9.98 978	2	37
24	9.33 190	57	9.34 215	60	0.65 785	9.98 975	3	36
25	9.33 248	58	9.34 276	61	0.65 724	9.98 972	3	35
26	9.33 305	57	9.34 336	60	0.65 664	9.98 969	3	34
27	9.33 362	57	9.34 396	60	0.65 604	9.98 967	2	33
28	9.33 420	58	9.34 456	60	0.65 544	9.98 964	3	32
29	9.33 477	57	9.34 516	60	0.65 484	9.98 961	3	31
30	9.33 534	57	9.34 576	60	0.65 424	9.98 958	3	30
31	9.33 591	57	9.34 635	59	0.65 365	9.98 955	3	29
32	9.33 647	56	9.34 695	60	0.65 305	9.98 953	2	28
33	9.33 704	57	9.34 755	60	0.65 245	9.98 950	3	27
34	9.33 761	57	9.34 814	59	0.65 186	9.98 947	3	26
35	9.33 818	57	9.34 874	60	0.65 126	9.98 944	3	25
36	9.33 874	56	9.34 933	59	0.65 067	9.98 941	3	24
37	9.33 931	57	9.34 992	59	0.65 008	9.98 938	3	23
38	9.33 987	56	9.35 051	59	0.64 949	9.98 936	2	22
39	9.34 043	56	9.35 111	60	0.64 889	9.98 933	3	21
40	9.34 100	57	9.35 170	59	0.64 830	9.98 930	3	20
41	9.34 156	56	9.35 229	59	0.64 771	9.98 927	3	19
42	9.34 212	56	9.35 288	59	0.64 712	9.98 924	3	18
43	9.34 268	56	9.35 347	59	0.64 653	9.98 921	3	17
44	9.34 324	56	9.35 405	58	0.64 595	9.98 919	2	16
45	9.34 380	56	9.35 464	59	0.64 536	9.98 916	3	15
46	9.34 436	56	9.35 523	59	0.64 477	9.98 913	3	14
47	9.34 491	55	9.35 581	58	0.64 419	9.98 910	3	13
48	9.34 547	56	9.35 640	59	0.64 360	9.98 907	3	12
49	9.34 602	55	9.35 698	58	0.64 302	9.98 904	3	11
50	9.34 658	56	9.35 757	59	0.64 243	9.98 901	3	10
51	9.34 713	55	9.35 815	58	0.64 185	9.98 898	3	9
52	9.34 769	56	9.35 873	58	0.64 127	9.98 896	2	8
53	9.34 824	55	9.35 931	58	0.64 069	9.98 893	3	7
54	9.34 879	55	9.35 989	58	0.64 011	9.98 890	3	6
55	9.34 934	55	9.36 047	58	0.63 953	9.98 887	3	5
56	9.34 989	55	9.36 105	58	0.63 895	9.98 884	3	4
57	9.35 044	55	9.36 163	58	0.63 837	9.98 881	3	3
58	9.35 099	55	9.36 221	58	0.63 779	9.98 878	3	2
59	9.35 154	55	9.36 279	58	0.63 721	9.98 875	3	1
60	9.35 209	55	9.36 336	57	0.63 664	9.98 872	3	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	63	62	61
1	1.0	1.0	1.0
2	2.1	2.1	2.0
3	3.2	3.1	3.0
4	4.2	4.1	4.1
5	5.2	5.2	5.1
6	6.3	6.2	6.1
7	7.4	7.2	7.1
8	8.4	8.3	8.1
9	9.4	9.3	9.2
10	10.5	10.3	10.2
20	21.0	20.7	20.3
30	31.5	31.0	30.5
40	42.0	41.3	40.7
50	52.5	51.7	50.8

″	60	59	58
1	1.0	1.0	1.0
2	2.0	2.0	1.9
3	3.0	3.0	2.9
4	4.0	3.9	3.9
5	5.0	4.9	4.8
6	6.0	5.9	5.8
7	7.0	6.9	6.8
8	8.0	7.9	7.7
9	9.0	8.8	8.7
10	10.0	9.8	9.7
20	20.0	19.7	19.3
30	30.0	29.5	29.0
40	40.0	39.3	38.7
50	50.0	49.2	48.3

″	57	56	55
1	1.0	0.9	0.9
2	1.9	1.9	1.8
3	2.8	2.8	2.8
4	3.8	3.7	3.7
5	4.8	4.7	4.6
6	5.7	5.6	5.5
7	6.6	6.5	6.4
8	7.6	7.5	7.3
9	8.6	8.4	8.2
10	9.5	9.3	9.2
20	19.0	18.7	18.3
30	28.5	28.0	27.5
40	38.0	37.3	36.7
50	47.5	46.7	45.8

	3/62	3/61	3/60
0			
1	10.3	10.2	10.0
2	31.0	30.5	30.0
3	51.7	50.8	50.0

	3/59	3/58	3/57
0			
1	9.8	9.7	9.5
2	29.5	29.0	28.5
3	49.2	48.3	47.5

102° (282°) (257°) **77°**

13° (193°) (346°) **166°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.35 209	54	9.36 336	58	0.63 664	9.98 872	3	**60**
1	9.35 263	55	9.36 394	58	0.63 606	9.98 869	2	59
2	9.35 318	55	9.36 452	57	0.63 548	9.98 867	3	58
3	9.35 373	54	9.36 509	57	0.63 491	9.98 864	3	57
4	9.35 427	54	9.36 566	58	0.63 434	9.98 861	3	56
5	9.35 481	55	9.36 624	57	0.63 376	9.98 858	3	55
6	9.35 536	54	9.36 681	57	0.63 319	9.98 855	3	54
7	9.35 590	54	9.36 738	57	0.63 262	9.98 852	3	53
8	9.35 644	54	9.36 795	57	0.63 205	9.98 849	3	52
9	9.35 698	54	9.36 852	57	0.63 148	9.98 846	3	51
10	9.35 752	54	9.36 909	57	0.63 091	9.98 843	3	**50**
11	9.35 806	54	9.36 966	57	0.63 034	9.98 840	3	49
12	9.35 860	54	9.37 023	57	0.62 977	9.98 837	3	48
13	9.35 914	54	9.37 080	57	0.62 920	9.98 834	3	47
14	9.35 968	54	9.37 137	56	0.62 863	9.98 831	3	46
15	9.36 022	53	9.37 193	57	0.62 807	9.98 828	3	45
16	9.36 075	54	9.37 250	56	0.62 750	9.98 825	3	44
17	9.36 129	53	9.37 306	57	0.62 694	9.98 822	3	43
18	9.36 182	54	9.37 363	56	0.62 637	9.98 819	3	42
19	9.36 236	53	9.37 419	57	0.62 581	9.98 816	3	41
20	9.36 289	53	9.37 476	56	0.62 524	9.98 813	3	**40**
21	9.36 342	53	9.37 532	56	0.62 468	9.98 810	3	39
22	9.36 395	54	9.37 588	56	0.62 412	9.98 807	3	38
23	9.36 449	53	9.37 644	56	0.62 356	9.98 804	3	37
24	9.36 502	53	9.37 700	56	0.62 300	9.98 801	3	36
25	9.36 555	53	9.37 756	56	0.62 244	9.98 798	3	35
26	9.36 608	52	9.37 812	56	0.62 188	9.98 795	3	34
27	9.36 660	53	9.37 868	56	0.62 132	9.98 792	3	33
28	9.36 713	53	9.37 924	56	0.62 076	9.98 789	3	32
29	9.36 766	53	9.37 980	55	0.62 020	9.98 786	3	31
30	9.36 819	52	9.38 035	56	0.61 965	9.98 783	3	**30**
31	9.36 871	53	9.38 091	56	0.61 909	9.98 780	3	29
32	9.36 924	52	9.38 147	55	0.61 853	9.98 777	3	28
33	9.36 976	52	9.38 202	55	0.61 798	9.98 774	3	27
34	9.37 028	53	9.38 257	56	0.61 743	9.98 771	3	26
35	9.37 081	52	9.38 313	55	0.61 687	9.98 768	3	25
36	9.37 133	52	9.38 368	55	0.61 632	9.98 765	3	24
37	9.37 185	52	9.38 423	56	0.61 577	9.98 762	3	23
38	9.37 237	52	9.38 479	55	0.61 521	9.98 759	3	22
39	9.37 289	52	9.38 534	55	0.61 466	9.98 756	3	21
40	9.37 341	52	9.38 589	55	0.61 411	9.98 753	3	**20**
41	9.37 393	52	9.38 644	55	0.61 356	9.98 750	4	19
42	9.37 445	52	9.38 699	55	0.61 301	9.98 746	3	18
43	9.37 497	52	9.38 754	54	0.61 246	9.98 743	3	17
44	9.37 549	51	9.38 808	55	0.61 192	9.98 740	3	16
45	9.37 600	52	9.38 863	55	0.61 137	9.98 737	3	15
46	9.37 652	51	9.38 918	54	0.61 082	9.98 734	3	14
47	9.37 703	52	9.38 972	55	0.61 028	9.98 731	3	13
48	9.37 755	51	9.39 027	55	0.60 973	9.98 728	3	12
49	9.37 806	52	9.39 082	54	0.60 918	9.98 725	3	11
50	9.37 858	51	9.39 136	54	0.60 864	9.98 722	3	**10**
51	9.37 909	51	9.39 190	55	0.60 810	9.98 719	4	9
52	9.37 960	51	9.39 245	54	0.60 755	9.98 715	3	8
53	9.38 011	51	9.39 299	54	0.60 701	9.98 712	3	7
54	9.38 062	51	9.39 353	54	0.60 647	9.98 709	3	6
55	9.38 113	51	9.39 407	54	0.60 593	9.98 706	3	5
56	9.38 164	51	9.39 461	54	0.60 539	9.98 703	3	4
57	9.38 215	51	9.39 515	54	0.60 485	9.98 700	3	3
58	9.38 266	51	9.39 569	54	0.60 431	9.98 697	3	2
59	9.38 317	51	9.39 623	54	0.60 377	9.98 694	4	1
60	9.38 368		9.39 677		0.60 323	9.98 690		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**57**	**56**	**55**
1	1.0	0.9	0.9
2	1.9	1.9	1.8
3	2.8	2.8	2.8
4	3.8	3.7	3.7
5	4.8	4.7	4.6
6	5.7	5.6	5.5
7	6.6	6.5	6.4
8	7.6	7.5	7.3
9	8.6	8.4	8.2
10	9.5	9.3	9.2
20	19.0	18.7	18.3
30	28.5	28.0	27.5
40	38.0	37.3	36.7
50	47.5	46.7	45.8

″	**54**	**53**	**52**
1	0.9	0.9	0.9
2	1.8	1.8	1.7
3	2.7	2.6	2.6
4	3.6	3.5	3.5
5	4.5	4.4	4.3
6	5.4	5.3	5.2
7	6.3	6.2	6.1
8	7.2	7.1	6.9
9	8.1	8.0	7.8
10	9.0	8.8	8.7
20	18.0	17.7	17.3
30	27.0	26.5	26.0
40	36.0	35.3	34.7
50	45.0	44.2	43.3

″	**51**	**4**	**3**	**2**
1	0.8	0.1	0.0	0.0
2	1.7	0.1	0.1	0.1
3	2.6	0.2	0.2	0.1
4	3.4	0.3	0.2	0.1
5	4.2	0.3	0.2	0.2
6	5.1	0.4	0.3	0.2
7	6.0	0.5	0.4	0.2
8	6.8	0.5	0.4	0.3
9	7.6	0.6	0.4	0.3
10	8.5	0.7	0.5	0.3
20	17.0	1.3	1.0	0.7
30	25.5	2.0	1.5	1.0
40	34.0	2.7	2.0	1.3
50	42.5	3.3	2.5	1.7

	4/55	**4/54**	**3/58**	**3/57**
0				
1	6.9	6.8	9.7	9.5
2	20.6	20.2	29.0	28.5
3	34.4	33.8	48.3	47.5
4	48.1	47.2	—	—

	3/56	**3/55**	**3/54**
0			
1	9.3	9.2	9.0
2	28.0	27.5	27.0
3	46.7	45.8	45.0

P. P.

103° (283°) (256°) **76°**

14° (194°) (345°) **165°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	
0	9.38 368	50	9.39 677	54	0.60 323	9.98 690	3	**60**
1	9.38 418	51	9.39 731	54	0.60 269	9.98 687	3	59
2	9.38 469	50	9.39 785	53	0.60 215	9.98 684	3	58
3	9.38 519	51	9.39 838	54	0.60 162	9.98 681	3	57
4	9.38 570	50	9.39 892	53	0.60 108	9.98 678	3	56
5	9.38 620	50	9.39 945	54	0.60 055	9.98 675	4	55
6	9.38 670	51	9.39 999	53	0.60 001	9.98 671	3	54
7	9.38 721	50	9.40 052	54	0.59 948	9.98 668	3	53
8	9.38 771	50	9.40 106	53	0.59 894	9.98 665	3	52
9	9.38 821	50	9.40 159	53	0.59 841	9.98 662	3	51
10	9.38 871	50	9.40 212	54	0.59 788	9.98 659	3	**50**
11	9.38 921	50	9.40 266	53	0.59 734	9.98 656	4	49
12	9.38 971	50	9.40 319	53	0.59 681	9.98 652	3	48
13	9.39 021	50	9.40 372	53	0.59 628	9.98 649	3	47
14	9.39 071	50	9.40 425	53	0.59 575	9.98 646	3	46
15	9.39 121	49	9.40 478	53	0.59 522	9.98 643	3	45
16	9.39 170	50	9.40 531	53	0.59 469	9.98 640	4	44
17	9.39 220	50	9.40 584	52	0.59 416	9.98 636	3	43
18	9.39 270	49	9.40 636	53	0.59 364	9.98 633	3	42
19	9.39 319	50	9.40 689	53	0.59 311	9.98 630	3	41
20	9.39 369	49	9.40 742	53	0.59 258	9.98 627	4	**40**
21	9.39 418	49	9.40 795	52	0.59 205	9.98 623	3	39
22	9.39 467	50	9.40 847	53	0.59 153	9.98 620	3	38
23	9.39 517	49	9.40 900	52	0.59 100	9.98 617	3	37
24	9.39 566	49	9.40 952	53	0.59 048	9.98 614	4	36
25	9.39 615	49	9.41 005	52	0.58 995	9.98 610	3	35
26	9.39 664	49	9.41 057	52	0.58 943	9.98 607	3	34
27	9.39 713	49	9.41 109	52	0.58 891	9.98 604	3	33
28	9.39 762	49	9.41 161	53	0.58 839	9.98 601	4	32
29	9.39 811	49	9.41 214	52	0.58 786	9.98 597	3	31
30	9.39 860	49	9.41 266	52	0.58 734	9.98 594	3	**30**
31	9.39 909	49	9.41 318	52	0.58 682	9.98 591	3	29
32	9.39 958	48	9.41 370	52	0.58 630	9.98 588	4	28
33	9.40 006	49	9.41 422	52	0.58 578	9.98 584	3	27
34	9.40 055	48	9.41 474	52	0.58 526	9.98 581	3	26
35	9.40 103	49	9.41 526	52	0.58 474	9.98 578	4	25
36	9.40 152	48	9.41 578	51	0.58 422	9.98 574	3	24
37	9.40 200	49	9.41 629	52	0.58 371	9.98 571	3	23
38	9.40 249	48	9.41 681	52	0.58 319	9.98 568	3	22
39	9.40 297	49	9.41 733	51	0.58 267	9.98 565	4	21
40	9.40 346	48	9.41 784	52	0.58 216	9.98 561	3	**20**
41	9.40 394	48	9.41 836	51	0.58 164	9.98 558	3	19
42	9.40 442	48	9.41 887	52	0.58 113	9.98 555	4	18
43	9.40 490	48	9.41 939	51	0.58 061	9.98 551	3	17
44	9.40 538	48	9.41 990	51	0.58 010	9.98 548	3	16
45	9.40 586	48	9.42 041	52	0.57 959	9.98 545	4	15
46	9.40 634	48	9.42 093	51	0.57 907	9.98 541	3	14
47	9.40 682	48	9.42 144	51	0.57 856	9.98 538	3	13
48	9.40 730	48	9.42 195	51	0.57 805	9.98 535	4	12
49	9.40 778	47	9.42 246	51	0.57 754	9.98 531	3	11
50	9.40 825	48	9.42 297	51	0.57 703	9.98 528	3	**10**
51	9.40 873	48	9.42 348	51	0.57 652	9.98 525	4	9
52	9.40 921	47	9.42 399	51	0.57 601	9.98 521	3	8
53	9.40 968	48	9.42 450	51	0.57 550	9.98 518	3	7
54	9.41 016	47	9.42 501	51	0.57 499	9.98 515	4	6
55	9.41 063	48	9.42 552	51	0.57 448	9.98 511	3	5
56	9.41 111	47	9.42 603	50	0.57 397	9.98 508	3	4
57	9.41 158	47	9.42 653	51	0.57 347	9.98 505	4	3
58	9.41 205	47	9.42 704	51	0.57 296	9.98 501	3	2
59	9.41 252	48	9.42 755	50	0.57 245	9.98 498	4	1
60	9.41 300		9.42 805		0.57 195	9.98 494		0
	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	54	53	52
1	0.9	0.9	0.9
2	1.8	1.8	1.7
3	2.7	2.6	2.6
4	3.6	3.5	3.5
5	4.5	4.4	4.3
6	5.4	5.3	5.2
7	6.3	6.2	6.1
8	7.2	7.1	6.9
9	8.1	8.0	7.8
10	9.0	8.8	8.7
20	18.0	17.7	17.3
30	27.0	26.5	26.0
40	36.0	35.3	34.7
50	45.0	44.2	43.3

″	51	50	49
1	0.8	0.8	0.8
2	1.7	1.7	1.6
3	2.6	2.5	2.4
4	3.4	3.3	3.3
5	4.2	4.2	4.1
6	5.1	5.0	4.9
7	6.0	5.8	5.7
8	6.8	6.7	6.5
9	7.6	7.5	7.4
10	8.5	8.3	8.2
20	17.0	16.7	16.3
30	25.5	25.0	24.5
40	34.0	33.3	32.7
50	42.5	41.7	40.8

″	48	47	4	3
1	0.8	0.8	0.1	0.0
2	1.6	1.6	0.1	0.1
3	2.4	2.4	0.2	0.2
4	3.2	3.1	0.3	0.2
5	4.0	3.9	0.3	0.2
6	4.8	4.7	0.4	0.3
7	5.6	5.5	0.5	0.4
8	6.4	6.3	0.5	0.4
9	7.2	7.0	0.6	0.4
10	8.0	7.8	0.7	0.5
20	16.0	15.7	1.3	1.0
30	24.0	23.5	2.0	1.5
40	32.0	31.3	2.7	2.0
50	40.0	39.2	3.3	2.5

	4/54	4/53	4/52	4/51
0	6.8	6.6	6.5	6.4
1	20.2	19.9	19.5	19.1
2	33.8	33.1	32.5	31.9
3	47.2	46.4	45.5	44.6

	3/54	3/53	3/52	3/51
0	9.0	8.8	8.7	8.5
1	27.0	26.5	26.0	25.5
2	45.0	44.2	43.3	42.5

P. P.

104° (284°) (255°) **75°**

15° (195°) (344°) **164°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot	L. Cos.	d.	′
0	9.41 300	47	9.42 805	51	0.57 195	9.98 494	3	60
1	9.41 347	47	9.42 856	50	0.57 144	9.98 491	3	59
2	9.41 394	47	9.42 906	51	0.57 094	9.98 488	4	58
3	9.41 441	47	9.42 957	50	0.57 043	9.98 484	3	57
4	9.41 488	47	9.43 007	50	0.56 993	9.98 481	4	56
5	9.41 535	47	9.43 057	51	0.56 943	9.98 477	3	55
6	9.41 582	46	9.43 108	50	0.56 892	9.98 474	3	54
7	9.41 628	47	9.43 158	50	0.56 842	9.98 471	4	53
8	9.41 675	47	9.43 208	50	0.56 792	9.98 467	3	52
9	9.41 722	46	9.43 258	50	0.56 742	9.98 464	4	51
10	9.41 768	47	9.43 308	50	0.56 692	9.98 460	3	50
11	9.41 815	46	9.43 358	50	0.56 642	9.98 457	4	49
12	9.41 861	47	9.43 408	50	0.56 592	9.98 453	3	48
13	9.41 908	46	9.43 458	50	0.56 542	9.98 450	3	47
14	9.41 954	47	9.43 508	50	0.56 492	9.98 447	4	46
15	9.42 001	46	9.43 558	49	0.56 442	9.98 443	3	45
16	9.42 047	46	9.43 607	50	0.56 393	9.98 440	4	44
17	9.42 093	47	9.43 657	50	0.56 343	9.98 436	3	43
18	9.42 140	46	9.43 707	49	0.56 293	9.98 433	4	42
19	9.42 186	46	9.43 756	50	0.56 244	9.98 429	3	41
20	9.42 232	46	9.43 806	49	0.56 194	9.98 426	4	40
21	9.42 278	46	9.43 855	50	0.56 145	9.98 422	3	39
22	9.42 324	46	9.43 905	49	0.56 095	9.98 419	4	38
23	9.42 370	46	9.43 954	50	0.56 046	9.98 415	3	37
24	9.42 416	45	9.44 004	49	0.55 996	9.98 412	3	36
25	9.42 461	46	9.44 053	49	0.55 947	9.98 409	4	35
26	9.42 507	46	9.44 102	49	0.55 898	9.98 405	3	34
27	9.42 553	46	9.44 151	50	0.55 849	9.98 402	4	33
28	9.42 599	45	9.44 201	49	0.55 799	9.98 398	3	32
29	9.42 644	46	9.44 250	49	0.55 750	9.98 395	4	31
30	9.42 690	45	9.44 299	49	0.55 701	9.98 391	3	30
31	9.42 735	46	9.44 348	49	0.55 652	9.98 388	4	29
32	9.42 781	45	9.44 397	49	0.55 603	9.98 384	3	28
33	9.42 826	46	9.44 446	49	0.55 554	9.98 381	4	27
34	9.42 872	45	9.44 495	49	0.55 505	9.98 377	4	26
35	9.42 917	45	9.44 544	48	0.55 456	9.98 373	3	25
36	9.42 962	46	9.44 592	49	0.55 408	9.98 370	4	24
37	9.43 008	45	9.44 641	49	0.55 359	9.98 366	3	23
38	9.43 053	45	9.44 690	48	0.55 310	9.98 363	4	22
39	9.43 098	45	9.44 738	49	0.55 262	9.98 359	3	21
40	9.43 143	45	9.44 787	49	0.55 213	9.98 356	4	20
41	9.43 188	45	9.44 836	48	0.55 164	9.98 352	3	19
42	9.43 233	45	9.44 884	49	0.55 116	9.98 349	4	18
43	9.43 278	45	9.44 933	48	0.55 067	9.98 345	3	17
44	9.43 323	44	9.44 981	48	0.55 019	9.98 342	4	16
45	9.43 367	45	9.45 029	49	0.54 971	9.98 338	4	15
46	9.43 412	45	9.45 078	48	0.54 922	9.98 334	3	14
47	9.43 457	45	9.45 126	48	0.54 874	9.98 331	4	13
48	9.43 502	44	9.45 174	48	0.54 826	9.98 327	3	12
49	9.43 546	45	9.45 222	49	0.54 778	9.98 324	4	11
50	9.43 591	44	9.45 271	48	0.54 729	9.98 320	3	10
51	9.43 635	45	9.45 319	48	0.54 681	9.98 317	4	9
52	9.43 680	44	9.45 367	48	0.54 633	9.98 313	4	8
53	9.43 724	45	9.45 415	48	0.54 585	9.98 309	3	7
54	9.43 769	44	9.45 463	48	0.54 537	9.98 306	4	6
55	9.43 813	44	9.45 511	48	0.54 489	9.98 302	3	5
56	9.43 857	44	9.45 559	47	0.54 441	9.98 299	4	4
57	9.43 901	45	9.45 606	48	0.54 394	9.98 295	4	3
58	9.43 946	44	9.45 654	48	0.54 346	9.98 291	3	2
59	9.43 990	44	9.45 702	48	0.54 298	9.98 288	4	1
60	9.44 034		9.45 750		0.54 250	9.98 284		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	51	50	49
1	0.8	0.8	0.8
2	1.7	1.7	1.6
3	2.6	2.5	2.4
4	3.4	3.3	3.3
5	4.2	4.2	4.1
6	5.1	5.0	4.9
7	6.0	5.8	5.7
8	6.8	6.7	6.5
9	7.6	7.5	7.4
10	8.5	8.3	8.2
20	17.0	16.7	16.3
30	25.5	25.0	24.5
40	34.0	33.3	32.7
50	42.5	41.7	40.8

″	48	47	46
1	0.8	0.8	0.8
2	1.6	1.6	1.5
3	2.4	2.4	2.3
4	3.2	3.1	3.1
5	4.0	3.9	3.8
6	4.8	4.7	4.6
7	5.6	5.5	5.4
8	6.4	6.3	6.1
9	7.2	7.0	6.9
10	8.0	7.8	7.7
20	16.0	15.7	15.3
30	24.0	23.5	23.0
40	32.0	31.3	30.7
50	40.0	39.2	38.3

″	45	44	4	3
1	0.8	0.7	0.1	0.0
2	1.5	1.5	0.1	0.1
3	2.2	2.2	0.2	0.2
4	3.0	2.9	0.3	0.2
5	3.8	3.7	0.3	0.2
6	4.5	4.4	0.4	0.3
7	5.2	5.1	0.5	0.4
8	6.0	5.9	0.5	0.4
9	6.8	6.6	0.6	0.4
10	7.5	7.3	0.7	0.5
20	15.0	14.7	1.3	1.0
30	22.5	22.0	2.0	1.5
40	30.0	29.3	2.7	2.0
50	37.5	36.7	3.3	2.5

	4/50	4/49	4/48	4/47
0	6.2	6.1	6.0	5.9
1	18.8	18.4	18.0	17.6
2	31.2	30.6	30.0	29.4
3	43.8	42.9	42.0	41.1
4				

	3/51	3/50	3/49	3/48
0	8.5	8.3	8.2	8.0
1	25.5	25.0	24.5	24.0
2	42.5	41.7	40.8	40.0
3				

P. P.

105° (285°) (254°) **74°**

16° (196°) (343°) **163°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.44 034	44	9.45 750	47	0.54 250	9.98 284	3	60
1	9.44 078	44	9.45 797	48	0.54 203	9.98 281	4	59
2	9.44 122	44	9.45 845	47	0.54 155	9.98 277	4	58
3	9.44 166	44	9.45 892	48	0.54 108	9.98 273	3	57
4	9.44 210	43	9.45 940	47	0.54 060	9.98 270	4	56
5	9.44 253	44	9.45 987	48	0.54 013	9.98 266	4	55
6	9.44 297	44	9.46 035	47	0.53 965	9.98 262	3	54
7	9.44 341	44	9.46 082	48	0.53 918	9.98 259	4	53
8	9.44 385	43	9.46 130	47	0.53 870	9.98 255	4	52
9	9.44 428	44	9.46 177	47	0.53 823	9.98 251	3	51
10	9.44 472	44	9.46 224	47	0.53 776	9.98 248	4	50
11	9.44 516	43	9.46 271	48	0.53 729	9.98 244	4	49
12	9.44 559	43	9.46 319	47	0.53 681	9.98 240	3	48
13	9.44 602	44	9.46 366	47	0.53 634	9.98 237	4	47
14	9.44 646	43	9.46 413	47	0.53 587	9.98 233	4	46
15	9.44 689	44	9.46 460	47	0.53 540	9.98 229	3	45
16	9.44 733	43	9.46 507	47	0.53 493	9.98 226	4	44
17	9.44 776	43	9.46 554	47	0.53 446	9.98 222	4	43
18	9.44 819	43	9.46 601	47	0.53 399	9.98 218	3	42
19	9.44 862	43	9.46 648	46	0.53 352	9.98 215	4	41
20	9.44 905	43	9.46 694	47	0.53 306	9.98 211	4	40
21	9.44 948	44	9.46 741	47	0.53 259	9.98 207	3	39
22	9.44 992	43	9.46 788	47	0.53 212	9.98 204	4	38
23	9.45 035	42	9.46 835	46	0.53 165	9.98 200	4	37
24	9.45 077	43	9.46 881	47	0.53 119	9.98 196	4	36
25	9.45 120	43	9.46 928	47	0.53 072	9.98 192	3	35
26	9.45 163	43	9.46 975	46	0.53 025	9.98 189	4	34
27	9.45 206	43	9.47 021	47	0.52 979	9.98 185	4	33
28	9.45 249	43	9.47 068	46	0.52 932	9.98 181	4	32
29	9.45 292	42	9.47 114	46	0.52 886	9.98 177	3	31
30	9.45 334	43	9.47 160	47	0.52 840	9.98 174	4	30
31	9.45 377	42	9.47 207	46	0.52 793	9.98 170	4	29
32	9.45 419	43	9.47 253	46	0.52 747	9.98 166	4	28
33	9.45 462	42	9.47 299	47	0.52 701	9.98 162	3	27
34	9.45 504	43	9.47 346	46	0.52 654	9.98 159	4	26
35	9.45 547	42	9.47 392	46	0.52 608	9.98 155	4	25
36	9.45 589	43	9.47 438	46	0.52 562	9.98 151	4	24
37	9.45 632	42	9.47 484	46	0.52 516	9.98 147	3	23
38	9.45 674	42	9.47 530	46	0.52 470	9.98 144	4	22
39	9.45 716	42	9.47 576	46	0.52 424	9.98 140	4	21
40	9.45 758	43	9.47 622	46	0.52 378	9.98 136	4	20
41	9.45 801	42	9.47 668	46	0.52 332	9.98 132	3	19
42	9.45 843	42	9.47 714	46	0.52 286	9.98 129	4	18
43	9.45 885	42	9.47 760	46	0.52 240	9.98 125	4	17
44	9.45 927	42	9.47 806	46	0.52 194	9.98 121	4	16
45	9.45 969	42	9.47 852	45	0.52 148	9.98 117	4	15
46	9.46 011	42	9.47 897	46	0.52 103	9.98 113	3	14
47	9.46 053	42	9.47 943	46	0.52 057	9.98 110	4	13
48	9.46 095	41	9.47 989	46	0.52 011	9.98 106	4	12
49	9.46 136	42	9.48 035	45	0.51 965	9.98 102	4	11
50	9.46 178	42	9.48 080	46	0.51 920	9.98 098	4	10
51	9.46 220	42	9.48 126	45	0.51 874	9.98 094	4	9
52	9.46 262	41	9.48 171	46	0.51 829	9.98 090	3	8
53	9.46 303	42	9.48 217	45	0.51 783	9.98 087	4	7
54	9.46 345	41	9.48 262	45	0.51 738	9.98 083	4	6
55	9.46 386	42	9.48 307	46	0.51 693	9.98 079	4	5
56	9.46 428	41	9.48 353	45	0.51 347	9.98 075	4	4
57	9.46 469	42	9.48 398	45	0.51 602	9.98 071	4	3
58	9.46 511	41	9.48 443	46	0.51 557	9.98 067	4	2
59	9.46 552	42	9.48 489	45	0.51 511	9.98 063	3	1
60	9.46 594		9.48 534		0.51 466	9.98 060		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	48	47	46
1	0.8	0.8	0.8
2	1.6	1.6	1.5
3	2.4	2.4	2.3
4	3.2	3.1	3.1
5	4.0	3.9	3.8
6	4.8	4.7	4.6
7	5.6	5.5	5.4
8	6.4	6.3	6.1
9	7.2	7.0	6.9
10	8.0	7.8	7.7
20	16.0	15.7	15.3
30	24.0	23.5	23.0
40	32.0	31.3	30.7
50	40.0	39.2	38.3

″	45	44	43
1	0.8	0.7	0.7
2	1.5	1.5	1.4
3	2.2	2.2	2.2
4	3.0	2.9	2.9
5	3.8	3.7	3.6
6	4.5	4.4	4.3
7	5.2	5.1	5.0
8	6.0	5.9	5.7
9	6.8	6.6	6.4
10	7.5	7.3	7.2
20	15.0	14.7	14.3
30	22.5	22.0	21.5
40	30.0	29.3	28.7
50	37.5	36.7	35.8

″	42	41	4	3
1	0.7	0.7	0.1	0.0
2	1.4	1.4	0.1	0.1
3	2.1	2.0	0.2	0.2
4	2.8	2.7	0.3	0.2
5	3.5	3.4	0.3	0.2
6	4.2	4.1	0.4	0.3
7	4.9	4.8	0.5	0.4
8	5.6	5.5	0.5	0.4
9	6.3	6.2	0.6	0.4
10	7.0	6.8	0.7	0.5
20	14.0	13.7	1.3	1.0
30	21.0	20.5	2.0	1.5
40	28.0	27.3	2.7	2.0
50	35.0	34.2	3.3	2.5

	$\frac{4}{48}$	$\frac{4}{47}$	$\frac{4}{46}$	$\frac{4}{45}$
0	6.0	5.9	5.8	5.6
1	18.0	17.6	17.2	16.9
2	30.0	29.4	28.8	28.1
3	42.0	41.1	40.2	39.4

	$\frac{3}{48}$	$\frac{3}{47}$	$\frac{3}{46}$	$\frac{3}{45}$
0	8.0	7.8	7.7	7.5
1	24.0	23.5	23.0	22.5
2	40.0	39.2	38.3	37.5

P.P.

106° (286°) (253°) **73°**

17° (197°) (342°) **162°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.46 594	41	9.48 534	45	0.51 466	9.98 060	4	**60**
1	9.46 635	41	9.48 579	45	0.51 421	9.98 056	4	59
2	9.46 676	41	9.48 624	45	0.51 376	9.98 052	4	58
3	9.46 717	41	9.48 669	45	0.51 331	9.98 048	4	57
4	9.46 758	42	9.48 714	45	0.51 286	9.98 044	4	56
5	9.46 800	41	9.48 759	45	0.51 241	9.98 040	4	55
6	9.46 841	41	9.48 804	45	0.51 196	9.98 036	4	54
7	9.46 882	41	9.48 849	45	0.51 151	9.98 032	3	53
8	9.46 923	41	9.48 894	45	0.51 106	9.98 029	4	52
9	9.46 964	41	9.48 939	45	0.51 061	9.98 025	4	51
10	9.47 005	40	9.48 984	45	0.51 016	9.98 021	4	**50**
11	9.47 045	41	9.49 029	44	0.50 971	9.98 017	4	49
12	9.47 086	41	9.49 073	45	0.50 927	9.98 013	4	48
13	9.47 127	41	9.49 118	45	0.50 882	9.98 009	4	47
14	9.47 168	41	9.49 163	44	0.50 837	9.98 005	4	46
15	9.47 209	40	9.49 207	45	0.50 793	9.98 001	4	45
16	9.47 249	41	9.49 252	44	0.50 748	9.97 997	4	44
17	9.47 290	40	9.49 296	45	0.50 704	9.97 993	4	43
18	9.47 330	41	9.49 341	44	0.50 659	9.97 989	3	42
19	9.47 371	40	9.49 385	45	0.50 615	9.97 986	4	41
20	9.47 411	41	9.49 430	44	0.50 570	9.97 982	4	**40**
21	9.47 452	40	9.49 474	45	0.50 526	9.97 978	4	39
22	9.47 492	41	9.49 519	44	0.50 481	9.97 974	4	38
23	9.47 533	40	9.49 563	44	0.50 437	9.97 970	4	37
24	9.47 573	40	9.49 607	45	0.50 393	9.97 966	4	36
25	9.47 613	41	9.49 652	44	0.50 348	9.97 962	4	35
26	9.47 654	40	9.49 696	44	0.50 304	9.97 958	4	34
27	9.47 694	40	9.49 740	44	0.50 260	9.97 954	4	33
28	9.47 734	40	9.49 784	44	0.50 216	9.97 950	4	32
29	9.47 774	40	9.49 828	44	0.50 172	9.97 946	4	31
30	9.47 814	40	9.49 872	44	0.50 128	9.97 942	4	**30**
31	9.47 854	40	9.49 916	44	0.50 084	9.97 938	4	29
32	9.47 894	40	9.49 960	44	0.50 040	9.97 934	4	28
33	9.47 934	40	9.50 004	44	0.49 996	9.97 930	4	27
34	9.47 974	40	9.50 048	44	0.49 952	9.97 926	4	26
35	9.48 014	40	9.50 092	44	0.49 908	9.97 922	4	25
36	9.48 054	40	9.50 136	44	0.49 864	9.97 918	4	24
37	9.48 094	39	9.50 180	43	0.49 820	9.97 914	4	23
38	9.48 133	40	9.50 223	44	0.49 777	9.97 910	4	22
39	9.48 173	40	9.50 267	44	0.49 733	9.97 906	4	21
40	9.48 213	39	9.50 311	44	0.49 689	9.97 902	4	**20**
41	9.48 252	40	9.50 355	43	0.49 645	9.97 898	4	19
42	9.48 292	40	9.50 398	44	0.49 602	9.97 894	4	18
43	9.48 332	39	9.50 442	43	0.49 558	9.97 890	4	17
44	9.48 371	40	9.50 485	44	0.49 515	9.97 886	4	16
45	9.48 411	39	9.50 529	43	0.49 471	9.97 882	4	15
46	9.48 450	40	9.50 572	44	0.49 428	9.97 878	4	14
47	9.48 490	39	9.50 616	43	0.49 384	9.97 874	4	13
48	9.48 529	39	9.50 659	44	0.49 341	9.97 870	4	12
49	9.48 568	39	9.50 703	43	0.49 297	9.97 866	5	11
50	9.48 607	40	9.50 746	43	0.49 254	9.97 861	4	**10**
51	9.48 647	39	9.50 789	44	0.49 211	9.97 857	4	9
52	9.48 686	39	9.50 833	43	0.49 167	9.97 853	4	8
53	9.48 725	39	9.50 876	43	0.49 124	9.97 849	4	7
54	9.48 764	39	9.50 919	43	0.49 081	9.97 845	4	6
55	9.48 803	39	9.50 962	43	0.49 038	9.97 841	4	5
56	9.48 842	39	9.51 005	43	0.48 995	9.97 837	4	4
57	9.48 881	39	9.51 048	44	0.48 952	9.97 833	4	3
58	9.48 920	39	9.51 092	43	0.48 908	9.97 829	4	2
59	9.48 959	39	9.51 135	43	0.48 865	9.97 825	4	1
60	9.48 998		9.51 178		0.48 822	9.97 821		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	45	44	43
1	0.8	0.7	0.7
2	1.5	1.5	1.4
3	2.2	2.2	2.2
4	3.0	2.9	2.9
5	3.8	3.7	3.6
6	4.5	4.4	4.3
7	5.2	5.1	5.0
8	6.0	5.9	5.7
9	6.8	6.6	6.4
10	7.5	7.3	7.2
20	15.0	14.7	14.3
30	22.5	22.0	21.5
40	30.0	29.3	28.7
50	37.5	36.7	35.8

″	42	41	40
1	0.7	0.7	0.7
2	1.4	1.4	1.3
3	2.1	2.0	2.0
4	2.8	2.7	2.7
5	3.5	3.4	3.3
6	4.2	4.1	4.0
7	4.9	4.8	4.7
8	5.6	5.5	5.3
9	6.3	6.2	6.0
10	7.0	6.8	6.7
20	14.0	13.7	13.3
30	21.0	20.5	20.0
40	28.0	27.3	26.7
50	35.0	34.2	33.3

″	39	5	4	3
1	0.6	0.1	0.1	0.0
2	1.3	0.2	0.1	0.1
3	2.0	0.2	0.2	0.2
4	2.6	0.3	0.3	0.2
5	3.2	0.4	0.3	0.2
6	3.9	0.5	0.4	0.3
7	4.6	0.6	0.5	0.4
8	5.2	0.7	0.5	0.4
9	5.8	0.8	0.6	0.4
10	6.5	0.8	0.7	0.5
20	13.0	1.7	1.3	1.0
30	19.5	2.5	2.0	1.5
40	26.0	3.3	2.7	2.0
50	32.5	4.2	3.3	2.5

	$\frac{5}{43}$	$\frac{4}{45}$	$\frac{4}{44}$
0	4.3	5.6	5.5
1	12.9	16.9	16.5
2	21.5	28.1	27.5
3	30.1	39.4	38.5
4	38.7	—	—
5			

	$\frac{4}{43}$	$\frac{3}{45}$	$\frac{3}{44}$
0	5.4	7.5	7.3
1	16.1	22.5	22.0
2	26.9	37.5	36.7
3	37.6	—	—
4			

107° (287°) (252°) **72°**

18° (198°) (341°) **161°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d	′
0	9.48 998	39	9.51 178	43	0.48 822	9.97 821	4	**60**
1	9.49 037	39	9.51 221	43	0.48 779	9.97 817	5	59
2	9.49 076	39	9.51 264	42	0.48 736	9.97 812	4	58
3	9.49 115	38	9.51 306	43	0.48 694	9.97 808	4	57
4	9.49 153	39	9.51 349	43	0.48 651	9.97 804	4	56
5	9.49 192	39	9.51 392	43	0.48 608	9.97 800	4	55
6	9.49 231	38	9.51 435	43	0.48 565	9.97 796	4	54
7	9.49 269	39	9.51 478	42	0.48 522	9.97 792	4	53
8	9.49 308	39	9.51 520	43	0.48 480	9.97 788	4	52
9	9.49 347	38	9.51 563	43	0.48 437	9.97 784	5	51
10	9.49 385	39	9.51 606	42	0.48 394	9.97 779	4	**50**
11	9.49 424	38	9.51 648	43	0.48 352	9.97 775	4	39
12	9.49 462	38	9.51 691	43	0.48 309	9.97 771	4	48
13	9.49 500	39	9.51 734	42	0.48 266	9.97 767	4	47
14	9.49 539	38	9.51 776	43	0.48 224	9.97 763	4	46
15	9.49 577	38	9.51 819	42	0.48 181	9.97 759	5	45
16	9.49 615	39	9.51 861	42	0.48 139	9.97 754	4	44
17	9.49 654	38	9.51 903	43	0.48 097	9.97 750	4	43
18	9.49 692	38	9.51 946	42	0.48 054	9.97 746	4	42
19	9.49 730	38	9.51 988	43	0.48 012	9.97 742	4	41
20	9.49 768	38	9.52 031	42	0.47 969	9.97 738	4	**40**
21	9.49 806	38	9.52 073	42	0.47 927	9.97 734	5	39
22	9.49 844	38	9.52 115	42	0.47 885	9.97 729	4	38
23	9.49 882	38	9.52 157	43	0.47 843	9.97 725	4	37
24	9.49 920	38	9.52 200	42	0.47 800	9.97 721	4	36
25	9.49 958	38	9.52 242	42	0.47 758	9.97 717	4	35
26	9.49 996	38	9.52 284	42	0.47 716	9.97 713	5	34
27	9.50 034	38	9.52 326	42	0.47 674	9.97 708	4	33
28	9.50 072	38	9.52 368	42	0.47 632	9.97 704	4	32
29	9.50 110	38	9.52 410	42	0.47 590	9.97 700	4	31
30	9.50 148	37	9.52 452	42	0.47 548	9.97 696	5	**30**
31	9.50 185	38	9.52 494	42	0.47 506	9.97 691	4	29
32	9.50 223	38	9.52 536	42	0.47 464	9.97 687	4	28
33	9.50 261	37	9.52 578	42	0.47 422	9.97 683	4	27
34	9.50 298	38	9.52 620	41	0.47 380	9.97 679	5	26
35	9.50 336	38	9.52 661	42	0.47 339	9.97 674	4	25
36	9.50 374	37	9.52 703	42	0.47 297	9.97 670	4	24
37	9.50 411	38	9.52 745	42	0.47 255	9.97 666	4	23
38	9.50 449	37	9.52 787	42	0.47 213	9.97 662	5	22
39	9.50 486	37	9.52 829	41	0.47 171	9.97 657	4	21
40	9.50 523	38	9.52 870	42	0.47 130	9.97 653	4	**20**
41	9.50 561	37	9.52 912	41	0.47 088	9.97 649	4	19
42	9.50 598	37	9.52 953	42	0.47 047	9.97 645	5	18
43	9.50 635	38	9.52 995	42	0.47 005	9.97 640	4	17
44	9.50 673	37	9.53 037	41	0.46 963	9.97 636	4	16
45	9.50 710	37	9.53 078	42	0.46 922	9.97 632	4	15
46	9.50 747	37	9.53 120	41	0.46 880	9.97 628	5	14
47	9.50 784	37	9 53 161	41	0.46 839	9.97 623	4	13
48	9.50 821	37	9.53 202	42	0.46 798	9.97 619	4	12
49	9.50 858	38	9.53 244	41	0.46 756	9.97 615	5	11
50	9.50 896	37	9.53 285	42	0.46 715	9.97 610	4	**10**
51	9.50 933	37	9.53 327	41	0.46 673	9.97 606	4	9
52	9.50 970	37	9.53 368	41	0.46 632	9.97 602	5	8
53	9.51 007	36	9.53 409	41	0.46 591	9.97 597	4	7
54	9.51 043	37	9.53 450	42	0.46 550	9.97 593	4	6
55	9.51 080	37	9.53 492	41	0.46 508	9.97 589	5	5
56	9.51 117	37	9.53 533	41	0.46 467	9.97 584	4	4
57	9.51 154	37	9.53 574	41	0.46 426	9.97 580	4	3
58	9.51 191	36	9.53 615	41	0.46 385	9.97 576	5	2
59	9.51 227	37	9.53 656	41	0.46 344	9.97 571	4	1
60	9.51 264		9.53 697		0.46 303	9.97 567		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d	′

P. P.			
″	**43**	**42**	**41**
1	0.7	0.7	0.7
2	1.4	1.4	1.4
3	2.2	2.1	2.0
4	2.9	2.8	2.7
5	3.6	3.5	3.4
6	4.3	4.2	4.1
7	5.0	4.9	4.8
8	5.7	5.6	5.5
9	6.4	6.3	6.2
10	7.2	7.0	6.8
20	14.3	14.0	13.7
30	21.5	21.0	20.5
40	28.7	28.0	27.3
50	35.8	35.0	34.2
″	**39**	**38**	**37**
1	0.6	0.6	0.6
2	1.3	1.3	1.2
3	2.0	1.9	1.8
4	2.6	2.5	2.5
5	3.2	3.2	3.1
6	3.9	3.8	3.7
7	4.6	4.4	4.3
8	5.2	5.1	4.9
9	5.8	5.7	5.6
10	6.5	6.3	6.2
20	13.0	12.7	12.3
30	19.5	19.0	18.5
40	26.0	25.3	24.7
50	32.5	31.7	30.8
″	**36**	**5**	**4**
1	0.6	0.1	0.1
2	1.2	0.2	0.1
3	1 8	0.2	0.2
4	2.4	0.3	0.3
5	3.0	0.4	0.3
6	3.6	0.5	0.4
7	4.2	0.6	0.5
8	4.8	0.7	0.5
9	5.4	0.8	0.6
10	6.0	0.8	0.7
20	12.0	1.7	1.3
30	18.0	2.5	2.0
40	24.0	3.3	2.7
50	30.0	4.2	3.3
	5/43	**5/42**	**5/41**
0	4.3	4.2	4.1
1	12.9	12.6	12.3
2	21.5	21.0	20.5
3	30.1	29.4	28.7
4	38.7	37.8	36.9
5			
	4/43	**4/42**	**4/41**
0	5.4	5.2	5.1
1	16.1	15.8	15.4
2	26.9	26.2	25.6
3	37.6	36.8	35.9
4			
P. P.			

108° (288°) (251°) **71°**

19° (199°) (340°) **160°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.51 264	37	9.53 697	41	0.46 303	9.97 567	4	60
1	9.51 301	37	9.53 738	41	0.46 262	9.97 563	5	59
2	9.51 338	36	9.53 779	41	0.46 221	9.97 558	4	58
3	9.51 374	37	9.53 820	41	0.46 180	9.97 554	4	57
4	9.51 411	36	9.53 861	41	0.46 139	9.97 550	5	56
5	9.51 447	37	9.53 902	41	0.46 098	9.97 545	4	55
6	9.51 484	36	9.53 943	41	0.46 057	9.97 541	5	54
7	9.51 520	37	9.53 984	41	0.46 016	9.97 536	4	53
8	9.51 557	36	9.54 025	40	0.45 975	9.97 532	4	52
9	9.51 593	36	9.54 065	41	0.45 935	9.97 528	5	51
10	9.51 629	37	9.54 106	41	0.45 894	9.97 523	4	50
11	9.51 666	36	9.54 147	40	0.45 853	9.97 519	4	49
12	9.51 702	36	9.54 187	41	0.45 813	9.97 515	5	48
13	9.51 738	36	9.54 228	41	0.45 772	9.97 510	4	47
14	9.51 774	37	9.54 269	40	0.45 731	9.97 506	5	46
15	9.51 811	36	9.54 309	41	0.45 691	9.97 501	4	45
16	9.51 847	36	9.54 350	40	0.45 650	9.97 497	5	44
17	9.51 883	36	9.54 390	41	0.45 610	9.97 492	4	43
18	9.51 919	36	9.54 431	40	0.45 569	9.97 488	4	42
19	9.51 955	36	9.54 471	41	0.45 529	9.97 484	5	41
20	9.51 991	36	9.54 512	40	0.45 488	9.97 479	4	40
21	9.52 027	36	9.54 552	41	0.45 448	9.97 475	5	39
22	9.52 063	36	9.54 593	40	0.45 407	9.97 470	4	38
23	9.52 099	36	9.54 633	40	0.45 367	9.97 466	5	37
24	9.52 135	36	9.54 673	41	0.45 327	9.97 461	4	36
25	9.52 171	36	9.54 714	40	0.45 286	9.97 457	4	35
26	9.52 207	35	9.54 754	40	0.45 246	9.97 453	5	34
27	9.52 242	36	9.54 794	41	0.45 206	9.97 448	4	33
28	9.52 278	36	9.54 835	40	0.45 165	9.97 444	5	32
29	9.52 314	36	9 54 875	40	0.45 125	9.97 439	4	31
30	9.52 350	35	9.54 915	40	0.45 085	9.97 435	5	30
31	9.52 385	36	9.54 955	40	0.45 045	9.97 430	4	29
32	9.52 421	35	9.54 995	40	0.45 005	9.97 426	5	28
33	9.52 456	36	9.55 035	40	0.44 965	9.97 421	4	27
34	9.52 492	35	9.55 075	40	0.44 925	9.97 417	5	26
35	9.52 527	36	9.55 115	40	0.44 885	9.97 412	4	25
36	9.52 563	35	9.55 155	40	0.44 845	9.97 408	5	24
37	9.52 598	36	9.55 195	40	0.44 805	9.97 403	4	23
38	9.52 634	35	9.55 235	40	0.44 765	9.97 399	5	22
39	9.52 669	36	9.55 275	40	0.44 725	9.97 394	4	21
40	9.52 705	35	9.55 315	40	0.44 685	9.97 390	5	20
41	9.52 740	35	9.55 355	40	0.44 645	9.97 385	4	19
42	9.52 775	36	9.55 395	39	0.44 605	9.97 381	5	18
43	9.52 811	35	9.55 434	40	0.44 566	9.97 376	4	17
44	9.52 846	35	9.55 474	40	0.44 526	9.97 372	5	16
45	9.52 881	35	9.55 514	40	0.44 486	9.97 367	4	15
46	9.52 916	35	9.55 554	39	0.44 446	9.97 363	5	14
47	9.52 951	35	9.55 593	40	0.44 407	9.97 358	5	13
48	9.52 986	35	9.55 633	40	0.44 367	9.97 353	4	12
49	9.53 021	35	9.55 673	39	0.44 327	9.97 349	5	11
50	9.53 056	36	9.55 712	40	0.44 288	9.97 344	4	10
51	9.53 092	34	9.55 752	39	0.44 248	9.97 340	5	9
52	9.53 126	35	9.55 791	40	0.44 209	9.97 335	4	8
53	9.53 161	35	9.55 831	39	0.44 169	9.97 331	5	7
54	9.53 196	35	9.55 870	40	0.44 130	9.97 326	4	6
55	9.53 231	35	9.55 910	39	0.44 090	9.97 322	5	5
56	9 53 266	35	9.55 949	40	0.44 051	9.97 317	5	4
57	9.53 301	35	9.55 989	39	0.44 011	9.97 312	4	3
58	9.53 336	34	9.56 028	39	0.43 972	9.97 308	5	2
59	9.53 370	35	9.56 067	40	0.43 933	9.97 303	4	1
60	9.53 405		9.56 107		0.43 893	9.97 299		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	41	40	39
1	0.7	0.7	0.6
2	1.4	1.3	1.3
3	2.0	2.0	2.0
4	2.7	2.7	2.6
5	3.4	3.3	3.2
6	4.1	4.0	3.9
7	4.8	4.7	4.6
8	5.5	5.3	5.2
9	6.2	6.0	5.8
10	6.8	6.7	6.5
20	13.7	13.3	13.0
30	20.5	20.0	19.5
40	27.3	26.7	26.0
50	34.2	33.3	32.5
″	**37**	**36**	**35**
1	0.6	0.6	0.6
2	1.2	1.2	1.2
3	1.8	1.8	1.8
4	2.5	2.4	2.3
5	3.1	3.0	2.9
6	3.7	3.6	3.5
7	4.3	4.2	4.1
8	4.9	4.8	4.7
9	5.6	5.4	5.2
10	6.2	6.0	5.8
20	12.3	12.0	11.7
30	18.5	18.0	17.5
40	24.7	24.0	23.3
50	30.8	30.0	29.2
″	**34**	**5**	**4**
1	0.6	0.1	0.1
2	1.1	0.2	0.1
3	1.7	0.2	0.2
4	2.3	0.3	0.3
5	2.8	0.4	0.3
6	3.4	0.5	0.4
7	4.0	0.6	0.5
8	4.5	0.7	0.5
9	5.1	0.8	0.6
10	5.7	0.8	0.7
20	11.3	1.7	1.3
30	17.0	2.5	2.0
40	22.7	3.3	2.7
50	28.3	4.2	3.3

	$\frac{5}{41}$	$\frac{5}{40}$	$\frac{5}{39}$
0	4.1	4.0	3.9
1	12.3	12.0	11.7
2	20.5	20.0	19.5
3	28.7	28.0	27.3
4	36.9	36.0	35.1
5			

	$\frac{4}{41}$	$\frac{4}{40}$	$\frac{4}{39}$
0	5.1	5.0	4.9
1	15.4	15.0	14.6
2	25.6	25.0	24.4
3	35.9	35.0	34.1
4			

P. P.

109° (289°) (250°) **70°**

20° (200°) (339°) **159°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.53 405	35	9.56 107	39	0.43 893	9.97 299	5	**60**
1	9.53 440	35	9.56 146	39	0.43 854	9.97 294	5	59
2	9.53 475	34	9.56 185	39	0.43 815	9.97 289	4	58
3	9.53 509	35	9.56 224	40	0.43 776	9.97 285	5	57
4	9.53 544	34	9.56 264	39	0.43 736	9.97 280	4	56
5	9.53 578	35	9.56 303	39	0.43 697	9.97 276	5	55
6	9.53 613	34	9.56 342	39	0.43 658	9.97 271	5	54
7	9.53 647	35	9.56 381	39	0.43 619	9.97 266	4	53
8	9.53 682	34	9.56 420	39	0.43 580	9.97 262	5	52
9	9.53 716	35	9.56 459	39	0.43 541	9.97 257	5	51
10	9.53 751	34	9.56 498	39	0.43 502	9.97 252	4	**50**
11	9.53 785	34	9.56 537	39	0.43 463	9.97 248	5	49
12	9.53 819	35	9.56 576	39	0.43 424	9.97 243	5	48
13	9.53 854	34	9.56 615	39	0.43 385	9.97 238	4	47
14	9.53 888	34	9.56 654	39	0.43 346	9.97 234	5	46
15	9.53 922	35	9.56 693	39	0.43 307	9.97 229	5	45
16	9.53 957	34	9.56 732	39	0.43 268	9.97 224	4	44
17	9.53 991	34	9.56 771	39	0.43 229	9.97 220	5	43
18	9.54 025	34	9.56 810	39	0.43 190	9.97 215	5	42
19	9.54 059	34	9.56 849	38	0.43 151	9.97 210	4	41
20	9.54 093	34	9.56 887	39	0.43 113	9.97 206	5	**40**
21	9.54 127	34	9.56 926	39	0.43 074	9.97 201	5	39
22	9.54 161	34	9.56 965	39	0.43 035	9.97 196	4	38
23	9.54 195	34	9.57 004	38	0.42 996	9.97 192	5	37
24	9.54 229	34	9.57 042	39	0.42 958	9.97 187	5	36
25	9.54 263	34	9.57 081	39	0.42 919	9.97 182	4	35
26	9.54 297	34	9.57 120	38	0.42 880	9.97 178	5	34
27	9.54 331	34	9.57 158	39	0.42 842	9.97 173	5	33
28	9.54 365	34	9.57 197	38	0.42 803	9.97 168	5	32
29	9.54 399	34	9.57 235	39	0.42 765	9.97 163	4	31
30	9.54 433	33	9.57 274	38	0.42 726	9.97 159	5	**30**
31	9.54 466	34	9.57 312	39	0.42 688	9.97 154	5	29
32	9.54 500	34	9.57 351	38	0.42 649	9.97 149	4	28
33	9.54 534	33	9.57 389	39	0.42 611	9.97 145	5	27
34	9.54 567	34	9.57 428	38	0.42 572	9.97 140	5	26
35	9.54 601	34	9.57 466	38	0.42 534	9.97 135	5	25
36	9.54 635	33	9.57 504	39	0.42 496	9.97 130	4	24
37	9.54 668	34	9.57 543	38	0.42 457	9.97 126	5	23
38	9.54 702	33	9.57 581	38	0.42 419	9.97 121	5	22
39	9.54 735	34	9.57 619	39	0.42 381	9.97 116	5	21
40	9.54 769	33	9.57 658	38	0.42 342	9.97 111	4	**20**
41	9.54 802	34	9.57 696	38	0.42 304	9.97 107	5	19
42	9.54 836	33	9.57 734	38	0.42 266	9.97 102	5	18
43	9.54 869	34	9.57 772	38	0.42 228	9.97 097	5	17
44	9.54 903	33	9.57 810	39	0.42 190	9.97 092	5	16
45	9.54 936	33	9.57 849	38	0.42 151	9.97 087	4	15
46	9.54 969	34	9.57 887	38	0.42 113	9.97 083	5	14
47	9.55 003	33	9.57 925	38	0.42 075	9.97 078	5	13
48	9.55 036	33	9.57 963	38	0.42 037	9.97 073	5	12
49	9.55 069	33	9.58 001	38	0.41 999	9.97 068	5	11
50	9.55 102	34	9.58 039	38	0.41 961	9.97 063	4	**10**
51	9.55 136	33	9.58 077	38	0.41 923	9.97 059	5	9
52	9.55 169	33	9.58 115	38	0.41 885	9.97 054	5	8
53	9.55 202	33	9.58 153	38	0.41 847	9.97 049	5	7
54	9.55 235	33	9.58 191	38	0.41 809	9.97 044	5	6
55	9.55 268	33	9.58 229	38	0.41 771	9.97 039	4	5
56	9.55 301	33	9.58 267	37	0.41 733	9.97 035	5	4
57	9.55 334	33	9.58 304	38	0.41 696	9.97 030	5	3
58	9.55 367	33	9.58 342	38	0.41 658	9.97 025	5	2
59	9.55 400	33	9.58 380	38	0.41 620	9.97 020	5	1
60	9.55 433		9.58 418		0.41 582	9.97 015		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**40**	**39**	**38**
1	0.7	0.6	0.6
2	1.3	1.3	1.3
3	2.0	2.0	1.9
4	2.7	2.6	2.5
5	3.3	3.2	3.2
6	4.0	3.9	3.8
7	4.7	4.6	4.4
8	5.3	5.2	5.1
9	6.0	5.8	5.7
10	6.7	6.5	6.3
20	13.3	13.0	12.7
30	20.0	19.5	19.0
40	26.7	26.0	25.3
50	33.3	32.5	31.7
″	**37**	**35**	**34**
1	0.6	0.6	0.6
2	1.2	1.2	1.1
3	1.8	1.8	1.7
4	2.5	2.3	2.3
5	3.1	2.9	2.8
6	3.7	3.5	3.4
7	4.3	4.1	4.0
8	4.9	4.7	4.5
9	5.6	5.2	5.1
10	6.2	5.8	5.7
20	12.3	11.7	11.3
30	18.5	17.5	17.0
40	24.7	23.3	22.7
50	30.8	29.2	28.3
″	**33**	**5**	**4**
1	0.6	0.1	0.1
2	1.1	0.2	0.1
3	1.6	0.2	0.2
4	2.2	0.3	0.3
5	2.8	0.4	0.3
6	3.3	0.5	0.4
7	3.8	0.6	0.5
8	4.4	0.7	0.5
9	5.0	0.8	0.6
10	5.5	0.8	0.7
20	11.0	1.7	1.3
30	16.5	2.5	2.0
40	22.0	3.3	2.7
50	27.5	4.2	3.3

	5/40	**5/39**	**5/38**
0	4.0	3.9	3.8
1	12.0	11.7	11.4
2	20.0	19.5	19.0
3	28.0	27.3	26.6
4	36.0	35.1	34.2
5			
	5/37	**4/39**	**4/38**
0	3.7	4.9	4.8
1	11.1	14.6	14.2
2	18.5	24.4	23.8
3	25.9	34.1	33.2
4	33.3	—	—
5			

P.P.

110° (290°) (249°) **69°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.55 433		9.58 418		0.41 582	9.97 015		**60**
1	9.55 466	33	9.58 455	37	0.41 545	9.97 010	5	59
2	9.55 499	33	9.58 493	38	0.41 507	9.97 005	5	58
3	9.55 532	33	9.58 531	38	0.41 469	9.97 001	4	57
4	9.55 564	32	9.58 569	38	0.41 431	9.96 996	5	56
5	9.55 597	33	9.58 606	37	0.41 394	9.96 991	5	55
6	9.55 630	33	9.58 644	38	0.41 356	9.96 986	5	54
7	9.55 663	33	9.58 681	37	0.41 319	9.96 981	5	53
8	9.55 695	32	9.58 719	38	0.41 281	9.96 976	5	52
9	9.55 728	33	9.58 757	38	0.41 243	9.96 971	5	51
10	9.55 761	33	9.58 794	37	0.41 206	9.96 966	5	**50**
11	9.55 793	32	9.58 832	38	0.41 168	9.96 962	4	49
12	9.55 826	33	9.58 869	37	0.41 131	9.96 957	5	48
13	9.55 858	32	9.58 907	38	0.41 093	9.96 952	5	47
14	9.55 891	33	9.58 944	37	0.41 056	9.96 947	5	46
15	9.55 923	32	9.58 981	37	0.41 019	9.96 942	5	45
16	9.55 956	33	9.59 019	38	0.40 981	9.96 937	5	44
17	9.55 988	32	9.59 056	37	0.40 944	9.96 932	5	43
18	9.56 021	33	9.59 094	38	0.40 906	9.96 927	5	42
19	9.56 053	32	9.59 131	37	0.40 869	9.96 922	5	41
20	9.56 085	32	9.59 168	37	0.40 832	9.96 917	5	**40**
21	9.56 118	33	9.59 205	37	0.40 795	9.96 912	5	39
22	9.56 150	32	9.59 243	38	0.40 757	9.96 907	5	38
23	9.56 182	32	9.59 280	37	0.40 720	9.96 903	4	37
24	9.56 215	33	9.59 317	37	0.40 683	9.96 898	5	36
25	9.56 247	32	9.59 354	37	0.40 646	9.96 893	5	35
26	9.56 279	32	9.59 391	37	0.40 609	9.96 888	5	34
27	9.56 311	32	9.59 429	38	0.40 571	9.96 883	5	33
28	9.56 343	32	9.59 466	37	0.40 534	9.96 878	5	32
29	9.56 375	32	9.59 503	37	0.40 497	9.96 873	5	31
30	9.56 408	33	9.59 540	37	0.40 460	9.96 868	5	**30**
31	9.56 440	32	9.59 577	37	0.40 423	9.96 863	5	29
32	9.56 472	32	9.59 614	37	0.40 386	9.96 858	5	28
33	9.56 504	32	9.59 651	37	0.40 349	9.96 853	5	27
34	9.56 536	32	9.59 688	37	0.40 312	9.96 848	5	26
35	9.56 568	32	9.59 725	37	0.40 275	9.96 843	5	25
36	9.56 599	31	9.59 762	37	0.40 238	9.96 838	5	24
37	9.56 631	32	9.59 799	37	0.40 201	9.96 833	5	23
38	9.56 663	32	9.59 835	36	0.40 165	9.96 828	5	22
39	9.56 695	32	9.59 872	37	0.40 128	9.96 823	5	21
40	9.56 727	32	9.59 909	37	0.40 091	9.96 818	5	**20**
41	9.56 759	32	9.59 946	37	0.40 054	9.96 813	5	19
42	9.56 790	31	9.59 983	37	0.40 017	9.96 808	5	18
43	9.56 822	32	9.60 019	36	0.39 981	9.96 803	5	17
44	9.56 854	32	9.60 056	37	0.39 944	9.96 798	5	16
45	9.56 886	32	9.60 093	37	0.39 907	9.96 793	5	15
46	9.56 917	31	9.60 130	37	0.39 870	9.96 788	5	14
47	9.56 949	32	9.60 166	36	0.39 834	9.96 783	5	13
48	9.56 980	31	9.60 203	37	0.39 797	9.96 778	5	12
49	9.57 012	32	9.60 240	37	0.39 760	9.96 772	6	11
50	9.57 044	32	9.60 276	36	0.39 724	9.96 767	5	**10**
51	9.57 075	31	9.60 313	37	0.39 687	9.96 762	5	9
52	9.57 107	32	9.60 349	36	0.39 651	9.96 757	5	8
53	9.57 138	31	9.60 386	37	0.39 614	9.96 752	5	7
54	9.57 169	31	9.60 422	36	0.39 578	9.96 747	5	6
55	9.57 201	32	9.60 459	37	0.39 541	9.96 742	5	5
56	9.57 232	31	9.60 495	36	0.39 505	9.96 737	5	4
57	9.57 264	32	9.60 532	37	0.39 468	9.96 732	5	3
58	9.57 295	31	9.60 568	36	0.39 432	9.96 727	5	2
59	9.57 326	31	9.60 605	37	0.39 395	9.96 722	5	1
60	9.57 358	32	9.60 641	36	0.39 359	9.96 717	5	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**38**	**37**	**36**
1	0.6	0.6	0.6
2	1.3	1.2	1.2
3	1.9	1.8	1.8
4	2.5	2.5	2.4
5	3.2	3.1	3.0
6	3.8	3.7	3.6
7	4.4	4.3	4.2
8	5.1	4.9	4.8
9	5.7	5.6	5.4
10	6.3	6.2	6.0
20	12.7	12.3	12.0
30	19.0	18.5	18.0
40	25.3	24.7	24.0
50	31.7	30.8	30.0

″	**33**	**32**	**31**
1	0.6	0.5	0.5
2	1.1	1.1	1.0
3	1.6	1.6	1.6
4	2.2	2.1	2.1
5	2.8	2.7	2.6
6	3.3	3.2	3.1
7	3.8	3.7	3.6
8	4.4	4.3	4.1
9	5.0	4.8	4.6
10	5.5	5.3	5.2
20	11.0	10.7	10.3
30	16.5	16.0	15.5
40	22.0	21.3	20.7
50	27.5	26.7	25.8

″	**6**	**5**	**4**
1	0.1	0.1	0.1
2	0.2	0.2	0.1
3	0.3	0.2	0.2
4	0.4	0.3	0.3
5	0.5	0.4	0.3
6	0.6	0.5	0.4
7	0.7	0.6	0.5
8	0.8	0.7	0.5
9	0.9	0.8	0.6
10	1.0	0.8	0.7
20	2.0	1.7	1.3
30	3.0	2.5	2.0
40	4.0	3.3	2.7
50	5.0	4.2	3.3

	6/37	**5/38**	**5/37**
0	3.1	3.8	3.7
1	9.2	11.4	11.1
2	15.4	19.0	18.5
3	21.6	26.6	25.9
4	27.8	34.2	33.3
5	33.9	—	—
6			

	5/36	**4/38**	**4/37**
0	3.6	4.8	4.6
1	10.8	14.2	13.9
2	18.0	23.8	23.1
3	25.2	33.2	32.4
4	32.4	—	—
5			

P.P.

22° (202°) (337°) **157°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.57 358	31	9.60 641	36	0.39 359	9.96 717	6	**60**
1	9.57 389	31	9.60 677	37	0.39 323	9.96 711	5	59
2	9.57 420	31	9.60 714	36	0.39 286	9.96 706	5	58
3	9.57 451	31	9.60 750	36	0.39 250	9.96 701	5	57
4	9.57 482	32	9.60 786	37	0.39 214	9.96 696	5	56
5	9.57 514	31	9.60 823	36	0.39 177	9.96 691	5	55
6	9.57 545	31	9.60 859	36	0.39 141	9.96 686	5	54
7	9.57 576	31	9.60 895	36	0.39 105	9.96 681	5	53
8	9.57 607	31	9.60 931	36	0.39 069	9.96 676	6	52
9	9.57 638	31	9.60 967	37	0.39 033	9.96 670	5	51
10	9.57 669	31	9.61 004	36	0.38 996	9.96 665	5	**50**
11	9.57 700	31	9.61 040	36	0.38 960	9.96 660	5	49
12	9.57 731	31	9.61 076	36	0.38 924	9.96 655	5	48
13	9.57 762	31	9.61 112	36	0.38 888	9.96 650	5	47
14	9.57 793	31	9.61 148	36	0.38 852	9.96 645	5	46
15	9.57 824	31	9.61 184	36	0.38 816	9.96 640	6	45
16	9.57 855	30	9.61 220	36	0.38 780	9.96 634	5	44
17	9.57 885	31	9.61 256	36	0.38 744	9.96 629	5	43
18	9.57 916	31	9.61 292	36	0.38 708	9.96 624	5	42
19	9.57 947	31	9.61 328	36	0.38 672	9.96 619	5	41
20	9.57 978	30	9.61 364	36	0.38 636	9.96 614	6	**40**
21	9.58 008	31	9.61 400	36	0.38 600	9.96 608	5	39
22	9.58 039	31	9.61 436	36	0.38 564	9.96 603	5	38
23	9.58 070	31	9.61 472	36	0.38 528	9.96 598	5	37
24	9.58 101	30	9.61 508	36	0.38 492	9.96 593	5	36
25	9.58 131	31	9.61 544	35	0.38 456	9.96 588	6	35
26	9.58 162	30	9.61 579	36	0.38 421	9.96 582	5	34
27	9.58 192	31	9.61 615	36	0.38 385	9.96 577	5	33
28	9.58 223	30	9.61 651	36	0.38 349	9.96 572	5	32
29	9.58 253	31	9.61 687	35	0.38 313	9.96 567	5	31
30	9.58 284	30	9.61 722	36	0.38 278	9.96 562	6	**30**
31	9.58 314	31	9.61 758	36	0.38 242	9.96 556	5	29
32	9.58 345	30	9.61 794	36	0.38 206	9.96 551	5	28
33	9.58 375	31	9.61 830	35	0.38 170	9.96 546	5	27
34	9.58 406	30	9.61 865	36	0.38 135	9.96 541	6	26
35	9.58 436	31	9.61 901	35	0.38 099	9.96 535	5	25
36	9.58 467	30	9.61 936	36	0.38 064	9.96 530	5	24
37	9.58 497	30	9.61 972	36	0.38 028	9.96 525	5	23
38	9.58 527	30	9.62 008	35	0.37 992	9.96 520	6	22
39	9.58 557	31	9.62 043	36	0.37 957	9.96 514	5	21
40	9.58 588	30	9.62 079	35	0.37 921	9.96 509	5	**20**
41	9.58 618	30	9.62 114	36	0.37 886	9.96 504	6	19
42	9.58 648	30	9.62 150	35	0.37 850	9.96 498	5	18
43	9.58 678	31	9.62 185	36	0.37 815	9.96 493	5	17
44	9.58 709	30	9.62 221	35	0.37 779	9.96 488	5	16
45	9.58 739	30	9.62 256	36	0.37 744	9.96 483	6	15
46	9.58 769	30	9.62 292	35	0.37 708	9.96 477	5	14
47	9.58 799	30	9.62 327	35	0.37 673	9.96 472	5	13
48	9.58 829	30	9.62 362	36	0.37 638	9.96 467	6	12
49	9.58 859	30	9.62 398	35	0.37 602	9.96 461	5	11
50	9.58 889	30	9.62 433	35	0.37 567	9.96 456	5	**10**
51	9.58 919	30	9.62 468	36	0.37 532	9.96 451	6	9
52	9.58 949	30	9.62 504	35	0.37 496	9.96 445	5	8
53	9.58 979	30	9.62 539	35	0.37 461	9.96 440	5	7
54	9.59 009	30	9.62 574	35	0.37 426	9.96 435	6	6
55	9.59 039	30	9.62 609	36	0.37 391	9.96 429	5	5
56	9.59 069	29	9.62 645	35	0.37 355	9.96 424	5	4
57	9.59 098	30	9.62 680	35	0.37 320	9.96 419	6	3
58	9.59 128	30	9.62 715	35	0.37 285	9.96 413	5	2
59	9.59 158	30	9.62 750	35	0.37 250	9.96 408	5	1
60	9.59 188		9.62 785		0.37 215	9.96 403		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	37	36	35
1	0.6	0.6	0.6
2	1.2	1.2	1.2
3	1.8	1.8	1.8
4	2.5	2.4	2.3
5	3.1	3.0	2.9
6	3.7	3.6	3.5
7	4.3	4.2	4.1
8	4.9	4.8	4.7
9	5.6	5.4	5.2
10	6.2	6.0	5.8
20	12.3	12.0	11.7
30	18.5	18.0	17.5
40	24.7	24.0	23.3
50	30.8	30.0	29.2

″	32	31	30
1	0.5	0.5	0.5
2	1.1	1.0	1.0
3	1.6	1.6	1.5
4	2.1	2.1	2.0
5	2.7	2.6	2.5
6	3.2	3.1	3.0
7	3.7	3.6	3.5
8	4.3	4.1	4.0
9	4.8	4.6	4.5
10	5.3	5.2	5.0
20	10.7	10.3	10.0
30	16.0	15.5	15.0
40	21.3	20.7	20.0
50	26.7	25.8	25.0

″	29	6	5
1	0.5	0.1	0.1
2	1.0	0.2	0.2
3	1.4	0.3	0.2
4	1.9	0.4	0.3
5	2.4	0.5	0.4
6	2.9	0.6	0.5
7	3.4	0.7	0.6
8	3.9	0.8	0.7
9	4.4	0.9	0.8
10	4.8	1.0	0.8
20	9.7	2.0	1.7
30	14.5	3.0	2.5
40	19.3	4.0	3.3
50	24.2	5.0	4.2

	6/36	6/35
0		
1	3.0	2.9
2	9.0	8.8
3	15.0	14.6
4	21.0	20.4
5	27.0	26.2
6	33.0	32.1

	5/37	5/36	5/35
0			
1	3.7	3.6	3.5
2	11.1	10.8	10.5
3	18.5	18.0	17.5
4	25.9	25.2	24.5
5	33.3	32.4	31.5

P. P.

112° (292°) (247°) **67**

23° (203°) (336°) **156°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.59 188	30	9.62 785	35	0.37 215	9.96 403	6	60
1	9.59 218	29	9.62 820	35	0.37 180	9.96 397	5	59
2	9.59 247	30	9.62 855	35	0.37 145	9.96 392	5	58
3	9.59 277	30	9.62 890	36	0.37 110	9.96 387	6	57
4	9.59 307	29	9.62 926	35	0.37 074	9.96 381	5	56
5	9.59 336	30	9.62 961	35	0.37 039	9.96 376	6	55
6	9.59 366	30	9.62 996	35	0.37 004	9.96 370	5	54
7	9.59 396	29	9.63 031	35	0.36 969	9.96 365	5	53
8	9.59 425	30	9.63 066	35	0.36 934	9.96 360	6	52
9	9.59 455	29	9.63 101	34	0.36 899	9.96 354	5	51
10	9.59 484	30	9.63 135	35	0.36 865	9.96 349	6	50
11	9.59 514	29	9.63 170	35	0.36 830	9.96 343	5	49
12	9.59 543	30	9.63 205	35	0.36 795	9.96 338	5	48
13	9.59 573	29	9.63 240	35	0.36 760	9.96 333	6	47
14	9.59 602	30	9.63 275	35	0.36 725	9.96 327	5	46
15	9.59 632	29	9.63 310	35	0.36 690	9.96 322	6	45
16	9.59 661	29	9.63 345	34	0.36 655	9.96 316	5	44
17	9.59 690	30	9.63 379	35	0.36 621	9.96 311	6	43
18	9.59 720	29	9.63 414	35	0.36 586	9.96 305	5	42
19	9.59 749	29	9.63 449	35	0.36 551	9.96 300	6	41
20	9.59 778	30	9.63 484	35	0.36 516	9.96 294	5	40
21	9.59 808	29	9.63 519	34	0.36 481	9.96 289	5	39
22	9.59 837	29	9.63 553	35	0.36 447	9.96 284	6	38
23	9.59 866	29	9.63 588	35	0.36 412	9.96 278	5	37
24	9.59 895	29	9.63 623	34	0.36 377	9.96 273	6	36
25	9.59 924	30	9.63 657	35	0.36 343	9.96 267	5	35
26	9.59 954	29	9.63 692	34	0.36 308	9.96 262	6	34
27	9.59 983	29	9.63 726	35	0.36 274	9.96 256	5	33
28	9.60 012	29	9.63 761	35	0.36 239	9.96 251	6	32
29	9.60 041	29	9.63 796	34	0.36 204	9.96 245	5	31
30	9.60 070	29	9.63 830	35	0.36 170	9.96 240	6	30
31	9.60 099	29	9.63 865	34	0.36 135	9.96 234	5	29
32	9.60 128	29	9.63 899	35	0.36 101	9.96 229	6	28
33	9.60 157	29	9.63 934	34	0.36 066	9.96 223	5	27
34	9.60 186	29	9.63 968	35	0.36 032	9.96 218	6	26
35	9.60 215	29	9.64 003	34	0.35 997	9.96 212	5	25
36	9.60 244	29	9.64 037	35	0.35 963	9.96 207	6	24
37	9.60 273	29	9.64 072	34	0.35 928	9.96 201	5	23
38	9.60 302	29	9.64 106	34	0.35 894	9.96 196	6	22
39	9.60 331	28	9.64 140	35	0.35 860	9.96 190	5	21
40	9.60 359	29	9.64 175	34	0.35 825	9.96 185	6	20
41	9.60 388	29	9.64 209	34	0.35 791	9.96 179	5	19
42	9.60 417	29	9.64 243	35	0.35 757	9.96 174	6	18
43	9.60 446	28	9.64 278	34	0.35 722	9.96 168	6	17
44	9.60 474	29	9.64 312	34	0.35 688	9.96 162	5	16
45	9.60 503	29	9.64 346	35	0.35 654	9.96 157	6	15
46	9.60 532	29	9.64 381	34	0.35 619	9.96 151	5	14
47	9.60 561	28	9.64 415	34	0.35 585	9.96 146	6	13
48	9.60 589	29	9.64 449	34	0.35 551	9.96 140	5	12
49	9.60 618	28	9.64 483	34	0.35 517	9.96 135	6	11
50	9.60 646	29	9.64 517	35	0.35 483	9.96 129	6	10
51	9.60 675	29	9.64 552	34	0.35 448	9.96 123	5	9
52	9.60 704	28	9.64 586	34	0.35 414	9.96 118	6	8
53	9.60 732	29	9.64 620	34	0.35 380	9.96 112	5	7
54	9.60 761	28	9.64 654	34	0.35 346	9.96 107	6	6
55	9.60 789	29	9.64 688	34	0.35 312	9.96 101	6	5
56	9.60 818	28	9.64 722	34	0.35 278	9.96 095	5	4
57	9.60 846	29	9.64 756	34	0.35 244	9.96 090	6	3
58	9.60 875	28	9.64 790	34	0.35 210	9.96 084	5	2
59	9.60 903	28	9.64 824	34	0.35 176	9.96 079	6	1
60	9.60 931		9.64 858		0.35 142	9.96 073		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	36	35	34
1	0.6	0.6	0.6
2	1.2	1.2	1.1
3	1.8	1.8	1.7
4	2.4	2.3	2.3
5	3.0	2.9	2.8
6	3.6	3.5	3.4
7	4.2	4.1	4.0
8	4.8	4.7	4.5
9	5.4	5.2	5.1
10	6.0	5.8	5.7
20	12.0	11.7	11.3
30	18.0	17.5	17.0
40	24.0	23.3	22.7
50	30.0	29.2	28.3

″	30	29	28
1	0.5	0.5	0.5
2	1.0	1.0	0.9
3	1.5	1.4	1.4
4	2.0	1.9	1.9
5	2.5	2.4	2.3
6	3.0	2.9	2.8
7	3.5	3.4	3.3
8	4.0	3.9	3.7
9	4.5	4.4	4.2
10	5.0	4.8	4.7
20	10.0	9.7	9.3
30	15.0	14.5	14.0
40	20.0	19.3	18.7
50	25.0	24.2	23.3

″	6	5
1	0.1	0.1
2	0.2	0.2
3	0.3	0.2
4	0.4	0.3
5	0.5	0.4
6	0.6	0.5
7	0.7	0.6
8	0.8	0.7
9	0.9	0.8
10	1.0	0.8
20	2.0	1.7
30	3.0	2.5
40	4.0	3.3
50	5.0	4.2

	6/36	6/35	6/34
0	3.0	2.9	2.8
1	9.0	8.8	8.5
2	15.0	14.6	14.2
3	21.0	20.4	19.8
4	27.0	26.2	25.5
5	33.0	32.1	31.2
6			

	5/35	5/34
0	3.5	3.4
1	10.5	10.2
2	17.5	17.0
3	24.5	23.8
4	31.5	30.6
5		

P. P.

113° (293°) (246°) **66°**

24° (204°) (335°) **155°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.60 931	29	9.64 858	34	0.35 142	9.96 073	6	60
1	9.60 960	28	9.64 892	34	0.35 108	9.96 067	5	59
2	9.60 988	28	9.64 926	34	0.35 074	9.96 062	6	58
3	9.61 016	29	9.64 960	34	0.35 040	9.96 056	6	57
4	9.61 045	28	9.64 994	34	0.35 006	9.96 050	5	56
5	9.61 073	28	9.65 028	34	0.34 972	9.96 045	6	55
6	9.61 101	28	9.65 062	34	0.34 938	9.96 039	5	54
7	9.61 129	29	9.65 096	34	0.34 904	9.96 034	6	53
8	9.61 158	28	9.65 130	34	0.34 870	9.96 028	6	52
9	9.61 186	28	9.65 164	33	0.34 836	9.96 022	5	51
10	9.61 214	28	9.65 197	34	0.34 803	9.96 017	6	50
11	9.61 242	28	9.65 231	34	0.34 769	9.96 011	6	49
12	9.61 270	28	9.65 265	34	0.34 735	9.96 005	5	48
13	9.61 298	28	9.65 299	34	0.34 701	9.96 000	6	47
14	9.61 326	28	9.65 333	33	0.34 667	9.95 994	6	46
15	9.61 354	28	9.65 366	34	0.34 634	9.95 988	6	45
16	9.61 382	29	9.65 400	34	0.34 600	9.95 982	5	44
17	9.61 411	27	9.65 434	33	0.34 566	9.95 977	6	43
18	9.61 438	28	9.65 467	34	0.34 533	9.95 971	6	42
19	9.61 466	28	9.65 501	34	0.34 499	9.95 965	5	41
20	9.61 494	28	9.65 535	33	0.34 465	9.95 960	6	40
21	9.61 522	28	9.65 568	34	0.34 432	9.95 954	6	39
22	9.61 550	28	9.65 602	34	0.34 398	9.95 948	6	38
23	9.61 578	28	9.65 636	33	0.34 364	9.95 942	5	37
24	9.61 606	28	9.65 669	34	0.34 331	9.95 937	6	36
25	9.61 634	28	9.65 703	33	0.34 297	9.95 931	6	35
26	9.61 662	27	9.65 736	34	0.34 264	9.95 925	5	34
27	9.61 689	28	9.65 770	33	0.34 230	9.95 920	6	33
28	9.61 717	28	9.65 803	34	0.34 197	9.95 914	6	32
29	9.61 745	28	9.65 837	33	0.34 163	9.95 908	6	31
30	9.61 773	27	9.65 870	34	0.34 130	9.95 902	5	30
31	9.61 800	28	9.65 904	33	0.34 096	9.95 897	6	29
32	9.61 828	28	9.65 937	34	0.34 063	9.95 891	6	28
33	9.61 856	27	9.65 971	33	0.34 029	9.95 885	6	27
34	9.61 883	28	9.66 004	34	0.33 996	9.95 879	6	26
35	9.61 911	28	9.66 038	33	0.33 962	9.95 873	5	25
36	9.61 939	27	9.66 071	33	0.33 929	9.95 868	6	24
37	9.61 966	28	9.66 104	34	0.33 896	9.95 862	6	23
38	9.61 994	27	9.66 138	33	0.33 862	9.95 856	6	22
39	9.62 021	28	9.66 171	33	0.33 829	9.95 850	6	21
40	9.62 049	27	9.66 204	34	0.33 796	9.95 844	5	20
41	9.62 076	28	9.66 238	33	0.33 762	9.95 839	6	19
42	9.62 104	27	9.66 271	33	0.33 729	9.95 833	6	18
43	9.62 131	28	9.66 304	33	0.33 696	9.95 827	6	17
44	9.62 159	27	9.66 337	34	0.33 663	9.95 821	6	16
45	9.62 186	28	9.66 371	33	0.33 629	9.95 815	5	15
46	9.62 214	27	9.66 404	33	0.33 596	9.95 810	6	14
47	9.62 241	27	9.66 437	33	0.33 563	9.95 804	6	13
48	9.62 268	28	9.66 470	33	0.33 530	9.95 798	6	12
49	9.62 296	27	9.66 503	34	0.33 497	9.95 792	6	11
50	9.62 323	27	9.66 537	33	0.33 463	9.95 786	6	10
51	9.62 350	27	9.66 570	33	0.33 430	9.95 780	5	9
52	9.62 377	28	9.66 603	33	0.33 397	9.95 775	6	8
53	9.62 405	27	9.66 636	33	0.33 364	9.95 769	6	7
54	9.62 432	27	9.66 669	33	0.33 331	9.95 763	6	6
55	9.62 459	27	9.66 702	33	0.33 298	9.95 757	6	5
56	9.62 486	27	9.66 735	33	0.33 265	9.95 751	6	4
57	9.62 513	28	9.66 768	33	0.33 232	9.95 745	6	3
58	9.62 541	27	9.66 801	33	0.33 199	9.95 739	6	2
59	9.62 568	27	9.66 834	33	0.33 166	9.95 733	5	1
60	9.62 595		9.66 867		0.33 133	9.95 728		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	34	33
1	0.6	0.6
2	1.1	1.1
3	1.7	1.6
4	2.3	2.2
5	2.8	2.8
6	3.4	3.3
7	4.0	3.8
8	4.5	4.4
9	5.1	5.0
10	5.7	5.5
20	11.3	11.0
30	17.0	16.5
40	22.7	22.0
50	28.3	27.5

″	29	28	27
1	0.5	0.5	0.4
2	1.0	0.9	0.9
3	1.4	1.4	1.4
4	1.9	1.9	1.8
5	2.4	2.3	2.2
6	2.9	2.8	2.7
7	3.4	3.3	3.2
8	3.9	3.7	3.6
9	4.4	4.2	4.0
10	4.8	4.7	4.5
20	9.7	9.3	9.0
30	14.5	14.0	13.5
40	19.3	18.7	18.0
50	24.2	23.3	22.5

″	6	5
1	0.1	0.1
2	0.2	0.2
3	0.3	0.2
4	0.4	0.3
5	0.5	0.4
6	0.6	0.5
7	0.7	0.6
8	0.8	0.7
9	0.9	0.8
10	1.0	0.8
20	2.0	1.7
30	3.0	2.5
40	4.0	3.3
50	5.0	4.2

	6/34	6/33	5/34
0	2.8	2.8	3.4
1	8.5	8.2	10.2
2	14.2	13.8	17.0
3	19.8	19.2	23.8
4	25.5	24.8	30.6
5	31.2	30.2	—
6			

P.P.

114° (294°) (245°) **65°**

25° (205°) (334°) **154°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.62 595	27	9.66 867	33	0.33 133	9.95 728	6	**60**
1	9.62 622	27	9.66 900	33	0.33 100	9.95 722	6	59
2	9.62 649	27	9.66 933	33	0.33 067	9.95 716	6	58
3	9.62 676	27	9.66 966	33	0.33 034	9.95 710	6	57
4	9.62 703	27	9.66 999	33	0.33 001	9.95 704	6	56
5	9.62 730	27	9.67 032	33	0.32 968	9.95 698	6	55
6	9.62 757	27	9.67 065	33	0.32 935	9.95 692	6	54
7	9.62 784	27	9.67 098	33	0.32 902	9.95 686	6	53
8	9.62 811	27	9.67 131	32	0.32 869	9.95 680	6	52
9	9.62 838	27	9.67 163	33	0.32 837	9.95 674	6	51
10	9.62 865	27	9.67 196	33	0.32 804	9.95 668	5	**50**
11	9.62 892	26	9.67 229	33	0.32 771	9.95 663	6	49
12	9.62 918	27	9.67 262	33	0.32 738	9.95 657	6	48
13	9.62 945	27	9.67 295	32	0.32 705	9.95 651	6	47
14	9.62 972	27	9.67 327	33	0.32 673	9.95 645	6	46
15	9.62 999	27	9.67 360	33	0.32 640	9.95 639	6	45
16	9.63 026	26	9.67 393	33	0.32 607	9.95 633	6	44
17	9.63 052	27	9.67 426	32	0.32 574	9.95 627	6	43
18	9.63 079	27	9.67 458	33	0.32 542	9.95 621	6	42
19	9.63 106	27	9.67 491	33	0.32 509	9.95 615	6	41
20	9.63 133	26	9.67 524	32	0.32 476	9.95 609	6	**40**
21	9.63 159	27	9.67 556	33	0.32 444	9.95 603	6	39
22	9.63 186	27	9.67 589	33	0.32 411	9.95 597	6	38
23	9.63 213	26	9.67 622	32	0.32 378	9.95 591	6	37
24	9.63 239	27	9.67 654	33	0.32 346	9.95 585	6	36
25	9.63 266	26	9.67 687	32	0.32 313	9.95 579	6	35
26	9.63 292	27	9.67 719	33	0.32 281	9.95 573	6	34
27	9.63 319	26	9.67 752	33	0.32 248	9.95 567	6	33
28	9.63 345	27	9.67 785	32	0.32 215	9.95 561	6	32
29	9.63 372	26	9.67 817	33	0.32 183	9.95 555	6	31
30	9.63 398	27	9.67 850	32	0.32 150	9.95 549	6	**30**
31	9.63 425	26	9.67 882	33	0.32 118	9.95 543	6	29
32	9.63 451	27	9.67 915	32	0.32 085	9.95 537	6	28
33	9.63 478	26	9.67 947	33	0.32 053	9.95 531	6	27
34	9.63 504	27	9.67 980	32	0.32 020	9.95 525	6	26
35	9.63 531	26	9.68 012	32	0.31 988	9.95 519	6	25
36	9.63 557	26	9.68 044	33	0.31 956	9.95 513	6	24
37	9.63 583	27	9.68 077	32	0.31 923	9.95 507	7	23
38	9.63 610	26	9.68 109	33	0.31 891	9.95 500	6	22
39	9.63 636	26	9.68 142	32	0.31 858	9.95 494	6	21
40	9.63 662	27	9.68 174	32	0.31 826	9.95 488	6	**20**
41	9.63 689	26	9.68 206	33	0.31 794	9.95 482	6	19
42	9.63 715	26	9.68 239	32	0.31 761	9.95 476	6	18
43	9.63 741	26	9.68 271	32	0.31 729	9.95 470	6	17
44	9.63 767	27	9.68 303	33	0.31 697	9.95 464	6	16
45	9.63 794	26	9.68 336	32	0.31 664	9.95 458	6	15
46	9.63 820	26	9.68 368	32	0.31 632	9.95 452	6	14
47	9.63 846	26	9.68 400	32	0.31 600	9.95 446	6	13
48	9.63 872	26	9.68 432	33	0.31 568	9.95 440	6	12
49	9.63 898	26	9.68 465	32	0.31 535	9.95 434	7	11
50	9.63 924	26	9.68 497	32	0.31 503	9.95 427	6	**10**
51	9.63 950	26	9.68 529	32	0.31 471	9.95 421	6	9
52	9.63 976	26	9.68 561	32	0.31 439	9.95 415	6	8
53	9.64 002	26	9.68 593	33	0.31 407	9.95 409	6	7
54	9.64 028	26	9.68 626	32	0.31 374	9.95 403	6	6
55	9.64 054	26	9.68 658	32	0.31 342	9.95 397	6	5
56	9.64 080	26	9.68 690	32	0.31 310	9.95 391	7	4
57	9.64 106	26	9.68 722	32	0.31 278	9.95 384	6	3
58	9.64 132	26	9.68 754	32	0.31 246	9.95 378	6	2
59	9.64 158	26	9.68 786	32	0.31 214	9.95 372	6	1
60	9.64 184		9.68 818		0.31 182	9.95 366		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**33**	**32**
1	0.6	0.5
2	1.1	1.1
3	1.6	1.6
4	2.2	2.1
5	2.8	2.7
6	3.3	3.2
7	3.8	3.7
8	4.4	4.3
9	5.0	4.8
10	5.5	5.3
20	11.0	10.7
30	16.5	16.0
40	22.0	21.3
50	27.5	26.7

″	**27**	**26**
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	**7**	**6**	**5**
1	0.1	0.1	0.1
2	0.2	0.2	0.2
3	0.4	0.3	0.2
4	0.5	0.4	0.3
5	0.6	0.5	0.4
6	0.7	0.6	0.5
7	0.8	0.7	0.6
8	0.9	0.8	0.7
9	1.0	0.9	0.8
10	1.2	1.0	0.8
20	2.3	2.0	1.7
30	3.5	3.0	2.5
40	4.7	4.0	3.3
50	5.8	5.0	4.2

	$\frac{7}{32}$	$\frac{6}{32}$	$\frac{5}{33}$
0	2.3	2.7	3.3
1	6.9	8.0	9.9
2	11.4	13.3	16.5
3	16.0	18.7	23.1
4	20.6	24.0	29.7
5	25.1	29.3	—
6	29.7	—	—
7			

P.P.

115° (295°) (244°) **64°**

26° (206°) (333°) **153°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.64 184	26	9.68 818	32	0.31 182	9.95 366	6	60
1	9.64 210	26	9.68 850	32	0.31 150	9.95 360	6	59
2	9.64 236	26	9.68 882	32	0.31 118	9.95 354	6	58
3	9.64 262	26	9.68 914	32	0.31 086	9.95 348	7	57
4	9.64 288	25	9.68 946	32	0.31 054	9.95 341	6	56
5	9.64 313	26	9.68 978	32	0.31 022	9.95 335	6	55
6	9.64 339	26	9.69 010	32	0.30 990	9.95 329	6	54
7	9.64 365	26	9.69 042	32	0.30 958	9.95 323	6	53
8	9.64 391	26	9.69 074	32	0.30 926	9.95 317	7	52
9	9.64 417	25	9.69 106	32	0.30 894	9.95 310	6	51
10	9.64 442	26	9.69 138	32	0.30 862	9.95 304	6	50
11	9.64 468	26	9.69 170	32	0.30 830	9.95 298	6	49
12	9.64 494	25	9.69 202	32	0.30 798	9.95 292	6	48
13	9.64 519	26	9.69 234	32	0.30 766	9.95 286	7	47
14	9.64 545	26	9.69 266	32	0.30 734	9.95 279	6	46
15	9.64 571	25	9.69 298	31	0.30 702	9.95 273	6	45
16	9.64 596	26	9.69 329	32	0.30 671	9.95 267	6	44
17	9.64 622	25	9.69 361	32	0.30 639	9.95 261	7	43
18	9.64 647	26	9.69 393	32	0.30 607	9.95 254	6	42
19	9.64 673	25	9.69 425	32	0.30 575	9.95 248	6	41
20	9.64 698	26	9.69 457	31	0.30 543	9.95 242	6	40
21	9.64 724	25	9.69 488	32	0.30 512	9.95 236	7	39
22	9.64 749	26	9.69 520	32	0.30 480	9.95 229	6	38
23	9.64 775	25	9.69 552	32	0.30 448	9.95 223	6	37
24	9.64 800	26	9.69 584	31	0.30 416	9.95 217	6	36
25	9.64 826	25	9.69 615	32	0.30 385	9.95 211	7	35
26	9.64 851	26	9.69 647	32	0.30 353	9.95 204	6	34
27	9.64 877	25	9.69 679	31	0.30 321	9.95 198	6	33
28	9.64 902	25	9.69 710	32	0.30 290	9.95 192	7	32
29	9.64 927	26	9.69 742	32	0.30 258	9.95 185	6	31
30	9.64 953	25	9.69 774	31	0.30 226	9.95 179	6	30
31	9.64 978	25	9.69 805	32	0.30 195	9.95 173	6	29
32	9.65 003	26	9.69 837	31	0.30 163	9.95 167	7	28
33	9.65 029	25	9.69 868	32	0.30 132	9.95 160	6	27
34	9.65 054	25	9.69 900	32	0.30 100	9.95 154	6	26
35	9.65 079	25	9.69 932	31	0.30 068	9.95 148	7	25
36	9.65 104	26	9.69 963	32	0.30 037	9.95 141	6	24
37	9.65 130	25	9.69 995	31	0.30 005	9.95 135	6	23
38	9.65 155	25	9.70 026	32	0.29 974	9.95 129	7	22
39	9.65 180	25	9.70 058	31	0.29 942	9.95 122	6	21
40	9.65 205	25	9.70 089	32	0.29 911	9.95 116	6	20
41	9.65 230	25	9.70 121	31	0.29 879	9.95 110	7	19
42	9.65 255	26	9.70 152	32	0.29 848	9.95 103	6	18
43	9.65 281	25	9.70 184	31	0.29 816	9.95 097	7	17
44	9.65 306	25	9.70 215	32	0.29 785	9.95 090	6	16
45	9.65 331	25	9.70 247	31	0.29 753	9.95 084	6	15
46	9.65 356	25	9.70 278	31	0.29 722	9.95 078	7	14
47	9.65 381	25	9.70 309	32	0.29 691	9.95 071	6	13
48	9.65 406	25	9.70 341	31	0.29 659	9.95 065	6	12
49	9.65 431	25	9.70 372	32	0.29 628	9.95 059	7	11
50	9.65 456	25	9.70 404	31	0.29 596	9.95 052	6	10
51	9.65 481	25	9.70 435	31	0.29 565	9.95 046	7	9
52	9.65 506	25	9.70 466	32	0.29 534	9.95 039	6	8
53	9.65 531	25	9.70 498	31	0.29 502	9.95 033	6	7
54	9.65 556	24	9.70 529	31	0.29 471	9.95 027	7	6
55	9.65 580	25	9.70 560	32	0.29 440	9.95 020	6	5
56	9.65 605	25	9.70 592	31	0.29 408	9.95 014	7	4
57	9.65 630	25	9.70 623	31	0.29 377	9.95 007	6	3
58	9.65 655	25	9.70 654	31	0.29 346	9.95 001	6	2
59	9.65 680	25	9.70 685	32	0.29 315	9.94 995	7	1
60	9.65 705		9.70 717		0.29 283	9.94 988		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	32	31
1	0.5	0.5
2	1.1	1.0
3	1.6	1.6
4	2.1	2.1
5	2.7	2.6
6	3.2	3.1
7	3.7	3 6
8	4.3	4.1
9	4.8	4.6
10	5.3	5.2
20	10.7	10.3
30	16.0	15.5
40	21.3	20.7
50	26.7	25.8

″	26	25	24
1	0.4	0.4	0.4
2	0.9	0.8	0.8
3	1.3	1.2	1.2
4	1.7	1.7	1.6
5	2.2	2.1	2.0
6	2.6	2.5	2.4
7	3.0	2.9	2.8
8	3.5	3.3	3.2
9	3.9	3.8	3.6
10	4.3	4.2	4.0
20	8.7	8.3	8.0
30	13.0	12.5	12.0
40	17.3	16.7	16.0
50	21.7	20.8	20.0

″	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

	7/32	7/31	6/32
0			
	2.3	2.2	2.7
1			
	6.9	6.6	8.0
2			
	11.4	11.1	13.3
3			
	16.0	15.5	18.7
4			
	20.6	19.9	24.0
5			
	25.1	24.4	29.3
6			
	29.7	28.8	—
7			

P.P.

116° (296°) (243°) **63°**

27° (207°) (332°) **152°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.65 705	24	9.70 717	31	0.29 283	9.94 988	6	**60**
1	9.65 729	25	9.70 748	31	0.29 252	9.94 982	7	59
2	9.65 754	25	9.70 779	31	0.29 221	9.94 975	6	58
3	9.65 779	25	9.70 810	31	0.29 190	9.94 969	7	57
4	9.65 804	24	9.70 841	32	0.29 159	9.94 962	6	56
5	9.65 828	25	9.70 873	31	0.29 127	9.94 956	7	55
6	9.65 853	25	9.70 904	31	0.29 096	9.94 949	6	54
7	9.65 878	24	9.70 935	31	0.29 065	9.94 943	7	53
8	9.65 902	25	9.70 966	31	0.29 034	9.94 936	6	52
9	9.65 927	25	9.70 997	31	0.29 003	9.94 930	7	51
10	9.65 952	24	9.71 028	31	0.28 972	9.94 923	6	**50**
11	9.65 976	25	9.71 059	31	0.28 941	9.94 917	6	49
12	9.66 001	24	9.71 090	31	0.28 910	9.94 911	7	48
13	9.66 025	25	9.71 121	32	0.28 879	9.94 904	6	47
14	9.66 050	25	9.71 153	31	0.28 847	9.94 898	7	46
15	9.66 075	24	9.71 184	31	0.28 816	9.94 891	6	45
16	9.66 099	25	9.71 215	31	0.28 785	9.94 885	7	44
17	9.66 124	24	9.71 246	31	0.28 754	9.94 878	7	43
18	9.66 148	25	9.71 277	31	0.28 723	9.94 871	6	42
19	9.66 173	24	9.71 308	31	0.28 692	9.94 865	7	41
20	9.66 197	24	9.71 339	31	0.28 661	9.94 858	6	**40**
21	9.66 221	25	9.71 370	31	0.28 630	9.94 852	7	39
22	9.66 246	24	9.71 401	30	0.28 599	9.94 845	6	38
23	9.66 270	25	9.71 431	31	0.28 569	9.94 839	7	37
24	9.66 295	24	9.71 462	31	0.28 538	9.94 832	6	36
25	9.66 319	24	9.71 493	31	0.28 507	9.94 826	7	35
26	9.66 343	25	9.71 524	31	0.28 476	9.94 819	6	34
27	9.66 368	24	9.71 555	31	0.28 445	9.94 813	7	33
28	9.66 392	24	9.71 586	31	0.28 414	9.94 806	7	32
29	9.66 416	25	9.71 617	31	0.28 383	9.94 799	6	31
30	9.66 441	24	9.71 648	31	0.28 352	9.94 793	7	**30**
31	9.66 465	24	9.71 679	30	0.28 321	9.94 786	6	29
32	9.66 489	24	9.71 709	31	0.28 291	9.94 780	7	28
33	9.66 513	24	9.71 740	31	0.28 260	9.94 773	6	27
34	9.66 537	25	9.71 771	31	0.28 229	9.94 767	7	26
35	9.66 562	24	9.71 802	31	0.28 198	9.94 760	7	25
36	9.66 586	24	9.71 833	30	0.28 167	9.94 753	6	24
37	9.66 610	24	9.71 863	31	0.28 137	9.94 747	7	23
38	9.66 634	24	9.71 894	31	0.28 106	9.94 740	6	22
39	9.66 658	24	9.71 925	30	0.28 075	9.94 734	7	21
40	9.66 682	24	9.71 955	31	0.28 045	9.94 727	7	**20**
41	9.66 706	25	9.71 986	31	0.28 014	9.94 720	6	19
42	9.66 731	24	9.72 017	31	0.27 983	9.94 714	7	18
43	9.66 755	24	9.72 048	30	0.27 952	9.94 707	7	17
44	9.66 779	24	9.72 078	31	0.27 922	9.94 700	6	16
45	9.66 803	24	9.72 109	31	0.27 891	9.94 694	7	15
46	9.66 827	24	9.72 140	30	0.27 860	9.94 687	7	14
47	9.66 851	24	9.72 170	31	0.27 830	9.94 680	6	13
48	9.66 875	24	9.72 201	30	0.27 799	9.94 674	7	12
49	9.66 899	23	9.72 231	31	0.27 769	9.94 667	7	11
50	9.66 922	24	9.72 262	31	0.27 738	9.94 660	6	**10**
51	9.66 946	24	9.72 293	30	0.27 707	9.94 654	7	9
52	9.66 970	24	9.72 323	31	0.27 677	9.94 647	7	8
53	9.66 994	24	9.72 354	30	0.27 646	9.94 640	6	7
54	9.67 018	24	9.72 384	31	0.27 616	9.94 634	7	6
55	9.67 042	24	9.72 415	30	0.27 585	9.94 627	7	5
56	9.67 066	24	9.72 445	31	0.27 555	9.94 620	6	4
57	9.67 090	23	9.72 476	30	0.27 524	9.94 614	7	3
58	9.67 113	24	9.72 506	31	0.27 494	9.94 607	7	2
59	9.67 137	24	9.72 537	30	0.27 463	9.94 600	7	1
60	9.67 161		9.72 567		0.27 433	9.94 593		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**32**	**31**	**30**
1	0.5	0.5	0.5
2	1.1	1.0	1.0
3	1.6	1.6	1.5
4	2.1	2.1	2.0
5	2.7	2.6	2.5
6	3.2	3.1	3.0
7	3.7	3.6	3.5
8	4.3	4.1	4.0
9	4.8	4.6	4.5
10	5.3	5.2	5.0
20	10.7	10.3	10.0
30	16.0	15.5	15.0
40	21.3	20.7	20.0
50	26.7	25.8	25.0

″	**25**	**24**	**23**
1	0.4	0.4	0.4
2	0.8	0.8	0.8
3	1.2	1.2	1.2
4	1.7	1.6	1.5
5	2.1	2.0	1.9
6	2.5	2.4	2.3
7	2.9	2.8	2.7
8	3.3	3.2	3.1
9	3.8	3.6	3.4
10	4.2	4.0	3.8
20	8.3	8.0	7.7
30	12.5	12.0	11.5
40	16.7	16.0	15.3
50	20.8	20.0	19.2

″	**7**	**6**
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

	$\frac{\mathbf{7}}{\mathbf{30}}$	$\frac{\mathbf{6}}{\mathbf{31}}$	$\frac{\mathbf{6}}{\mathbf{30}}$
0	2.1	2.6	2.5
1	6.4	7.8	7.5
2	10.7	12.9	12.5
3	15.0	18.1	17.5
4	19.3	23.2	22.5
5	23.6	28.4	27.5
6	27.9	—	—
7			

P.P.

28° (208°) (331°) **151°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.67 161	24	9.72 567	31	0.27 433	9.94 593	6	60
1	9.67 185	23	9.72 598	30	0.27 402	9.94 587	7	59
2	9.67 208	24	9.72 628	31	0.27 372	9.94 580	7	58
3	9.67 232	24	9.72 659	30	0.27 341	9.94 573	6	57
4	9.67 256	24	9.72 689	31	0.27 311	9.94 567	7	56
5	9.67 280	23	9.72 720	30	0.27 280	9.94 560	7	55
6	9.67 303	24	9.72 750	30	0.27 250	9.94 553	7	54
7	9.67 327	23	9.72 780	31	0.27 220	9.94 546	6	53
8	9.67 350	24	9.72 811	30	0.27 189	9.94 540	7	52
9	9.67 374	24	9.72 841	31	0.27 159	9.94 533	7	51
10	9.67 398	23	9.72 872	30	0.27 128	9.94 526	7	50
11	9.67 421	24	9.72 902	30	0.27 098	9.94 519	6	49
12	9.67 445	23	9.72 932	31	0.27 068	9.94 513	7	48
13	9.67 468	24	9.72 963	30	0.27 037	9.94 506	7	47
14	9.67 492	23	9.72 993	30	0.27 007	9.94 499	7	46
15	9.67 515	24	9.73 023	31	0.26 977	9.94 492	7	45
16	9.67 539	23	9.73 054	30	0.26 946	9.94 485	6	44
17	9.67 562	24	9.73 084	30	0.26 916	9.94 479	7	43
18	9.67 586	23	9.73 114	30	0.26 886	9.94 472	7	42
19	9.67 609	24	9.73 144	31	0.26 856	9.94 465	7	41
20	9.67 633	23	9.73 175	30	0.26 825	9.94 458	7	40
21	9.67 656	24	9.73 205	30	0.26 795	9.94 451	6	39
22	9.67 680	23	9.73 235	30	0.26 765	9.94 445	7	38
23	9.67 703	23	9.73 265	30	0.26 735	9.94 438	7	37
24	9.67 726	24	9.73 295	31	0.26 705	9.94 431	7	36
25	9.67 750	23	9.73 326	30	0.26 674	9.94 424	7	35
26	9.67 773	23	9.73 356	30	0.26 644	9.94 417	7	34
27	9.67 796	24	9.73 386	30	0.26 614	9.94 410	6	33
28	9.67 820	23	9.73 416	30	0.26 584	9.94 404	7	32
29	9.67 843	23	9.73 446	30	0.26 554	9.94 397	7	31
30	9.67 866	24	9.73 476	31	0.26 524	9.94 390	7	30
31	9.67 890	23	9.73 507	30	0.26 493	9.94 383	7	29
32	9.67 913	23	9.73 537	30	0.26 463	9.94 376	7	28
33	9.67 936	23	9.73 567	30	0.26 433	9.94 369	7	27
34	9.67 959	23	9.73 597	30	0.26 403	9.94 362	7	26
35	9.67 982	24	9.73 627	30	0.26 373	9.94 355	6	25
36	9.68 006	23	9.73 657	30	0.26 343	9.94 349	7	24
37	9.68 029	23	9.73 687	30	0.26 313	9.94 342	7	23
38	9.68 052	23	9.73 717	30	0.26 283	9.94 335	7	22
39	9.68 075	23	9.73 747	30	0.26 253	9.94 328	7	21
40	9.68 098	23	9.73 777	30	0.26 223	9.94 321	7	20
41	9.68 121	23	9.73 807	30	0.26 193	9.94 314	7	19
42	9.68 144	23	9.73 837	30	0.26 163	9.94 307	7	18
43	9.68 167	23	9.73 867	30	0.26 133	9.94 300	7	17
44	9.68 190	23	9.73 897	30	0.26 103	9.94 293	7	16
45	9.68 213	24	9.73 927	30	0.26 073	9.94 286	7	15
46	9.68 237	23	9.73 957	30	0.26 043	9.94 279	6	14
47	9.68 260	23	9.73 987	30	0.26 013	9.94 273	7	13
48	9.68 283	22	9.74 017	30	0.25 983	9.94 266	7	12
49	9.68 305	23	9.74 047	30	0.25 953	9.94 259	7	11
50	9.68 328	23	9.74 077	30	0.25 923	9.94 252	7	10
51	9.68 351	23	9.74 107	30	0.25 893	9.94 245	7	9
52	9.68 374	23	9.74 137	29	0.25 863	9.94 238	7	8
53	9.68 397	23	9.74 166	30	0.25 834	9.94 231	7	7
54	9.68 420	23	9.74 196	30	0.25 804	9.94 224	7	6
55	9.68 443	23	9.74 226	30	0.25 774	9.94 217	7	5
56	9.68 466	23	9.74 256	30	0.25 744	9.94 210	7	4
57	9.68 489	23	9.74 286	30	0.25 714	9.94 203	7	3
58	9.68 512	22	9.74 316	29	0.25 684	9.94 196	7	2
59	9.68 534	23	9.74 345	30	0.25 655	9.94 189	7	1
60	9.68 557		9.74 375		0.25 625	9.94 182		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d	′

P. P.

″	31	30	29
1	0.5	0.5	0.5
2	1.0	1.0	1.0
3	1.6	1.5	1.4
4	2.1	2.0	1.9
5	2.6	2.5	2.4
6	3.1	3.0	2.9
7	3.6	3.5	3.4
8	4.1	4.0	3.9
9	4.6	4.5	4.4
10	5.2	5.0	4.8
20	10.3	10.0	9.7
30	15.5	15.0	14.5
40	20.7	20.0	19.3
50	25.8	25.0	24.2

″	24	23	22
1	0.4	0.4	0.4
2	0.8	0.8	0.7
3	1.2	1.2	1.1
4	1.6	1.5	1.5
5	2.0	1.9	1.8
6	2.4	2.3	2.2
7	2.8	2.7	2.6
8	3.2	3.1	2.9
9	3.6	3.4	3.3
10	4.0	3.8	3.7
20	8.0	7.7	7.3
30	12.0	11.5	11.0
40	16.0	15.3	14.7
50	20.0	19.2	18.3

″	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

	7/31	6/31	5/30
0	2.2	2.6	2.5
1	6.6	7.8	7.5
2	11.1	12.9	12.5
3	15.5	18.1	17.5
4	19.9	23.2	22.5
5	24.4	28.4	27.5
6	28.8	—	—
7			

P. P.

118° (298°) (241°) **61°**

29° (209°) (330°) **150°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.68 557	23	9.74 375	30	0.25 625	9.94 182	7	**60**
1	9.68 580	23	9.74 405	30	0.25 595	9.94 175	7	59
2	9.68 603	22	9.74 435	30	0.25 565	9.94 168	7	58
3	9.68 625	23	9.74 465	29	0.25 535	9.94 161	7	57
4	9.68 648	23	9.74 494	30	0.25 506	9.94 154	7	56
5	9.68 671	23	9.74 524	30	0.25 476	9.94 147	7	55
6	9.68 694	22	9.74 554	29	0.25 446	9.94 140	7	54
7	9.68 716	23	9.74 583	30	0.25 417	9.94 133	7	53
8	9.68 739	23	9.74 613	30	0.25 387	9.94 126	7	52
9	9.68 762	22	9.74 643	30	0.25 357	9.94 119	7	51
10	9.68 784	23	9.74 673	29	0.25 327	9.94 112	7	**50**
11	9.68 807	22	9.74 702	30	0.25 298	9.94 105	7	49
12	9.68 829	23	9.74 732	30	0.25 268	9.94 098	8	48
13	9.68 852	23	9.74 762	29	0.25 238	9.94 090	7	47
14	9.68 875	22	9.74 791	30	0.25 209	9.94 083	7	46
15	9.68 897	23	9.74 821	30	0.25 179	9.94 076	7	45
16	9.68 920	22	9.74 851	29	0.25 149	9.94 069	7	44
17	9.68 942	23	9.74 880	30	0.25 120	9.94 062	7	43
18	9.68 965	22	9.74 910	29	0.25 090	9.94 055	7	42
19	9.68 987	23	9.74 939	30	0.25 061	9.94 048	7	41
20	9.69 010	22	9.74 969	29	0.25 031	9.94 041	7	**40**
21	9.69 032	23	9.74 998	30	0.25 002	9.94 034	7	39
22	9.69 055	22	9.75 028	30	0.24 972	9.94 027	7	38
23	9.69 077	23	9.75 058	29	0.24 942	9.94 020	8	37
24	9.69 100	22	9.75 087	30	0.24 913	9.94 012	7	36
25	9.69 122	22	9.75 117	29	0.24 883	9.94 005	7	35
26	9.69 144	23	9.75 146	30	0.24 854	9.93 998	7	34
27	9.69 167	22	9.75 176	29	0.24 824	9.93 991	7	33
28	9.69 189	23	9.75 205	30	0.24 795	9.93 984	7	32
29	9.69 212	22	9.75 235	29	0.24 765	9.93 977	7	31
30	9.69 234	22	9.75 264	30	0.24 736	9.93 970	7	**30**
31	9.69 256	23	9.75 294	29	0.24 706	9.93 963	8	29
32	9.69 279	22	9.75 323	30	0.24 677	9.93 955	7	28
33	9.69 301	22	9.75 353	29	0.24 647	9.93 948	7	27
34	9.69 323	22	9.75 382	29	0.24 618	9.93 941	7	26
35	9.69 345	23	9.75 411	30	0.24 589	9.93 934	7	25
36	9.69 368	22	9.75 441	29	0.24 559	9.93 927	7	24
37	9.69 390	22	9.75 470	30	0.24 530	9.93 920	8	23
38	9.69 412	22	9.75 500	29	0.24 500	9.93 912	7	22
39	9.69 434	22	9.75 529	29	0.24 471	9.93 905	7	21
40	9.69 456	23	9.75 558	30	0.24 442	9.93 898	7	**20**
41	9.69 479	22	9.75 588	29	0.24 412	9.93 891	7	19
42	9.69 501	22	9.75 617	30	0.24 383	9.93 884	8	18
43	9.69 523	22	9.75 647	29	0.24 353	9.93 876	7	17
44	9.69 545	22	9.75 676	29	0.24 324	9.93 869	7	16
45	9.69 567	22	9.75 705	30	0.24 295	9.93 862	7	15
46	9.69 589	22	9.75 735	29	0.24 265	9.93 855	8	14
47	9.69 611	22	9.75 764	29	0.24 236	9.93 847	7	13
48	9.69 633	22	9.75 793	29	0.24 207	9.93 840	7	12
49	9.69 655	22	9.75 822	30	0.24 178	9.93 833	7	11
50	9.69 677	22	9.75 852	29	0.24 148	9.93 826	7	**10**
51	9.69 699	22	9.75 881	29	0.24 119	9.93 819	8	9
52	9.69 721	22	9.75 910	29	0.24 090	9.93 811	7	8
53	9.69 743	22	9.75 939	30	0.24 061	9.93 804	7	7
54	9.69 765	22	9.75 969	29	0.24 031	9.93 797	8	6
55	9.69 787	22	9.75 998	29	0.24 002	9.93 789	7	5
56	9.69 809	22	9.76 027	29	0.23 973	9.93 782	7	4
57	9.69 831	22	9.76 056	30	0.23 944	9.93 775	7	3
58	9.69 853	22	9.76 086	29	0.23 914	9.93 768	8	2
59	9.69 875	22	9.76 115	29	0.23 885	9.93 760	7	1
60	9.69 897		9.76 144		0.23 856	9.93 753		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	30	29	23
1	0.5	0.5	0.4
2	1.0	1.0	0.8
3	1.5	1.4	1.2
4	2.0	1.9	1.5
5	2.5	2.4	1.9
6	3.0	2.9	2.3
7	3.5	3.4	2.7
8	4.0	3.9	3.1
9	4.5	4.4	3.4
10	5.0	4.8	3.8
20	10.0	9.7	7.7
30	15.0	14.5	11.5
40	20.0	19.3	15.3
50	25.0	24.2	19.2

″	22	8	7
1	0.4	0.1	0.1
2	0.7	0.3	0.2
3	1.1	0.4	0.4
4	1.5	0.5	0.5
5	1.8	0.7	0.6
6	2.2	0.8	0.7
7	2.6	0.9	0.8
8	2.9	1.1	0.9
9	3.3	1.2	1.0
10	3.7	1.3	1.2
20	7.3	2.7	2.3
30	11.0	4.0	3.5
40	14.7	5.3	4.7
50	18.3	6.7	5.8

	8/30	8/29
0	1.9	1.8
1	5.6	5.4
2	9.4	9.1
3	13.1	12.7
4	16.9	16.3
5	20.6	19.9
6	24.4	23.6
7	28.1	27.2
8		

	7/30	7/29
0	2.1	2.1
1	6.4	6.2
2	10.7	10.4
3	15.0	14.5
4	19.3	18.6
5	23.6	22.8
6	27.9	26.9
7		

P. P.

119° (299°) (240°) **60°**

30° (210°) (329°) **149°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.69 897	22	9.76 144	29	0.23 856	9.93 753	7	**60**
1	9.69 919	22	9.76 173	29	0.23 827	9.93 746	8	59
2	9.69 941	22	9.76 202	29	0.23 798	9.93 738	7	58
3	9.69 963	21	9.76 231	30	0.23 769	9.93 731	7	57
4	9.69 984	22	9.76 261	29	0.23 739	9.93 724	7	56
5	9.70 006	22	9.76 290	29	0.23 710	9.93 717	8	55
6	9.70 028	22	9.76 319	29	0.23 681	9.93 709	7	54
7	9.70 050	22	9.76 348	29	0.23 652	9.93 702	7	53
8	9.70 072	21	9.76 377	29	0.23 623	9.93 695	8	52
9	9.70 093	22	9.76 406	29	0.23 594	9.93 687	7	51
10	9.70 115	22	9.76 435	29	0.23 565	9.93 680	7	**50**
11	9.70 137	22	9.76 464	29	0.23 536	9.93 673	8	49
12	9.70 159	21	9.76 493	29	0.23 507	9.93 665	7	48
13	9.70 180	22	9.76 522	29	0.23 478	9.93 658	8	47
14	9.70 202	22	9.76 551	29	0.23 449	9.93 650	7	46
15	9.70 224	21	9.76 580	29	0.23 420	9.93 643	7	45
16	9.70 245	22	9.76 609	30	0.23 391	9.93 636	8	44
17	9.70 267	21	9.76 639	29	0.23 361	9.93 628	7	43
18	9.70 288	22	9.76 668	29	0.23 332	9.93 621	7	42
19	9.70 310	22	9.76 697	28	0.23 303	9.93 614	8	41
20	9.70 332	21	9.76 725	29	0.23 275	9.93 606	7	**40**
21	9.70 353	22	9.76 754	29	0.23 246	9.93 599	8	39
22	9.70 375	21	9.76 783	29	0.23 217	9.93 591	7	38
23	9.70 396	22	9.76 812	29	0.23 188	9.93 584	7	37
24	9.70 418	21	9.76 841	29	0.23 159	9.93 577	8	36
25	9.70 439	22	9.76 870	29	0.23 130	9.93 569	7	35
26	9.70 461	21	9.76 899	29	0.23 101	9.93 562	8	34
27	9.70 482	22	9.76 928	29	0.23 072	9.93 554	7	33
28	9.70 504	21	9.76 957	29	0.23 043	9.93 547	8	32
29	9.70 525	22	9.76 986	29	0.23 014	9.93 539	7	31
30	9.70 547	21	9.77 015	29	0.22 985	9.93 532	7	**30**
31	9.70 568	22	9.77 044	29	0.22 956	9.93 525	8	29
32	9.70 590	21	9.77 073	28	0.22 927	9.93 517	7	28
33	9.70 611	22	9.77 101	29	0.22 899	9.93 510	8	27
34	9.70 633	21	9.77 130	29	0.22 870	9.93 502	7	26
35	9.70 654	21	9.77 159	29	0.22 841	9.93 495	8	25
36	9.70 675	22	9.77 188	29	0.22 812	9.93 487	7	24
37	9.70 697	21	9.77 217	29	0.22 783	9.93 480	8	23
38	9.70 718	21	9.77 246	28	0.22 754	9.93 472	7	22
39	9.70 739	22	9.77 274	29	0.22 726	9.93 465	8	21
40	9.70 761	21	9.77 303	29	0.22 697	9.93 457	7	**20**
41	9.70 782	21	9.77 332	29	0.22 668	9.93 450	8	19
42	9.70 803	21	9.77 361	29	0.22 639	9.93 442	7	18
43	9.70 824	22	9.77 390	28	0.22 610	9.93 435	8	17
44	9.70 846	21	9.77 418	29	0.22 582	9.93 427	7	16
45	9.70 867	21	9.77 447	29	0.22 553	9.93 420	8	15
46	9.70 888	21	9.77 476	29	0.22 524	9.93 412	7	14
47	9.70 909	22	9.77 505	28	0.22 495	9.93 405	8	13
48	9.70 931	21	9.77 533	29	0.22 467	9.93 397	7	12
49	9.70 952	21	9.77 562	29	0.22 438	9.93 390	8	11
50	9.70 973	21	9.77 591	28	0.22 409	9.93 382	7	**10**
51	9.70 994	21	9.77 619	29	0.22 381	9.93 375	8	9
52	9.71 015	21	9.77 648	29	0.22 352	9.93 367	7	8
53	9.71 036	22	9.77 677	29	0.22 323	9.93 360	8	7
54	9.71 058	21	9.77 706	28	0.22 294	9.93 352	8	6
55	9.71 079	21	9.77 734	29	0.22 266	9.93 344	7	5
56	9.71 100	21	9.77 763	28	0.22 237	9.93 337	8	4
57	9.71 121	21	9.77 791	29	0.22 209	9.93 329	7	3
58	9.71 142	21	9.77 820	29	0.22 180	9.93 322	8	2
59	9.71 163	21	9 77 849	28	0.22 151	9.93 314	7	1
60	9.71 184		9.77 877		0.22 123	9.93 307		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**30**	**29**	**28**
1	0.5	0.5	0.5
2	1.0	1.0	0.9
3	1.5	1.4	1.4
4	2.0	1.9	1.9
5	2.5	2.4	2.3
6	3.0	2.9	2.8
7	3.5	3.4	3.3
8	4.0	3.9	3.7
9	4.5	4.4	4.2
10	5.0	4.8	4.7
20	10.0	9.7	9.3
30	15.0	14.5	14.0
40	20.0	19.3	18.7
50	25.0	24.2	23.3

″	**22**	**21**
1	0.4	0.4
2	0.7	0.7
3	1.1	1.0
4	1.5	1.4
5	1.8	1.8
6	2.2	2.1
7	2.6	2.4
8	2.9	2.8
9	3.3	3.2
10	3.7	3.5
20	7.3	7.0
30	11.0	10.5
40	14.7	14.0
50	18.3	17.5

″	**8**	**7**
1	0.1	0.1
2	0.3	0.2
3	0.4	0.4
4	0.5	0.5
5	0.7	0.6
6	0.8	0.7
7	0.9	0.8
8	1.1	0.9
9	1.2	1.0
10	1.3	1.2
20	2.7	2.3
30	4.0	3.5
40	5.3	4.7
50	6.7	5.8

	$\frac{7}{30}$	$\frac{7}{29}$	$\frac{7}{28}$
0	2.1	2.1	2.0
1	6.4	6.2	6.0
2	10.7	10.4	10.0
3	15.0	14.5	14.0
4	19.3	18.6	18.0
5	23.6	22.8	22.0
6	27.9	26.9	26.0
7			

P.P.

120° (300°) (239°) **59°**

31° (211°) (328°) **148°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.71 184	21	9.77 877	29	0.22 123	9.93 307	8	60
1	9.71 205	21	9.77 906	29	0.22 094	9.93 299	8	59
2	9.71 226	21	9.77 935	28	0.22 065	9.93 291	7	58
3	9.71 247	21	9.77 963	29	0.22 037	9.93 284	8	57
4	9.71 268	21	9.77 992	28	0.22 008	9.93 276	7	56
5	9.71 289	21	9.78 020	29	0.21 980	9.93 269	8	55
6	9.71 310	21	9.78 049	28	0.21 951	9.93 261	8	54
7	9.71 331	21	9.78 077	29	0.21 923	9.93 253	7	53
8	9.71 352	21	9.78 106	29	0.21 894	9.93 246	8	52
9	9.71 373	20	9.78 135	28	0.21 865	9.93 238	8	51
10	9.71 393	21	9.78 163	29	0.21 837	9.93 230	7	50
11	9.71 414	21	9.78 192	28	0.21 808	9.93 223	8	49
12	9.71 435	21	9.78 220	29	0.21 780	9.93 215	8	48
13	9.71 456	21	9.78 249	28	0.21 751	9.93 207	7	47
14	9.71 477	21	9.78 277	29	0.21 723	9.93 200	8	46
15	9.71 498	21	9.78 306	28	0.21 694	9.93 192	8	45
16	9.71 519	20	9.78 334	29	0.21 666	9.93 184	7	44
17	9.71 539	21	9.78 363	28	0.21 637	9.93 177	8	43
18	9.71 560	21	9.78 391	28	0.21 609	9.93 169	8	42
19	9.71 581	21	9.78 419	29	0.21 581	9.93 161	7	41
20	9.71 602	20	9.78 448	28	0.21 552	9.93 154	8	40
21	9.71 622	21	9.78 476	29	0.21 524	9.93 146	8	39
22	9.71 643	21	9.78 505	28	0.21 495	9.93 138	7	38
23	9.71 664	21	9.78 533	29	0.21 467	9.93 131	8	37
24	9.71 685	20	9.78 562	28	0.21 438	9.93 123	8	36
25	9.71 705	21	9.78 590	28	0.21 410	9.93 115	7	35
26	9.71 726	21	9.78 618	29	0.21 382	9.93 108	8	34
27	9.71 747	20	9.78 647	28	0.21 353	9.93 100	8	33
28	9.71 767	21	9.78 675	29	0.21 325	9.93 092	8	32
29	9.71 788	21	9.78 704	28	0.21 296	9.93 084	7	31
30	9.71 809	20	9.78 732	28	0.21 268	9.93 077	8	30
31	9.71 829	21	9.78 760	29	0.21 240	9.93 069	8	29
32	9.71 850	20	9.78 789	28	0.21 211	9.93 061	8	28
33	9.71 870	21	9.78 817	28	0.21 183	9.93 053	7	27
34	9.71 891	20	9.78 845	29	0.21 155	9.93 046	8	26
35	9.71 911	21	9.78 874	28	0.21 126	9.93 038	8	25
36	9.71 932	20	9.78 902	28	0.21 098	9.93 030	8	24
37	9.71 952	21	9.78 930	29	0.21 070	9.93 022	8	23
38	9.71 973	21	9.78 959	28	0.21 041	9.93 014	7	22
39	9.71 994	20	9.78 987	28	0.21 013	9.93 007	8	21
40	9.72 014	20	9.79 015	28	0.20 985	9.92 999	8	20
41	9.72 034	21	9.79 043	29	0.20 957	9.92 991	8	19
42	9.72 055	20	9.79 072	28	0.20 928	9.92 983	7	18
43	9.72 075	21	9.79 100	28	0.20 900	9.92 976	8	17
44	9.72 096	20	9.79 128	28	0.20 872	9.92 968	8	16
45	9.72 116	21	9.79 156	29	0.20 844	9.92 960	8	15
46	9.72 137	20	9.79 185	28	0.20 815	9.92 952	8	14
47	9.72 157	20	9.79 213	28	0.20 787	9.92 944	8	13
48	9.72 177	21	9.79 241	28	0.20 759	9.92 936	7	12
49	9.72 198	20	9.79 269	28	0.20 731	9.92 929	8	11
50	9.72 218	20	9.79 297	29	0.20 703	9.92 921	8	10
51	9.72 238	21	9.79 326	28	0.20 674	9.92 913	8	9
52	9.72 259	20	9.79 354	28	0.20 646	9.92 905	8	8
53	9.72 279	20	9.79 382	28	0.20 618	9.92 897	8	7
54	9.72 299	21	9.79 410	28	0.20 590	9.92 889	8	6
55	9.72 320	20	9.79 438	28	0.20 562	9.92 881	7	5
56	9.72 340	20	9.79 466	29	0.20 534	9.92 874	8	4
57	9.72 360	21	9.79 495	28	0.20 505	9.92 866	8	3
58	9.72 381	20	9.79 523	28	0.20 477	9.92 858	8	2
59	9.72 401	20	9.79 551	28	0.20 449	9.92 850	8	1
60	9.72 421		9.79 579		0.20 421	9.92 842		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	29	28
1	0.5	0.5
2	1.0	0.9
3	1.4	1.4
4	1.9	1.9
5	2.4	2.3
6	2.9	2.8
7	3.4	3.3
8	3.9	3.7
9	4.4	4.2
10	4.8	4.7
20	9.7	9.3
30	14.5	14.0
40	19.3	18.7
50	24.2	23.3

″	21	20
1	0.4	0.3
2	0.7	0.7
3	1.0	1.0
4	1.4	1.3
5	1.8	1.7
6	2.1	2.0
7	2.4	2.3
8	2.8	2.7
9	3.2	3.0
10	3.5	3.3
20	7.0	6.7
30	10.5	10.0
40	14.0	13.3
50	17.5	16.7

″	8	7
1	0.1	0.1
2	0.3	0.2
3	0.4	0.4
4	0.5	0.5
5	0.7	0.6
6	0.8	0.7
7	0.9	0.8
8	1.1	0.9
9	1.2	1.0
10	1.3	1.2
20	2.7	2.3
30	4.0	3.5
40	5.3	4.7
50	6.7	5.8

	8/30	8/29	8/28
0	1.9	1.8	1.8
1	5.6	5.4	5.2
2	9.4	9.1	8.8
3	13.1	12.7	12.2
4	16.9	16.3	15.8
5	20.6	19.9	19.2
6	24.4	23.6	22.8
7	28.1	27.2	26.2
8			

P.P.

121° (301°) (238°) **58°**

32° (212°) (327°) **147°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.72 421	20	9.79 579	28	0.20 421	9.92 842	8	60
1	9.72 441	20	9.79 607	28	0.20 393	9.92 834	8	59
2	9.72 461	21	9.79 635	28	0.20 365	9.92 826	8	58
3	9.72 482	20	9.79 663	28	0.20 337	9.92 818	8	57
4	9.72 502	20	9.79 691	28	0.20 309	9.92 810	7	56
5	9.72 522	20	9.79 719	28	0.20 281	9.92 803	8	55
6	9.72 542	20	9.79 747	29	0.20 253	9.92 795	8	54
7	9.72 562	20	9.79 776	28	0.20 224	9.92 787	8	53
8	9.72 582	20	9.79 804	28	0.20 196	9.92 779	8	52
9	9.72 602	20	9.79 832	28	0.20 168	9.92 771	8	51
10	9.72 622	21	9.79 860	28	0.20 140	9.92 763	8	50
11	9.72 643	20	9.79 888	28	0.20 112	9.92 755	8	49
12	9.72 663	20	9.79 916	28	0.20 084	9.92 747	8	48
13	9.72 683	20	9.79 944	28	0.20 056	9.92 739	8	47
14	9.72 703	20	9.79 972	28	0.20 028	9.92 731	8	46
15	9.72 723	20	9.80 000	28	0.20 000	9.92 723	8	45
16	9.72 743	20	9.80 028	28	0.19 972	9.92 715	8	44
17	9.72 763	20	9.80 056	28	0.19 944	9.92 707	8	43
18	9.72 783	20	9.80 084	28	0.19 916	9.92 699	8	42
19	9.72 803	20	9.80 112	28	0.19 888	9.92 691	8	41
20	9.72 823	20	9.80 140	28	0.19 860	9.92 683	8	40
21	9.72 843	20	9.80 168	27	0.19 832	9.92 675	8	39
22	9.72 863	20	9.80 195	28	0.19 805	9.92 667	8	38
23	9.72 883	19	9.80 223	28	0.19 777	9.92 659	8	37
24	9.72 902	20	9.80 251	28	0.19 749	9.92 651	8	36
25	9.72 922	20	9.80 279	28	0.19 721	9.92 643	8	35
26	9.72 942	20	9.80 307	28	0.19 693	9.92 635	8	34
27	9.72 962	20	9.80 335	28	0.19 665	9.92 627	8	33
28	9.72 982	20	9.80 363	28	0.19 637	9.92 619	8	32
29	9.73 002	20	9.80 391	28	0.19 609	9.92 611	8	31
30	9.73 022	19	9.80 419	28	0.19 581	9.92 603	8	30
31	9.73 041	20	9.80 447	27	0.19 553	9.92 595	8	29
32	9.73 061	20	9.80 474	28	0.19 526	9.92 587	8	28
33	9.73 081	20	9.80 502	28	0.19 498	9.92 579	8	27
34	9.73 101	20	9.80 530	28	0.19 470	9.92 571	8	26
35	9.73 121	19	9.80 558	28	0.19 442	9.92 563	8	25
36	9.73 140	20	9.80 586	28	0.19 414	9.92 555	9	24
37	9.73 160	20	9.80 614	28	0.19 386	9.92 546	8	23
38	9.73 180	20	9.80 642	27	0.19 358	9.92 538	8	22
39	9.73 200	19	9.80 669	28	0.19 331	9.92 530	8	21
40	9.73 219	20	9.80 697	28	0.19 303	9.92 522	8	20
41	9.73 239	20	9.80 725	28	0.19 275	9.92 514	8	19
42	9.73 259	19	9.80 753	28	0.19 247	9.92 506	8	18
43	9.73 278	20	9.80 781	27	0.19 219	9.92 498	8	17
44	9.73 298	20	9.80 808	28	0.19 192	9.92 490	8	16
45	9.73 318	19	9.80 836	28	0.19 164	9.92 482	9	15
46	9.73 337	20	9.80 864	28	0.19 136	9.92 473	8	14
47	9.73 357	20	9.80 892	27	0.19 108	9.92 465	8	13
48	9.73 377	19	9.80 919	28	0.19 081	9.92 457	8	12
49	9.73 396	20	9.80 947	28	0.19 053	9.92 449	8	11
50	9.73 416	19	9.80 975	28	0.19 025	9.92 441	8	10
51	9.73 435	20	9.81 003	27	0.18 997	9.92 433	8	9
52	9.73 455	19	9.81 030	28	0.18 970	9.92 425	9	8
53	9.73 474	20	9.81 058	28	0.18 942	9.92 416	8	7
54	9.73 494	19	9.81 086	27	0.18 914	9.92 408	8	6
55	9.73 513	20	9.81 113	28	0.18 887	9.92 400	8	5
56	9.73 533	19	9.81 141	28	0.18 859	9.92 392	8	4
57	9.73 552	20	9.81 169	27	0.18 831	9.92 384	8	3
58	9.73 572	19	9.81 196	28	0.18 804	9.92 376	9	2
59	9.73 591	20	9.81 224	28	0.18 776	9.92 367	8	1
60	9.73 611		9.81 252		0.18 748	9.92 359		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	29	28	27
1	0.5	0.5	0.4
2	1.0	0.9	0.9
3	1.4	1.4	1.4
4	1.9	1.9	1.8
5	2.4	2.3	2.2
6	2.9	2.8	2.7
7	3.4	3.3	3.2
8	3.9	3.7	3.6
9	4.4	4.2	4.0
10	4.8	4.7	4.5
20	9.7	9.3	9.0
30	14.5	14.0	13.5
40	19.3	18.7	18.0
50	24.2	23.3	22.5

″	21	20	19
1	0.4	0.3	0.3
2	0.7	0.7	0.6
3	1.0	1.0	1.0
4	1.4	1.3	1.3
5	1.8	1.7	1.6
6	2.1	2.0	1.9
7	2.4	2.3	2.2
8	2.8	2.7	2.5
9	3.2	3.0	2.8
10	3.5	3.3	3.2
20	7.0	6.7	6.3
30	10.5	10.0	9.5
40	14.0	13.3	12.7
50	17.5	16.7	15.8

″	9	8	7
1	0.2	0.1	0.1
2	0.3	0.3	0.2
3	0.4	0.4	0.4
4	0.6	0.5	0.5
5	0.8	0.7	0.6
6	0.9	0.8	0.7
7	1.0	0.9	0.8
8	1.2	1.1	0.9
9	1.4	1.2	1.0
10	1.5	1.3	1.2
20	3.0	2.7	2.3
30	4.5	4.0	3.5
40	6.0	5.3	4.7
50	7.5	6.7	5.8

	$\frac{8}{29}$	$\frac{8}{28}$	$\frac{7}{28}$
0	1.8	1.8	2.0
1	5.4	5.2	6.0
2	9.1	8.8	10.0
3	12.7	12.2	14.0
4	16.3	15.8	18.0
5	19.9	19.2	22.0
6	23.6	22.8	26.0
7	27.2	26.2	—
8			

P. P.

122° (302°) (237°) **57°**

33° (213°) (326°) **146°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.73 611	19	9.81 252	27	0.18 748	9.92 359	8	**60**
1	9.73 630	20	9.81 279	28	0.18 721	9.92 351	8	59
2	9.73 650	19	9.81 307	28	0.18 693	9.92 343	8	58
3	9.73 669	20	9.81 335	27	0.18 665	9.92 335	9	57
4	9.73 689	19	9.81 362	28	0.18 638	9.92 326	8	56
5	9.73 708	19	9.81 390	28	0.18 610	9.92 318	8	55
6	9.73 727	20	9.81 418	27	0.18 582	9.92 310	8	54
7	9.73 747	19	9.81 445	28	0.18 555	9.92 302	9	53
8	9.73 766	19	9.81 473	27	0.18 527	9.92 293	8	52
9	9.73 785	20	9.81 500	28	0.18 500	9.92 285	8	51
10	9.73 805	19	9.81 528	28	0.18 472	9.92 277	8	**50**
11	9.73 824	19	9.81 556	27	0.18 444	9.92 269	9	49
12	9.73 843	20	9.81 583	28	0.18 417	9.92 260	8	48
13	9.73 863	19	9.81 611	27	0.18 389	9.92 252	8	47
14	9.73 882	19	9.81 638	28	0.18 362	9.92 244	9	46
15	9.73 901	20	9.81 666	27	0.18 334	9.92 235	8	45
16	9.73 921	19	9.81 693	28	0.18 307	9.92 227	8	44
17	9.73 940	19	9.81 721	27	0.18 279	9.92 219	8	43
18	9.73 959	19	9.81 748	28	0.18 252	9.92 211	9	42
19	9.73 978	19	9.81 776	27	0.18 224	9.92 202	8	41
20	9.73 997	20	9.81 803	28	0.18 197	9.92 194	8	**40**
21	9.74 017	19	9.81 831	27	0.18 169	9.92 186	9	39
22	9.74 036	19	9.81 858	28	0.18 142	9.92 177	8	38
23	9.74 055	19	9.81 886	27	0.18 114	9.92 169	8	37
24	9.74 074	19	9.81 913	28	0.18 087	9.92 161	9	36
25	9.74 093	20	9.81 941	27	0.18 059	9.92 152	8	35
26	9.74 113	19	9.81 968	28	0.18 032	9.92 144	8	34
27	9.74 132	19	9.81 996	27	0.18 004	9.92 136	9	33
28	9.74 151	19	9.82 023	28	0.17 977	9.92 127	8	32
29	9.74 170	19	9.82 051	27	0.17 949	9.92 119	8	31
30	9.74 189	19	9.82 078	28	0.17 922	9.92 111	9	**30**
31	9.74 208	19	9.82 106	27	0.17 894	9.92 102	8	29
32	9.74 227	19	9.82 133	28	0.17 867	9.92 094	8	28
33	9.74 246	19	9.82 161	27	0.17 839	9.92 086	9	27
34	9.74 265	19	9.82 188	27	0.17 812	9.92 077	8	26
35	9.74 284	19	9.82 215	28	0.17 785	9.92 069	9	25
36	9.74 303	19	9.82 243	27	0.17 757	9.92 060	8	24
37	9.74 322	19	9.82 270	28	0.17 730	9.92 052	8	23
38	9.74 341	19	9.82 298	27	0.17 702	9.92 044	9	22
39	9.74 360	19	9.82 325	27	0.17 675	9.92 035	8	21
40	9.74 379	19	9.82 352	28	0.17 648	9.92 027	9	**20**
41	9.74 398	19	9.82 380	27	0.17 620	9.92 018	8	19
42	9.74 417	19	9.82 407	28	0.17 593	9.92 010	8	18
43	9.74 436	19	9.82 435	27	0.17 565	9.92 002	9	17
44	9.74 455	19	9.82 462	27	0.17 538	9.91 993	8	16
45	9.74 474	19	9.82 489	28	0.17 511	9.91 985	9	15
46	9.74 493	19	9.82 517	27	0.17 483	9.91 976	8	14
47	9.74 512	19	9.82 544	27	0.17 456	9.91 968	9	13
48	9.74 531	18	9.82 571	28	0.17 429	9.91 959	8	12
49	9.74 549	19	9.82 599	27	0.17 401	9.91 951	9	11
50	9.74 568	19	9.82 626	27	0.17 374	9.91 942	8	**10**
51	9.74 587	19	9.82 653	28	0.17 347	9.91 934	9	9
52	9.74 606	19	9.82 681	27	0.17 319	9.91 925	8	8
53	9.74 625	19	9.82 708	27	0.17 292	9.91 917	9	7
54	9.74 644	18	9.82 735	27	0.17 265	9.91 908	8	6
55	9.74 662	19	9.82 762	28	0.17 238	9.91 900	9	5
56	9.74 681	19	9.82 790	27	0.17 210	9.91 891	8	4
57	9.74 700	19	9.82 817	27	0.17 183	9.91 883	9	3
58	9.74 719	18	9.82 844	27	0.17 156	9.91 874	8	2
59	9.74 737	19	9.82 871	28	0.17 129	9.91 866	9	1
60	9.74 756		9.82 899		0.17 101	9.91 857		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	28	27
1	0.5	0.4
2	0.9	0.9
3	1.4	1.4
4	1.9	1.8
5	2.3	2.2
6	2.8	2.7
7	3.3	3.2
8	3.7	3.6
9	4.2	4.0
10	4.7	4.5
20	9.3	9.0
30	14.0	13.5
40	18.7	18.0
50	23.3	22.5

″	20	19	18
1	0.3	0.3	0.3
2	0.7	0.6	0.6
3	1.0	1.0	0.9
4	1.3	1.3	1.2
5	1.7	1.6	1.5
6	2.0	1.9	1.8
7	2.3	2.2	2.1
8	2.7	2.5	2.4
9	3.0	2.8	2.7
10	3.3	3.2	3.0
20	6.7	6.3	6.0
30	10.0	9.5	9.0
40	13.3	12.7	12.0
50	16.7	15.8	15.0

″	9	8
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

	$\frac{9}{28}$	$\frac{9}{27}$	$\frac{8}{27}$
0	1.6	1.5	1.7
1	4.7	4.5	5.1
2	7.8	7.5	8.4
3	10.9	10.5	11.8
4	14.0	13.5	15.2
5	17.1	16.5	18.6
6	20.2	19.5	21.9
7	23.3	22.5	25.3
8	26.4	25.5	—
9			

P. P.

123° (303°) (236°) **56°**

34° (214°) (325°) **145°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.74 756	19	9.82 899	27	0.17 101	9.91 857	8	**60**
1	9.74 775	19	9.82 926	27	0.17 074	9.91 849	9	59
2	9.74 794	18	9.82 953	27	0.17 047	9.91 840	8	58
3	9.74 812	19	9.82 980	28	0.17 020	9.91 832	9	57
4	9.74 831	19	9.83 008	27	0.16 992	9.91 823	8	56
5	9.74 850	18	9.83 035	27	0.16 965	9.91 815	9	55
6	9.74 868	19	9.83 062	27	0.16 938	9.91 806	8	54
7	9.74 887	19	9.83 089	28	0.16 911	9.91 798	9	53
8	9.74 906	18	9.83 117	27	0.16 883	9.91 789	8	52
9	9.74 924	19	9.83 144	27	0.16 856	9.91 781	9	51
10	9.74 943	18	9.83 171	27	0.16 829	9.91 772	9	**50**
11	9.74 961	19	9.83 198	27	0.16 802	9.91 763	8	49
12	9.74 980	19	9.83 225	27	0.16 775	9.91 755	9	48
13	9.74 999	18	9.83 252	28	0.16 748	9.91 746	8	47
14	9.75 017	19	9.83 280	27	0.16 720	9.91 738	9	46
15	9.75 036	18	9.83 307	27	0.16 693	9.91 729	9	45
16	9.75 054	19	9.83 334	27	0.16 666	9.91 720	8	44
17	9.75 073	18	9.83 361	27	0.16 639	9.91 712	9	43
18	9.75 091	19	9.83 388	27	0.16 612	9.91 703	8	42
19	9.75 110	18	9.83 415	27	0.16 585	9.91 695	9	41
20	9.75 128	19	9.83 442	28	0.16 558	9.91 686	9	**40**
21	9.75 147	18	9.83 470	27	0.16 530	9.91 677	8	39
22	9.75 165	19	9.83 497	27	0.16 503	9.91 669	9	38
23	9.75 184	18	9.83 524	27	0.16 476	9.91 660	9	37
24	9.75 202	19	9.83 551	27	0.16 449	9.91 651	8	36
25	9.75 221	18	9.83 578	27	0.16 422	9.91 643	9	35
26	9.75 239	19	9.83 605	27	0.16 395	9.91 634	9	34
27	9.75 258	18	9.83 632	27	0.16 368	9.91 625	8	33
28	9.75 276	18	9.83 659	27	0.16 341	9.91 617	9	32
29	9.75 294	19	9.83 686	27	0.16 314	9.91 608	9	31
30	9.75 313	18	9.83 713	27	0.16 287	9.91 599	8	**30**
31	9.75 331	19	9.83 740	28	0.16 260	9.91 591	9	29
32	9.75 350	18	9.83 768	27	0.16 232	9.91 582	9	28
33	9.75 368	18	9.83 795	27	0.16 205	9.91 573	8	27
34	9.75 386	19	9.83 822	27	0.16 178	9.91 565	9	26
35	9.75 405	18	9.83 849	27	0.16 151	9.91 556	9	25
36	9.75 423	18	9.83 876	27	0.16 124	9.91 547	9	24
37	9.75 441	18	9.83 903	27	0.16 097	9.91 538	8	23
38	9.75 459	19	9.83 930	27	0.16 070	9.91 530	9	22
39	9.75 478	18	9.83 957	27	0.16 043	9.91 521	9	21
40	9.75 496	18	9.83 984	27	0.16 016	9.91 512	8	**20**
41	9.75 514	19	9.84 011	27	0.15 989	9.91 504	9	19
42	9.75 533	18	9.84 038	27	0.15 962	9.91 495	9	18
43	9.75 551	18	9.84 065	27	0.15 935	9.91 486	9	17
44	9.75 569	18	9.84 092	27	0.15 908	9.91 477	8	16
45	9.75 587	18	9.84 119	27	0.15 881	9.91 469	9	15
46	9.75 605	19	9.84 146	27	0.15 854	9.91 460	9	14
47	9.75 624	18	9.84 173	27	0.15 827	9.91 451	9	13
48	9.75 642	18	9.84 200	27	0.15 800	9.91 442	9	12
49	9.75 660	18	9.84 227	27	0.15 773	9.91 433	8	11
50	9.75 678	18	9.84 254	26	0.15 746	9.91 425	9	**10**
51	9.75 696	18	9.84 280	27	0.15 720	9.91 416	9	9
52	9.75 714	19	9.84 307	27	0.15 693	9.91 407	9	8
53	9.75 733	18	9.84 334	27	0.15 666	9.91 398	9	7
54	9.75 751	18	9.84 361	27	0.15 639	9.91 389	8	6
55	9.75 769	18	9.84 388	27	0.15 612	9.91 381	9	5
56	9.75 787	18	9.84 415	27	0.15 585	9.91 372	9	4
57	9.75 805	18	9.84 442	27	0.15 558	9.91 363	9	3
58	9.75 823	18	9.84 469	27	0.15 531	9.91 354	9	2
59	9.75 841	18	9.84 496	27	0.15 504	9.91 345	9	1
60	9.75 859		9.84 523		0.15 477	9.91 336		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**28**	**27**	**26**
1	0.5	0.4	0.4
2	0.9	0.9	0.9
3	1.4	1.4	1.3
4	1.9	1.8	1.7
5	2.3	2.2	2.2
6	2.8	2.7	2.6
7	3.3	3.2	3.0
8	3.7	3.6	3.5
9	4.2	4.0	3.9
10	4.7	4.5	4.3
20	9.3	9.0	8.7
30	14.0	13.5	13.0
40	18.7	18.0	17.3
50	23.3	22.5	21.7

″	**19**	**18**
1	0.3	0.3
2	0.6	0.6
3	1.0	0.9
4	1.3	1.2
5	1.6	1.5
6	1.9	1.8
7	2.2	2.1
8	2.5	2.4
9	2.8	2.7
10	3.2	3.0
20	6.3	6.0
30	9.5	9.0
40	12.7	12.0
50	15.8	15.0

″	**9**	**8**
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

	$\frac{\mathbf{9}}{\mathbf{28}}$	$\frac{\mathbf{8}}{\mathbf{28}}$	$\frac{\mathbf{8}}{\mathbf{27}}$
0	1.6	1.8	1.7
1	4.7	5.2	5.1
2	7.8	8.8	8.4
3	10.9	12.2	11.8
4	14.0	15.8	15.2
5	17.1	19.2	18.6
6	20.2	22.8	21.9
7	23.3	26.2	25.3
8	26.4	—	—
9			

P.P.

124° (304°) (235°) **55°**

35° (215°) (324°) **144°**

'	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	'
0	9.75 859	18	9.84 523	27	0.15 477	9.91 336	8	60
1	9.75 877	18	9.84 550	26	0.15 450	9.91 328	9	59
2	9.75 895	18	9.84 576	27	0.15 424	9.91 319	9	58
3	9.75 913	18	9.84 603	27	0.15 397	9.91 310	9	57
4	9.75 931	18	9.84 630	27	0.15 370	9.91 301	9	56
5	9.75 949	18	9.84 657	27	0.15 343	9.91 292	9	55
6	9.75 967	18	9.84 684	27	0.15 316	9.91 283	9	54
7	9.75 985	18	9.84 711	27	0.15 289	9.91 274	8	53
8	9.76 003	18	9.84 738	26	0.15 262	9.91 266	9	52
9	9.76 021	18	9.84 764	27	0.15 236	9.91 257	9	51
10	9.76 039	18	9.84 791	27	0.15 209	9.91 248	9	50
11	9.76 057	18	9.84 818	27	0.15 182	9.91 239	9	49
12	9.76 075	18	9.84 845	27	0.15 155	9.91 230	9	48
13	9.76 093	18	9.84 872	27	0.15 128	9.91 221	9	47
14	9.76 111	18	9.84 899	26	0.15 101	9.91 212	9	46
15	9.76 129	17	9.84 925	27	0.15 075	9.91 203	9	45
16	9.76 146	18	9.84 952	27	0.15 048	9.91 194	9	44
17	9.76 164	18	9.84 979	27	0.15 021	9.91 185	9	43
18	9.76 182	18	9.85 006	27	0.14 994	9.91 176	9	42
19	9.76 200	18	9.85 033	26	0.14 967	9.91 167	9	41
20	9.76 218	18	9.85 059	27	0.14 941	9.91 158	9	40
21	9.76 236	17	9.85 086	27	0.14 914	9.91 149	8	39
22	9.76 253	18	9.85 113	27	0.14 887	9.91 141	9	38
23	9.76 271	18	9.85 140	26	0.14 860	9.91 132	9	37
24	9.76 289	18	9.85 166	27	0.14 834	9.91 123	9	36
25	9.76 307	17	9.85 193	27	0.14 807	9.91 114	9	35
26	9.76 324	18	9.85 220	27	0.14 780	9.91 105	9	34
27	9.76 342	18	9.85 247	26	0.14 753	9.91 096	9	33
28	9.76 360	18	9.85 273	27	0.14 727	9.91 087	9	32
29	9.76 378	17	9.85 300	27	0.14 700	9.91 078	9	31
30	9.76 395	18	9.85 327	27	0.14 673	9.91 069	9	30
31	9.76 413	18	9.85 354	26	0.14 646	9.91 060	9	29
32	9.76 431	17	9.85 380	27	0.14 620	9.91 051	9	28
33	9.76 448	18	9.85 407	27	0.14 593	9.91 042	9	27
34	9.76 466	18	9.85 434	26	0.14 566	9.91 033	10	26
35	9.76 484	17	9.85 460	27	0.14 540	9.91 023	9	25
36	9.76 501	18	9.85 487	27	0.14 513	9.91 014	9	24
37	9.76 519	18	9.85 514	26	0.14 486	9.91 005	9	23
38	9.76 537	17	9.85 540	27	0.14 460	9.90 996	9	22
39	9.76 554	18	9.85 567	27	0.14 433	9.90 987	9	21
40	9.76 572	18	9.85 594	26	0.14 406	9.90 978	9	20
41	9.76 590	17	9.85 620	27	0.14 380	9.90 969	9	19
42	9.76 607	18	9.85 647	27	0.14 353	9.90 960	9	18
43	9.76 625	17	9.85 674	26	0.14 326	9.90 951	9	17
44	9.76 642	18	9.85 700	27	0.14 300	9.90 942	9	16
45	9.76 660	17	9.85 727	27	0.14 273	9.90 933	9	15
46	9.76 677	18	9.85 754	26	0.14 246	9.90 924	9	14
47	9.76 695	17	9.85 780	27	0.14 220	9.90 915	9	13
48	9.76 712	18	9.85 807	27	0.14 193	9.90 906	10	12
49	9.76 730	17	9.85 834	26	0.14 166	9.90 896	9	11
50	9.76 747	18	9.85 860	27	0.14 140	9.90 887	9	10
51	9.76 765	17	9.85 887	26	0.14 113	9.90 878	9	9
52	9.76 782	18	9.85 913	27	0.14 087	9.90 869	9	8
53	9.76 800	17	9.85 940	27	0.14 060	9.90 860	9	7
54	9.76 817	18	9.85 967	26	0.14 033	9.90 851	9	6
55	9.76 835	17	9.85 993	27	0.14 007	9.90 842	10	5
56	9.76 852	18	9.86 020	26	0.13 980	9.90 832	9	4
57	9.76 870	17	9.86 046	27	0.13 954	9.90 823	9	3
58	9.76 887	17	9.86 073	27	0.13 927	9.90 814	9	2
59	9.76 904	18	9.86 100	26	0.13 900	9.90 805	9	1
60	9.76 922		9.86 126		0.13 874	9.90 796		0
'	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	'

P.P.

"	27	26	18
1	0.4	0.4	0.3
2	0.9	0.9	0.6
3	1.4	1.3	0.9
4	1.8	1.7	1.2
5	2.2	2.2	1.5
6	2.7	2.6	1.8
7	3.2	3.0	2.1
8	3.6	3.5	2.4
9	4.0	3.9	2.7
10	4.5	4.3	3.0
20	9.0	8.7	6.0
30	13.5	13.0	9.0
40	18.0	17.3	12.0
50	22.5	21.7	15.0

"	17	10	9	8
1	0.3	0.2	0.2	0.1
2	0.6	0.3	0.3	0.3
3	0.8	0.5	0.4	0.4
4	1.1	0.7	0.6	0.5
5	1.4	0.8	0.8	0.7
6	1.7	1.0	0.9	0.8
7	2.0	1.2	1.0	0.9
8	2.3	1.3	1.2	1.1
9	2.6	1.5	1.4	1.2
10	2.8	1.7	1.5	1.3
20	5.7	3.3	3.0	2.7
30	8.5	5.0	4.5	4.0
40	11.3	6.7	6.0	5.3
50	14.2	8.3	7.5	6.7

	10/27	10/26
0	1.4	1.3
1	4.1	3.9
2	6.8	6.5
3	9.4	9.1
4	12.2	11.7
5	14.8	14.3
6	17.6	16.9
7	20.2	19.5
8	22.9	22.1
9	25.6	24.7
10		

	9/27	9/26
0	1.5	1.4
1	4.5	4.3
2	7.5	7.2
3	10.5	10.1
4	13.5	13.0
5	16.5	15.9
6	19.5	18.8
7	22.5	21.7
8	25.5	24.6
9		

P.P.

125° (305°) (234°) **54°**

36° (216°) (323°) **143°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.76 922	17	9.86 126	27	0.13 874	9.90 796	9	60
1	9.76 939	18	9.86 153	26	0.13 847	9.90 787	10	59
2	9.76 957	17	9.86 179	27	0.13 821	9.90 777	9	58
3	9.76 974	17	9.86 206	26	0.13 794	9.90 768	9	57
4	9.76 991	18	9.86 232	27	0.13 768	9.90 759	9	56
5	9.77 009	17	9.86 259	26	0.13 741	9.90 750	9	55
6	9.77 026	17	9.86 285	27	0.13 715	9.90 741	10	54
7	9.77 043	18	9.86 312	26	0.13 688	9.90 731	9	53
8	9.77 061	17	9.86 338	27	0.13 662	9.90 722	9	52
9	9.77 078	17	9.86 365	27	0.13 635	9.90 713	9	51
10	9.77 095	17	9.86 392	26	0.13 608	9.90 704	10	**50**
11	9.77 112	18	9.86 418	27	0.13 582	9.90 694	9	49
12	9.77 130	17	9.86 445	26	0.13 555	9.90 685	9	48
13	9.77 147	17	9.86 471	27	0.13 529	9.90 676	9	47
14	9.77 164	17	9.86 498	26	0.13 502	9.90 667	10	46
15	9.77 181	18	9.86 524	27	0.13 476	9.90 657	9	45
16	9.77 199	17	9.86 551	26	0.13 449	9.90 648	9	44
17	9.77 216	17	9.86 577	26	0.13 423	9.90 639	9	43
18	9.77 233	17	9.86 603	27	0.13 397	9.90 630	10	42
19	9.77 250	18	9.86 630	26	0.13 370	9.90 620	9	41
20	9.77 268	17	9.86 656	27	0.13 344	9.90 611	9	**40**
21	9.77 285	17	9.86 683	26	0.13 317	9.90 602	10	39
22	9.77 302	17	9.86 709	27	0.13 291	9.90 592	9	38
23	9.77 319	17	9.86 736	26	0.13 264	9.90 583	9	37
24	9.77 336	17	9.86 762	27	0.13 238	9.90 574	9	36
25	9.77 353	17	9.86 789	26	0.13 211	9.90 565	10	35
26	9.77 370	17	9.86 815	27	0.13 185	9.90 555	9	34
27	9.77 387	18	9.86 842	26	0.13 158	9.90 546	9	33
28	9.77 405	17	9.86 868	26	0.13 132	9.90 537	10	32
29	9.77 422	17	9.86 894	27	0.13 106	9.90 527	9	31
30	9.77 439	17	9.86 921	26	0.13 079	9.90 518	9	**30**
31	9.77 456	17	9.86 947	27	0.13 053	9.90 509	10	29
32	9.77 473	17	9.86 974	26	0.13 026	9.90 499	9	28
33	9.77 490	17	9.87 000	27	0.13 000	9.90 490	10	27
34	9.77 507	17	9.87 027	26	0.12 973	9.90 480	9	26
35	9.77 524	17	9.87 053	26	0.12 947	9 90 471	9	25
36	9.77 541	17	9.87 079	27	0.12 921	9.90 462	10	24
37	9.77 558	17	9.87 106	26	0.12 894	9.90 452	9	23
38	9.77 575	17	9.87 132	26	0.12 868	9.90 443	9	22
39	9.77 592	17	9.87 158	27	0.12 842	9.90 434	10	21
40	9.77 609	17	9.87 185	26	0.12 815	9.90 424	9	**20**
41	9.77 626	17	9.87 211	27	0.12 789	9.90 415	10	19
42	9.77 643	17	9.87 238	26	0.12 762	9.90 405	9	18
43	9.77 660	17	9.87 264	26	0.12 736	9.90 396	10	17
44	9.77 677	17	9.87 290	27	0.12 710	9.90 386	9	16
45	9.77 694	17	9.87 317	26	0.12 683	9.90 377	9	15
46	9.77 711	17	9.87 343	26	0.12 657	9.90 368	10	14
47	9.77 728	16	9.87 369	27	0.12 631	9.90 358	9	13
48	9.77 744	17	9.87 396	26	0.12 604	9.90 349	10	12
49	9.77 761	17	9.87 422	26	0.12 578	9.90 339	9	11
50	9.77 778	17	9.87 448	27	0.12 552	9.90 330	10	**10**
51	9.77 795	17	9.87 475	26	0.12 525	9.90 320	9	9
52	9.77 812	17	9.87 501	26	0.12 499	9.90 311	10	8
53	9.77 829	17	9.87 527	27	0.12 473	9.90 301	9	7
54	9.77 846	16	9.87 554	26	0.12 446	9.90 292	10	6
55	9.77 862	17	9.87 580	26	0.12 420	9.90 282	9	5
56	9.77 879	17	9.87 606	27	0.12 394	9.90 273	10	4
57	9.77 896	17	9.87 633	26	0.12 367	9.90 263	9	3
58	9.77 913	17	9.87 659	26	0.12 341	9.90 254	10	2
59	9.77 930	16	9.87 685	26	0.12 315	9.90 244	9	1
60	9.77 946		9.87 711		0.12 289	9.90 235		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	18	17	16
1	0.3	0.3	0.3
2	0.6	0.6	0.5
3	0.9	0.8	0.8
4	1.2	1.1	1.1
5	1.5	1.4	1.3
6	1.8	1.7	1.6
7	2.1	2.0	1.9
8	2.4	2.3	2.1
9	2.7	2.6	2.4
10	3.0	2.8	2.7
20	6.0	5.7	5.3
30	9.0	8.5	8.0
40	12.0	11.3	10.7
50	15.0	14.2	13.3

″	10	9
1	0.2	0.2
2	0.3	0.3
3	0.5	0.4
4	0.7	0.6
5	0.8	0.8
6	1.0	0.9
7	1.2	1.0
8	1.3	1.2
9	1.5	1.4
10	1.7	1.5
20	3.3	3.0
30	5.0	4.5
40	6.7	6.0
50	8.3	7.5

	$\frac{9}{27}$	$\frac{9}{26}$
0	1.5	1.4
1	4.5	4.3
2	7.5	7.2
3	10.5	10.1
4	13.5	13.0
5	16.5	15.9
6	19.5	18.8
7	22.5	21.7
8	25.5	24.6
9		

P. P.

126° (306°) (233°) **53°**

37° (217°) (322°) **142°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.77 946	17	9.87 711	27	0.12 289	9.90 235	10	60
1	9.77 963	17	9.87 738	26	0.12 262	9.90 225	9	59
2	9.77 980	17	9.87 764	26	0.12 236	9.90 216	10	58
3	9.77 997	16	9.87 790	27	0.12 210	9.90 206	9	57
4	9.78 013	17	9.87 817	26	0.12 183	9.90 197	10	56
5	9.78 030	17	9.87 843	26	0.12 157	9.90 187	9	55
6	9.78 047	16	9.87 869	26	0.12 131	9.90 178	10	54
7	9.78 063	17	9.87 895	27	0.12 105	9.90 168	9	53
8	9.78 080	17	9.87 922	26	0.12 078	9.90 159	10	52
9	9.78 097	16	9.87 948	26	0.12 052	9.90 149	10	51
10	9.78 113	17	9.87 974	26	0.12 026	9.90 139	9	50
11	9.78 130	17	9.88 000	27	0.12 000	9.90 130	10	49
12	9.78 147	16	9.88 027	26	0.11 973	9.90 120	9	48
13	9.78 163	17	9.88 053	26	0.11 947	9.90 111	10	47
14	9.78 180	17	9.88 079	26	0.11 921	9.90 101	10	46
15	9.78 197	16	9.88 105	26	0.11 895	9.90 091	9	45
16	9.78 213	17	9.88 131	27	0.11 869	9.90 082	10	44
17	9.78 230	16	9.88 158	26	0.11 842	9.90 072	9	43
18	9.78 246	17	9.88 184	26	0.11 816	9.90 063	10	42
19	9.78 263	17	9.88 210	26	0.11 790	9.90 053	10	41
20	9.78 280	16	9.88 236	26	0.11 764	9.90 043	9	40
21	9.78 296	17	9.88 262	27	0.11 738	9.90 034	10	39
22	9.78 313	16	9.88 289	26	0.11 711	9.90 024	10	38
23	9.78 329	17	9.88 315	26	0.11 685	9.90 014	9	37
24	9.78 346	16	9.88 341	26	0.11 659	9.90 005	10	36
25	9.78 362	17	9.88 367	26	0.11 633	9.89 995	10	35
26	9.78 379	16	9.88 393	27	0.11 607	9.89 985	9	34
27	9.78 395	17	9.88 420	26	0.11 580	9.89 976	10	33
28	9.78 412	16	9.88 446	26	0.11 554	9.89 966	10	32
29	9.78 428	17	9.88 472	26	0.11 528	9.89 956	9	31
30	9.78 445	16	9.88 498	26	0.11 502	9.89 947	10	30
31	9.78 461	17	9.88 524	26	0.11 476	9.89 937	10	29
32	9.78 478	16	9.88 550	27	0.11 450	9.89 927	9	28
33	9.78 494	16	9.88 577	26	0.11 423	9.89 918	10	27
34	9.78 510	17	9.88 603	26	0.11 397	9.89 908	10	26
35	9.78 527	16	9.88 629	26	0.11 371	9.89 898	10	25
36	9.78 543	17	9.88 655	26	0.11 345	9.89 888	9	24
37	9.78 560	16	9.88 681	26	0.11 319	9.89 879	10	23
38	9.78 576	16	9.88 707	26	0.11 293	9.89 869	10	22
39	9.78 592	17	9.88 733	26	0.11 267	9.89 859	10	21
40	9.78 609	16	9.88 759	27	0.11 241	9.89 849	9	20
41	9.78 625	17	9.88 786	26	0.11 214	9.89 840	10	19
42	9.78 642	16	9.88 812	26	0.11 188	9.89 830	10	18
43	9.78 658	16	9.88 838	26	0.11 162	9.89 820	10	17
44	9.78 674	17	9.88 864	26	0.11 136	9.89 810	9	16
45	9.78 691	16	9.88 890	26	0.11 110	9.89 801	10	15
46	9.78 707	16	9.88 916	26	0.11 084	9.89 791	10	14
47	9.78 723	16	9.88 942	26	0.11 058	9.89 781	10	13
48	9.78 739	17	9.88 968	26	0.11 032	9.89 771	10	12
49	9.78 756	16	9.88 994	26	0.11 006	9.89 761	9	11
50	9.78 772	16	9.89 020	26	0.10 980	9.89 752	10	10
51	9.78 788	17	9.89 046	27	0.10 954	9.89 742	10	9
52	9.78 805	16	9.89 073	26	0.10 927	9.89 732	10	8
53	9.78 821	16	9.89 099	26	0.10 901	9.89 722	10	7
54	9.78 837	16	9.89 125	26	0.10 875	9.89 712	10	6
55	9.78 853	16	9.89 151	26	0.10 849	9.89 702	9	5
56	9.78 869	17	9.89 177	26	0.10 823	9.89 693	10	4
57	9.78 886	16	9.89 203	26	0.10 797	9.89 683	10	3
58	9.78 902	16	9.89 229	26	0.10 771	9.89 673	10	2
59	9.78 918	16	9.89 255	26	0.10 745	9.89 663	10	1
60	9.78 934		9.89 281		0.10 719	9.89 653		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	17	16
1	0.3	0.3
2	0.6	0.5
3	0.8	0.8
4	1.1	1.1
5	1.4	1.3
6	1.7	1.6
7	2.0	1.9
8	2.3	2.1
9	2.6	2.4
10	2.8	2.7
20	5.7	5.3
30	8.5	8.0
40	11.3	10.7
50	14.2	13.3

″	10	9
1	0.2	0.2
2	0.3	0.3
3	0.5	0.4
4	0.7	0.6
5	0.8	0.8
6	1.0	0.9
7	1.2	1.0
8	1.3	1.2
9	1.5	1.4
10	1.7	1.5
20	3.3	3.0
30	5.0	4.5
40	6.7	6.0
50	8.3	7.5

	$\frac{10}{27}$	$\frac{10}{26}$
0	1.4	1.3
1	4.1	3.9
2	6.8	6.5
3	9.4	9.1
4	12.2	11.7
5	14.8	14.3
6	17.6	16.9
7	20.2	19.5
8	22.9	22.1
9	25.6	24.7
10		

P. P.

127° (307°) (232°) **52°**

38° (218°) (321°) **141°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.78 934	16	9.89 281	26	0.10 719	9.89 653	10	60
1	9.78 950	17	9.89 307	26	0.10 693	9.89 643	10	59
2	9.78 967	16	9.89 333	26	0.10 667	9.89 633	9	58
3	9.78 983	16	9.89 359	26	0.10 641	9.89 624	10	57
4	9.78 999	16	9.89 385	26	0.10 615	9.89 614	10	56
5	9.79 015	16	9.89 411	26	0.10 589	9.89 604	10	55
6	9.79 031	16	9.89 437	26	0.10 563	9.89 594	10	54
7	9.79 047	16	9.89 463	26	0.10 537	9.89 584	10	53
8	9.79 063	16	9.89 489	26	0.10 511	9.89 574	10	52
9	9.79 079	16	9.89 515	26	0.10 485	9.89 564	10	51
10	9.79 095	16	9.89 541	26	0.10 459	9,89 554	10	50
11	9.79 111	17	9.89 567	26	0.10 433	9.89 544	10	49
12	9.79 128	16	9.89 593	26	0.10 407	9.89 534	10	48
13	9.79 144	16	9.89 619	26	0.10 381	9.89 524	10	47
14	9.79 160	16	9.89 645	26	0.10 355	9.89 514	10	46
15	9.79 176	16	9.89 671	26	0.10 329	9.89 504	9	45
16	9.79 192	16	9.89 697	26	0.10 303	9.89 495	10	44
17	9.79 208	16	9.89 723	26	0.10 277	9.89 485	10	43
18	9.79 224	16	9.89 749	26	0.10 251	9.89 475	10	42
19	9.79 240	16	9.89 775	26	0.10 225	9.89 465	10	41
20	9.79 256	16	9.89 801	26	0.10 199	9.89 455	10	40
21	9.79 272	16	9.89 827	26	0.10 173	9.89 445	10	39
22	9.79 288	16	9.89 853	26	0.10 147	9.89 435	10	38
23	9.79 304	15	9.89 879	26	0.10 121	9.89 425	10	37
24	9.79 319	16	9.89 905	26	0.10 095	9.89 415	10	36
25	9.79 335	16	9.89 931	26	0.10 069	9.89 405	10	35
26	9.79 351	16	9.89 957	26	0.10 043	9.89 395	10	34
27	9.79 367	16	9.89 983	26	0.10 017	9.89 385	10	33
28	9.79 383	16	9.90 009	26	0.09 991	9.89 375	11	32
29	9.79 399	16	9.90 035	26	0.09 965	9.89 364	10	31
30	9.79 415	16	9.90 061	25	0.09 939	9.89 354	10	30
31	9.79 431	16	9.90 086	26	0.09 914	9.89 344	10	29
32	9.79 447	16	9.90 112	26	0.09 888	9.89 334	10	28
33	9.79 463	15	9.90 138	26	0.09 862	9.89 324	10	27
34	9.79 478	16	9.90 164	26	0.09 836	9.89 314	10	26
35	9.79 494	16	9.90 190	26	0.09 810	9.89 304	10	25
36	9.79 510	16	9.90 216	26	0.09 784	9.89 294	10	24
37	9.79 526	16	9.90 242	26	0.09 758	9.89 284	10	23
38	9.79 542	16	9.90 268	26	0.09 732	9.89 274	10	22
39	9.79 558	15	9.90 294	26	0.09 706	9.89 264	10	21
40	9.79 573	16	9.90 320	26	0.09 680	9.89 254	10	20
41	9.79 589	16	9.90 346	25	0.09 654	9.89 244	11	19
42	9.79 605	16	9.90 371	26	0.09 629	9.89 233	10	18
43	9.79 621	15	9.90 397	26	0.09 603	9.89 223	10	17
44	9.79 636	16	9.90 423	26	0.09 577	9.89 213	10	16
45	9.79 652	16	9.90 449	26	0.09 551	9.89 203	10	15
46	9.79 668	16	9.90 475	26	0.09 525	9.89 193	10	14
47	9.79 684	15	9.90 501	26	0.09 499	9.89 183	10	13
48	9.79 699	16	9.90 527	26	0.09 473	9.89 173	11	12
49	9.79 715	16	9.90 553	25	0.09 447	9.89 162	10	11
50	9.79 731	15	9.90 578	26	0.09 422	9.89 152	10	10
51	9.79 746	16	9.90 604	26	0.09 396	9.89 142	10	9
52	9.79 762	16	9.90 630	26	0.09 370	9.89 132	10	8
53	9.79 778	15	9.90 656	26	0.09 344	9.89 122	10	7
54	9.79 793	16	9.90 682	26	0.09 318	9.89 112	11	6
55	9.79 809	16	9.90 708	26	0.09 292	9.89 101	10	5
56	9.79 825	15	9.90 734	25	0.09 266	9.89 091	10	4
57	9.79 840	16	9.90 759	26	0.09 241	9.89 081	10	3
58	9.79 856	16	9.90 785	26	0.09 215	9.89 071	11	2
59	9.79 872	15	9.90 811	26	0.09 189	9.89 060	10	1
60	9.79 887		9.90 837		0.09 163	9.89 050		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	17	16	15
1	0.3	0.3	0.2
2	0.6	0.5	0.5
3	0.8	0.8	0.8
4	1.1	1.1	1.0
5	1.4	1.3	1.2
6	1.7	1.6	1.5
7	2.0	1.9	1.8
8	2.3	2.1	2.0
9	2.6	2.4	2.2
10	2.8	2.7	2.5
20	5.7	5.3	5.0
30	8.5	8.0	7.5
40	11.3	10.7	10.0
50	14.2	13.3	12.5

″	11	10	9
1	0.2	0.2	0.2
2	0.4	0.3	0.3
3	0.6	0.5	0.4
4	0.7	0.7	0.6
5	0.9	0.8	0.8
6	1.1	1.0	0.9
7	1.3	1.2	1.0
8	1.5	1.3	1.2
9	1.6	1.5	1.4
10	1.8	1.7	1.5
20	3.7	3.3	3.0
30	5.5	5.0	4.5
40	7.3	6.7	6.0
50	9.2	8.3	7.5

	10/26	10/25	9/26
0	1.3	1.2	1.4
1	3.9	3.8	4.3
2	6.5	6.2	7.2
3	9.1	8.8	10.1
4	11.7	11.2	13.0
5	14.3	13.8	15.9
6	16.9	16.2	18.8
7	19.5	18.8	21.7
8	22.1	21.2	24.6
9	24.7	23.8	—
10			

P. P.

128° (308°) (231°) **51°**

39° (219°) (320°) **140°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.79 887	16	9.90 837	26	0.09 163	9.89 050	10	**60**
1	9.79 903	15	9.90 863	26	0.09 137	9.89 040	10	59
2	9.79 918	16	9.90 889	25	0.09 111	9.89 030	10	58
3	9.79 934	16	9.90 914	26	0.09 086	9.89 020	11	57
4	9.79 950	15	9.90 940	26	0.09 060	9.89 009	10	56
5	9.79 965	16	9.90 966	26	0.09 034	9.88 999	10	55
6	9.79 981	15	9.90 992	26	0.09 008	9.88 989	11	54
7	9.79 996	16	9.91 018	25	0.08 982	9.88 978	10	53
8	9.80 012	15	9.91 043	26	0.08 957	9.88 968	10	52
9	9.80 027	16	9.91 069	26	0.08 931	9.88 958	10	51
10	9.80 043	15	9.91 095	26	0.08 905	9.88 948	11	**50**
11	9.80 058	16	9.91 121	26	0.08 879	9.88 937	10	49
12	9.80 074	15	9.91 147	25	0.08 853	9.88 927	10	48
13	9.80 089	16	9.91 172	26	0.08 828	9.88 917	11	47
14	9.80 105	15	9.91 198	26	0.08 802	9.88 906	10	46
15	9.80 120	16	9.91 224	26	0.08 776	9.88 896	10	45
16	9.80 136	15	9.91 250	26	0.08 750	9.88 886	11	44
17	9.80 151	15	9.91 276	25	0.08 724	9.88 875	10	43
18	9.80 166	16	9.91 301	26	0.08 699	9.88 865	10	42
19	9.80 182	15	9.91 327	26	0.08 673	9.88 855	11	41
20	9.80 197	16	9.91 353	26	0.08 647	9.88 844	10	**40**
21	9.80 213	15	9.91 379	25	0.08 621	9.88 834	10	39
22	9.80 228	16	9.91 404	26	0.08 596	9.88 824	11	38
23	9.80 244	15	9.91 430	26	0.08 570	9.88 813	10	37
24	9.80 259	15	9.91 456	26	0.08 544	9.88 803	10	36
25	9.80 274	16	9.91 482	25	0.08 518	9.88 793	11	35
26	9.80 290	15	9.91 507	26	0.08 493	9.88 782	10	34
27	9.80 305	15	9.91 533	26	0.08 467	9.88 772	11	33
28	9.80 320	16	9.91 559	26	0.08 441	9.88 761	10	32
29	9.80 336	15	9.91 585	25	0.08 415	9.88 751	10	31
30	9.80 351	15	9.91 610	26	0.08 390	9.88 741	11	**30**
31	9.80 366	16	9.91 636	26	0.08 364	9.88 730	10	29
32	9.80 382	15	9.91 662	26	0.08 338	9.88 720	11	28
33	9.80 397	15	9.91 688	25	0.08 312	9.88 709	10	27
34	9.80 412	16	9.91 713	26	0.08 287	9.88 699	11	26
35	9.80 428	15	9.91 739	26	0.08 261	9.88 688	10	25
36	9.80 443	15	9.91 765	26	0.08 235	9.88 678	10	24
37	9.80 458	15	9.91 791	25	0.08 209	9.88 668	11	23
38	9.80 473	16	9.91 816	26	0.08 184	9.88 657	10	22
39	9.80 489	15	9.91 842	26	0.08 158	9.88 647	11	21
40	9.80 504	15	9.91 868	25	0.08 132	9.88 636	10	**20**
41	9.80 519	15	9.91 893	26	0.08 107	9.88 626	11	19
42	9.80 534	16	9.91 919	26	0.08 081	9.88 615	10	18
43	9.80 550	15	9.91 945	26	0.08 055	9.88 605	11	17
44	9.80 565	15	9.91 971	25	0.08 029	9.88 594	10	16
45	9.80 580	15	9.91 996	26	0.08 004	9.88 584	11	15
46	9.80 595	15	9.92 022	26	0.07 978	9.88 573	10	14
47	9.80 610	15	9.92 048	25	0.07 952	9.88 563	11	13
48	9.80 625	16	9.92 073	26	0.07 927	9.88 552	10	12
49	9.80 641	15	9.92 099	26	0.07 901	9.88 542	11	11
50	9.80 656	15	9.92 125	25	0.07 875	9.88 531	10	**10**
51	9.80 671	15	9.92 150	26	0.07 850	9.88 521	11	9
52	9.80 686	15	9.92 176	26	0.07 824	9.88 510	11	8
53	9.80 701	15	9.92 202	25	0.07 798	9.88 499	10	7
54	9.80 716	15	9.92 227	26	0.07 773	9.88 489	11	6
55	9.80 731	15	9.92 253	26	0.07 747	9.88 478	10	5
56	9.80 746	16	9.92 279	25	0.07 721	9.88 468	11	4
57	9.80 762	15	9.92 304	26	0.07 696	9.88 457	10	3
58	9.80 777	15	9.92 330	26	0.07 670	9.88 447	11	2
59	9.80 792	15	9.92 356	25	0.07 644	9.88 436	11	1
60	9.80 807		9.92 381		0.07 619	9.88 425		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	**16**	**15**
1	0.3	0.2
2	0.5	0.5
3	0.8	0.8
4	1.1	1.0
5	1.3	1.2
6	1.6	1.5
7	1.9	1.8
8	2.1	2.0
9	2.4	2.2
10	2.7	2.5
20	5.3	5.0
30	8.0	7.5
40	10.7	10.0
50	13.3	12.5

″	**11**	**10**
1	0.2	0.2
2	0.4	0.3
3	0.6	0.5
4	0.7	0.7
5	0.9	0.8
6	1.1	1.0
7	1.3	1.2
8	1.5	1.3
9	1.6	1.5
10	1.8	1.7
20	3.7	3.3
30	5.5	5.0
40	7.3	6.7
50	9.2	8.3

	11/26	**11/25**
0	1.2	1.1
1	3.5	3.4
2	5.9	5.7
3	8.3	7.9
4	10.6	10.2
5	13.0	12.5
6	15.4	14.8
7	17.7	17.1
8	20.1	19.3
9	22.5	21.6
10	24.8	23.9
11		

P. P.

129° (309°) (230°) **50°**

40° (220°) | (319°) **139°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.80 807	15	9.92 381	26	0.07 619	9.88 425	10	60
1	9.80 822	15	9.92 407	26	0.07 593	9.88 415	11	59
2	9.80 837	15	9.92 433	25	0.07 567	9.88 404	10	58
3	9.80 852	15	9.92 458	26	0.07 542	9.88 394	11	57
4	9.80 867	15	9.92 484	26	0.07 516	9.88 383	11	56
5	9.80 882	15	9.92 510	25	0.07 490	9.88 372	10	55
6	9.80 897	15	9.92 535	26	0.07 465	9.88 362	11	54
7	9.80 912	15	9.92 561	26	0.07 439	9.88 351	11	53
8	9.80 927	15	9.92 587	25	0.07 413	9.88 340	10	52
9	9.80 942	15	9.92 612	26	0.07 388	9.88 330	11	51
10	9.80 957	15	9.92 638	25	0.07 362	9.88 319	11	50
11	9.80 972	15	9.92 663	26	0.07 337	9.88 308	10	49
12	9.80 987	15	9.92 689	26	0.07 311	9.88 298	11	48
13	9.81 002	15	9.92 715	25	0.07 285	9.88 287	11	47
14	9.81 017	15	9.92 740	26	0.07 260	9.88 276	10	46
15	9.81 032	15	9.92 766	26	0.07 234	9.88 266	11	45
16	9.81 047	14	9.92 792	25	0.07 208	9.88 255	11	44
17	9.81 061	15	9.92 817	26	0.07 183	9.88 244	10	43
18	9.81 076	15	9.92 843	25	0.07 157	9.88 234	11	42
19	9.81 091	15	9.92 868	26	0.07 132	9.88 223	11	41
20	9.81 106	15	9.92 894	26	0.07 106	9.88 212	11	40
21	9.81 121	15	9.92 920	25	0.07 080	9.88 201	10	39
22	9.81 136	15	9.92 945	26	0.07 055	9.88 191	11	38
23	9.81 151	15	9.92 971	25	0.07 029	9.88 180	11	37
24	9.81 166	14	9.92 996	26	0.07 004	9.88 169	11	36
25	9.81 180	15	9.93 022	26	0.06 978	9.88 158	10	35
26	9.81 195	15	9.93 048	25	0.06 952	9.88 148	11	34
27	9.81 210	15	9.93 073	26	0.06 927	9.88 137	11	33
28	9.81 225	15	9.93 099	25	0.06 901	9.88 126	11	32
29	9.81 240	14	9.93 124	26	0.06 876	9.88 115	10	31
30	9.81 254	15	9.93 150	25	0.06 850	9.88 105	11	30
31	9.81 269	15	9.93 175	26	0.06 825	9.88 094	11	29
32	9.81 284	15	9.93 201	26	0.06 799	9.88 083	11	28
33	9.81 299	15	9.93 227	25	0.06 773	9.88 072	11	27
34	9.81 314	14	9.93 252	26	0.06 748	9.88 061	10	26
35	9.81 328	15	9.93 278	25	0.06 722	9.88 051	11	25
36	9.81 343	15	9.93 303	26	0.06 697	9.88 040	11	24
37	9.81 358	14	9.93 329	25	0.06 671	9.88 029	11	23
38	9.81 372	15	9.93 354	26	0.06 646	9.88 018	11	22
39	9.81 387	15	9.93 380	26	0.06 620	9.88 007	11	21
40	9.81 402	15	9.93 406	25	0.06 594	9.87 996	11	20
41	9.81 417	14	9.93 431	26	0.06 569	9.87 985	10	19
42	9.81 431	15	9.93 457	25	0.06 543	9.87 975	11	18
43	9.81 446	15	9.93 482	26	0.06 518	9.87 964	11	17
44	9.81 461	14	9.93 508	25	0.06 492	9.87 953	11	16
45	9.81 475	15	9.93 533	26	0.06 467	9.87 942	11	15
46	9.81 490	15	9.93 559	25	0.06 441	9.87 931	11	14
47	9.81 505	14	9.93 584	26	0.06 416	9.87 920	11	13
48	9.81 519	15	9.93 610	26	0.06 390	9.87 909	11	12
49	9.81 534	15	9.93 636	25	0.06 364	9.87 898	11	11
50	9.81 549	14	9.93 661	26	0.06 339	9.87 887	10	10
51	9.81 563	15	9.93 687	25	0.06 313	9.87 877	11	9
52	9.81 578	14	9.93 712	26	0.06 288	9.87 866	11	8
53	9.81 592	15	9.93 738	25	0.06 262	9.87 855	11	7
54	9.81 607	15	9.93 763	26	0.06 237	9.87 844	11	6
55	9.81 622	14	9.93 789	25	0.06 211	9.87 833	11	5
56	9.81 636	15	9.93 814	26	0.06 186	9.87 822	11	4
57	9.81 651	14	9.93 840	25	0.06 160	9.87 811	11	3
58	9.81 665	15	9.93 865	26	0.06 135	9.87 800	11	2
59	9.81 680	14	9.93 891	25	0.06 109	9.87 789	11	1
60	9.81 694		9.93 916		0.06 084	9.87 778		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	15	14
1	0.2	0.2
2	0.5	0.5
3	0.8	0.7
4	1.0	0.9
5	1.2	1.2
6	1.5	1.4
7	1.8	1.6
8	2.0	1.9
9	2.2	2.1
10	2.5	2.3
20	5.0	4.7
30	7.5	7.0
40	10.0	9.3
50	12.5	11.7

″	11	10
1	0.2	0.2
2	0.4	0.3
3	0.6	0.5
4	0.7	0.7
5	0.9	0.8
6	1.1	1.0
7	1.3	1.2
8	1.5	1.3
9	1.6	1.5
10	1.8	1.7
20	3.7	3.3
30	5.5	5.0
40	7.3	6.7
50	9.2	8.3

	11/26	10/26	10/25
0	1.2	1.3	1.2
1	3.5	3.9	3.8
2	5.9	6.5	6.2
3	8.3	9.1	8.8
4	10.6	11.7	11.2
5	13.0	14.3	13.8
6	15.4	16.9	16.2
7	17.7	19.5	18.8
8	20.1	22.1	21.2
9	22.5	24.7	23.8
10	24.8	—	—
11			

P. P.

130° (310°) | (229°) **49°**

41° (221°) (318°) **138°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.81 694	15	9.93 916	26	0.06 084	9.87 778	11	**60**
1	9.81 709	14	9.93 942	25	0.06 058	9.87 767	11	59
2	9.81 723	15	9.93 967	26	0.06 033	9.87 756	11	58
3	9.81 738	14	9.93 993	25	0.06 007	9.87 745	11	57
4	9.81 752	15	9.94 018	26	0.05 982	9.87 734	11	56
5	9.81 767	14	9.94 044	25	0.05 956	9.87 723	11	55
6	9.81 781	15	9.94 069	26	0.05 931	9.87 712	11	54
7	9.81 796	14	9.94 095	25	0.05 905	9.87 701	11	53
8	9.81 810	15	9.94 120	26	0.05 880	9.87 690	11	52
9	9.81 825	14	9.94 146	25	0.05 854	9.87 679	11	51
10	9.81 839	15	9.94 171	26	0.05 829	9.87 668	11	**50**
11	9.81 854	14	9.94 197	25	0.05 803	9.87 657	11	49
12	9.81 868	14	9.94 222	26	0.05 778	9.87 646	11	48
13	9.81 882	15	9.94 248	25	0.05 752	9.87 635	11	47
14	9.81 897	14	9.94 273	26	0.05 727	9.87 624	11	46
15	9.81 911	15	9.94 299	25	0.05 701	9.87 613	12	45
16	9.81 926	14	9.94 324	26	0.05 676	9.87 601	11	44
17	9.81 940	15	9.94 350	25	0.05 650	9.87 590	11	43
18	9.81 955	14	9.94 375	26	0.05 625	9.87 579	11	42
19	9.81 969	14	9.94 401	25	0.05 599	9.87 568	11	41
20	9.81 983	15	9.94 426	26	0.05 574	9.87 557	11	**40**
21	9.81 998	14	9.94 452	25	0.05 548	9.87 546	11	39
22	9.82 012	14	9.94 477	26	0.05 523	9.87 535	11	38
23	9.82 026	15	9.94 503	25	0.05 497	9.87 524	11	37
24	9.82 041	14	9.94 528	26	0.05 472	9.87 513	12	36
25	9.82 055	14	9.94 554	25	0.05 446	9.87 501	11	35
26	9.82 069	15	9.94 579	25	0.05 421	9.87 490	11	34
27	9.82 084	14	9.94 604	26	0.05 396	9.87 479	11	33
28	9.82 098	14	9.94 630	25	0.05 370	9.87 468	11	32
29	9.82 112	14	9.94 655	26	0.05 345	9.87 457	11	31
30	9.82 126	15	9.94 681	25	0.05 319	9.87 446	12	**30**
31	9.82 141	14	9.94 706	26	0.05 294	9.87 434	11	29
32	9.82 155	14	9.94 732	25	0.05 268	9.87 423	11	28
33	9.82 169	15	9.94 757	26	0.05 243	9.87 412	11	27
34	9.82 184	14	9.94 783	25	0.05 217	9.87 401	11	26
35	9.82 198	14	9.94 808	26	0.05 192	9.87 390	12	25
36	9.82 212	14	9.94 834	25	0.05 166	9.87 378	11	24
37	9.82 226	14	9.94 859	25	0.05 141	9.87 367	11	23
38	9.82 240	15	9.94 884	26	0.05 116	9.87 356	11	22
39	9.82 255	14	9.94 910	25	0.05 090	9.87 345	11	21
40	9.82 269	14	9.94 935	26	0.05 065	9.87 334	12	**20**
41	9.82 283	14	9.94 961	25	0.05 039	9.87 322	11	19
42	9.82 297	14	9.94 986	26	0.05 014	9.87 311	11	18
43	9.82 311	15	9.95 012	25	0.04 988	9.87 300	12	17
44	9.82 326	14	9.95 037	25	0.04 963	9.87 288	11	16
45	9.82 340	14	9.95 062	26	0.04 938	9.87 277	11	15
46	9.82 354	14	9.95 088	25	0.04 912	9.87 266	11	14
47	9.82 368	14	9.95 113	26	0.04 887	9.87 255	12	13
48	9.82 382	14	9.95 139	25	0.04 861	9.87 243	11	12
49	9.82 396	14	9.95 164	26	0.04 836	9.87 232	11	11
50	9.82 410	14	9.95 190	25	0.04 810	9.87 221	12	**10**
51	9.82 424	15	9.95 215	25	0.04 785	9.87 209	11	9
52	9.82 439	14	9.95 240	26	0.04 760	9.87 198	11	8
53	9.82 453	14	9.95 266	25	0.04 734	9.87 187	12	7
54	9.82 467	14	9.95 291	26	0.04 709	9.87 175	11	6
55	9.82 481	14	9.95 317	25	0.04 683	9.87 164	11	5
56	9.82 495	14	9.95 342	26	0.04 658	9.87 153	12	4
57	9.82 509	14	9.95 368	25	0.04 632	9.87 141	11	3
58	9.82 523	14	9.95 393	25	0.04 607	9.87 130	11	2
59	9.82 537	14	9.95 418	26	0.04 582	9.87 119	12	1
60	9.82 551		9.95 444		0.04 556	9.87 107		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	15	14
1	0.2	0.2
2	0.5	0.5
3	0.8	0.7
4	1.0	0.9
5	1.2	1.2
6	1.5	1.4
7	1.8	1.6
8	2.0	1.9
9	2.2	2.1
10	2.5	2.3
20	5.0	4.7
30	7.5	7.0
40	10.0	9.3
50	12.5	11.7

″	12	11
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

	12/26	12/25	11/25
0	1.1	1.1	1.1
1	3.2	3.1	3.4
2	5.4	5.2	5.7
3	7.6	7.3	7.9
4	9.8	9.4	10.2
5	11.9	11.5	12.5
6	14.1	13.6	14.8
7	16.2	15.6	17.1
8	18.4	17.7	19.3
9	20.6	19.8	21.6
10	22.8	21.9	23.9
11	24.9	23.9	—
12			

P. P.

131° (311°) (228°) **48°**

42° (222°) (317°) **137°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.82 551	14	9.95 444	25	0.04 556	9.87 107	11	60
1	9.82 565	14	9.95 469	26	0.04 531	9.87 096	11	59
2	9.82 579	14	9.95 495	25	0.04 505	9.87 085	12	58
3	9.82 593	14	9.95 520	25	0.04 480	9.87 073	11	57
4	9.82 607	14	9.95 545	26	0.04 455	9.87 062	12	56
5	9.82 621	14	9.95 571	25	0.04 429	9.87 050	11	55
6	9.82 635	14	9.95 596	26	0.04 404	9.87 039	11	54
7	9.82 649	14	9.95 622	25	0.04 378	9.87 028	12	53
8	9.82 663	14	9.95 647	25	0.04 353	9.87 016	11	52
9	9.82 677	14	9.95 672	26	0.04 328	9.87 005	12	51
10	9.82 691	14	9.95 698	25	0.04 302	9.86 993	11	50
11	9.82 705	14	9.95 723	25	0.04 277	9.86 982	12	49
12	9.82 719	14	9.95 748	26	0.04 252	9.86 970	11	48
13	9.82 733	14	9.95 774	25	0.04 226	9.86 959	12	47
14	9.82 747	14	9.95 799	26	0.04 201	9.86 947	11	46
15	9.82 761	14	9.95 825	25	0.04 175	9.86 936	12	45
16	9.82 775	13	9.95 850	25	0.04 150	9.86 924	11	44
17	9.82 788	14	9.95 875	26	0.04 125	9.86 913	11	43
18	9.82 802	14	9.95 901	25	0.04 099	9.86 902	12	42
19	9.82 816	14	9.95 926	26	0.04 074	9.86 890	11	41
20	9.82 830	14	9.95 952	25	0.04 048	9.86 879	12	40
21	9.82 844	14	9.95 977	25	0.04 023	9.86 867	12	39
22	9.82 858	14	9.96 002	26	0.03 998	9.86 855	11	38
23	9.82 872	13	9.96 028	25	0.03 972	9.86 844	12	37
24	9.82 885	14	9.96 053	25	0.03 947	9.86 832	11	36
25	9.82 899	14	9.96 078	26	0.03 922	9.86 821	12	35
26	9.82 913	14	9.96 104	25	0.03 896	9.86 809	11	34
27	9.82 927	14	9.96 129	26	0.03 871	9.86 798	12	33
28	9.82 941	14	9.96 155	25	0.03 845	9.86 786	11	32
29	9.82 955	13	9.96 180	25	0.03 820	9.86 775	12	31
30	9.82 968	14	9.96 205	26	0.03 795	9.86 763	11	30
31	9.82 982	14	9.96 231	25	0.03 769	9.86 752	12	29
32	9.82 996	14	9.96 256	25	0.03 744	9.86 740	12	28
33	9.83 010	13	9.96 281	26	0.03 719	9.86 728	11	27
34	9.83 023	14	9.96 307	25	0.03 693	9.86 717	12	26
35	9.83 037	14	9.96 332	25	0.03 668	9.86 705	11	25
36	9.83 051	14	9.96 357	26	0.03 643	9.86 694	12	24
37	9.83 065	13	9.96 383	25	0.03 617	9.86 682	12	23
38	9.83 078	14	9.96 408	25	0.03 592	9.86 670	11	22
39	9.83 092	14	9.96 433	26	0.03 567	9.86 659	12	21
40	9.83 106	14	9.96 459	25	0.03 541	9.86 647	12	20
41	9.83 120	13	9.96 484	26	0.03 516	9.86 635	11	19
42	9.83 133	14	9.96 510	25	0.03 490	9.86 624	12	18
43	9.83 147	14	9.96 535	25	0.03 465	9.86 612	12	17
44	9.83 161	13	9.96 560	26	0.03 440	9.86 600	11	16
45	9.83 174	14	9.96 586	25	0.03 414	9.86 589	12	15
46	9.83 188	14	9.96 611	25	0.03 389	9.86 577	12	14
47	9.83 202	13	9.96 636	26	0.03 364	9.86 565	11	13
48	9.83 215	14	9.96 662	25	0.03 338	9.86 554	12	12
49	9.83 229	13	9.96 687	25	0.03 313	9.86 542	12	11
50	9.83 242	14	9.96 712	26	0.03 288	9.86 530	12	10
51	9.83 256	14	9.96 738	25	0.03 262	9.86 518	11	9
52	9.83 270	13	9.96 763	25	0.03 237	9.86 507	12	8
53	9.83 283	14	9.96 788	26	0.03 212	9.86 495	12	7
54	9.83 297	13	9.96 814	25	0.03 186	9.86 483	11	6
55	9.83 310	14	9.96 839	25	0.03 161	9.86 472	12	5
56	9.83 324	14	9.96 864	26	0.03 136	9.86 460	12	4
57	9.83 338	13	9.96 890	25	0.03 110	9.86 448	12	3
58	9.83 351	14	9.96 915	25	0.03 085	9.86 436	11	2
59	9.83 365	13	9.96 940	26	0.03 060	9.86 425	12	1
60	9.83 378		9.96 966		0.03 034	9.86 413		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	14	13
1	0.2	0.2
2	0.5	0.4
3	0.7	0.6
4	0.9	0.9
5	1.2	1.1
6	1.4	1.3
7	1.6	1.5
8	1.9	1.7
9	2.1	2.0
10	2.3	2.2
20	4.7	4.3
30	7.0	6.5
40	9.3	8.7
50	11.7	10.8

″	12	11
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

	12/26	11/26	11/25
0	1.1	1.2	1.1
1	3.2	3.5	3.4
2	5.4	5.9	5.7
3	7.6	8.3	7.9
4	9.8	10.6	10.2
5	11.9	13.0	12.5
6	14.1	15.4	14.8
7	16.2	17.7	17.1
8	18.4	20.1	19.3
9	20.6	22.5	21.6
10	22.8	24.8	23.9
11	24.9	—	—
12			

P. P.

132° (312°) (227°) **47°**

43° (223°) (316°) **136°**

'	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	'
0	9.83 378	14	9.96 966	25	0.03 034	9.86 413	12	**60**
1	9.83 392	13	9.96 991	25	0.03 009	9.86 401	12	59
2	9.83 405	14	9.97 016	26	0.02 984	9.86 389	12	58
3	9.83 419	13	9.97 042	25	0.02 958	9.86 377	11	57
4	9.83 432	14	9.97 067	25	0.02 933	9.86 366	12	56
5	9.83 446	13	9.97 092	26	0.02 908	9.86 354	12	55
6	9.83 459	14	9.97 118	25	0.02 882	9.86 342	12	54
7	9.83 473	13	9.97 143	25	0.02 857	9.86 330	12	53
8	9.83 486	14	9.97 168	25	0.02 832	9.86 318	12	52
9	9.83 500	13	9.97 193	26	0.02 807	9.86 306	11	51
10	9.83 513	14	9.97 219	25	0.02 781	9.86 295	12	**50**
11	9.83 527	13	9.97 244	25	0.02 756	9.86 283	12	49
12	9.83 540	14	9.97 269	26	0.02 731	9.86 271	12	48
13	9.83 554	13	9.97 295	25	0.02 705	9.86 259	12	47
14	9.83 567	14	9.97 320	25	0.02 680	9.86 247	12	46
15	9.83 581	13	9.97 345	26	0.02 655	9.86 235	12	45
16	9.83 594	14	9.97 371	25	0.02 629	9.86 223	12	44
17	9.83 608	13	9.97 396	25	0.02 604	9.86 211	11	43
18	9.83 621	13	9.97 421	26	0.02 579	9.86 200	12	42
19	9.83 634	14	9.97 447	25	0.02 553	9.86 188	12	41
20	9.83 648	13	9.97 472	25	0.02 528	9.86 176	12	**40**
21	9.83 661	13	9.97 497	26	0.02 503	9.86 164	12	39
22	9.83 674	14	9.97 523	25	0.02 477	9.86 152	12	38
23	9.83 688	13	9.97 548	25	0.02 452	9.86 140	12	37
24	9.83 701	14	9.97 573	25	0.02 427	9.86 128	12	36
25	9.83 715	13	9.97 598	26	0.02 402	9.86 116	12	35
26	9.83 728	13	9.97 624	25	0.02 376	9.86 104	12	34
27	9.83 741	14	9.97 649	25	0.02 351	9.86 092	12	33
28	9.83 755	13	9.97 674	26	0.02 326	9.86 080	12	32
29	9.83 768	13	9.97 700	25	0.02 300	9.86 068	12	31
30	9.83 781	14	9.97 725	25	0.02 275	9.86 056	12	**30**
31	9.83 795	13	9.97 750	26	0.02 250	9.86 044	12	29
32	9.83 808	13	9.97 776	25	0.02 224	9.86 032	12	28
33	9.83 821	13	9.97 801	25	0.02 199	9.86 020	12	27
34	9.83 834	14	9.97 826	25	0.02 174	9.86 008	12	26
35	9.83 848	13	9.97 851	26	0.02 149	9.85 996	12	25
36	9.83 861	13	9.97 877	25	0.02 123	9.85 984	12	24
37	9.83 874	13	9.97 902	25	0.02 098	9.85 972	12	23
38	9.83 887	14	9.97 927	26	0.02 073	9.85 960	12	22
39	9.83 901	13	9.97 953	25	0.02 047	9.85 948	12	21
40	9.83 914	13	9.97 978	25	0.02 022	9.85 936	12	**20**
41	9.83 927	13	9.98 003	26	0.01 997	9.85 924	12	19
42	9.83 940	14	9.98 029	25	0.01 971	9.85 912	12	18
43	9.83 954	13	9.98 054	25	0.01 946	9.85 900	12	17
44	9.83 967	13	9.98 079	25	0.01 921	9.85 888	12	16
45	9.83 980	13	9.98 104	26	0.01 896	9.85 876	12	15
46	9.83 993	13	9.98 130	25	0.01 870	9.85 864	13	14
47	9.84 006	14	9.98 155	25	0.01 845	9.85 851	12	13
48	9.84 020	13	9.98 180	26	0.01 820	9.85 839	12	12
49	9.84 033	13	9.98 206	25	0.01 794	9.85 827	12	11
50	9.84 046	13	9.98 231	25	0.01 769	9.85 815	12	**10**
51	9.84 059	13	9.98 256	25	0.01 744	9.85 803	12	9
52	9.84 072	13	9.98 281	26	0.01 719	9.85 791	12	8
53	9.84 085	13	9.98 307	25	0.01 693	9.85 779	13	7
54	9.84 098	14	9.98 332	25	0.01 668	9.85 766	12	6
55	9.84 112	13	9.98 357	26	0.01 643	9.85 754	12	5
56	9.84 125	13	9.98 383	25	0.01 617	9.85 742	12	4
57	9.84 138	13	9.98 408	25	0.01 592	9.85 730	12	3
58	9.84 151	13	9.98 433	25	0.01 567	9.85 718	12	2
59	9.84 164	13	9.98 458	26	0.01 542	9.85 706	13	1
60	9.84 177		9.98 484		0.01 516	9.85 693		**0**
'	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	'

P. P.

"	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

"	**14**	**13**
1	0.2	0.2
2	0.5	0.4
3	0.7	0.6
4	0.9	0.9
5	1.2	1.1
6	1.4	1.3
7	1.6	1.5
8	1.9	1.7
9	2.1	2.0
10	2.3	2.2
20	4.7	4.3
30	7.0	6.5
40	9.3	8.7
50	11.7	10.8

"	**12**	**11**
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

	$\frac{13}{26}$	$\frac{13}{25}$	$\frac{12}{25}$
0			
1	1.0	0.9	1.1
2	3.0	2.9	3.1
3	5.0	4.8	5.2
4	7.0	6.7	7.3
5	9.0	8.7	9.4
6	11.0	10.6	11.5
7	13.0	12.5	13.5
8	15.0	14.4	15.6
9	17.0	16.3	17.7
10	19.0	18.3	19.8
11	21.0	20.2	21.9
12	23.0	22.1	23.9
13	25.0	24.1	—

P. P.

133° (313°) (226°) **46°**

44° (224°) (315°) **135°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.84 177		9.98 484		0.01 516	9.85 693		**60**
1	9.84 190	13	9.98 509	25	0.01 491	9.85 681	12	59
2	9.84 203	13	9.98 534	25	0.01 466	9.85 669	12	58
3	9.84 216	13	9.98 560	26	0.01 440	9.85 657	12	57
4	9.84 229	13	9.98 585	25	0.01 415	9.85 645	12	56
5	9.84 242	13	9.98 610	25	0.01 390	9.85 632	13	55
6	9.84 255	13	9.98 635	25	0.01 365	9.85 620	12	54
7	9.84 269	14	9.98 661	26	0.01 339	9.85 608	12	53
8	9.84 282	13	9.98 686	25	0.01 314	9.85 596	12	52
9	9.84 295	13	9.98 711	25	0.01 289	9.85 583	13	51
10	9.84 308	13	9.98 737	26	0.01 263	9.85 571	12	**50**
11	9.84 321	13	9.98 762	25	0.01 238	9.85 559	12	49
12	9.84 334	13	9.98 787	25	0.01 213	9.85 547	12	48
13	9.84 347	13	9.98 812	25	0.01 188	9.85 534	13	47
14	9.84 360	13	9.98 838	26	0.01 162	9.85 522	12	46
15	9.84 373	13	9.98 863	25	0.01 137	9.85 510	12	45
16	9.84 385	12	9.98 888	25	0.01 112	9.85 497	13	44
17	9.84 398	13	9.98 913	25	0.01 087	9.85 485	12	43
18	9.84 411	13	9.98 939	26	0.01 061	9.85 473	12	42
19	9.84 424	13	9.98 964	25	0.01 036	9.85 460	13	41
20	9.84 437	13	9.98 989	25	0.01 011	9.85 448	12	**40**
21	9.84 450	13	9.99 015	26	0.00 985	9.85 436	12	39
22	9.84 463	13	9.99 040	25	0.00 960	9.85 423	13	38
23	9.84 476	13	9.99 065	25	0.00 935	9.85 411	12	37
24	9.84 489	13	9.99 090	25	0.00 910	9.85 399	12	36
25	9.84 502	13	9.99 116	26	0.00 884	9.85 386	13	35
26	9.84 515	13	9.99 141	25	0.00 859	9.85 374	12	34
27	9.84 528	13	9.99 166	25	0.00 834	9.85 361	13	33
28	9.84 540	12	9.99 191	25	0.00 809	9.85 349	12	32
29	9.84 553	13	9.99 217	26	0.00 783	9.85 337	12	31
30	9.84 566	13	9.99 242	25	0.00 758	9.85 324	13	**30**
31	9.84 579	13	9.99 267	25	0.00 733	9.85 312	12	29
32	9.84 592	13	9.99 293	26	0.00 707	9.85 299	13	28
33	9.84 605	13	9.99 318	25	0.00 682	9.85 287	12	27
34	9.84 618	13	9.99 343	25	0.00 657	9.85 274	13	26
35	9.84 630	12	9.99 368	25	0.00 632	9.85 262	12	25
36	9.84 643	13	9.99 394	26	0.00 606	9.85 250	12	24
37	9.84 656	13	9.99 419	25	0.00 581	9.85 237	13	23
38	9.84 669	13	9.99 444	25	0.00 556	9.85 225	12	22
39	9.84 682	13	9.99 469	25	0.00 531	9.85 212	13	21
40	9.84 694	12	9.99 495	26	0.00 505	9.85 200	12	**20**
41	9.84 707	13	9.99 520	25	0.00 480	9.85 187	13	19
42	9.84 720	13	9.99 545	25	0.00 455	9.85 175	12	18
43	9.84 733	13	9.99 570	25	0.00 430	9.85 162	13	17
44	9.84 745	12	9.99 596	26	0.00 404	9.85 150	12	16
45	9.84 758	13	9.99 621	25	0.00 379	9.85 137	13	15
46	9.84 771	13	9.99 646	25	0.00 354	9.85 125	12	14
47	9.84 784	13	9.99 672	26	0.00 328	9.85 112	13	13
48	9.84 796	12	9.99 697	25	0.00 303	9.85 100	12	12
49	9.84 809	13	9.99 722	25	0.00 278	9.85 087	13	11
50	9.84 822	13	9.99 747	25	0.00 253	9.85 074	13	**10**
51	9.84 835	13	9.99 773	26	0.00 227	9.85 062	12	9
52	9.84 847	12	9.99 798	25	0.00 202	9.85 049	13	8
53	9.84 860	13	9.99 823	25	0.00 177	9.85 037	12	7
54	9.84 873	13	9.99 848	25	0.00 152	9.85 024	13	6
55	9.84 885	12	9.99 874	26	0.00 126	9.85 012	12	5
56	9.84 898	13	9.99 899	25	0.00 101	9.84 999	13	4
57	9.84 911	13	9.99 924	25	0.00 076	9.84 986	13	3
58	9.84 923	12	9.99 949	25	0.00 051	9.84 974	12	2
59	9.84 936	13	9.99 975	26	0.00 025	9.84 961	13	1
60	9.84 949	13	0.00 000	25	0.00 000	9.84 949	12	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	14	13	12
1	0.2	0.2	0.2
2	0.5	0.4	0.4
3	0.7	0.6	0.6
4	0.9	0.9	0.8
5	1.2	1.1	1.0
6	1.4	1.3	1.2
7	1.6	1.5	1.4
8	1.9	1.7	1.6
9	2.1	2.0	1.8
10	2.3	2.2	2.0
20	4.7	4.3	4.0
30	7.0	6.5	6.0
40	9.3	8.7	8.0
50	11.7	10.8	10.0

	13/26	13/25
0	1.0	0.9
1	3.0	2.9
2	5.0	4.8
3	7.0	6.7
4	9.0	8.7
5	11.0	10.6
6	13.0	12.5
7	15.0	14.4
8	17.0	16.3
9	19.0	18.3
10	21.0	20.2
11	23.0	22.1
12	25.0	24.1
13		

	12/26	12/25
0	1.1	1.1
1	3.2	3.1
2	5.4	5.2
3	7.6	7.3
4	9.8	9.4
5	11.9	11.5
6	14.1	13.5
7	16.2	15.6
8	18.4	17.7
9	20.6	19.8
10	22.8	21.9
11	24.9	23.9
12		

P. P.

134° (314°) (225°) **45°**

NATURAL TRIGONOMETRIC FUNCTIONS

Values of the trigonometric functions of angles for each minute from 0–360°.

For degrees indicated at the top of the page use the column headings at the top. For degrees indicated at the bottom use the column indications at the bottom.

With degrees at the left of each block (top or bottom), use the minute column at the left and with degrees at the right of each block use the minute column at the right.

0° (180°) (359°) **179°**

′	Sin	Tan	Cot	Cos	′
0	.00000	.00000	———	1.0000	**60**
1	.00029	.00029	3437.7	1.0000	59
2	.00058	.00058	1718.9	1.0000	58
3	.00087	.00087	1145.9	1.0000	57
4	.00116	.00116	859.44	1.0000	56
5	.00145	.00145	687.55	1.0000	**55**
6	.00175	.00175	572.96	1.0000	54
7	.00204	.00204	491.11	1.0000	53
8	.00233	.00233	429.72	1.0000	52
9	.00262	.00262	381.97	1.0000	51
10	.00291	.00291	343.77	1.0000	**50**
11	.00320	.00320	312.52	.99999	49
12	.00349	.00349	286.48	.99999	48
13	.00378	.00378	264.44	.99999	47
14	.00407	.00407	245.55	.99999	46
15	.00436	.00436	229.18	.99999	**45**
16	.00465	.00465	214.86	.99999	44
17	.00495	.00495	202.22	.99999	43
18	.00524	.00524	190.98	.99999	42
19	.00553	.00553	180.93	.99998	41
20	.00582	.00582	171.89	.99998	**40**
21	.00611	.00611	163.70	.99998	39
22	.00640	.00640	156.26	.99998	38
23	.00669	.00669	149.47	.99998	37
24	.00698	.00698	143.24	.99998	36
25	.00727	.00727	137.51	.99997	**35**
26	.00756	.00756	132.22	.99997	34
27	.00785	.00785	127.32	.99997	33
28	.00814	.00815	122.77	.99997	32
29	.00844	.00844	118.54	.99996	31
30	.00873	.00873	114.59	.99996	**30**
31	.00902	.00902	110.89	.99996	29
32	.00931	.00931	107.43	.99996	28
33	.00960	.00960	104.17	.99995	27
34	.00989	.00989	101.11	.99995	26
35	.01018	.01018	98.218	.99995	**25**
36	.01047	.01047	95.489	.99995	24
37	.01076	.01076	92.908	.99994	23
38	.01105	.01105	90.463	.99994	22
39	.01134	.01135	88.144	.99994	21
40	.01164	.01164	85.940	.99993	**20**
41	.01193	.01193	83.844	.99993	19
42	.01222	.01222	81.847	.99993	18
43	.01251	.01251	79.943	.99992	17
44	.01280	.01280	78.126	.99992	16
45	.01309	.01309	76.390	.99991	**15**
46	.01338	.01338	74.729	.99991	14
47	.01367	.01367	73.139	.99991	13
48	.01396	.01396	71.615	.99990	12
49	.01425	.01425	70.153	.99990	11
50	.01454	.01455	68.750	.99989	**10**
51	.01483	.01484	67.402	.99989	9
52	.01513	.01513	66.105	.99989	8
53	.01542	.01542	64.858	.99988	7
54	.01571	.01571	63.657	.99988	6
55	.01600	.01600	62.499	.99987	**5**
56	.01629	.01629	61.383	.99987	4
57	.01658	.01658	60.306	.99986	3
58	.01687	.01687	59.266	.99986	2
59	.01716	.01716	58.261	.99985	1
60	.01745	.01746	57.290	.99985	**0**
′	Cos	Cot	Tan	Sin	′

90° (270°) (269°) **89°**

1° (181°) (358°) **178°**

′	Sin	Tan	Cot	Cos	′
0	.01745	.01746	57.290	.99985	**60**
1	.01774	.01775	56.351	.99984	59
2	.01803	.01804	55.442	.99984	58
3	.01832	.01833	54.561	.99983	57
4	.01862	.01862	53.709	.99983	56
5	.01891	.01891	52.882	.99982	**55**
6	.01920	.01920	52.081	.99982	54
7	.01949	.01949	51.303	.99981	53
8	.01978	.01978	50.549	.99980	52
9	.02007	.02007	49.816	.99980	51
10	.02036	.02036	49.104	.99979	**50**
11	.02065	.02066	48.412	.99979	49
12	.02094	.02095	47.740	.99978	48
13	.02123	.02124	47.085	.99977	47
14	.02152	.02153	46.449	.99977	46
15	.02181	.02182	45.829	.99976	**45**
16	.02211	.02211	45.226	.99976	44
17	.02240	.02240	44.639	.99975	43
18	.02269	.02269	44.066	.99974	42
19	.02298	.02298	43.508	.99974	41
20	.02327	.02328	42.964	.99973	**40**
21	.02356	.02357	42.433	.99972	39
22	.02385	.02386	41.916	.99972	38
23	.02414	.02415	41.411	.99971	37
24	.02443	.02444	40.917	.99970	36
25	.02472	.02473	40.436	.99969	**35**
26	.02501	.02502	39.965	.99969	34
27	.02530	.02531	39.506	.99968	33
28	.02560	.02560	39.057	.99967	32
29	.02589	.02589	38.618	.99966	31
30	.02618	.02619	38.188	.99966	**30**
31	.02647	.02648	37.769	.99965	29
32	.02676	.02677	37.358	.99964	28
33	.02705	.02706	36.956	.99963	27
34	.02734	.02735	36.563	.99963	26
35	.02763	.02764	36.178	.99962	**25**
36	.02792	.02793	35.801	.99961	24
37	.02821	.02822	35.431	.99960	23
38	.02850	.02851	35.070	.99959	22
39	.02879	.02881	34.715	.99959	21
40	.02908	.02910	34.368	.99958	**20**
41	.02938	.02939	34.027	.99957	19
42	.02967	.02968	33.694	.99956	18
43	.02996	.02997	33.366	.99955	17
44	.03025	.03026	33.045	.99954	16
45	.03054	.03055	32.730	.99953	**15**
46	.03083	.03084	32.421	.99952	14
47	.03112	.03114	32.118	.99952	13
48	.03141	.03143	31.821	.99951	12
49	.03170	.03172	31.528	.99950	11
50	.03199	.03201	31.242	.99949	**10**
51	.03228	.03230	30.960	.99948	9
52	.03257	.03259	30.683	.99947	8
53	.03286	.03288	30.412	.99946	7
54	.03316	.03317	30.145	.99945	6
55	.03345	.03346	29.882	.99944	**5**
56	.03374	.03376	29.624	.99943	4
57	.03403	.03405	29.371	.99942	3
58	.03432	.03434	29.122	.99941	2
59	.03461	.03463	28.877	.99940	1
60	.03490	.03492	28.636	.99939	**0**
′	Cos	Cot	Tan	Sin	′

91° (271°) (268°) **88°**

2° (182°) (357°) **177°**

′	Sin	Tan	Cot	Cos	′
0	.03490	.03492	28.636	.99939	**60**
1	.03519	.03521	28.399	.99938	59
2	.03548	.03550	28.166	.99937	58
3	.03577	.03579	27.937	.99936	57
4	.03606	.03609	27.712	.99935	56
5	.03635	.03638	27.490	.99934	**55**
6	.03664	.03667	27.271	.99933	54
7	.03693	.03696	27.057	.99932	53
8	.03723	.03725	26.845	.99931	52
9	.03752	.03754	26.637	.99930	51
10	.03781	.03783	26.432	.99929	**50**
11	.03810	.03812	26.230	.99927	49
12	.03839	.03842	26.031	.99926	48
13	.03868	.03871	25.835	.99925	47
14	.03897	.03900	25.642	.99924	46
15	.03926	.03929	25.452	.99923	**45**
16	.03955	.03958	25.264	.99922	44
17	.03984	.03987	25.080	.99921	43
18	.04013	.04016	24.898	.99919	42
19	.04042	.04046	24.719	.99918	41
20	.04071	.04075	24.542	.99917	**40**
21	.04100	.04104	24.368	.99916	39
22	.04129	.04133	24.196	.99915	38
23	.04159	.04162	24.026	.99913	37
24	.04188	.04191	23.859	.99912	36
25	.04217	.04220	23.695	.99911	**35**
26	.04246	.04250	23.532	.99910	34
27	.04275	.04279	23.372	.99909	33
28	.04304	.04308	23.214	.99907	32
29	.04333	.04337	23.058	.99906	31
30	.04362	.04366	22.904	.99905	**30**
31	.04391	.04395	22.752	.99904	29
32	.04420	.04424	22.602	.99902	28
33	.04449	.04454	22.454	.99901	27
34	.04478	.04483	22.308	.99900	26
35	.04507	.04512	22.164	.99898	**25**
36	.04536	.04541	22.022	.99897	24
37	.04565	.04570	21.881	.99896	23
38	.04594	.04599	21.743	.99894	22
39	.04623	.04628	21.606	.99893	21
40	.04653	.04658	21.470	.99892	**20**
41	.04682	.04687	21.337	.99890	19
42	.04711	.04716	21.205	.99889	18
43	.04740	.04745	21.075	.99888	17
44	.04769	.04774	20.946	.99886	16
45	.04798	.04803	20.819	.99885	**15**
46	.04827	.04833	20.693	.99883	14
47	.04856	.04862	20.569	.99882	13
48	.04885	.04891	20.446	.99881	12
49	.04914	.04920	20.325	.99879	11
50	.04943	.04949	20.206	.99878	**10**
51	.04972	.04978	20.087	.99876	9
52	.05001	.05007	19.970	.99875	8
53	.05030	.05037	19.855	.99873	7
54	.05059	.05066	19.740	.99872	6
55	.05088	.05095	19.627	.99870	**5**
56	.05117	.05124	19.516	.99869	4
57	.05146	.05153	19.405	.99867	3
58	.05175	.05182	19.296	.99866	2
59	.05205	.05212	19.188	.99864	1
60	.05234	.05241	19.081	.99863	**0**
′	Cos	Cot	Tan	Sin	′

92° (272°) (267°) **87°**

3° (183°) (356°) **176°**

′	Sin	Tan	Cot	Cos	′
0	.05234	.05241	19.081	.99863	**60**
1	.05263	.05270	18.976	.99861	59
2	.05292	.05299	18.871	.99860	58
3	.05321	.05328	18.768	.99858	57
4	.05350	.05357	18.666	.99857	56
5	.05379	.05387	18.564	.99855	**55**
6	.05408	.05416	18.464	.99854	54
7	.05437	.05445	18.366	.99852	53
8	.05466	.05474	18.268	.99851	52
9	.05495	.05503	18.171	.99849	51
10	.05524	.05533	18.075	.99847	**50**
11	.05553	.05562	17.980	.99846	49
12	.05582	.05591	17.886	.99844	48
13	.05611	.05620	17.793	.99842	47
14	.05640	.05649	17.702	.99841	46
15	.05669	.05678	17.611	.99839	**45**
16	.05698	.05708	17.521	.99838	44
17	.05727	.05737	17.431	.99836	43
18	.05756	.05766	17.343	.99834	42
19	.05785	.05795	17.256	.99833	41
20	.05814	.05824	17.169	.99831	**40**
21	.05844	.05854	17.084	.99829	39
22	.05873	.05883	16.999	.99827	38
23	.05902	.05912	16.915	.99826	37
24	.05931	.05941	16.832	.99824	36
25	.05960	.05970	16.750	.99822	**35**
26	.05989	.05999	16.668	.99821	34
27	.06018	.06029	16.587	.99819	33
28	.06047	.06058	16.507	.99817	32
29	.06076	.06087	16.428	.99815	31
30	.06105	.06116	16.350	.99813	**30**
31	.06134	.06145	16.272	.99812	29
32	.06163	.06175	16.195	.99810	28
33	.06192	.06204	16.119	.99808	27
34	.06221	.06233	16.043	.99806	26
35	.06250	.06262	15.969	.99804	**25**
36	.06279	.06291	15.895	.99803	24
37	.06308	.06321	15.821	.99801	23
38	.06337	.06350	15.748	.99799	22
39	.06366	.06379	15.676	.99797	21
40	.06395	.06408	15.605	.99795	**20**
41	.06424	.06438	15.534	.99793	19
42	.06453	.06467	15.464	.99792	18
43	.06482	.06496	15.394	.99790	17
44	.06511	.06525	15.325	.99788	16
45	.06540	.06554	15.257	.99786	**15**
46	.06569	.06584	15.189	.99784	14
47	.06598	.06613	15.122	.99782	13
48	.06627	.06642	15.056	.99780	12
49	.06656	.06671	14.990	.99778	11
50	.06685	.06700	14.924	.99776	**10**
51	.06714	.06730	14.860	.99774	9
52	.06743	.06759	14.795	.99772	8
53	.06773	.06788	14.732	.99770	7
54	.06802	.06817	14.669	.99768	6
55	.06831	.06847	14.606	.99766	**5**
56	.06860	.06876	14.544	.99764	4
57	.06889	.06905	14.482	.99762	3
58	.06918	.06934	14.421	.99760	2
59	.06947	.06963	14.361	.99758	1
60	.06976	.06993	14.301	.99756	**0**
′	Cos	Cot	Tan	Sin	′

93° (273°) (266°) **86°**

4° (184°) (355°) **175°**

′	Sin	Tan	Cot	Cos	′
0	.06976	.06993	14.301	.99756	**60**
1	.07005	.07022	14.241	.99754	59
2	.07034	.07051	14.182	.99752	58
3	.07063	.07080	14.124	.99750	57
4	.07092	.07110	14.065	.99748	56
5	.07121	.07139	14.008	.99746	**55**
6	.07150	.07168	13.951	.99744	54
7	.07179	.07197	13.894	.99742	53
8	.07208	.07227	13.838	.99740	52
9	.07237	.07256	13.782	.99738	51
10	.07266	.07285	13.727	.99736	**50**
11	.07295	.07314	13.672	.99734	49
12	.07324	.07344	13.617	.99731	48
13	.07353	.07373	13.563	.99729	47
14	.07382	.07402	13.510	.99727	46
15	.07411	.07431	13.457	.99725	**45**
16	.07440	.07461	13.404	.99723	44
17	.07469	.07490	13.352	.99721	43
18	.07498	.07519	13.300	.99719	42
19	.07527	.07548	13.248	.99716	41
20	.07556	.07578	13.197	.99714	**40**
21	.07585	.07607	13.146	.99712	39
22	.07614	.07636	13.096	.99710	38
23	.07643	.07665	13.046	.99708	37
24	.07672	.07695	12.996	.99705	36
25	.07701	.07724	12.947	.99703	**35**
26	.07730	.07753	12.898	.99701	34
27	.07759	.07782	12.850	.99699	33
28	.07788	.07812	12.801	.99696	32
29	.07817	.07841	12.754	.99694	31
30	.07846	.07870	12.706	.99692	**30**
31	.07875	.07899	12.659	.99689	29
32	.07904	.07929	12.612	.99687	28
33	.07933	.07958	12.566	.99685	27
34	.07962	.07987	12.520	.99683	26
35	.07991	.08017	12.474	.99680	**25**
36	.08020	.08046	12.429	.99678	24
37	.08049	.08075	12.384	.99676	23
38	.08078	.08104	12.339	.99673	22
39	.08107	.08134	12.295	.99671	21
40	.08136	.08163	12.251	.99668	**20**
41	.08165	.08192	12.207	.99666	19
42	.08194	.08221	12.163	.99664	18
43	.08223	.08251	12.120	.99661	17
44	.08252	.08280	12.077	.99659	16
45	.08281	.08309	12.035	.99657	**15**
46	.08310	.08339	11.992	.99654	14
47	.08339	.08368	11.950	.99652	13
48	.08368	.08397	11.909	.99649	12
49	.08397	.08427	11.867	.99647	11
50	.08426	.08456	11.826	.99644	**10**
51	.08455	.08485	11.785	.99642	9
52	.08484	.08514	11.745	.99639	8
53	.08513	.08544	11.705	.99637	7
54	.08542	.08573	11.664	.99635	6
55	.08571	.08602	11.625	.99632	**5**
56	.08600	.08632	11.585	.99630	4
57	.08629	.08661	11.546	.99627	3
58	.08658	.08690	11.507	.99625	2
59	.08687	.08720	11.468	.99622	1
60	.08716	.08749	11.430	.99619	**0**
′	Cos	Cot	Tan	Sin	′

94° (274°) (265°) **85°**

5° (185°) (354°) **174°**

′	Sin	Tan	Cot	Cos	′
0	.08716	.08749	11.430	.99619	**60**
1	.08745	.08778	11.392	.99617	59
2	.08774	.08807	11.354	.99614	58
3	.08803	.08837	11.316	.99612	57
4	.08831	.08866	11.279	.99609	56
5	.08860	.08895	11.242	.99607	**55**
6	.08889	.08925	11.205	.99604	54
7	.08918	.08954	11.168	.99602	53
8	.08947	.08983	11.132	.99599	52
9	.08976	.09013	11.095	.99596	51
10	.09005	.09042	11.059	.99594	**50**
11	.09034	.09071	11.024	.99591	49
12	.09063	.09101	10.988	.99588	48
13	.09092	.09130	10.953	.99586	47
14	.09121	.09159	10.918	.99583	46
15	.09150	.09189	10.883	.99580	**45**
16	.09179	.09218	10.848	.99578	44
17	.09208	.09247	10.814	.99575	43
18	.09237	.09277	10.780	.99572	42
19	.09266	.09306	10.746	.99570	41
20	.09295	.09335	10.712	.99567	**40**
21	.09324	.09365	10.678	.99564	39
22	.09353	.09394	10.645	.99562	38
23	.09382	.09423	10.612	.99559	37
24	.09411	.09453	10.579	.99556	36
25	.09440	.09482	10.546	.99553	**35**
26	.09469	.09511	10.514	.99551	34
27	.09498	.09541	10.481	.99548	33
28	.09527	.09570	10.449	.99545	32
29	.09556	.09600	10.417	.99542	31
30	.09585	.09629	10.385	.99540	**30**
31	.09614	.09658	10.354	.99537	29
32	.09642	.09688	10.322	.99534	28
33	.09671	.09717	10.291	.99531	27
34	.09700	.09746	10.260	.99528	26
35	.09729	.09776	10.229	.99526	**25**
36	.09758	.09805	10.199	.99523	24
37	.09787	.09834	10.168	.99520	23
38	.09816	.09864	10.138	.99517	22
39	.09845	.09893	10.108	.99514	21
40	.09874	.09923	10.078	.99511	**20**
41	.09903	.09952	10.048	.99508	19
42	.09932	.09981	10.019	.99506	18
43	.09961	.10011	9.9893	.99503	17
44	.09990	.10040	9.9601	.99500	16
45	.10019	.10069	9.9310	.99497	**15**
46	.10048	.10099	9.9021	.99494	14
47	.10077	.10128	9.8734	.99491	13
48	.10106	.10158	9.8448	.99488	12
49	.10135	.10187	9.8164	.99485	11
50	.10164	.10216	9.7882	.99482	**10**
51	.10192	.10246	9.7601	.99479	9
52	.10221	.10275	9.7322	.99476	8
53	.10250	.10305	9.7044	.99473	7
54	.10279	.10334	9.6768	.99470	6
55	.10308	.10363	9.6493	.99467	**5**
56	.10337	.10393	9.6220	.99464	4
57	.10366	.10422	9.5949	.99461	3
58	.10395	.10452	9.5679	.99458	2
59	.10424	.10481	9.5411	.99455	1
60	.10453	.10510	9.5144	.99452	**0**
′	Cos	Cot	Tan	Sin	′

95° (275°) (264°) **84°**

6° (186°) (353°) **173°**

′	Sin	Tan	Cot	Cos	′
0	.10453	.10510	9.5144	.99452	**60**
1	.10482	.10540	9.4878	.99449	59
2	.10511	.10569	9.4614	.99446	58
3	.10540	.10599	9.4352	.99443	57
4	.10569	.10628	9.4090	.99440	56
5	.10597	.10657	9.3831	.99437	**55**
6	.10626	.10687	9.3572	.99434	54
7	.10655	.10716	9.3315	.99431	53
8	.10684	.10746	9.3060	.99428	52
9	.10713	.10775	9.2806	.99424	51
10	.10742	.10805	9.2553	.99421	**50**
11	.10771	.10834	9.2302	.99418	49
12	.10800	.10863	9.2052	.99415	48
13	.10829	.10893	9.1803	.99412	47
14	.10858	.10922	9.1555	.99409	46
15	.10887	.10952	9.1309	.99406	**45**
16	.10916	.10981	9.1065	.99402	44
17	.10945	.11011	9.0821	.99399	43
18	.10973	.11040	9.0579	.99396	42
19	.11002	.11070	9.0338	.99393	41
20	.11031	.11099	9.0098	.99390	**40**
21	.11060	.11128	8.9860	.99386	39
22	.11089	.11158	8.9623	.99383	38
23	.11118	.11187	8.9387	.99380	37
24	.11147	.11217	8.9152	.99377	36
25	.11176	.11246	8.8919	.99374	**35**
26	.11205	.11276	8.8686	.99370	34
27	.11234	.11305	8.8455	.99367	33
28	.11263	.11335	8.8225	.99364	32
29	.11291	.11364	8.7996	.99360	31
30	.11320	.11394	8.7769	.99357	**30**
31	.11349	.11423	8.7542	.99354	29
32	.11378	.11452	8.7317	.99351	28
33	.11407	.11482	8.7093	.99347	27
34	.11436	.11511	8.6870	.99344	26
35	.11465	.11541	8.6648	.99341	**25**
36	.11494	.11570	8.6427	.99337	24
37	.11523	.11600	8.6208	.99334	23
38	.11552	.11629	8.5989	.99331	22
39	.11580	.11659	8.5772	.99327	21
40	.11609	.11688	8.5555	.99324	**20**
41	.11638	.11718	8.5340	.99320	19
42	.11667	.11747	8.5126	.99317	18
43	.11696	.11777	8.4913	.99314	17
44	.11725	.11806	8.4701	.99310	16
45	.11754	.11836	8.4490	.99307	**15**
46	.11783	.11865	8.4280	.99303	14
47	.11812	.11895	8.4071	.99300	13
48	.11840	.11924	8.3863	.99297	12
49	.11869	.11954	8.3656	.99293	11
50	.11898	.11983	8.3450	.99290	**10**
51	.11927	.12013	8.3245	.99286	9
52	.11956	.12042	8.3041	.99283	8
53	.11985	.12072	8.2838	.99279	7
54	.12014	.12101	8.2636	.99276	6
55	.12043	.12131	8.2434	.99272	**5**
56	.12071	.12160	8.2234	.99269	4
57	.12100	.12190	8.2035	.99265	3
58	.12129	.12219	8.1837	.99262	2
59	.12158	.12249	8.1640	.99258	1
60	.12187	.12278	8.1443	.99255	**0**
′	Cos	Cot	Tan	Sin	′

96° (276°) (263°) **83°**

7° (187°) (352°) **172°**

′	Sin	Tan	Cot	Cos	′
0	.12187	.12278	8.1443	.99255	**60**
1	.12216	.12308	8.1248	.99251	59
2	.12245	.12338	8.1054	.99248	58
3	.12274	.12367	8.0860	.99244	57
4	.12302	.12397	8.0667	.99240	56
5	.12331	.12426	8.0476	.99237	**55**
6	.12360	.12456	8.0285	.99233	54
7	.12389	.12485	8.0095	.99230	53
8	.12418	.12515	7.9906	.99226	52
9	.12447	.12544	7.9718	.99222	51
10	.12476	.12574	7.9530	.99219	**50**
11	.12504	.12603	7.9344	.99215	49
12	.12533	.12633	7.9158	.99211	48
13	.12562	.12662	7.8973	.99208	47
14	.12591	.12692	7.8789	.99204	46
15	.12620	.12722	7.8606	.99200	**45**
16	.12649	.12751	7.8424	.99197	44
17	.12678	.12781	7.8243	.99193	43
18	.12706	.12810	7.8062	.99189	42
19	.12735	.12840	7.7882	.99186	41
20	.12764	.12869	7.7704	.99182	**40**
21	.12793	.12899	7.7525	.99178	39
22	.12822	.12929	7.7348	.99175	38
23	.12851	.12958	7.7171	.99171	37
24	.12880	.12988	7.6996	.99167	36
25	.12908	.13017	7.6821	.99163	**35**
26	.12937	.13047	7.6647	.99160	34
27	.12966	.13076	7.6473	.99156	33
28	.12995	.13106	7.6301	.99152	32
29	.13024	.13136	7.6129	.99148	31
30	.13053	.13165	7.5958	.99144	**30**
31	.13081	.13195	7.5787	.99141	29
32	.13110	.13224	7.5618	.99137	28
33	.13139	.13254	7.5449	.99133	27
34	.13168	.13284	7.5281	.99129	26
35	.13197	.13313	7.5113	.99125	**25**
36	.13226	.13343	7.4947	.99122	24
37	.13254	.13372	7.4781	.99118	23
38	.13283	.13402	7.4615	.99114	22
39	.13312	.13432	7.4451	.99110	21
40	.13341	.13461	7.4287	.99106	**20**
41	.13370	.13491	7.4124	.99102	19
42	.13399	.13521	7.3962	.99098	18
43	.13427	.13550	7.3800	.99094	17
44	.13456	.13580	7.3639	.99091	16
45	.13485	.13609	7.3479	.99087	**15**
46	.13514	.13639	7.3319	.99083	14
47	.13543	.13669	7.3160	.99079	13
48	.13572	.13698	7.3002	.99075	12
49	.13600	.13728	7.2844	.99071	11
50	.13629	.13758	7.2687	.99067	**10**
51	.13658	.13787	7.2531	.99063	9
52	.13687	.13817	7.2375	.99059	8
53	.13716	.13846	7.2220	.99055	7
54	.13744	.13876	7.2066	.99051	6
55	.13773	.13906	7.1912	.99047	**5**
56	.13802	.13935	7.1759	.99043	4
57	.13831	.13965	7.1607	.99039	3
58	.13860	.13995	7.1455	.99035	2
59	.13889	.14024	7.1304	.99031	1
60	.13917	.14054	7.1154	.99027	**0**
′	Cos	Cot	Tan	Sin	′

97° (277°) (262°) **82°**

8° (188°) (351°) **171°**

′	Sin	Tan	Cot	Cos	′
0	.13917	.14054	7.1154	.99027	**60**
1	.13946	.14084	7.1004	.99023	59
2	.13975	.14113	7.0855	.99019	58
3	.14004	.14143	7.0706	.99015	57
4	.14033	.14173	7.0558	.99011	56
5	.14061	.14202	7.0410	.99006	**55**
6	.14090	.14232	7.0264	.99002	54
7	.14119	.14262	7.0117	.98998	53
8	.14148	.14291	6.9972	.98994	52
9	.14177	.14321	6.9827	.98990	51
10	.14205	.14351	6.9682	.98986	**50**
11	.14234	.14381	6.9538	.98982	49
12	.14263	.14410	6.9395	.98978	48
13	.14292	.14440	6.9252	.98973	47
14	.14320	.14470	6.9110	.98969	46
15	.14349	.14499	6.8969	.98965	**45**
16	.14378	.14529	6.8828	.98961	44
17	.14407	.14559	6.8687	.98957	43
18	.14436	.14588	6.8548	.98953	42
19	.14464	.14618	6.8408	.98948	41
20	.14493	.14648	6.8269	.98944	**40**
21	.14522	.14678	6.8131	.98940	39
22	.14551	.14707	6.7994	.98936	38
23	.14580	.14737	6.7856	.98931	37
24	.14608	.14767	6.7720	.98927	36
25	.14637	.14796	6.7584	.98923	**35**
26	.14666	.14826	6.7448	.98919	34
27	.14695	.14856	6.7313	.98914	33
28	.14723	.14886	6.7179	.98910	32
29	.14752	.14915	6.7045	.98906	31
30	.14781	.14945	6.6912	.98902	**30**
31	.14810	.14975	6.6779	.98897	29
32	.14838	.15005	6.6646	.98893	28
33	.14867	.15034	6.6514	.98889	27
34	.14896	.15064	6.6383	.98884	26
35	.14925	.15094	6.6252	.98880	**25**
36	.14954	.15124	6.6122	.98876	24
37	.14982	.15153	6.5992	.98871	23
38	.15011	.15183	6.5863	.98867	22
39	.15040	.15213	6.5734	.98863	21
40	.15069	.15243	6.5606	.98858	**20**
41	.15097	.15272	6.5478	.98854	19
42	.15126	.15302	6.5350	.98849	18
43	.15155	.15332	6.5223	.98845	17
44	.15184	.15362	6.5097	.98841	16
45	.15212	.15391	6.4971	.98836	**15**
46	.15241	.15421	6.4846	.98832	14
47	.15270	.15451	6.4721	.98827	13
48	.15299	.15481	6.4596	.98823	12
49	.15327	.15511	6.4472	.98818	11
50	.15356	.15540	6.4348	.98814	**10**
51	.15385	.15570	6.4225	.98809	9
52	.15414	.15600	6.4103	.98805	8
53	.15442	.15630	6.3980	.98800	7
54	.15471	.15660	6.3859	.98796	6
55	.15500	.15689	6.3737	.98791	**5**
56	.15529	.15719	6.3617	.98787	4
57	.15557	.15749	6.3496	.98782	3
58	.15586	.15779	6.3376	.98778	2
59	.15615	.15809	6.3257	.98773	1
60	.15643	.15838	6.3138	.98769	**0**
′	Cos	Cot	Tan	Sin	′

98° (278°) (261°) **81°**

9° (189°) (350°) **170°**

′	Sin	Tan	Cot	Cos	′
0	.15643	.15838	6.3138	.98769	**60**
1	.15672	.15868	6.3019	.98764	59
2	.15701	.15898	6.2901	.98760	58
3	.15730	.15928	6.2783	.98755	57
4	.15758	.15958	6.2666	.98751	56
5	.15787	.15988	6.2549	.98746	**55**
6	.15816	.16017	6.2432	.98741	54
7	.15845	.16047	6.2316	.98737	53
8	.15873	.16077	6.2200	.98732	52
9	.15902	.16107	6.2085	.98728	51
10	.15931	.16137	6.1970	.98723	**50**
11	.15959	.16167	6.1856	.98718	49
12	.15988	.16196	6.1742	.98714	48
13	.16017	.16226	6.1628	.98709	47
14	.16046	.16256	6.1515	.98704	46
15	.16074	.16286	6.1402	.98700	**45**
16	.16103	.16316	6.1290	.98695	44
17	.16132	.16346	6.1178	.98690	43
18	.16160	.16376	6.1066	.98686	42
19	.16189	.16405	6.0955	.98681	41
20	.16218	.16435	6.0844	.98676	**40**
21	.16246	.16465	6.0734	.98671	39
22	.16275	.16495	6.0624	.98667	38
23	.16304	.16525	6.0514	.98662	37
24	.16333	.16555	6.0405	.98657	36
25	.16361	.16585	6.0296	.98652	**35**
26	.16390	.16615	6.0188	.98648	34
27	.16419	.16645	6.0080	.98643	33
28	.16447	.16674	5.9972	.98638	32
29	.16476	.16704	5.9865	.98633	31
30	.16505	.16734	5.9758	.98629	**30**
31	.16533	.16764	5.9651	.98624	29
32	.16562	.16794	5.9545	.98619	28
33	.16591	.16824	5.9439	.98614	27
34	.16620	.16854	5.9333	.98609	26
35	.16648	.16884	5.9228	.98604	**25**
36	.16677	.16914	5.9124	.98600	24
37	.16706	.16944	5.9019	.98595	23
38	.16734	.16974	5.8915	.98590	22
39	.16763	.17004	5.8811	.98585	21
40	.16792	.17033	5.8708	.98580	**20**
41	.16820	.17063	5.8605	.98575	19
42	.16849	.17093	5.8502	.98570	18
43	.16878	.17123	5.8400	.98565	17
44	.16906	.17153	5.8298	.98561	16
45	.16935	.17183	5.8197	.98556	**15**
46	.16964	.17213	5.8095	.98551	14
47	.16992	.17243	5.7994	.98546	13
48	.17021	.17273	5.7894	.98541	12
49	.17050	.17303	5.7794	.98536	11
50	.17078	.17333	5.7694	.98531	**10**
51	.17107	.17363	5.7594	.98526	9
52	.17136	.17393	5.7495	.98521	8
53	.17164	.17423	5.7396	.98516	7
54	.17193	.17453	5.7297	.98511	6
55	.17222	.17483	5.7199	.98506	**5**
56	.17250	.17513	5.7101	.98501	4
57	.17279	.17543	5.7004	.98496	3
58	.17308	.17573	5.6906	.98491	2
59	.17336	.17603	5.6809	.98486	1
60	.17365	.17633	5.6713	.98481	**0**
′	Cos	Cot	Tan	Sin	

99° (279°) (260°) **80°**

10° (190°) (349°) **169°**

′	Sin	Tan	Cot	Cos	′
0	.17365	.17633	5.6713	.98481	**60**
1	.17393	.17663	5.6617	.98476	59
2	.17422	.17693	5.6521	.98471	58
3	.17451	.17723	5.6425	.98466	57
4	.17479	.17753	5.6329	.98461	56
5	.17508	.17783	5.6234	.98455	**55**
6	.17537	.17813	5.6140	.98450	54
7	.17565	.17843	5.6045	.98445	53
8	.17594	.17873	5.5951	.98440	52
9	.17623	.17903	5.5857	.98435	51
10	.17651	.17933	5.5764	.98430	**50**
11	.17680	.17963	5.5671	.98425	49
12	.17708	.17993	5.5578	.98420	48
13	.17737	.18023	5.5485	.98414	47
14	.17766	.18053	5.5393	.98409	46
15	.17794	.18083	5.5301	.98404	**45**
16	.17823	.18113	5.5209	.98399	44
17	.17852	.18143	5.5118	.98394	43
18	.17880	.18173	5.5026	.98389	42
19	.17909	.18203	5.4936	.98383	41
20	.17937	.18233	5.4845	.98378	**40**
21	.17966	.18263	5.4755	.98373	39
22	.17995	.18293	5.4665	.98368	38
23	.18023	.18323	5.4575	.98362	37
24	.18052	.18353	5.4486	.98357	36
25	.18081	.18384	5.4397	.98352	**35**
26	.18109	.18414	5.4308	.98347	34
27	.18138	.18444	5.4219	.98341	33
28	.18166	.18474	5.4131	.98336	32
29	.18195	.18504	5.4043	.98331	31
30	.18224	.18534	5.3955	.98325	**30**
31	.18252	.18564	5.3868	.98320	29
32	.18281	.18594	5.3781	.98315	28
33	.18309	.18624	5.3694	.98310	27
34	.18338	.18654	5.3607	.98304	26
35	.18367	.18684	5.3521	.98299	**25**
36	.18395	.18714	5.3435	.98294	24
37	.18424	.18745	5.3349	.98288	23
38	.18452	.18775	5.3263	.98283	22
39	.18481	.18805	5.3178	.98277	21
40	.18509	.18835	5.3093	.98272	**20**
41	.18538	.18865	5.3008	.98267	19
42	.18567	.18895	5.2924	.98261	18
43	.18595	.18925	5.2839	.98256	17
44	.18624	.18955	5.2755	.98250	16
45	.18652	.18986	5.2672	.98245	**15**
46	.18681	.19016	5.2588	.98240	14
47	.18710	.19046	5.2505	.98234	13
48	.18738	.19076	5.2422	.98229	12
49	.18767	.19106	5.2339	.98223	11
50	.18795	.19136	5.2257	.98218	**10**
51	.18824	.19166	5.2174	.98212	9
52	.18852	.19197	5.2092	.98207	8
53	.18881	.19227	5.2011	.98201	7
54	.18910	.19257	5.1929	.98196	6
55	.18938	.19287	5.1848	.98190	**5**
56	.18967	.19317	5.1767	.98185	4
57	.18995	.19347	5.1686	.98179	3
58	.19024	.19378	5.1606	.98174	2
59	.19052	.19408	5.1526	.98168	1
60	.19081	.19438	5.1446	.98163	**0**
′	Cos	Cot	Tan	Sin	′

100°(280°) (259°)**79°**

11° (191°) (348°) **168°**

′	Sin	Tan	Cot	Cos	′
0	.19081	.19438	5.1446	.98163	**60**
1	.19109	.19468	5.1366	.98157	59
2	.19138	.19498	5.1286	.98152	58
3	.19167	.19529	5.1207	.98146	57
4	.19195	.19559	5.1128	.98140	56
5	.19224	.19589	5.1049	.98135	**55**
6	.19252	.19619	5.0970	.98129	54
7	.19281	.19649	5.0892	.98124	53
8	.19309	.19680	5.0814	.98118	52
9	.19338	.19710	5.0736	.98112	51
10	.19366	.19740	5.0658	.98107	**50**
11	.19395	.19770	5.0581	.98101	49
12	.19423	.19801	5.0504	.98096	48
13	.19452	.19831	5.0427	.98090	47
14	.19481	.19861	5.0350	.98084	46
15	.19509	.19891	5.0273	.98079	**45**
16	.19538	.19921	5.0197	.98073	44
17	.19566	.19952	5.0121	.98067	43
18	.19595	.19982	5.0045	.98061	42
19	.19623	.20012	4.9969	.98056	41
20	.19652	.20042	4.9894	.98050	**40**
21	.19680	.20073	4.9819	.98044	39
22	.19709	.20103	4.9744	.98039	38
23	.19737	.20133	4.9669	.98033	37
24	.19766	.20164	4.9594	.98027	36
25	.19794	.20194	4.9520	.98021	**35**
26	.19823	.20224	4.9446	.98016	34
27	.19851	.20254	4.9372	.98010	33
28	.19880	.20285	4.9298	.98004	32
29	.19908	.20315	4.9225	.97998	31
30	.19937	.20345	4.9152	.97992	**30**
31	.19965	.20376	4.9078	.97987	29
32	.19994	.20406	4.9006	.97981	28
33	.20022	.20436	4.8933	.97975	27
34	.20051	.20466	4.8860	.97969	26
35	.20079	.20497	4.8788	.97963	**25**
36	.20108	.20527	4.8716	.97958	24
37	.20136	.20557	4.8644	.97952	23
38	.20165	.20588	4.8573	.97946	22
39	.20193	.20618	4.8501	.97940	21
40	.20222	.20648	4.8430	.97934	**20**
41	.20250	.20679	4.8359	.97928	19
42	.20279	.20709	4.8288	.97922	18
43	.20307	.20739	4.8218	.97916	17
44	.20336	.20770	4.8147	.97910	16
45	.20364	.20800	4.8077	.97905	**15**
46	.20393	.20830	4.8007	.97899	14
47	.20421	.20861	4.7937	.97893	13
48	.20450	.20891	4.7867	.97887	12
49	.20478	.20921	4.7798	.97881	11
50	.20507	.20952	4.7729	.97875	**10**
51	.20535	.20982	4.7659	.97869	9
52	.20563	.21013	4.7591	.97863	8
53	.20592	.21043	4.7522	.97857	7
54	.20620	.21073	4.7453	.97851	6
55	.20649	.21104	4.7385	.97845	**5**
56	.20677	.21134	4.7317	.97839	4
57	.20706	.21164	4.7249	.97833	3
58	.20734	.21195	4.7181	.97827	2
59	.20763	.21225	4.7114	.97821	1
60	.20791	.21256	4.7046	.97815	**0**
′	Cos	Cot	Tan	Sin	′

101°(281°) (258°)**78°**

12° (192°) (347°) **167°**

′	Sin	Tan	Cot	Cos	′
0	.20791	.21256	4.7046	.97815	**60**
1	.20820	.21286	4.6979	.97809	59
2	.20848	.21316	4.6912	.97803	58
3	.20877	.21347	4.6845	.97797	57
4	.20905	.21377	4.6779	.97791	56
5	.20933	.21408	4.6712	.97784	**55**
6	.20962	.21438	4.6646	.97778	54
7	.20990	.21469	4.6580	.97772	53
8	.21019	.21499	4.6514	.97766	52
9	.21047	.21529	4.6448	.97760	51
10	.21076	.21560	4.6382	.97754	**50**
11	.21104	.21590	4.6317	.97748	49
12	.21132	.21621	4.6252	.97742	48
13	.21161	.21651	4.6187	.97735	47
14	.21189	.21682	4.6122	.97729	46
15	.21218	.21712	4.6057	.97723	**45**
16	.21246	.21743	4.5993	.97717	44
17	.21275	.21773	4.5928	.97711	43
18	.21303	.21804	4.5864	.97705	42
19	.21331	.21834	4.5800	.97698	41
20	.21360	.21864	4.5736	.97692	**40**
21	.21388	.21895	4.5673	.97686	39
22	.21417	.21925	4.5609	.97680	38
23	.21445	.21956	4.5546	.97673	37
24	.21474	.21986	4.5483	.97667	36
25	.21502	.22017	4.5420	.97661	**35**
26	.21530	.22047	4.5357	.97655	34
27	.21559	.22078	4.5294	.97648	33
28	.21587	.22108	4.5232	.97642	32
29	.21616	.22139	4.5169	.97636	31
30	.21644	.22169	4.5107	.97630	**30**
31	.21672	.22200	4.5045	.97623	29
32	.21701	.22231	4.4983	.97617	28
33	.21729	.22261	4.4922	.97611	27
34	.21758	.22292	4.4860	.97604	26
35	.21786	.22322	4.4799	.97598	**25**
36	.21814	.22353	4.4737	.97592	24
37	.21843	.22383	4.4676	.97585	23
38	.21871	.22414	4.4615	.97579	22
39	.21899	.22444	4.4555	.97573	21
40	.21928	.22475	4.4494	.97566	**20**
41	.21956	.22505	4.4434	.97560	19
42	.21985	.22536	4.4373	.97553	18
43	.22013	.22567	4.4313	.97547	17
44	.22041	.22597	4.4253	.97541	16
45	.22070	.22628	4.4194	.97534	**15**
46	.22098	.22658	4.4134	.97528	14
47	.22126	.22689	4.4075	.97521	13
48	.22155	.22719	4.4015	.97515	12
49	.22183	.22750	4.3956	.97508	11
50	.22212	.22781	4.3897	.97502	**10**
51	.22240	.22811	4.3838	.97496	9
52	.22268	.22842	4.3779	.97489	8
53	.22297	.22872	4.3721	.97483	7
54	.22325	.22903	4.3662	.97476	6
55	.22353	.22934	4.3604	.97470	**5**
56	.22382	.22964	4.3546	.97463	4
57	.22410	.22995	4.3488	.97457	3
58	.22438	.23026	4.3430	.97450	2
59	.22467	.23056	4.3372	.97444	1
60	.22495	.23087	4.3315	.97437	**0**
′	Cos	Cot	Tan	Sin	′

102° (282°) (257°) **77°**

13° (193°) (346°) **166°**

′	Sin	Tan	Cot	Cos	′
0	.22495	.23087	4.3315	.97437	**60**
1	.22523	.23117	4.3257	.97430	59
2	.22552	.23148	4.3200	.97424	58
3	.22580	.23179	4.3143	.97417	57
4	.22608	.23209	4.3086	.97411	56
5	.22637	.23240	4.3029	.97404	**55**
6	.22665	.23271	4.2972	.97398	54
7	.22693	.23301	4.2916	.97391	53
8	.22722	.23332	4.2859	.97384	52
9	.22750	.23363	4.2803	.97378	51
10	.22778	.23393	4.2747	.97371	**50**
11	.22807	.23424	4.2691	.97365	49
12	.22835	.23455	4.2635	.97358	48
13	.22863	.23485	4.2580	.97351	47
14	.22892	.23516	4.2524	.97345	46
15	.22920	.23547	4.2468	.97338	**45**
16	.22948	.23578	4.2413	.97331	44
17	.22977	.23608	4.2358	.97325	43
18	.23005	.23639	4.2303	.97318	42
19	.23033	.23670	4.2248	.97311	41
20	.23062	.23700	4.2193	.97304	**40**
21	.23090	.23731	4.2139	.97298	39
22	.23118	.23762	4.2084	.97291	38
23	.23146	.23793	4.2030	.97284	37
24	.23175	.23823	4.1976	.97278	36
25	.23203	.23854	4.1922	.97271	**35**
26	.23231	.23885	4.1868	.97264	34
27	.23260	.23916	4.1814	.97257	33
28	.23288	.23946	4.1760	.97251	32
29	.23316	.23977	4.1706	.97244	31
30	.23345	.24008	4.1653	.97237	**30**
31	.23373	.24039	4.1600	.97230	29
32	.23401	.24069	4.1547	.97223	28
33	.23429	.24100	4.1493	.97217	27
34	.23458	.24131	4.1441	.97210	26
35	.23486	.24162	4.1388	.97203	**25**
36	.23514	.24193	4.1335	.97196	24
37	.23542	.24223	4.1282	.07189	23
38	.23571	.24254	4.1230	.97182	22
39	.23599	.24285	4.1178	.97176	21
40	.23627	.24316	4.1126	.97169	**20**
41	.23656	.24347	4.1074	.97162	19
42	.23684	.24377	4.1022	.97155	18
43	.23712	.24408	4.0970	.97148	17
44	.23740	.24439	4.0918	.97141	16
45	.23769	.24470	4.0867	.97134	**15**
46	.23797	.24501	4.0815	.97127	14
47	.23825	.24532	4.0764	.97120	13
48	.23853	.24562	4.0713	.97113	12
49	.23882	.24593	4.0662	.97106	11
50	.23910	.24624	4.0611	.97100	**10**
51	.23938	.24655	4.0560	.97093	9
52	.23966	.24686	4.0509	.97086	8
53	.23995	.24717	4.0459	.97079	7
54	.24023	.24747	4.0408	.97072	6
55	.24051	.24778	4.0358	.97065	**5**
56	.24079	.24809	4.0308	.97058	4
57	.24108	.24840	4.0257	.97051	3
58	.24136	.24871	4.0207	.97044	2
59	.24164	.24902	4.0158	.97037	1
60	.24192	.24933	4.0108	.97030	**0**
′	Cos	Cot	Tan	Sin	′

103° (283°) (256°) **76°**

14° (194°) (345°) **165°**

′	Sin	Tan	Cot	Cos	′
0	.24192	.24933	4.0108	.97030	**60**
1	.24220	.24964	4.0058	.97023	59
2	.24249	.24995	4.0009	.97015	58
3	.24277	.25026	3.9959	.97008	57
4	.24305	.25056	3.9910	.97001	56
5	.24333	.25087	3.9861	.96994	**55**
6	.24362	.25118	3.9812	.96987	54
7	.24390	.25149	3.9763	.96980	53
8	.24418	.25180	3.9714	.96973	52
9	.24446	.25211	3.9665	.96966	51
10	.24474	.25242	3.9617	.96959	**50**
11	.24503	.25273	3.9568	.96952	49
12	.24531	.25304	3.9520	.96945	48
13	.24559	.25335	3.9471	.96937	47
14	.24587	.25366	3.9423	.96930	46
15	.24615	.25397	3.9375	.96923	**45**
16	.24644	.25428	3.9327	.96916	44
17	.24672	.25459	3.9279	.96909	43
18	.24700	.25490	3.9232	.96902	42
19	.24728	.25521	3.9184	.96894	41
20	.24756	.25552	3.9136	.96887	**40**
21	.24784	.25583	3.9089	.96880	39
22	.24813	.25614	3.9042	.96873	38
23	.24841	.25645	3.8995	.96866	37
24	.24869	.25676	3.8947	.96858	36
25	.24897	.25707	3.8900	.96851	**35**
26	.24925	.25738	3.8854	.96844	34
27	.24954	.25769	3.8807	.96837	33
28	.24982	.25800	3.8760	.96829	32
29	.25010	.25831	3.8714	.96822	31
30	.25038	.25862	3.8667	.96815	**30**
31	.25066	.25893	3.8621	.96807	29
32	.25094	.25924	3.8575	.96800	28
33	.25122	.25955	3.8528	.96793	27
34	.25151	.25986	3.8482	.96786	26
35	.25179	.26017	3.8436	.96778	**25**
36	.25207	.26048	3.8391	.96771	24
37	.25235	.26079	3.8345	.96764	23
38	.25263	.26110	3.8299	.96756	22
39	.25291	.26141	3.8254	.96749	21
40	.25320	.26172	3.8208	.96742	**20**
41	.25348	.26203	3.8163	.96734	19
42	.25376	.26235	3.8118	.96727	18
43	.25404	.26266	3.8073	.96719	17
44	.25432	.26297	3.8028	.96712	16
45	.25460	.26328	3.7983	.96705	**15**
46	.25488	.26359	3.7938	.96697	14
47	.25516	.26390	3.7893	.96690	13
48	.25545	.26421	3.7848	.96682	12
49	.25573	.26452	3.7804	.96675	11
50	.25601	.26483	3.7760	.96667	**10**
51	.25629	.26515	3.7715	.96660	9
52	.25657	.26546	3.7671	.96653	8
53	.25685	.26577	3.7627	.96645	7
54	.25713	.26608	3.7583	.96638	6
55	.25741	.26639	3.7539	.96630	**5**
56	.25769	.26670	3.7495	.96623	4
57	.25798	.26701	3.7451	.96615	3
58	.25826	.26733	3.7408	.96608	2
59	.25854	.26764	3.7364	.96600	1
60	.25882	.26795	3.7321	.96593	**0**
′	Cos	Cot	Tan	Sin	′

104° (284°) (255°) **75°**

15° (195°) (344°) **164°**

′	Sin	Tan	Cot	Cos	′
0	.25882	.26795	3.7321	.96593	**60**
1	.25910	.26826	3.7277	.96585	59
2	.25938	.26857	3.7234	.96578	58
3	.25966	.26888	3.7191	.96570	57
4	.25994	.26920	3.7148	.96562	56
5	.26022	.26951	3.7105	.96555	**55**
6	.26050	.26982	3.7062	.96547	54
7	.26079	.27013	3.7019	.96540	53
8	.26107	.27044	3.6976	.96532	52
9	.26135	.27076	3.6933	.96524	51
10	.26163	.27107	3.6891	.96517	**50**
11	.26191	.27138	3.6848	.96509	49
12	.26219	.27169	3.6806	.96502	48
13	.26247	.27201	3.6764	.96494	47
14	.26275	.27232	3.6722	.96486	46
15	.26303	.27263	3.6680	.96479	**45**
16	.26331	.27294	3.6638	.96471	44
17	.26359	.27326	3.6596	.96463	43
18	.26387	.27357	3.6554	.96456	42
19	.26415	.27388	3.6512	.96448	41
20	.26443	.27419	3.6470	.96440	**40**
21	.26471	.27451	3.6429	.96433	39
22	.26500	.27482	3.6387	.96425	38
23	.26528	.27513	3.6346	.96417	37
24	.26556	.27545	3.6305	.96410	36
25	.26584	.27576	3.6264	.96402	**35**
26	.26612	.27607	3.6222	.96394	34
27	.26640	.27638	3.6181	.96386	33
28	.26668	.27670	3.6140	.96379	32
29	.26696	.27701	3.6100	.96371	31
30	.26724	.27732	3.6059	.96363	**30**
31	.26752	.27764	3.6018	.96355	29
32	.26780	.27795	3.5978	.96347	28
33	.26808	.27826	3.5937	.96340	27
34	.26836	.27858	3.5897	.96332	26
35	.26864	.27889	3.5856	.96324	**25**
36	.26892	.27921	3.5816	.96316	24
37	.26920	.27952	3.5776	.96308	23
38	.26948	.27983	3.5736	.96301	22
39	.26976	.28015	3.5696	.96293	21
40	.27004	.28046	3.5656	.96285	**20**
41	.27032	.28077	3.5616	.96277	19
42	.27060	.28109	3.5576	.96269	18
43	.27088	.28140	3.5536	.96261	17
44	.27116	.28172	3.5497	.96253	16
45	.27144	.28203	3.5457	.96246	**15**
46	.27172	.28234	3.5418	.96238	14
47	.27200	.28266	3.5379	.96230	13
48	.27228	.28297	3.5339	.96222	12
49	.27256	.28329	3.5300	.96214	11
50	.27284	.28360	3.5261	.96206	**10**
51	.27312	.28391	3.5222	.96198	9
52	.27340	.28423	3.5183	.96190	8
53	.27368	.28454	3.5144	.96182	7
54	.27396	.28486	3.5105	.96174	6
55	.27424	.28517	3.5067	.96166	**5**
56	.27452	.28549	3.5028	.96158	4
57	.27480	.28580	3.4989	.96150	3
58	.27508	.28612	3.4951	.96142	2
59	.27536	.28643	3.4912	.96134	1
60	.27564	.28675	3.4874	.96126	**0**
′	Cos	Cot	Tan	Sin	′

105° (285°) (254°) **74°**

16° (196°) (343°) **163°**

′	Sin	Tan	Cot	Cos	′
0	.27564	.28675	3.4874	.96126	60
1	.27592	.28706	3.4836	.96118	59
2	.27620	.28738	3.4798	.96110	58
3	.27648	.28769	3.4760	.96102	57
4	.27676	.28801	3.4722	.96094	56
5	.27704	.28832	3.4684	.96086	55
6	.27731	.28864	3.4646	.96078	54
7	.27759	.28895	3.4608	.96070	53
8	.27787	.28927	3.4570	.96062	52
9	.27815	.28958	3.4533	.96054	51
10	.27843	.28990	3.4495	.96046	50
11	.27871	.29021	3.4458	.96037	49
12	.27899	.29053	3.4420	.96029	48
13	.27927	.29084	3.4383	.96021	47
14	.27955	.29116	3.4346	.96013	46
15	.27983	.29147	3.4308	.96005	45
16	.28011	.29179	3.4271	.95997	44
17	.28039	.29210	3.4234	.95989	43
18	.28067	.29242	3.4197	.95981	42
19	.28095	.29274	3.4160	.95972	41
20	.28123	.29305	3.4124	.95964	40
21	.28150	.29337	3.4087	.95956	39
22	.28178	.29368	3.4050	.95948	38
23	.28206	.29400	3.4014	.95940	37
24	.28234	.29432	3.3977	.95931	36
25	.28262	.29463	3.3941	.95923	35
26	.28290	.29495	3.3904	.95915	34
27	.28318	.29526	3.3868	.95907	33
28	.28346	.29558	3.3832	.95898	32
29	.28374	.29590	3.3796	.95890	31
30	.28402	.29621	3.3759	.95882	30
31	.28429	.29653	3.3723	.95874	29
32	.28457	.29685	3.3687	.95865	28
33	.28485	.29716	3.3652	.95857	27
34	.28513	.29748	3.3616	.95849	26
35	.28541	.29780	3.3580	.95841	25
36	.28569	.29811	3.3544	.95832	24
37	.28597	.29843	3.3509	.95824	23
38	.28625	.29875	3.3473	.95816	22
39	.28652	.29906	3.3438	.95807	21
40	.28680	.29938	3.3402	.95799	20
41	.28708	.29970	3.3367	.95791	19
42	.28736	.30001	3.3332	.95782	18
43	.28764	.30033	3.3297	.95774	17
44	.28792	.30065	3.3261	.95766	16
45	.28820	.30097	3.3226	.95757	15
46	.28847	.30128	3.3191	.95749	14
47	.28875	.30160	3.3156	.95740	13
48	.28903	.30192	3.3122	.95732	12
49	.28931	.30224	3.3087	.95724	11
50	.28959	.30255	3.3052	.95715	10
51	.28987	.30287	3.3017	.95707	9
52	.29015	.30319	3.2983	.95698	8
53	.29042	.30351	3.2948	.95690	7
54	.29070	.30382	3.2914	.95681	6
55	.29098	.30414	3.2879	.95673	5
56	.29126	.30446	3.2845	.95664	4
57	.29154	.30478	3.2811	.95656	3
58	.29182	.30509	3.2777	.95647	2
59	.29209	.30541	3.2743	.95639	1
60	.29237	.30573	3.2709	.95630	0
′	Cos	Cot	Tan	Sin	′

106° (286°) (253°) **73°**

17° (197°) (342°) **162°**

′	Sin	Tan	Cot	Cos	′
0	.29237	.30573	3.2709	.95630	60
1	.29265	.30605	3.2675	.95622	59
2	.29293	.30637	3.2641	.95613	58
3	.29321	.30669	3.2607	.95605	57
4	.29348	.30700	3.2573	.95596	56
5	.29376	.30732	3.2539	.95588	55
6	.29404	.30764	3.2506	.95579	54
7	.29432	.30796	3.2472	.95571	53
8	.29460	.30828	3.2438	.95562	52
9	.29487	.30860	3.2405	.95554	51
10	.29515	.30891	3.2371	.95545	50
11	.29543	.30923	3.2338	.95536	49
12	.29571	.30955	3.2305	.95528	48
13	.29599	.30987	3.2272	.95519	47
14	.29626	.31019	3.2238	.95511	46
15	.29654	.31051	3.2205	.95502	45
16	.29682	.31083	3.2172	.95493	44
17	.29710	.31115	3.2139	.95485	43
18	.29737	.31147	3.2106	.95476	42
19	.29765	.31178	3.2073	.95467	41
20	.29793	.31210	3.2041	.95459	40
21	.29821	.31242	3.2008	.95450	39
22	.29849	.31274	3.1975	.95441	38
23	.29876	.31306	3.1943	.95433	37
24	.29904	.31338	3.1910	.95424	36
25	.29932	.31370	3.1878	.95415	35
26	.29960	.31402	3.1845	.95407	34
27	.29987	.31434	3.1813	.95398	33
28	.30015	.31466	3.1780	.95389	32
29	.30043	.31498	3.1748	.95380	31
30	.30071	.31530	3.1716	.95372	30
31	.30098	.31562	3.1684	.95363	29
32	.30126	.31594	3.1652	.95354	28
33	.30154	.31626	3.1620	.95345	27
34	.30182	.31658	3.1588	.95337	26
35	.30209	.31690	3.1556	.95328	25
36	.30237	.31722	3.1524	.95319	24
37	.30265	.31754	3.1492	.95310	23
38	.30292	.31786	3.1460	.95301	22
39	.30320	.31818	3.1429	.95293	21
40	.30348	.31850	3.1397	.95284	20
41	.30376	.31882	3.1366	.95275	19
42	.30403	.31914	3.1334	.95266	18
43	.30431	.31946	3.1303	.95257	17
44	.30459	.31978	3.1271	.95248	16
45	.30486	.32010	3.1240	.95240	15
46	.30514	.32042	3.1209	.95231	14
47	.30542	.32074	3.1178	.95222	13
48	.30570	.32106	3.1146	.95213	12
49	.30597	.32139	3.1115	.95204	11
50	.30625	.32171	3.1084	.95195	10
51	.30653	.32203	3.1053	.95186	9
52	.30680	.32235	3.1022	.95177	8
53	.30708	.32267	3.0991	.95168	7
54	.30736	.32299	3.0961	.95159	6
55	.30763	.32331	3.0930	.95150	5
56	.30791	.32363	3.0899	.95142	4
57	.30819	.32396	3.0868	.95133	3
58	.30846	.32428	3.0838	.95124	2
59	.30874	.32460	3.0807	.95115	1
60	.30902	.32492	3.0777	.95106	0
′	Cos	Cot	Tan	Sin	′

107° (287°) (252°) **72°**

18° (198°) (341°) **161°**

′	Sin	Tan	Cot	Cos	′
0	.30902	.32492	3.0777	.95106	**60**
1	.30929	.32524	3.0746	.95097	59
2	.30957	.32556	3.0716	.95088	58
3	.30985	.32588	3.0686	.95079	57
4	.31012	.32621	3.0655	.95070	56
5	.31040	.32653	3.0625	.95061	**55**
6	.31068	.32685	3.0595	.95052	54
7	.31095	.32717	3.0565	.95043	53
8	.31123	.32749	3.0535	.95033	52
9	.31151	.32782	3.0505	.95024	51
10	.31178	.32814	3.0475	.95015	**50**
11	.31206	.32846	3.0445	.95006	49
12	.31233	.32878	3.0415	.94997	48
13	.31261	.32911	3.0385	.94988	47
14	.31289	.32943	3.0356	.94979	46
15	.31316	.32975	3.0326	.94970	**45**
16	.31344	.33007	3.0296	.94961	44
17	.31372	.33040	3.0267	.94952	43
18	.31399	.33072	3.0237	.94943	42
19	.31427	.33104	3.0208	.94933	41
20	.31454	.33136	3.0178	.94924	**40**
21	.31482	.33169	3.0149	.94915	39
22	.31510	.33201	3.0120	.94906	38
23	.31537	.33233	3.0090	.94897	37
24	.31565	.33266	3.0061	.94888	36
25	.31593	.33298	3.0032	.94878	**35**
26	.31620	.33330	3.0003	.94869	34
27	.31648	.33363	2.9974	.94860	33
28	.31675	.33395	2.9945	.94851	32
29	.31703	.33427	2.9916	.94842	31
30	.31730	.33460	2.9887	.94832	**30**
31	.31758	.33492	2.9858	.94823	29
32	.31786	.33524	2.9829	.94814	28
33	.31813	.33557	2.9800	.94805	27
34	.31841	.33589	2.9772	.94795	26
35	.31868	.33621	2.9743	.94786	**25**
36	.31896	.33654	2.9714	.94777	24
37	.31923	.33686	2.9686	.94768	23
38	.31951	.33718	2.9657	.94758	22
39	.31979	.33751	2.9629	.94749	21
40	.32006	.33783	2.9600	.94740	**20**
41	.32034	.33816	2.9572	.94730	19
42	.32061	.33848	2.9544	.94721	18
43	.32089	.33881	2.9515	.94712	17
44	.32116	.33913	2.9487	.94702	16
45	.32144	.33945	2.9459	.94693	**15**
46	.32171	.33978	2.9431	.94684	14
47	.32199	.34010	2.9403	.94674	13
48	.32227	.34043	2.9375	.94665	12
49	.32254	.34075	2.9347	.94656	11
50	.32282	.34108	2.9319	.94646	**10**
51	.32309	.34140	2.9291	.94637	9
52	.32337	.34173	2.9263	.94627	8
53	.32364	.34205	2.9235	.94618	7
54	.32392	.34238	2.9208	.94609	6
55	.32419	.34270	2.9180	.94599	**5**
56	.32447	.34303	2.9152	.94590	4
57	.32474	.34335	2.9125	.94580	3
58	.32502	.34368	2.9097	.94571	2
59	.32529	.34400	2.9070	.94561	1
60	.32557	.34433	2.9042	.94552	**0**
′	Cos	Cot	Tan	Sin	′

108° (288°) (251°) **71°**

19° (199°) (340°) **160°**

′	Sin	Tan	Cot	Cos	′
0	.32557	.34433	2.9042	.94552	**60**
1	.32584	.34465	2.9015	.94542	59
2	.32612	.34498	2.8987	.94533	58
3	.32639	.34530	2.8960	.94523	57
4	.32667	.34563	2.8933	.94514	56
5	.32694	.34596	2.8905	.94504	**55**
6	.32722	.34628	2.8878	.94495	54
7	.32749	.34661	2.8851	.94485	53
8	.32777	.34693	2.8824	.94476	52
9	.32804	.34726	2.8797	.94466	51
10	.32832	.34758	2.8770	.94457	**50**
11	.32859	.34791	2.8743	.94447	49
12	.32887	.34824	2.8716	.94438	48
13	.32914	.34856	2.8689	.94428	47
14	.32942	.34889	2.8662	.94418	46
15	.32969	.34922	2.8636	.94409	**45**
16	.32997	.34954	2.8609	.94399	44
17	.33024	.34987	2.8582	.94390	43
18	.33051	.35020	2.8556	.94380	42
19	.33079	.35052	2.8529	.94370	41
20	.33106	.35085	2.8502	.94361	**40**
21	.33134	.35118	2.8476	.94351	39
22	.33161	.35150	2.8449	.94342	38
23	.33189	.35183	2.8423	.94332	37
24	.33216	.35216	2.8397	.94322	36
25	.33244	.35248	2.8370	.94313	**35**
26	.33271	.35281	2.8344	.94303	34
27	.33298	.35314	2.8318	.94293	33
28	.33326	.35346	2.8291	.94284	32
29	.33353	.35379	2.8265	.94274	31
30	.33381	.35412	2.8239	.94264	**30**
31	.33408	.35445	2.8213	.94254	29
32	.33436	.35477	2.8187	.94245	28
33	.33463	.35510	2.8161	.94235	27
34	.33490	.35543	2.8135	.94225	26
35	.33518	.35576	2.8109	.94215	**25**
36	.33545	.35608	2.8083	.94206	24
37	.33573	.35641	2.8057	.94196	23
38	.33600	.35674	2.8032	.94186	22
39	.33627	.35707	2.8006	.94176	21
40	.33655	.35740	2.7980	.94167	**20**
41	.33682	.35772	2.7955	.94157	19
42	.33710	.35805	2.7929	.94147	18
43	.33737	.35838	2.7903	.94137	17
44	.33764	.35871	2.7878	.94127	16
45	.33792	.35904	2.7852	.94118	**15**
46	.33819	.35937	2.7827	.94108	14
47	.33846	.35969	2.7801	.94098	13
48	.33874	.36002	2.7776	.94088	12
49	.33901	.36035	2.7751	.94078	11
50	.33929	.36068	2.7725	.94068	**10**
51	.33956	.36101	2.7700	.94058	9
52	.33983	.36134	2.7675	.94049	8
53	.34011	.36167	2.7650	.94039	7
54	.34038	.36199	2.7625	.94029	6
55	.34065	.36232	2.7600	.94019	**5**
56	.34093	.36265	2.7575	.94009	4
57	.34120	.36298	2.7550	.93999	3
58	.34147	.36331	2.7525	.93989	2
59	.34175	.36364	2.7500	.93979	1
60	.34202	.36397	2.7475	.93969	**0**
′	Cos	Cot	Tan	Sin	′

109° (289°) (250°) **70°**

20° (200°) (339°) **159°**

′	Sin	Tan	Cot	Cos	′
0	.34202	.36397	2.7475	.93969	**60**
1	.34229	.36430	2.7450	.93959	59
2	.34257	.36463	2.7425	.93949	58
3	.34284	.36496	2.7400	.93939	57
4	.34311	.36529	2.7376	.93929	56
5	.34339	.36562	2.7351	.93919	**55**
6	.34366	.36595	2.7326	.93909	54
7	.34393	.36628	2.7302	.93899	53
8	.34421	.36661	2.7277	.93889	52
9	.34448	.36694	2.7253	.93879	51
10	.34475	.36727	2.7228	.93869	**50**
11	.34503	.36760	2.7204	.93859	49
12	.34530	.36793	2.7179	.93849	48
13	.34557	.36826	2.7155	.93839	47
14	.34584	.36859	2.7130	.93829	46
15	.34612	.36892	2.7106	.93819	**45**
16	.34639	.36925	2.7082	.93809	44
17	.34666	.36958	2.7058	.93799	43
18	.34694	.36991	2.7034	.93789	42
19	.34721	.37024	2.7009	.93779	41
20	.34748	.37057	2.6985	.93769	**40**
21	.34775	.37090	2.6961	.93759	39
22	.34803	.37123	2.6937	.93748	38
23	.34830	.37157	2.6913	.93738	37
24	.34857	.37190	2.6889	.93728	36
25	.34884	.37223	2.6865	.93718	**35**
26	.34912	.37256	2.6841	.93708	34
27	.34939	.37289	2.6818	.93698	33
28	.34966	.37322	2.6794	.93688	32
29	.34993	.37355	2.6770	.93677	31
30	.35021	.37388	2.6746	.93667	**30**
31	.35048	.37422	2.6723	.93657	29
32	.35075	.37455	2.6699	.93647	28
33	.35102	.37488	2.6675	.93637	27
34	.35130	.37521	2.6652	.93626	26
35	.35157	.37554	2.6628	.93616	**25**
36	.35184	.37588	2.6605	.93606	24
37	.35211	.37621	2.6581	.93596	23
38	.35239	.37654	2.6558	.93585	22
39	.35266	.37687	2.6534	.93575	21
40	.35293	.37720	2.6511	.93565	**20**
41	.35320	.37754	2.6488	.93555	19
42	.35347	.37787	2.6464	.93544	18
43	.35375	.37820	2.6441	.93534	17
44	.35402	.37853	2.6418	.93524	16
45	.35429	.37887	2.6395	.93514	**15**
46	.35456	.37920	2.6371	.93503	14
47	.35484	.37953	2.6348	.93493	13
48	.35511	.37986	2.6325	.93483	12
49	.35538	.38020	2.6302	.93472	11
50	.35565	.38053	2.6279	.93462	**10**
51	.35592	.38086	2.6256	.93452	9
52	.35619	.38120	2.6233	.93441	8
53	.35647	.38153	2.6210	.93431	7
54	.35674	.38186	2.6187	.93420	6
55	.35701	.38220	2.6165	.93410	**5**
56	.35728	.38253	2.6142	.93400	4
57	.35755	.38286	2.6119	.93389	3
58	.35782	.38320	2.6096	.93379	2
59	.35810	.38353	2.6074	.93368	1
60	.35837	.38386	2.6051	.93358	**0**
′	Cos	Cot	Tan	Sin	′

110° (290°) (249°) **69°**

21° (201°) (338°) **158°**

′	Sin	Tan	Cot	Cos	′
0	.35837	.38386	2.6051	.93358	**60**
1	.35864	.38420	2.6028	.93348	59
2	.35891	.38453	2.6006	.93337	58
3	.35918	.38487	2.5983	.93327	57
4	.35945	.38520	2.5961	.93316	56
5	.35973	.38553	2.5938	.93306	**55**
6	.36000	.38587	2.5916	.93295	54
7	.36027	.38620	2.5893	.93285	53
8	.36054	.38654	2.5871	.93274	52
9	.36081	.38687	2.5848	.93264	51
10	.36108	.38721	2.5826	.93253	**50**
11	.36135	.38754	2.5804	.93243	49
12	.36162	.38787	2.5782	.93232	48
13	.36190	.38821	2.5759	.93222	47
14	.36217	.38854	2.5737	.93211	46
15	.36244	.38888	2.5715	.93201	**45**
16	.36271	.38921	2.5693	.93190	44
17	.36298	.38955	2.5671	.93180	43
18	.36325	.38988	2.5649	.93169	42
19	.36352	.39022	2.5627	.93159	41
20	.36379	.39055	2.5605	.93148	**40**
21	.36406	.39089	2.5583	.93137	39
22	.36434	.39122	2.5561	.93127	38
23	.36461	.39156	2.5539	.93116	37
24	.36488	.39190	2.5517	.93106	36
25	.36515	.39223	2.5495	.93095	**35**
26	.36542	.39257	2.5473	.93084	34
27	.36569	.39290	2.5452	.93074	33
28	.36596	.39324	2.5430	.93063	32
29	.36623	.39357	2.5408	.93052	31
30	.36650	.39391	2.5386	.93042	**30**
31	.36677	.39425	2.5365	.93031	29
32	.36704	.39458	2.5343	.93020	28
33	.36731	.39492	2.5322	.93010	27
34	.36758	.39526	2.5300	.92999	26
35	.36785	.39559	2.5279	.92988	**25**
36	.36812	.39593	2.5257	.92978	24
37	.36839	.39626	2.5236	.92967	23
38	.36867	.39660	2.5214	.92956	22
39	.36894	.39694	2.5193	.92945	21
40	.36921	.39727	2.5172	.92935	**20**
41	.36948	.39761	2.5150	.92924	19
42	.36975	.39795	2.5129	.92913	18
43	.37002	.39829	2.5108	.92902	17
44	.37029	.39862	2.5086	.92892	16
45	.37056	.39896	2.5065	.92881	**15**
46	.37083	.39930	2.5044	.92870	14
47	.37110	.39963	2.5023	.92859	13
48	.37137	.39997	2.5002	.92849	12
49	.37164	.40031	2.4981	.92838	11
50	.37191	.40065	2.4960	.92827	**10**
51	.37218	.40098	2.4939	.92816	9
52	.37245	.40132	2.4918	.92805	8
53	.37272	.40166	2.4897	.92794	7
54	.37299	.40200	2.4876	.92784	6
55	.37326	.40234	2.4855	.92773	**5**
56	.37353	.40267	2.4834	.92762	4
57	.37380	.40301	2.4813	.92751	3
58	.37407	.40335	2.4792	.92740	2
59	.37434	.40369	2.4772	.92729	1
60	.37461	.40403	2.4751	.92718	**0**
′	Cos	Cot	Tan	Sin	′

111° (291°) (248°) **68°**

22° (202°) (337°) **157°**

′	Sin	Tan	Cot	Cos	′
0	.37461	.40403	2.4751	.92718	**60**
1	.37488	.40436	2.4730	.92707	59
2	.37515	.40470	2.4709	.92697	58
3	.37542	.40504	2.4689	.92686	57
4	.37569	.40538	2.4668	.92675	56
5	.37595	.40572	2.4648	.92664	**55**
6	.37622	.40606	2.4627	.92653	54
7	.37649	.40640	2.4606	.92642	53
8	.37676	.40674	2.4586	.92631	52
9	.37703	.40707	2.4566	.92620	51
10	.37730	.40741	2.4545	.92609	**50**
11	.37757	.40775	2.4525	.92598	49
12	.37784	.40809	2.4504	.92587	48
13	.37811	.40843	2.4484	.92576	47
14	.37838	.40877	2.4464	.92565	46
15	.37865	.40911	2.4443	.92554	**45**
16	.37892	.40945	2.4423	.92543	44
17	.37919	.40979	2.4403	.92532	43
18	.37946	.41013	2.4383	.92521	42
19	.37973	.41047	2.4362	.92510	41
20	.37999	.41081	2.4342	.92499	**40**
21	.38026	.41115	2.4322	.92488	39
22	.38053	.41149	2.4302	.92477	38
23	.38080	.41183	2.4282	.92466	37
24	.38107	.41217	2.4262	.92455	36
25	.38134	.41251	2.4242	.92444	**35**
26	.38161	.41285	2.4222	.92432	34
27	.38188	.41319	2.4202	.92421	33
28	.38215	.41353	2.4182	.92410	32
29	.38241	.41387	2.4162	.92399	31
30	.38268	.41421	2.4142	.92388	**30**
31	.38295	.41455	2.4122	.92377	29
32	.38322	.41490	2.4102	.92366	28
33	.38349	.41524	2.4083	.92355	27
34	.38376	.41558	2.4063	.92343	26
35	.38403	.41592	2.4043	.92332	**25**
36	.38430	.41626	2.4023	.92321	24
37	.38456	.41660	2.4004	.92310	23
38	.38483	.41694	2.3984	.92299	22
39	.38510	.41728	2.3964	.92287	21
40	.38537	.41763	2.3945	.92276	**20**
41	.38564	.41797	2.3925	.92265	19
42	.38591	.41831	2.3906	.92254	18
43	.38617	.41865	2.3886	.92243	17
44	.38644	.41899	2.3867	.92231	16
45	.38671	.41933	2.3847	.92220	**15**
46	.38698	.41968	2.3828	.92209	14
47	.38725	.42002	2.3808	.92198	13
48	.38752	.42036	2.3789	.92186	12
49	.38778	.42070	2.3770	.92175	11
50	.38805	.42105	2.3750	.92164	**10**
51	.38832	.42139	2.3731	.92152	9
52	.38859	.42173	2.3712	.92141	8
53	.38886	.42207	2.3693	.92130	7
54	.38912	.42242	2.3673	.92119	6
55	.38939	.42276	2.3654	.92107	**5**
56	.38966	.42310	2.3635	.92096	4
57	.38993	.42345	2.3616	.92085	3
58	.39020	.42379	2.3597	.92073	2
59	.39046	.42413	2.3578	.92062	1
60	.39073	.42447	2.3559	.92050	**0**
′	Cos	Cot	Tan	Sin	′

112° (292°) (247°) **67°**

23° (203°) (336°) **156°**

′	Sin	Tan	Cot	Cos	′
0	.39073	.42447	2.3559	.92050	**60**
1	.39100	.42482	2.3539	.92039	59
2	.39127	.42516	2.3520	.92028	58
3	.39153	.42551	2.3501	.92016	57
4	.39180	.42585	2.3483	.92005	56
5	.39207	.42619	2.3464	.91994	**55**
6	.39234	.42654	2.3445	.91982	54
7	.39260	.42688	2.3426	.91971	53
8	.39287	.42722	2.3407	.91959	52
9	.39314	.42757	2.3388	.91948	51
10	.39341	.42791	2.3369	.91936	**50**
11	.39367	.42826	2.3351	.91925	49
12	.39394	.42860	2.3332	.91914	48
13	.39421	.42894	2.3313	.91902	47
14	.39448	.42929	2.3294	.91891	46
15	.39474	.42963	2.3276	.91879	**45**
16	.39501	.42998	2.3257	.91868	44
17	.39528	.43032	2.3238	.91856	43
18	.39555	.43067	2.3220	.91845	42
19	.39581	.43101	2.3201	.91833	41
20	.39608	.43136	2.3183	.91822	**40**
21	.39635	.43170	2.3164	.91810	39
22	.39661	.43205	2.3146	.91799	38
23	.39688	.43239	2.3127	.91787	37
24	.39715	.43274	2.3109	.91775	36
25	.39741	.43308	2.3090	.91764	**35**
26	.39768	.43343	2.3072	.91752	34
27	.39795	.43378	2.3053	.91741	33
28	.39822	.43412	2.3035	.91729	32
29	.39848	.43447	2.3017	.91718	31
30	.39875	.43481	2.2998	.91706	**30**
31	.39902	.43516	2.2980	.91694	29
32	.39928	.43550	2.2962	.91683	28
33	.39955	.43585	2.2944	.91671	27
34	.39982	.43620	2.2925	.91660	26
35	.40008	.43654	2.2907	.91648	**25**
36	.40035	.43689	2.2889	.91636	24
37	.40062	.43724	2.2871	.91625	23
38	.40088	.43758	2.2853	.91613	22
39	.40115	.43793	2.2835	.91601	21
40	.40141	.43828	2.2817	.91590	**20**
41	.40168	.43862	2.2799	.91578	19
42	.40195	.43897	2.2781	.91566	18
43	.40221	.43932	2.2763	.91555	17
44	.40248	.43966	2.2745	.91543	16
45	.40275	.44001	2.2727	.91531	**15**
46	.40301	.44036	2.2709	.91519	14
47	.40328	.44071	2.2691	.91508	13
48	.40355	.44105	2.2673	.91496	12
49	.40381	.44140	2.2655	.91484	11
50	.40408	.44175	2.2637	.91472	**10**
51	.40434	.44210	2.2620	.91461	9
52	.40461	.44244	2.2602	.91449	8
53	.40488	.44279	2.2584	.91437	7
54	.40514	.44314	2.2566	.91425	6
55	.40541	.44349	2.2549	.91414	**5**
56	.40567	.44384	2.2531	.91402	4
57	.40594	.44418	2.2513	.91390	3
58	.40621	.44453	2.2496	.91378	2
59	.40647	.44488	2.2478	.91366	1
60	.40674	.44523	2.2460	.91355	**0**
′	Cos	Cot	Tan	Sin	

113° (293°) (246°) **66°**

24° (204°) (335°) **155°**

′	Sin	Tan	Cot	Cos	′
0	.40674	.44523	2.2460	.91355	**60**
1	.40700	.44558	2.2443	.91343	59
2	.40727	.44593	2.2425	.91331	58
3	.40753	.44627	2.2408	.91319	57
4	.40780	.44662	2.2390	.91307	56
5	.40806	.44697	2.2373	.91295	**55**
6	.40833	.44732	2.2355	.91283	54
7	.40860	.44767	2.2338	.91272	53
8	.40886	.44802	2.2320	.91260	52
9	.40913	.44837	2.2303	.91248	51
10	.40939	.44872	2.2286	.91236	**50**
11	.40966	.44907	2.2268	.91224	49
12	.40992	.44942	2.2251	.91212	48
13	.41019	.44977	2.2234	.91200	47
14	.41045	.45012	2.2216	.91188	46
15	.41072	.45047	2.2199	.91176	**45**
16	.41098	.45082	2.2182	.91164	44
17	.41125	.45117	2.2165	.91152	43
18	.41151	.45152	2.2148	.91140	42
19	.41178	.45187	2.2130	.91128	41
20	.41204	.45222	2.2113	.91116	**40**
21	.41231	.45257	2.2096	.91104	39
22	.41257	.45292	2.2079	.91092	38
23	.41284	.45327	2.2062	.91080	37
24	.41310	.45362	2.2045	.91068	36
25	.41337	.45397	2.2028	.91056	**35**
26	.41363	.45432	2.2011	.91044	34
27	.41390	.45467	2.1994	.91032	33
28	.41416	.45502	2.1977	.91020	32
29	.41443	.45538	2.1960	.91008	31
30	.41469	.45573	2.1943	.90996	**30**
31	.41496	.45608	2.1926	.90984	29
32	.41522	.45643	2.1909	.90972	28
33	.41549	.45678	2.1892	.90960	27
34	.41575	.45713	2.1876	.90948	26
35	.41602	.45748	2.1859	.90936	**25**
36	.41628	.45784	2.1842	90924	24
37	.41655	.45819	2.1825	.90911	23
38	.41681	.45854	2.1808	.90899	22
39	.41707	.45889	2.1792	.90887	21
40	.41734	.45924	2.1775	.90875	**20**
41	.41760	.45960	2.1758	.90863	19
42	.41787	.45995	2.1742	.90851	18
43	.41813	.46030	2.1725	.90839	17
44	.41840	.46065	2.1708	.90826	16
45	.41866	.46101	2.1692	.90814	**15**
46	.41892	.46136	2.1675	.90802	14
47	.41919	.46171	2.1659	.90790	13
48	.41945	.46206	2.1642	.90778	12
49	.41972	.46242	2.1625	.90766	11
50	.41998	.46277	2.1609	.90753	**10**
51	.42024	.46312	2.1592	.90741	9
52	.42051	.46348	2.1576	.90729	8
53	.42077	.46383	2.1560	.90717	7
54	.42104	.46418	2.1543	.90704	6
55	.42130	.46454	2.1527	.90692	**5**
56	.42156	.46489	2.1510	.90680	4
57	.42183	.46525	2.1494	.90668	3
58	.42209	.46560	2.1478	.90655	2
59	.42235	.46595	2.1461	.90643	1
60	.42262	.46631	2.1445	.90631	**0**
′	Cos	Cot	Tan	Sin	′

114° (294°) (245°) **65°**

25° (205°) (334°) **154°**

′	Sin	Tan	Cot	Cos	′
0	.42262	.46631	2.1445	.90631	**60**
1	.42288	.46666	2.1429	.90618	59
2	.42315	.46702	2.1413	.90606	58
3	.42341	.46737	2.1396	.90594	57
4	.42367	.46772	2.1380	.90582	56
5	.42394	.46808	2.1364	.90569	**55**
6	.42420	.46843	2.1348	.90557	54
7	.42446	.46879	2.1332	.90545	53
8	.42473	.46914	2.1315	.90532	52
9	.42499	.46950	2.1299	.90520	51
10	.42525	.46985	2.1283	.90507	**50**
11	.42552	.47021	2.1267	.90495	49
12	.42578	.47056	2.1251	.90483	48
13	.42604	.47092	2.1235	.90470	47
14	.42631	.47128	2.1219	.90458	46
15	.42657	.47163	2.1203	.90446	**45**
16	.42683	.47199	2.1187	.90433	44
17	.42709	.47234	2.1171	.90421	43
18	.42736	.47270	2.1155	.90408	42
19	.42762	.47305	2.1139	.90396	41
20	.42788	.47341	2.1123	.90383	**40**
21	.42815	.47377	2.1107	.90371	39
22	.42841	.47412	2.1092	.90358	38
23	.42867	.47448	2.1076	.90346	37
24	.42894	.47483	2.1060	.90334	36
25	.42920	.47519	2.1044	.90321	**35**
26	.42946	.47555	2.1028	.90309	34
27	.42972	.47590	2.1013	.90296	33
28	.42999	.47626	2.0997	.90284	32
29	.43025	.47662	2.0981	.90271	31
30	.43051	.47698	2.0965	.90259	**30**
31	.43077	.47733	2.0950	.90246	29
32	.43104	.47769	2.0934	.90233	28
33	.43130	.47805	2.0918	.90221	27
34	.43156	.47840	2.0903	.90208	26
35	.43182	.47876	2.0887	.90196	**25**
36	.43209	.47912	2.0872	.90183	24
37	.43235	.47948	2.0856	.90171	23
38	.43261	.47984	2.0840	.90158	22
39	.43287	.48019	2.0825	90146	21
40	.43313	.48055	2.0809	.90133	**20**
41	.43340	.48091	2.0794	.90120	19
42	.43366	.48127	2.0778	.90108	18
43	.43392	.48163	2.0763	.90095	17
44	.43418	.48198	2.0748	.90082	16
45	.43445	.48234	2.0732	.90070	**15**
46	.43471	.48270	2.0717	.90057	14
47	.43497	.48306	2.0701	.90045	13
48	.43523	.48342	2.0686	.90032	12
49	.43549	.48378	2.0671	.90019	11
50	.43575	.48414	2.0655	.90007	**10**
51	.43602	.48450	2.0640	.89994	9
52	.43628	.48486	2.0625	.89981	8
53	.43654	.48521	2.0609	.89968	7
54	.43680	.48557	2.0594	.89956	6
55	.43706	.48593	2.0579	.89943	**5**
56	.43733	.48629	2.0564	.89930	4
57	.43759	.48665	2.0549	.89918	3
58	.43785	.48701	2.0533	.89905	2
59	.43811	.48737	2.0518	.89892	1
60	.43837	.48773	2.0503	.89879	**0**
′	Cos	Cot	Tan	Sin	′

115° (295°) (244°) **64°**

26° (206°) (333°) **153°**

′	Sin	Tan	Cot	Cos	′
0	.43837	.48773	2.0503	.89879	**60**
1	.43863	.48809	2.0488	.89867	59
2	.43889	.48845	2.0473	.89854	58
3	.43916	.48881	2.0458	.89841	57
4	.43942	.48917	2.0443	.89828	56
5	.43968	.48953	2.0428	.89816	**55**
6	.43994	.48989	2.0413	.89803	54
7	.44020	.49026	2.0398	.89790	53
8	.44046	.49062	2.0383	.89777	52
9	.44072	.49098	2.0368	.89764	51
10	.44098	.49134	2.0353	.89752	**50**
11	.44124	.49170	2.0338	.89739	49
12	.44151	.49206	2.0323	.89726	48
13	.44177	.49242	2.0308	.89713	47
14	.44203	.49278	2.0293	.89700	46
15	.44229	.49315	2.0278	.89687	**45**
16	.44255	.49351	2.0263	.89674	44
17	.44281	.49387	2.0248	.89662	43
18	.44307	.49423	2.0233	.89649	42
19	.44333	.49459	2.0219	.89636	41
20	.44359	.49495	2.0204	.89623	**40**
21	.44385	.49532	2.0189	.89610	39
22	.44411	.49568	2.0174	.89597	38
23	.44437	.49604	2.0160	.89584	37
24	.44464	.49640	2.0145	.89571	36
25	.44490	.49677	2.0130	.89558	**35**
26	.44516	.49713	2.0115	.89545	34
27	.44542	.49749	2.0101	.89532	33
28	.44568	.49786	2.0086	.89519	32
29	.44594	.49822	2.0072	.89506	31
30	.44620	.49858	2.0057	.89493	**30**
31	.44646	.49894	2.0042	.89480	29
32	.44672	.49931	2.0028	.89467	28
33	.44698	.49967	2.0013	.89454	27
34	.44724	.50004	1.9999	.89441	26
35	.44750	.50040	1.9984	.89428	**25**
36	.44776	.50076	1.9970	.89415	24
37	.44802	.50113	1.9955	.89402	23
38	.44828	.50149	1.9941	.89389	22
39	.44854	.50185	1.9926	.89376	21
40	.44880	.50222	1.9912	.89363	**20**
41	.44906	.50258	1.9897	.89350	19
42	.44932	.50295	1.9883	.89337	18
43	.44958	.50331	1.9868	.89324	17
44	.44984	.50368	1.9854	.89311	16
45	.45010	.50404	1.9840	.89298	**15**
46	.45036	.50441	1.9825	.89285	14
47	.45062	.50477	1.9811	.89272	13
48	.45088	.50514	1.9797	.89259	12
49	.45114	.50550	1.9782	.89245	11
50	.45140	.50587	1.9768	.89232	**10**
51	.45166	.50623	1.9754	.89219	9
52	.45192	.50660	1.9740	.89206	8
53	.45218	.50696	1.9725	.89193	7
54	.45243	.50733	1.9711	.89180	6
55	.45269	.50769	1.9697	.89167	**5**
56	.45295	.50806	1.9683	.89153	4
57	.45321	.50843	1.9669	.89140	3
58	.45347	.50879	1.9654	.89127	2
59	.45373	.50916	1.9640	.89114	1
60	.45399	.50953	1.9626	.89101	**0**
′	Cos	Cot	Tan	Sin	′

116° (296°) (243°) **63°**

27° (207°) (332°) **152°**

′	Sin	Tan	Cot	Cos	′
0	.45399	.50953	1.9626	.89101	**60**
1	.45425	.50989	1.9612	.89087	59
2	.45451	.51026	1.9598	.89074	58
3	.45477	.51063	1.9584	.89061	57
4	.45503	.51099	1.9570	.89048	56
5	.45529	.51136	1.9556	.89035	**55**
6	.45554	.51173	1.9542	.89021	54
7	.45580	.51209	1.9528	.89008	53
8	.45606	.51246	1.9514	.88995	52
9	.45632	.51283	1.9500	.88981	51
10	.45658	.51319	1.9486	.88968	**50**
11	.45684	.51356	1.9472	.88955	49
12	.45710	.51393	1.9458	.88942	48
13	.45736	.51430	1.9444	.88928	47
14	.45762	.51467	1.9430	.88915	46
15	.45787	.51503	1.9416	.88902	**45**
16	.45813	.51540	1.9402	.88888	44
17	.45839	.51577	1.9388	.88875	43
18	.45865	.51614	1.9375	.88862	42
19	.45891	.51651	1.9361	.88848	41
20	.45917	.51688	1.9347	.88835	**40**
21	.45942	.51724	1.9333	.88822	39
22	.45968	.51761	1.9319	.88808	38
23	.45994	.51798	1.9306	.88795	37
24	.46020	.51835	1.9292	.88782	36
25	.46046	.51872	1.9278	.88768	**35**
26	.46072	.51909	1.9265	.88755	34
27	.46097	.51946	1.9251	.88741	33
28	.46123	.51983	1.9237	.88728	32
29	.46149	.52020	1.9223	.88715	31
30	.46175	.52057	1.9210	.88701	**30**
31	.46201	.52094	1.9196	.88688	29
32	.46226	.52131	1.9183	.88674	28
33	.46252	.52168	1.9169	.88661	27
34	.46278	.52205	1.9155	.88647	26
35	.46304	.52242	1.9142	.88634	**25**
36	.46330	.52279	1.9128	.88620	24
37	.46355	.52316	1.9115	.88607	23
38	.46381	.52353	1.9101	.88593	22
39	.46407	.52390	1.9088	.88580	21
40	.46433	.52427	1.9074	.88566	**20**
41	.46458	.52464	1.9061	.88553	19
42	.46484	.52501	1.9047	.88539	18
43	.46510	.52538	1.9034	.88526	17
44	.46536	.52575	1.9020	.88512	16
45	.46561	.52613	1.9007	.88499	**15**
46	.46587	.52650	1.8993	.88485	14
47	.46613	.52687	1.8980	.88472	13
48	.46639	.52724	1.8967	.88458	12
49	.46664	.52761	1.8953	.88445	11
50	.46690	.52798	1.8940	.88431	**10**
51	.46716	.52836	1.8927	.88417	9
52	.46742	.52873	1.8913	.88404	8
53	.46767	.52910	1.8900	.88390	7
54	.46793	.52947	1.8887	.88377	6
55	.46819	.52985	1.8873	.88363	**5**
56	.46844	.53022	1.8860	.88349	4
57	.46870	.53059	1.8847	.88336	3
58	.46896	.53096	1.8834	.88322	2
59	.46921	.53134	1.8820	.88308	1
60	.46947	.53171	1.8807	.88295	**0**
′	Cos	Cot	Tan	Sin	′

117° (297°) (242°) **62°**

28° (208°) (331°) **151°**

′	Sin	Tan	Cot	Cos	′
0	.46947	.53171	1.8807	.88295	**60**
1	.46973	.53208	1.8794	.88281	59
2	.46999	.53246	1.8781	.88267	58
3	.47024	.53283	1.8768	.88254	57
4	.47050	.53320	1.8755	.88240	56
5	.47076	.53358	1.8741	.88226	**55**
6	.47101	.53395	1.8728	.88213	54
7	.47127	.53432	1.8715	.88199	53
8	.47153	.53470	1.8702	.88185	52
9	.47178	.53507	1.8689	.88172	51
10	.47204	.53545	1.8676	.88158	**50**
11	.47229	.53582	1.8663	.88144	49
12	.47255	.53620	1.8650	.88130	48
13	.47281	.53657	1.8637	.88117	47
14	.47306	.53694	1.8624	.88103	46
15	.47332	.53732	1.8611	.88089	**45**
16	.47358	.53769	1.8598	.88075	44
17	.47383	.53807	1.8585	.88062	43
18	.47409	.53844	1.8572	.88048	42
19	.47434	.53882	1.8559	.88034	41
20	.47460	.53920	1.8546	.88020	**40**
21	.47486	.53957	1.8533	.88006	39
22	.47511	.53995	1.8520	.87993	38
23	.47537	.54032	1.8507	.87979	37
24	.47562	.54070	1.8495	.87965	36
25	.47588	.54107	1.8482	.87951	**35**
26	.47614	.54145	1.8469	.87937	34
27	.47639	.54183	1.8456	.87923	33
28	.47665	.54220	1.8443	.87909	32
29	.47690	.54258	1.8430	.87896	31
30	.47716	.54296	1.8418	.87882	**30**
31	.47741	.54333	1.8405	.87868	29
32	.47767	.54371	1.8392	.87854	28
33	.47793	.54409	1.8379	.87840	27
34	.47818	.54446	1.8367	.87826	26
35	.47844	.54484	1.8354	.87812	**25**
36	.47869	.54522	1.8341	.87798	24
37	.47895	.54560	1.8329	.87784	23
38	.47920	.54597	1.8316	.87770	22
39	.47946	.54635	1.8303	.87756	21
40	.47971	.54673	1.8291	.87743	**20**
41	.47997	.54711	1.8278	.87729	19
42	.48022	.54748	1.8265	.87715	18
43	.48048	.54786	1.8253	.87701	17
44	.48073	.54824	1.8240	.87687	16
45	.48099	.54862	1.8228	.87673	**15**
46	.48124	.54900	1.8215	.87659	14
47	.48150	.54938	1.8202	.87645	13
48	.48175	.54975	1.8190	.87631	12
49	.48201	.55013	1.8177	.87617	11
50	.48226	.55051	1.8165	.87603	**10**
51	.48252	.55089	1.8152	.87589	9
52	.48277	.55127	1.8140	.87575	8
53	.48303	.55165	1.8127	.87561	7
54	.48328	.55203	1.8115	.87546	6
55	.48354	.55241	1.8103	.87532	**5**
56	.48379	.55279	1.8090	.87518	4
57	.48405	.55317	1.8078	.87504	3
58	.48430	.55355	1.8065	.87490	2
59	.48456	.55393	1.8053	.87476	1
60	.48481	.55431	1.8040	.87462	**0**
′	Cos	Cot	Tan	Sin	′

118° (298°) (241°) **61°**

29° (209°) (330°) **150°**

′	Sin	Tan	Cot	Cos	′
0	.48481	.55431	1.8040	.87462	**60**
1	.48506	.55469	1.8028	.87448	59
2	.48532	.55507	1.8016	.87434	58
3	.48557	.55545	1.8003	.87420	57
4	.48583	.55583	1.7991	.87406	56
5	.48608	.55621	1.7979	.87391	**55**
6	.48634	.55659	1.7966	.87377	54
7	.48659	.55697	1.7954	.87363	53
8	.48684	.55736	1.7942	.87349	52
9	.48710	.55774	1.7930	.87335	51
10	.48735	.55812	1.7917	.87321	**50**
11	.48761	.55850	1.7905	.87306	49
12	.48786	.55888	1.7893	.87292	48
13	.48811	.55926	1.7881	.87278	47
14	.48837	.55964	1.7868	.87264	46
15	.48862	.56003	1.7856	.87250	**45**
16	.48888	.56041	1.7844	.87235	44
17	.48913	.56079	1.7832	.87221	43
18	.48938	.56117	1.7820	.87207	42
19	.48964	.56156	1.7808	.87193	41
20	.48989	.56194	1.7796	.87178	**40**
21	.49014	.56232	1.7783	.87164	39
22	.49040	.56270	1.7771	.87150	38
23	.49065	.56309	1.7759	.87136	37
24	.49090	.56347	1.7747	.87121	36
25	.49116	.56385	1.7735	.87107	**35**
26	.49141	.56424	1.7723	.87093	34
27	.49166	.54462	1.7711	.87079	33
28	.49192	.56501	1.7699	.87064	32
29	.49217	.56539	1.7687	.87050	31
30	.49242	.56577	1.7675	.87036	**30**
31	.49268	.56616	1.7663	.87021	29
32	.49293	.56654	1.7651	.87007	28
33	.49318	.56693	1.7639	.86993	27
34	.49344	.56731	1.7627	.86978	26
35	.49369	.56769	1.7615	.86964	**25**
36	.49394	.56808	1.7603	.86949	24
37	.49419	.56846	1.7591	.86935	23
38	.49445	.56885	1.7579	.86921	22
39	.49470	.56923	1.7567	.86906	21
40	.49495	.56962	1.7556	.86892	**20**
41	.49521	.57000	1.7544	.86878	19
42	.49546	.57039	1.7532	.86863	18
43	.49571	.57078	1.7520	.86849	17
44	.49596	.57116	1.7508	.86834	16
45	.49622	.57155	1.7496	.86820	**15**
46	.49647	.57193	1.7485	.86805	14
47	.49672	.57232	1.7473	.86791	13
48	.49697	.57271	1.7461	.86777	12
49	.49723	.57309	1.7449	.86762	11
50	.49748	.57348	1.7437	.86748	**10**
51	.49773	.57386	1.7426	.86733	9
52	.49798	.57425	1.7414	.86719	8
53	.49824	.57464	1.7402	.86704	7
54	.49849	.57503	1.7391	.86690	6
55	.49874	.57541	1.7379	.86675	**5**
56	.49899	.57580	1.7367	.86661	4
57	.49924	.57619	1.7355	.86646	3
58	.49950	.57657	1.7344	.86632	2
59	.49975	.57696	1.7332	.86617	1
60	.50000	.57735	1.7321	.86603	**0**
′	Cos	Cot	Tan	Sin	′

119° (299°) (240°) **60°**

30° (210°) (329°) **149°**

'	Sin	Tan	Cot	Cos	'
0	.50000	.57735	1.7321	.86603	**60**
1	.50025	.57774	1.7309	.86588	59
2	.50050	.57813	1.7297	.86573	58
3	.50076	.57851	1.7286	.86559	57
4	.50101	.57890	1.7274	.86544	56
5	.50126	.57929	1.7262	.86530	**55**
6	.50151	.57968	1.7251	.86515	54
7	.50176	.58007	1.7239	.86501	53
8	.50201	.58046	1.7228	.86486	52
9	.50227	.58085	1.7216	.86471	51
10	.50252	.58124	1.7205	.86457	**50**
11	.50277	.58162	1.7193	.86442	49
12	.50302	.58201	1.7182	.86427	48
13	.50327	.58240	1.7170	.86413	47
14	.50352	.58279	1.7159	.86398	46
15	.50377	.58318	1.7147	.86384	**45**
16	.50403	.58357	1.7136	.86369	44
17	.50428	.58396	1.7124	.86354	43
18	.50453	.58435	1.7113	.86340	42
19	.50478	.58474	1.7102	.86325	41
20	.50503	.58513	1.7090	.86310	**40**
21	.50528	.58552	1.7079	.86295	39
22	.50553	.58591	1.7067	.86281	38
23	.50578	.58631	1.7056	.86266	37
24	.50603	.58670	1.7045	.86251	36
25	.50628	.58709	1.7033	.86237	**35**
26	.50654	.58748	1.7022	.86222	34
27	.50679	.58787	1.7011	.86207	33
28	.50704	.58826	1.6999	.86192	32
29	.50729	.58865	1.6988	.86178	31
30	.50754	.58905	1.6977	.86163	**30**
31	.50779	.58944	1.6965	.86148	29
32	.50804	.58983	1.6954	.86133	28
33	.50829	.59022	1.6943	.86119	27
34	.50854	.59061	1.6932	.86104	26
35	.50879	.59101	1.6920	.86089	**25**
36	.50904	.59140	1.6909	.86074	24
37	.50929	.59179	1.6898	.86059	23
38	.50954	.59218	1.6887	.86045	22
39	.50979	.59258	1.6875	.86030	21
40	.51004	.59297	1.6864	.86015	**20**
41	.51029	.59336	1.6853	.86000	19
42	.51054	.59376	1.6842	.85985	18
43	.51079	.59415	1.6831	.85970	17
44	.51104	.59454	1.6820	.85956	16
45	.51129	.59494	1.6808	.85941	**15**
46	.51154	.59533	1.6797	.85926	14
47	.51179	.59573	1.6786	.85911	13
48	.51204	.59612	1.6775	.85896	12
49	.51229	.59651	1.6764	.85881	11
50	.51254	.59691	1.6753	.85866	**10**
51	.51279	.59730	1.6742	.85851	9
52	.51304	.59770	1.6731	.85836	8
53	.51329	.59809	1.6720	.85821	7
54	.51354	.59849	1.6709	.85806	6
55	.51379	.59888	1.6698	.85792	**5**
56	.51404	.59928	1.6687	.85777	4
57	.51429	.59967	1.6676	.85762	3
58	.51454	.60007	1.6665	.85747	2
59	.51479	.60046	1.6654	.85732	1
60	.51504	.60086	1.6643	.85717	**0**
'	Cos	Cot	Tan	Sin	'

120° (300°) (239°) **59°**

31° (211°) (328°) **148°**

'	Sin	Tan	Cot	Cos	'
0	.51504	.60086	1.6643	.85717	**60**
1	.51529	.60126	1.6632	.85702	59
2	.51554	.60165	1.6621	.85687	58
3	.51579	.60205	1.6610	.85672	57
4	.51604	.60245	1.6599	.85657	56
5	.51628	.60284	1.6588	.85642	**55**
6	.51653	.60324	1.6577	.85627	54
7	.51678	.60364	1.6566	.85612	53
8	.51703	.60403	1.6555	.85597	52
9	.51728	.60443	1.6545	.85582	51
10	.51753	.60483	1.6534	.85567	**50**
11	.51778	.60522	1.6523	.85551	49
12	.51803	.60562	1.6512	.85536	48
13	.51828	.60602	1.6501	.85521	47
14	.51852	.60642	1.6490	.85506	46
15	.51877	.60681	1.6479	.85491	**45**
16	.51902	.60721	1.6469	.85476	44
17	.51927	.60761	1.6458	.85461	43
18	.51952	.60801	1.6447	.85446	42
19	.51977	.60841	1.6436	.85431	41
20	.52002	.60881	1.6426	.85416	**40**
21	.52026	.60921	1.6415	.85401	39
22	.52051	.60960	1.6404	.85385	38
23	.52076	.61000	1.6393	.85370	37
24	.52101	.61040	1.6383	.85355	36
25	.52126	.61080	1.6372	.85340	**35**
26	.52151	.61120	1.6361	.85325	34
27	.52175	.61160	1.6351	.85310	33
28	.52200	.61200	1.6340	.85294	32
29	.52225	.61240	1.6329	.85279	31
30	.52250	.61280	1.6319	.85264	**30**
31	.52275	.61320	1.6308	.85249	29
32	.52299	.61360	1.6297	.85234	28
33	.52324	.61400	1.6287	.85218	27
34	.52349	.61440	1.6276	.85203	26
35	.52374	.61480	1.6265	.85188	**25**
36	.52399	.61520	1.6255	.85173	24
37	.52423	.61561	1.6244	.85157	23
38	.52448	.61601	1.6234	.85142	22
39	.52473	.61641	1.6223	.85127	21
40	.52498	.61681	1.6212	.85112	**20**
41	.52522	.61721	1.6202	.85096	19
42	.52547	.61761	1.6191	.85081	18
43	.52572	.61801	1.6181	.85066	17
44	.52597	.61842	1.6170	.85051	16
45	.52621	.61882	1.6160	.85035	**15**
46	.52646	.61922	1.6149	.85020	14
47	.52671	.61962	1.6139	.85005	13
48	.52696	.62003	1.6128	.84989	12
49	.52720	.62043	1.6118	.84974	11
50	.52745	.62083	1.6107	.84959	**10**
51	.52770	.62124	1.6097	.84943	9
52	.52794	.62164	1.6087	.84928	8
53	.52819	.62204	1.6076	.84913	7
54	.52844	.62245	1.6066	.84897	6
55	.52869	.62285	1.6055	.84882	**5**
56	.52893	.62325	1.6045	.84866	4
57	.52918	.62366	1.6034	.84851	3
58	.52943	.62406	1.6024	.84836	2
59	.52967	.62446	1.6014	.84820	1
60	.52992	.62487	1.6003	.84805	**0**
'	Cos	Cot	Tan	Sin	'

121° (301°) (238°) **58°**

32° (212°) (327°) **147°**

′	Sin	Tan	Cot	Cos	′
0	.52992	.62487	1.6003	.84805	**60**
1	.53017	.62527	1.5993	.84789	59
2	.53041	.62568	1.5983	.84774	58
3	.53066	.62608	1.5972	.84759	57
4	.53091	.62649	1.5962	.84743	56
5	.53115	.62689	1.5952	.84728	**55**
6	.53140	.62730	1.5941	.84712	54
7	.53164	.62770	1.5931	.84697	53
8	.53189	.62811	1.5921	.84681	52
9	.53214	.62852	1.5911	.84666	51
10	.53238	.62892	1.5900	.84650	**50**
11	.53263	.62933	1.5890	.84635	49
12	.53288	.62973	1.5880	.84619	48
13	.53312	.63014	1.5869	.84604	47
14	.53337	.63055	1.5859	.84588	46
15	.53361	.63095	1.5849	.84573	**45**
16	.53386	.63136	1.5839	.84557	44
17	.53411	.63177	1.5829	.84542	43
18	.53435	.63217	1.5818	.84526	42
19	.53460	.63258	1.5808	.84511	41
20	.53484	.63299	1.5798	.84495	**40**
21	.53509	.63340	1.5788	.84480	39
22	.53534	.63380	1.5778	.84464	38
23	.53558	.63421	1.5768	.84448	37
24	.53583	.63462	1.5757	.84433	36
25	.53607	.63503	1.5747	.84417	**35**
26	.53632	.63544	1.5737	.84402	34
27	.53656	.63584	1.5727	.84386	33
28	.53681	.63625	1.5717	.84370	32
29	.53705	.63666	1.5707	.84355	31
30	.53730	.63707	1.5697	.84339	**30**
31	.53754	.63748	1.5687	.84324	29
32	.53779	.63789	1.5677	.84308	28
33	.53804	.63830	1.5667	.84292	27
34	.53828	.63871	1.5657	.84277	26
35	.53853	.63912	1.5647	.84261	**25**
36	.53877	.63953	1.5637	.84245	24
37	.53902	.63994	1.5627	.84230	23
38	.53926	.64035	1.5617	.84214	22
39	.53951	.64076	1.5607	.84198	21
40	.53975	.64117	1.5597	.84182	**20**
41	.54000	.64158	1.5587	.84167	19
42	.54024	.64199	1.5577	.84151	18
43	.54049	.64240	1.5567	.84135	17
44	.54073	.64281	1.5557	.84120	16
45	.54097	.64322	1.5547	.84104	**15**
46	.54122	.64363	1.5537	.84088	14
47	.54146	.64404	1.5527	.84072	13
48	.54171	.64446	1.5517	.84057	12
49	.54195	.64487	1.5507	.84041	11
50	.54220	.64528	1.5497	.84025	**10**
51	.54244	.64569	1.5487	.84009	9
52	.54269	.64610	1.5477	.83994	8
53	.54293	.64652	1.5468	.83978	7
54	.54317	.64693	1.5458	.83962	6
55	.54342	.64734	1.5448	.83946	**5**
56	.54366	.64775	1.5438	.83930	4
57	.54391	.64817	1.5428	.83915	3
58	.54415	.64858	1.5418	.83899	2
59	.54440	.64899	1.5408	.83883	1
60	.54464	.64941	1.5399	.83867	**0**
′	Cos	Cot	Tan	Sin	′

122° (302°) (237°) **57°**

33° (213°) (326°) **146°**

′	Sin	Tan	Cot	Cos	′
0	.54464	.64941	1.5399	.83867	**60**
1	.54488	.64982	1.5389	.83851	59
2	.54513	.65024	1.5379	.83835	58
3	.54537	.65065	1.5369	.83819	57
4	.54561	.65106	1.5359	.83804	56
5	.54586	.65148	1.5350	.83788	**55**
6	.54610	.65189	1.5340	.83772	54
7	.54635	.65231	1.5330	.83756	53
8	.54659	.65272	1.5320	.83740	52
9	.54683	.65314	1.5311	.83724	51
10	.54708	.65355	1.5301	.83708	**50**
11	.54732	.65397	1.5291	.83692	49
12	.54756	.65438	1.5282	.83676	48
13	.54781	.65480	1.5272	.83660	47
14	.54805	.65521	1.5262	.83645	46
15	.54829	.65563	1.5253	.83629	**45**
16	.54854	.65604	1.5243	.83613	44
17	.54878	.65646	1.5233	.83597	43
18	.54902	.65688	1.5224	.83581	42
19	.54927	.65729	1.5214	.83565	41
20	.54951	.65771	1.5204	.83549	**40**
21	.54975	.65813	1.5195	.83533	39
22	.54999	.65854	1.5185	.83517	38
23	.55024	.65896	1.5175	.83501	37
24	.55048	.65938	1.5166	.83485	36
25	.55072	.65980	1.5156	.83469	**35**
26	.55097	.66021	1.5147	.83453	34
27	.55121	.66063	1.5137	.83437	33
28	.55145	.66105	1.5127	.83421	32
29	.55169	.66147	1.5118	.83405	31
30	.55194	.66189	1.5108	.83389	**30**
31	.55218	.66230	1.5099	.83373	29
32	.55242	.66272	1.5089	.83356	28
33	.55266	.66314	1.5080	.83340	27
34	.55291	.66356	1.5070	.83324	26
35	.55315	.66398	1.5061	.83308	**25**
36	.55339	.66440	1.5051	.83292	24
37	.55363	.66482	1.5042	.83276	23
38	.55388	.66524	1.5032	.83260	22
39	.55412	.66566	1.5023	.83244	21
40	.55436	.66608	1.5013	.83228	**20**
41	.55460	.66650	1.5004	.83212	19
42	.55484	.66692	1.4994	.83195	18
43	.55509	.66734	1.4985	.83179	17
44	.55533	.66776	1.4975	.83163	16
45	.55557	.66818	1.4966	.83147	**15**
46	.55581	.66860	1.4957	.83131	14
47	.55605	.66902	1.4947	.83115	13
48	.55630	.66944	1.4938	.83098	12
49	.55654	.66986	1.4928	.83082	11
50	.55678	.67028	1.4919	.83066	**10**
51	.55702	.67071	1.4910	.83050	9
52	.55726	.67113	1.4900	.83034	8
53	.55750	.67155	1.4891	.83017	7
54	.55775	.67197	1.4882	.83001	6
55	.55799	.67239	1.4872	.82985	**5**
56	.55823	.67282	1.4863	.82969	4
57	.55847	.67324	1.4854	.82953	3
58	.55871	.67366	1.4844	.82936	2
59	.55895	.67409	1.4835	.82920	1
60	.55919	.67451	1.4826	.82904	**0**
′	Cos	Cot	Tan	Sin	′

123° (303°) (236°) **56°**

34° (214°) (325°) **145°**

′	Sin	Tan	Cot	Cos	′
0	.55919	.67451	1.4826	.82904	**60**
1	.55943	.67493	1.4816	.82887	59
2	.55968	.67536	1.4807	.82871	58
3	.55992	.67578	1.4798	.82855	57
4	.56016	.67620	1.4788	.82839	56
5	.56040	.67663	1.4779	.82822	**55**
6	.56064	.67705	1.4770	.82806	54
7	.56088	.67748	1.4761	.82790	53
8	.56112	.67790	1.4751	.82773	52
9	.56136	.67832	1.4742	.82757	51
10	.56160	.67875	1.4733	.82741	**50**
11	.56184	.67917	1.4724	.82724	49
12	.56208	.67960	1.4715	.82708	48
13	.56232	.68002	1.4705	.82692	47
14	.56256	.68045	1.4696	.82675	46
15	.56280	.68088	1.4687	.82659	**45**
16	.56305	.68130	1.4678	.82643	44
17	.56329	.68173	1.4669	.82626	43
18	.56353	.68215	1.4659	.82610	42
19	.56377	.68258	1.4650	.82593	41
20	.56401	.68301	1.4641	.82577	**40**
21	.56425	.68343	1.4632	.82561	39
22	.56449	.68386	1.4623	.82544	38
23	.56473	.68429	1.4614	.82528	37
24	.56497	.68471	1.4605	.82511	36
25	.56521	.68514	1.4596	.82495	**35**
26	.56545	.68557	1.4586	.82478	34
27	.56569	.68600	1.4577	.82462	33
28	.56593	.68642	1.4568	.82446	32
29	.56617	.68685	1.4559	.82429	31
30	.56641	.68728	1.4550	.82413	**30**
31	.56665	.68771	1.4541	.82396	29
32	.56689	.68814	1.4532	.82380	28
33	.56713	.68857	1.4523	.82363	27
34	.56736	.68900	1.4514	.82347	26
35	.56760	.68942	1.4505	.82330	**25**
36	.56784	.68985	1.4496	.82314	24
37	.56808	.69028	1.4487	.82297	23
38	.56832	.69071	1.4478	.82281	22
39	.56856	.69114	1.4469	.82264	21
40	.56880	.69157	1.4460	.82248	**20**
41	.56904	.69200	1.4451	.82231	19
42	.56928	.69243	1.4442	.82214	18
43	.56952	.69286	1.4433	.82198	17
44	.56976	.69329	1.4424	.82181	16
45	.57000	.69372	1.4415	.82165	**15**
46	.57024	.69416	1.4406	.82148	14
47	.57047	.69459	1.4397	.82132	13
48	.57071	.69502	1.4388	.82115	12
49	.57095	.69545	1.4379	.82098	11
50	.57119	.69588	1.4370	.82082	**10**
51	.57143	.69631	1.4361	.82065	9
52	.57167	.69675	1.4352	.82048	8
53	.57191	.69718	1.4344	.82032	7
54	.57215	.69761	1.4335	.82015	6
55	.57238	.69804	1.4326	.81999	**5**
56	.57262	.69847	1.4317	.81982	4
57	.57286	.69891	1.4308	.81965	3
58	.57310	.69934	1.4299	.81949	2
59	.57334	.69977	1.4290	.81932	1
60	.57358	.70021	1.4281	.81915	**0**
′	Cos	Cot	Tan	Sin	′

124° (304°) (235°) **55°**

35° (215°) (324°) **144°**

′	Sin	Tan	Cot	Cos	′
0	.57358	.70021	1.4281	.81915	**60**
1	.57381	.70064	1.4273	.81899	59
2	.57405	.70107	1.4264	.81882	58
3	.57429	.70151	1.4255	.81865	57
4	.57453	.70194	1.4246	.81848	56
5	.57477	.70238	1.4237	.81832	**55**
6	.57501	.70281	1.4229	.81815	54
7	.57524	.70325	1.4220	.81798	53
8	.57548	.70368	1.4211	.81782	52
9	.57572	.70412	1.4202	.81765	51
10	.57596	.70455	1.4193	.81748	**50**
11	.57619	.70499	1.4185	.81731	49
12	.57643	.70542	1.4176	.81714	48
13	.57667	.70586	1.4167	.81698	47
14	.57691	.70629	1.4158	.81681	46
15	.57715	.70673	1.4150	.81664	**45**
16	.57738	.70717	1.4141	.81647	44
17	.57762	.70760	1.4132	.81631	43
18	.57786	.70804	1.4124	.81614	42
19	.57810	.70848	1.4115	.81597	41
20	.57833	.70891	1.4106	.81580	**40**
21	.57857	.70935	1.4097	.81563	39
22	.57881	.70979	1.4089	.81546	38
23	.57904	.71023	1.4080	.81530	37
24	.57928	.71066	1.4071	.81513	36
25	.57952	.71110	1.4063	.81496	**35**
26	.57976	.71154	1.4054	.81479	34
27	.57999	.71198	1.4045	.81462	33
28	.58023	.71242	1.4037	.81445	32
29	.58047	.71285	1.4028	.81428	31
30	.58070	.71329	1.4019	.81412	**30**
31	.58094	.71373	1.4011	.81395	29
32	.58118	.71417	1.4002	.81378	28
33	.58141	.71461	1.3994	.81361	27
34	.58165	.71505	1.3985	.81344	26
35	.58189	.71549	1.3976	.81327	**25**
36	.58212	.71593	1.3968	.81310	24
37	.58236	.71637	1.3959	.81293	23
38	.58260	.71681	1.3951	.81276	22
39	.58283	.71725	1.3942	.81259	21
40	.58307	.71769	1.3934	.81242	**20**
41	.58330	.71813	1.3925	.81225	19
42	.58354	.71857	1.3916	.81208	18
43	.58378	.71901	1.3908	.81191	17
44	.58401	.71946	1.3899	.81174	16
45	.58425	.71990	1.3891	.81157	**15**
46	.58449	.72034	1.3882	.81140	14
47	.58472	.72078	1.3874	.81123	13
48	.58496	.72122	1.3865	.81106	12
49	.58519	.72167	1.3857	.81089	11
50	.58543	.72211	1.3848	.81072	**10**
51	.58567	.72255	1.3840	.81055	9
52	.58590	.72299	1.3831	.81038	8
53	.58614	.72344	1.3823	.81021	7
54	.58637	.72388	1.3814	.81004	6
55	.58661	.72432	1.3806	.80987	**5**
56	.58684	.72477	1.3798	.80970	4
57	.58708	.72521	1.3789	.80953	3
58	.58731	.72565	1.3781	.80936	2
59	.58755	.72610	1.3772	.80919	1
60	.58779	.72654	1.3764	.80902	**0**
′	Cos	Cot	Tan	Sin	′

125° (305°) (234°) **54°**

36° (216°) (323°) **143°**

′	Sin	Tan	Cot	Cos	′
0	.58779	.72654	1.3764	.80902	**60**
1	.58802	.72699	1.3755	.80885	59
2	.58826	.72743	1.3747	.80867	58
3	.58849	.72788	1.3739	.80850	57
4	.58873	.72832	1.3730	.80833	56
5	.58896	.72877	1.3722	.80816	**55**
6	.58920	.72921	1.3713	.80799	54
7	.58943	.72966	1.3705	.80782	53
8	.58967	.73010	1.3697	.80765	52
9	.58990	.73055	1.3688	.80748	51
10	.59014	.73100	1.3680	.80730	**50**
11	.59037	.73144	1.3672	.80713	49
12	.59061	.73189	1.3663	.80696	48
13	.59084	.73234	1.3655	.80679	47
14	.59108	.73278	1.3647	.80662	46
15	.59131	.73323	1.3638	.80644	**45**
16	.59154	.73368	1.3630	.80627	44
17	.59178	.73413	1.3622	.80610	43
18	.59201	.73457	1.3613	.80593	42
19	.59225	.73502	1.3605	.80576	41
20	.59248	.73547	1.3597	.80558	**40**
21	.59272	.73592	1.3588	.80541	39
22	.59295	.73637	1.3580	.80524	38
23	.59318	.73681	1.3572	.80507	37
24	.59342	.73726	1.3564	.80489	36
25	.59365	.73771	1.3555	.80472	**35**
26	.59389	.73816	1.3547	.80455	34
27	.59412	.73861	1.3539	.80438	33
28	.59436	.73906	1.3531	.80420	32
29	.59459	.73951	1.3522	.80403	31
30	.59482	.73996	1.3514	.80386	**30**
31	.59506	.74041	1.3506	.80368	29
32	.59529	.74086	1.3498	.80351	28
33	.59552	.74131	1.3490	.80334	27
34	.59576	.74176	1.3481	.80316	26
35	.59599	.74221	1.3473	.80299	**25**
36	.59622	.74267	1.3465	.80282	24
37	.59646	.74312	1.3457	.80264	23
38	.59669	.74357	1.3449	.80247	22
39	.59693	.74402	1.3440	.80230	21
40	.59716	.74447	1.3432	.80212	**20**
41	.59739	.74492	1.3424	.80195	19
42	.59763	.74538	1.3416	.80178	18
43	.59786	.74583	1.3408	.80160	17
44	.59809	.74628	1.3400	.80143	16
45	.59832	.74674	1.3392	.80125	**15**
46	.59856	.74719	1.3384	.80108	14
47	.59879	.74764	1.3375	.80091	13
48	.59902	.74810	1.3367	.80073	12
49	.59926	.74855	1.3359	.80056	11
50	.59949	.74900	1.3351	.80038	**10**
51	.59972	.74946	1.3343	.80021	9
52	.59995	.74991	1.3335	.80003	8
53	.60019	.75037	1.3327	.79986	7
54	.60042	.75082	1.3319	.79968	6
55	.60065	.75128	1.3311	.79951	**5**
56	.60089	.75173	1.3303	.79934	4
57	.60112	.75219	1.3295	.79916	3
58	.60135	.75264	1.3287	.79899	2
59	.60158	.75310	1.3278	.79881	1
60	.60182	.75355	1.3270	.79864	**0**
′	Cos	Cot	Tan	Sin	′

126° (306°) (233°) **53°**

37° (217°) (322°) **142°**

′	Sin	Tan	Cot	Cos	′
0	.60182	.75355	1.3270	.79864	**60**
1	.60205	.75401	1.3262	.79846	59
2	.60228	.75447	1.3254	.79829	58
3	.60251	.75492	1.3246	.79811	57
4	.60274	.75538	1.3238	.79793	56
5	.60298	.75584	1.3230	.79776	**55**
6	.60321	.75629	1.3222	.79758	54
7	.60344	.75675	1.3214	.79741	53
8	.60367	.75721	1.3206	.79723	52
9	.60390	.75767	1.3198	.79706	51
10	.60414	.75812	1.3190	.79688	**50**
11	.60437	.75858	1.3182	.79671	49
12	.60460	.75904	1.3175	.79653	48
13	.60483	.75950	1.3167	.79635	47
14	.60506	.75996	1.3159	.79618	46
15	.60529	.76042	1.3151	.79600	**45**
16	.60553	.76088	1.3143	.79583	44
17	.60576	.76134	1.3135	.79565	43
18	.60599	.76180	1.3127	.79547	42
19	.60622	.76226	1.3119	.79530	41
20	.60645	.76272	1.3111	.79512	**40**
21	.60668	.76318	1.3103	.79494	39
22	.60691	.76364	1.3095	.79477	38
23	.60714	.76410	1.3087	.79459	37
24	.60738	.76456	1.3079	.79441	36
25	.60761	.76502	1.3072	.79424	**35**
26	.60784	.76548	1.3064	.79406	34
27	.60807	.76594	1.3056	.79388	33
28	.60830	.76640	1.3048	.79371	32
29	.60853	.76686	1.3040	.79353	31
30	.60876	.76733	1.3032	.79335	**30**
31	.60899	.76779	1.3024	.79318	29
32	.60922	.76825	1.3017	.79300	28
33	.60945	.76871	1.3009	.79282	27
34	.60968	.76918	1.3001	.79264	26
35	.60991	.76964	1.2993	.79247	**25**
36	.61015	.77010	1.2985	.79229	24
37	.61038	.77057	1.2977	.79211	23
38	.61061	.77103	1.2970	.79193	22
39	.61084	.77149	1.2962	.79176	21
40	.61107	.77196	1.2954	.79158	**20**
41	.61130	.77242	1.2946	.79140	19
42	.61153	.77289	1.2938	.79122	18
43	.61176	.77335	1.2931	.79105	17
44	.61199	.77382	1.2923	.79087	16
45	.61222	.77428	1.2915	.79069	**15**
46	.61245	.77475	1.2907	.79051	14
47	.61268	.77521	1.2900	.79033	13
48	.61291	.77568	1.2892	.79016	12
49	.61314	.77615	1.2884	.78998	11
50	.61337	.77661	1.2876	.78980	**10**
51	.61360	.77708	1.2869	.78962	9
52	.61383	.77754	1.2861	.78944	8
53	.61406	.77801	1.2853	.78926	7
54	.61429	.77848	1.2846	.78908	6
55	.61451	.77895	1.2838	.78891	**5**
56	.61474	.77941	1.2830	.78873	4
57	.61497	.77988	1.2822	.78855	3
58	.61520	.78035	1.2815	.78837	2
59	.61543	.78082	1.2807	.78819	1
60	.61566	.78129	1.2799	.78801	**0**
′	Cos	Cot	Tan	Sin	′

127° (307°) (232°) **52°**

38° (218°) (321°) **141°**

′	Sin	Tan	Cot	Cos	′
0	.61566	.78129	1.2799	.78801	60
1	.61589	.78175	1.2792	.78783	59
2	.61612	.78222	1.2784	.78765	58
3	.61635	.78269	1.2776	.78747	57
4	.61658	.78316	1.2769	.78729	56
5	.61681	.78363	1.2761	.78711	55
6	.61704	.78410	1.2753	.78694	54
7	.61726	.78457	1.2746	.78676	53
8	.61749	.78504	1.2738	.78658	52
9	.61772	.78551	1.2731	.78640	51
10	.61795	.78598	1.2723	.78622	50
11	.61818	.78645	1.2715	.78604	49
12	.61841	.78692	1.2708	.78586	48
13	.61864	.78739	1.2700	.78568	47
14	.61887	.78786	1.2693	.78550	46
15	.61909	.78834	1.2685	.78532	45
16	.61932	.78881	1.2677	.78514	44
17	.61955	.78928	1.2670	.78496	43
18	.61978	.78975	1.2662	.78478	42
19	.62001	.79022	1.2655	.78460	41
20	.62024	.79070	1.2647	.78442	40
21	.62046	.79117	1.2640	.78424	39
22	.62069	.79164	1.2632	.78405	38
23	.62092	.79212	1.2624	.78387	37
24	.62115	.79259	1.2617	.78369	36
25	.62138	.79306	1.2609	.78351	35
26	.62160	.79354	1.2602	.78333	34
27	.62183	.79401	1.2594	.78315	33
28	.62206	.79449	1.2587	.78297	32
29	.62229	.79496	1.2579	.78279	31
30	.62251	.79544	1.2572	.78261	30
31	.62274	.79591	1.2564	.78243	29
32	.62297	.79639	1.2557	.78225	28
33	.62320	.79686	1.2549	.78206	27
34	.62342	.79734	1.2542	.78188	26
35	.62365	.79781	1.2534	.78170	25
36	.62388	.79829	1.2527	.78152	24
37	.62411	.79877	1.2519	.78134	23
38	.62433	.79924	1.2512	.78116	22
39	.62456	.79972	1.2504	.78098	21
40	.62479	.80020	1.2497	.78079	20
41	.62502	.80067	1.2489	.78061	19
42	.62524	.80115	1.2482	.78043	18
43	.62547	.80163	1.2475	.78025	17
44	.62570	.80211	1.2467	.78007	16
45	.62592	.80258	1.2460	.77988	15
46	.62615	.80306	1.2452	.77970	14
47	.62638	.80354	1.2445	.77952	13
48	.62660	.80402	1.2437	.77934	12
49	.62683	.80450	1.2430	.77916	11
50	.62706	.80498	1.2423	.77897	10
51	.62728	.80546	1.2415	.77879	9
52	.62751	.80594	1.2408	.77861	8
53	.62774	.80642	1.2401	.77843	7
54	.62796	.80690	1.2393	.77824	6
55	.62819	.80738	1.2386	.77806	5
56	.62842	.80786	1.2378	.77788	4
57	.62864	.80834	1.2371	.77769	3
58	.62887	.80882	1.2364	.77751	2
59	.62909	.80930	1.2356	.77733	1
60	.62932	.80978	1.2349	.77715	0
′	Cos	Cot	Tan	Sin	′

128° (308°) (231°) **51°**

39° (219°) (320°) **140°**

′	Sin	Tan	Cot	Cos	′
0	.62932	.80978	1.2349	.77715	60
1	.62955	.81027	1.2342	.77696	59
2	.62977	.81075	1.2334	.77678	58
3	.63000	.81123	1.2327	.77660	57
4	.63022	.81171	1.2320	.77641	56
5	.63045	.81220	1.2312	.77623	55
6	.63068	.81268	1.2305	.77605	54
7	.63090	.81316	1.2298	.77586	53
8	.63113	.81364	1.2290	.77568	52
9	.63135	.81413	1.2283	.77550	51
10	.63158	.81461	1.2276	.77531	50
11	.63180	.81510	1.2268	.77513	49
12	.63203	.81558	1.2261	.77494	48
13	.63225	.81606	1.2254	.77476	47
14	.63248	.81655	1.2247	.77458	46
15	.63271	.81703	1.2239	.77439	45
16	.63293	.81752	1.2232	.77421	44
17	.63316	.81800	1.2225	.77402	43
18	.63338	.81849	1.2218	.77384	42
19	.63361	.81898	1.2210	.77366	41
20	.63383	.81946	1.2203	.77347	40
21	.63406	.81995	1.2196	.77329	39
22	.63428	.82044	1.2189	.77310	38
23	.63451	.82092	1.2181	.77292	37
24	.63473	.82141	1.2174	.77273	36
25	.63496	.82190	1.2167	.77255	35
26	.63518	.82238	1.2160	.77236	34
27	.63540	.82287	1.2153	.77218	33
28	.63563	.82336	1.2145	.77199	32
29	.63585	.82385	1.2138	.77181	31
30	.63608	.82434	1.2131	.77162	30
31	.63630	.82483	1.2124	.77144	29
32	.63653	.82531	1.2117	.77125	28
33	.63675	.82580	1.2109	.77107	27
34	.63698	.82629	1.2102	.77088	26
35	.63720	.82678	1.2095	.77070	25
36	.63742	.82727	1.2088	.77051	24
37	.63765	.82776	1.2081	.77033	23
38	.63787	.82825	1.2074	.77014	22
39	.63810	.82874	1.2066	.76996	21
40	.63832	.82923	1.2059	.76977	20
41	.63854	.82972	1.2052	.76959	19
42	.63877	.83022	1.2045	.76940	18
43	.63899	.83071	1.2038	.76921	17
44	.63922	.83120	1.2031	.76903	16
45	.63944	.83169	1.2024	.76884	15
46	.63966	.83218	1.2017	.76866	14
47	.63989	.83268	1.2009	.76847	13
48	.64011	.83317	1.2002	.76828	12
49	.64033	.83366	1.1995	.76810	11
50	.64056	.83415	1.1988	.76791	10
51	.64078	.83465	1.1981	.76772	9
52	.64100	.83514	1.1974	.76754	8
53	.64123	.83564	1.1967	.76735	7
54	.64145	.83613	1.1960	.76717	6
55	.64167	.83662	1.1953	.76698	5
56	.64190	.83712	1.1946	.76679	4
57	.64212	.83761	1.1939	.76661	3
58	.64234	.83811	1.1932	.76642	2
59	.64256	.83860	1.1925	.76623	1
60	.64279	.83910	1.1918	.76604	0
′	Cos	Cot	Tan	Sin	′

129° (309°) (230°) **50°**

40° (220°) (319°) **139°**

′	Sin	Tan	Cot	Cos	′
0	.64279	.83910	1.1918	.76604	**60**
1	.64301	.83960	1.1910	.76586	59
2	.64323	.84009	1.1903	.76567	58
3	.64346	.84059	1.1896	.76548	57
4	.64368	.84108	1.1889	.76530	56
5	.64390	.84158	1.1882	.76511	**55**
6	.64412	.84208	1.1875	.76492	54
7	.64435	.84258	1.1868	.76473	53
8	.64457	.84307	1.1861	.76455	52
9	.64479	.84357	1.1854	.76436	51
10	.64501	.84407	1.1847	.76417	**50**
11	.64524	.84457	1.1840	.76398	49
12	.64546	.84507	1.1833	.76380	48
13	.64568	.84556	1.1826	.76361	47
14	.64590	.84606	1.1819	.76342	46
15	.64612	.84656	1.1812	.76323	**45**
16	.64635	.84706	1.1806	.76304	44
17	.64657	.84756	1.1799	.76286	43
18	.64679	.84806	1.1792	.76267	42
19	.64701	.84856	1.1785	.76248	41
20	.64723	.84906	1.1778	.76229	**40**
21	.64746	.84956	1.1771	.76210	39
22	.64768	.85006	1.1764	.76192	38
23	.64790	.85057	1.1757	.76173	37
24	.64812	.85107	1.1750	.76154	36
25	.64834	.85157	1.1743	.76135	**35**
26	.64856	.85207	1.1736	.76116	34
27	.64878	.85257	1.1729	.76097	33
28	.64901	.85308	1.1722	.76078	32
29	.64923	.85358	1.1715	.76059	31
30	.64945	.85408	1.1708	.76041	**30**
31	.64967	.85458	1.1702	.76022	29
32	.64989	.85509	1.1695	.76003	28
33	.65011	.85559	1.1688	.75984	27
34	.65033	.85609	1.1681	.75965	26
35	.65055	.85660	1.1674	.75946	**25**
36	.65077	.85710	1.1667	.75927	24
37	.65100	.85761	1.1660	.75908	23
38	.65122	.85811	1.1653	.75889	22
39	.65144	.85862	1.1647	.75870	21
40	.65166	.85912	1.1640	.75851	**20**
41	.65188	.85963	1.1633	.75832	19
42	.65210	.86014	1.1626	.75813	18
43	.65232	.86064	1.1619	.75794	17
44	.65254	.86115	1.1612	.75775	16
45	.65276	.86166	1.1606	.75756	**15**
46	.65298	.86216	1.1599	.75738	14
47	.65320	.86267	1.1592	.75719	13
48	.65342	.86318	1.1585	.75700	12
49	.65364	.86368	1.1578	.75680	11
50	.65386	.86419	1.1571	.75661	**10**
51	.65408	.86470	1.1565	.75642	9
52	.65430	.86521	1.1558	.75623	8
53	.65452	.86572	1.1551	.75604	7
54	.65474	.86623	1.1544	.75585	6
55	.65496	.86674	1.1538	.75566	**5**
56	.65518	.86725	1.1531	.75547	4
57	.65540	.86776	1.1524	.75528	3
58	.65562	.86827	1.1517	.75509	2
59	.65584	.86878	1.1510	.75490	1
60	.65606	.86929	1.1504	.75471	**0**
′	Cos	Cot	Tan	Sin	′

130° (310°) (229°) **49°**

41° (221°) (318°) **138°**

′	Sin	Tan	Cot	Cos	′
0	.65606	.86929	1.1504	.75471	**60**
1	.65628	.86980	1.1497	.75452	59
2	.65650	.87031	1.1490	.75433	58
3	.65672	.87082	1.1483	.75414	57
4	.65694	.87133	1.1477	.75395	56
5	.65716	.87184	1.1470	.75375	**55**
6	.65738	.87236	1.1463	.75356	54
7	.65759	.87287	1.1456	.75337	53
8	.65781	.87338	1.1450	.75318	52
9	.65803	.87389	1.1443	.75299	51
10	.65825	.87441	1.1436	.75280	**50**
11	.65847	.87492	1.1430	.75261	49
12	.65869	.87543	1.1423	.75241	48
13	.65891	.87595	1.1416	.75222	47
14	.65913	.87646	1.1410	.75203	46
15	.65935	.87698	1.1403	.75184	**45**
16	.65956	.87749	1.1396	.75165	44
17	.65978	.87801	1.1389	.75146	43
18	.66000	.87852	1.1383	.75126	42
19	.66022	.87904	1.1376	.75107	41
20	.66044	.87955	1.1369	.75088	**40**
21	.66066	.88007	1.1363	.75069	39
22	.66088	.88059	1.1356	.75050	38
23	.66109	.88110	1.1349	.75030	37
24	.66131	.88162	1.1343	.75011	36
25	.66153	.88214	1.1336	.74992	**35**
26	.66175	.88265	1.1329	.74973	34
27	.66197	.88317	1.1323	.74953	33
28	.66218	.88369	1.1316	.74934	32
29	.66240	.88421	1.1310	.74915	31
30	.66262	.88473	1.1303	.74896	**30**
31	.66284	.88524	1.1296	.74876	29
32	.66306	.88576	1.1290	.74857	28
33	.66327	.88628	1.1283	.74838	27
34	.66349	.88680	1.1276	.74818	26
35	.66371	.88732	1.1270	.74799	**25**
36	.66393	.88784	1.1263	.74780	24
37	.66414	.88836	1.1257	.74760	23
38	.66436	.88888	1.1250	.74741	22
39	.66458	.88940	1.1243	.74722	21
40	.66480	.88992	1.1237	.74703	**20**
41	.66501	.89045	1.1230	.74683	19
42	.66523	.89097	1.1224	.74664	18
43	.66545	.89149	1.1217	.74644	17
44	.66566	.89201	1.1211	.74625	16
45	.66588	.89253	1.1204	.74606	**15**
46	.66610	.89306	1.1197	.74586	14
47	.66632	.89358	1.1191	.74567	13
48	.66653	.89410	1.1184	.74548	12
49	.66675	.89463	1.1178	.74528	11
50	.66697	.89515	1.1171	.74509	**10**
51	.66718	.89567	1.1165	.74489	9
52	.66740	.89620	1.1158	.74470	8
53	.66762	.89672	1.1152	.74451	7
54	.66783	.89725	1.1145	.74431	6
55	.66805	.89777	1.1139	.74412	**5**
56	.66827	.89830	1.1132	.74392	4
57	.66848	.89883	1.1126	.74373	3
58	.66870	.89935	1.1119	.74353	2
59	.66891	.89988	1.1113	.74334	1
60	.66913	.90040	1.1106	.74314	**0**
′	Cos	Cot	Tan	Sin	′

131° (311°) (228°) **48°**

42° (222°) (317°) **137°**

′	Sin	Tan	Cot	Cos	′
0	.66913	.90040	1.1106	.74314	60
1	.66935	.90093	1.1100	.74295	59
2	.66956	.90146	1.1093	.74276	58
3	.66978	.90199	1.1087	.74256	57
4	.66999	.90251	1.1080	.74237	56
5	.67021	.90304	1.1074	.74217	55
6	.67043	.90357	1.1067	.74198	54
7	.67064	.90410	1.1061	.74178	53
8	.67086	.90463	1.1054	.74159	52
9	.67107	.90516	1.1048	.74139	51
10	.67129	.90569	1.1041	.74120	50
11	.67151	.90621	1.1035	.74100	49
12	.67172	.90674	1.1028	.74080	48
13	.67194	.90727	1.1022	.74061	47
14	.67215	.90781	1.1016	.74041	46
15	.67237	.90834	1.1009	.74022	45
16	.67258	.90887	1.1003	.74002	44
17	.67280	.90940	1.0996	.73983	43
18	.67301	.90993	1.0990	.73963	42
19	.67323	.91046	1.0983	.73944	41
20	.67344	.91099	1.0977	.73924	40
21	.67366	.91153	1.0971	.73904	39
22	.67387	.91206	1.0964	.73885	38
23	.67409	.91259	1.0958	.73865	37
24	.67430	.91313	1.0951	.73846	36
25	.67452	.91366	1.0945	.73826	35
26	.67473	.91419	1.0939	.73806	34
27	.67495	.91473	1.0932	.73787	33
28	.67516	.91526	1.0926	.73767	32
29	.67538	.91580	1.0919	.73747	31
30	.67559	.91633	1.0913	.73728	30
31	.67580	.91687	1.0907	.73708	29
32	.67602	.91740	1.0900	.73688	28
33	.67623	.91794	1.0894	.73669	27
34	.67645	.91847	1.0888	.73649	26
35	.67666	.91901	1.0881	.73629	25
36	.67688	.91955	1.0875	.73610	24
37	.67709	.92008	1.0869	.73590	23
38	.67730	.92062	1.0862	.73570	22
39	.67752	.92116	1.0856	.73551	21
40	.67773	.92170	1.0850	.73531	20
41	.67795	.92224	1.0843	.73511	19
42	.67816	.92277	1.0837	.73491	18
43	.67837	.92331	1.0831	.73472	17
44	.67859	.92385	1.0824	.73452	16
45	.67880	.92439	1.0818	.73432	15
46	.67901	.92493	1.0812	.73413	14
47	.67923	.92547	1.0805	.73393	13
48	.67944	.92601	1.0799	.73373	12
49	.67965	.92655	1.0793	.73353	11
50	.67987	.92709	1.0786	.73333	10
51	.68008	.92763	1.0780	.73314	9
52	.68029	.92817	1.0774	.73294	8
53	.68051	.92872	1.0768	.73274	7
54	.68072	.92926	1.0761	.73254	6
55	.68093	.92980	1.0755	.73234	5
56	.68115	.93034	1.0749	.73215	4
57	.68136	.93088	1.0742	.73195	3
58	.68157	.93143	1.0736	.73175	2
59	.68179	.93197	1.0730	.73155	1
60	.68200	.93252	1.0724	.73135	0
′	Cos	Cot	Tan	Sin	′

132° (312°) (227°) **47°**

43° (223°) (316°) **136°**

′	Sin	Tan	Cot	Cos	′
0	.68200	.93252	1.0724	.73135	60
1	.68221	.93306	1.0717	.73116	59
2	.68242	.93360	1.0711	.73096	58
3	.68264	.93415	1.0705	.73076	57
4	.68285	.93469	1.0699	.73056	56
5	.68306	.93524	1.0692	.73036	55
6	.68327	.93578	1.0686	.73016	54
7	.68349	.93633	1.0680	.72996	53
8	.68370	.93688	1.0674	.72976	52
9	.68391	.93742	1.0668	.72957	51
10	.68412	.93797	1.0661	.72937	50
11	.68434	.93852	1.0655	.72917	49
12	.68455	.93906	1.0649	.72897	48
13	.68476	.93961	1.0643	.72877	47
14	.68497	.94016	1.0637	.72857	46
15	.68518	.94071	1.0630	.72837	45
16	.68539	.94125	1.0624	.72817	44
17	.68561	.94180	1.0618	.72797	43
18	.68582	.94235	1.0612	.72777	42
19	.68603	.94290	1.0606	.72757	41
20	.68624	.94345	1.0599	.72737	40
21	.68645	.94400	1.0593	.72717	39
22	.68666	.94455	1.0587	.72697	38
23	.68688	.94510	1.0581	.72677	37
24	.68709	.94565	1.0575	.72657	36
25	.68730	.94620	1.0569	.72637	35
26	.68751	.94676	1.0562	.72617	34
27	.68772	.94731	1.0556	.72597	33
28	.68793	.94786	1.0550	.72577	32
29	.68814	.94841	1.0544	.72557	31
30	.68835	.94896	1.0538	.72537	30
31	.68857	.94952	1.0532	.72517	29
32	.68878	.95007	1.0526	.72497	28
33	.68899	.95062	1.0519	.72477	27
34	.68920	.95118	1.0513	.72457	26
35	.68941	.95173	1.0507	.72437	25
36	.68962	.95229	1.0501	.72417	24
37	.68983	.95284	1.0495	.72397	23
38	.69004	.95340	1.0489	.72377	22
39	.69025	.95395	1.0483	.72357	21
40	.69046	.95451	1.0477	.72337	20
41	.69067	.95506	1.0470	.72317	19
42	.69088	.95562	1.0464	.72297	18
43	.69109	.95618	1.0458	.72277	17
44	.69130	.95673	1.0452	.72257	16
45	.69151	.95729	1.0446	.72236	15
46	.69172	.95785	1.0440	.72216	14
47	.69193	.95841	1.0434	.72196	13
48	.69214	.95897	1.0428	.72176	12
49	.69235	.95952	1.0422	.72156	11
50	.69256	.96008	1.0416	.72136	10
51	.69277	.96064	1.0410	.72116	9
52	.69298	.96120	1.0404	.72095	8
53	.69319	.96176	1.0398	.72075	7
54	.69340	.96232	1.0392	.72055	6
55	.69361	.96288	1.0385	.72035	5
56	.69382	.96344	1.0379	.72015	4
57	.69403	.96400	1.0373	.71995	3
58	.69424	.96457	1.0367	.71974	2
59	.69445	.96513	1.0361	.71954	1
60	.69466	.96569	1.0355	.71934	0
′	Cos	Cot	Tan	Sin	′

133° (313°) (226°) **46°**

44° (224°) (315°) **135°**

′	Sin	Tan	Cot	Cos	′
0	.69466	.96569	1.0355	.71934	**60**
1	.69487	.96625	1.0349	.71914	59
2	.69508	.96681	1.0343	.71894	58
3	.69529	.96738	1.0337	.71873	57
4	.69549	.96794	1.0331	.71853	56
5	.69570	.96850	1.0325	.71833	**55**
6	.69591	.96907	1.0319	.71813	54
7	.69612	.96963	1.0313	.71792	53
8	.69633	.97020	1.0307	.71772	52
9	.69654	.97076	1.0301	.71752	51
10	.69675	.97133	1.0295	.71732	**50**
11	.69696	.97189	1.0289	.71711	49
12	.69717	.97246	1.0283	.71691	48
13	.69737	.97302	1.0277	.71671	47
14	.69758	.97359	1.0271	.71650	46
15	.69779	.97416	1.0265	.71630	**45**
16	.69800	.97472	1.0259	.71610	44
17	.69821	.97529	1.0253	.71590	43
18	.69842	.97586	1.0247	.71569	42
19	.69862	.97643	1.0241	.71549	41
20	.69883	.97700	1.0235	.71529	**40**
21	.69904	.97756	1.0230	.71508	39
22	.69925	.97813	1.0224	.71488	38
23	.69946	.97870	1.0218	.71468	37
24	.69966	.97927	1.0212	.71447	36
25	.69987	.97984	1.0206	.71427	**35**
26	.70008	.98041	1.0200	.71407	34
27	.70029	.98098	1.0194	.71386	33
28	.70049	.98155	1.0188	.71366	32
29	.70070	.98213	1.0182	.71345	31
30	.70091	.98270	1.0176	.71325	**30**
31	.70112	.98327	1.0170	.71305	29
32	.70132	.98384	1.0164	.71284	28
33	.70153	.98441	1.0158	.71264	27
34	.70174	.98499	1.0152	.71243	26
35	.70195	.98556	1.0147	.71223	**25**
36	.70215	.98613	1.0141	.71203	24
37	.70236	.98671	1.0135	.71182	23
38	.70257	.98728	1.0129	.71162	22
39	.70277	.98786	1.0123	.71141	21
40	.70298	.98843	1.0117	.71121	**20**
41	.70319	.98901	1.0111	.71100	19
42	.70339	.98958	1.0105	.71080	18
43	.70360	.99016	1.0099	.71059	17
44	.70381	.99073	1.0094	.71039	16
45	.70401	.99131	1.0088	.71019	**15**
46	.70422	.99189	1.0082	.70998	14
47	.70443	.99247	1.0076	.70978	13
48	.70463	.99304	1.0070	.70957	12
49	.70484	.99362	1.0064	.70937	11
50	.70505	.99420	1.0058	.70916	**10**
51	.70525	.99478	1.0052	.70896	9
52	.70546	.99536	1.0047	.70875	8
53	.70567	.99594	1.0041	.70855	7
54	.70587	.99652	1.0035	.70834	6
55	.70608	.99710	1.0029	.70813	**5**
56	.70628	.99768	1.0023	.70793	4
57	.70649	.99826	1.0017	.70772	3
58	.70670	.99884	1.0012	.70752	2
59	.70690	.99942	1.0006	.70731	1
60	.70711	1.0000	1.0000	.70711	**0**
′	Cos	Cot	Tan	Sin	′

134° (314°) (225°) **45°**

Deg.	Sin	Cos	Tan	Cot	Deg.
0.0	.00000	1.0000	.00000	∞	90.0
.1	.00175	1.0000	.00175	573.0	.9
.2	.00349	1.0000	.00349	286.5	.8
.3	.00524	1.0000	.00524	191.0	.7
.4	.00698	1.0000	.00698	143.24	.6
.5	.00873	1.0000	.00873	114.59	.5
.6	.01047	0.9999	.01047	95.49	.4
.7	.01222	.9999	.01222	81.85	.3
.8	.01396	.9999	.01396	71.62	.2
.9	.01571	.9999	.01571	63.66	.1
1.0	.01745	0.9998	.01746	57.29	89.0
.1	.01920	.9998	.01920	52.08	.9
.2	.02094	.9998	.02095	47.74	.8
.3	.02269	.9997	.02269	44.07	.7
.4	.02443	.9997	.02444	40.92	.6
.5	.02618	.9997	.02619	38.19	.5
.6	.02792	.9996	.02793	35.80	.4
.7	.02967	.9996	.02968	33.69	.3
.8	.03141	.9995	.03143	31.82	.2
.9	.03316	.9995	.03317	30.14	.1
2.0	.03490	0.9994	.03492	28.64	88.0
.1	.03664	.9993	.03667	27.27	.9
.2	.03839	.9993	.03842	26.03	.8
.3	.04013	.9992	.04016	24.90	.7
.4	.04188	.9991	.04191	23.86	.6
.5	.04362	.9990	.04366	22.90	.5
.6	.04536	.9990	.04541	22.02	.4
.7	.04711	.9989	.04716	21.20	.3
.8	.04885	.9988	.04891	20.45	.2
.9	.05059	.9987	.05066	19.74	.1
3.0	.05234	0.9986	.05241	19.081	87.0
.1	.05408	.9985	.05416	18.464	.9
.2	.05582	.9984	.05591	17.886	.8
.3	.05756	.9983	.05766	17.343	.7
.4	.05931	.9982	.05941	16.832	.6
.5	.06105	.9981	.06116	16.350	.5
.6	.06279	.9980	.06291	15.895	.4
.7	.06453	.9979	.06467	15.464	.3
.8	.06627	.9978	.06642	15.056	.2
.9	.06802	.9977	.06817	14.669	.1
4.0	.06976	0.9976	.06993	14.301	86.0
.1	.07150	.9974	.07168	13.951	.9
.2	.07324	.9973	.07344	13.617	.8
.3	.07498	.9972	.07519	13.300	.7
.4	.07672	.9971	.07695	12.996	.6
.5	.07846	.9969	.07870	12.706	.5
.6	.08020	.9968	.08046	12.429	.4
.7	.08194	.9966	.08221	12.163	.3
.8	.08368	.9965	.08397	11.909	.2
.9	.08542	.9963	.08573	11.664	.1
5.0	.08716	0.9962	.08749	11.430	85.0
.1	.08889	.9960	.08925	11.205	.9
.2	.09063	.9959	.09101	10.988	.8
.3	.09237	.9957	.09277	10.780	.7
.4	.09411	.9956	.09453	10.579	.6
.5	.09585	.9954	.09629	10.385	.5
.6	.09758	.9952	.09805	10.199	.4
.7	.09932	.9951	.09981	10.019	.3
.8	.10106	.9949	.10158	9.845	.2
.9	.10279	.9947	.10334	9.677	.1
6.0	.10453	0.9945	.10510	9.514	84.0
Deg.	Cos	Sin	Cot	Tan	Deg.

Deg.	Sin	Cos	Tan	Cot	Deg.
6.0	.10453	0.9945	.10510	9.514	84.0
.1	.10626	.9943	.10687	9.357	.9
.2	.10800	.9942	.10863	9.205	.8
.3	.10973	.9940	.11040	9.058	.7
.4	.11147	.9938	.11217	8.915	.6
.5	.11320	.9936	.11394	8.777	.5
.6	.11494	.9934	.11570	8.643	.4
.7	.11667	.9932	.11747	8.513	.3
.8	.11840	.9930	.11924	8.386	.2
.9	.12014	.9928	.12101	8.264	.1
7.0	.12187	0.9925	.12278	8.144	83.0
.1	.12360	.9923	.12456	8.028	.9
.2	.12533	.9921	.12633	7.916	.8
.3	.12706	.9919	.12810	7.806	.7
.4	.12880	.9917	.12988	7.700	.6
.5	.13053	.9914	.13165	7.596	.5
.6	.13226	.9912	.13343	7.495	.4
.7	.13399	.9910	.13521	7.396	.3
.8	.13572	.9907	.13698	7.300	.2
.9	.13744	.9905	.13876	7.207	.1
8.0	.13917	0.9903	.14054	7.115	82.0
.1	.14090	.9900	.14232	7.026	.9
.2	.14263	.9898	.14410	6.940	.8
.3	.14436	.9895	.14588	6.855	.7
.4	.14608	.9893	.14767	6.772	.6
.5	.14781	.9890	.14945	6.691	.5
.6	.14954	.9888	.15124	6.612	.4
.7	.15126	.9885	.15302	6.535	.3
.8	.15299	.9882	.15481	6.460	.2
.9	.15471	.9880	.15660	6.386	.1
9.0	.15643	0.9877	.15838	6.314	81.0
.1	.15816	.9874	.16017	6.243	.9
.2	.15988	.9871	.16196	6.174	.8
.3	.16160	.9869	.16376	6.107	.7
.4	.16333	.9866	.16555	6.041	.6
.5	.16505	.9863	.16734	5.976	.5
.6	.16677	.9860	.16914	5.912	.4
.7	.16849	.9857	.17093	5.850	.3
.8	.17021	.9854	.17273	5.789	.2
.9	.17193	.9851	.17453	5.730	.1
10.0	.1736	0.9848	.1763	5.671	80.0
.1	.1754	.9845	.1781	5.614	.9
.2	.1771	.9842	.1799	5.558	.8
.3	.1788	.9839	.1817	5.503	.7
.4	.1805	.9836	.1835	5.449	.6
.5	.1822	.9833	.1853	5.396	.5
.6	.1840	.9829	.1871	5.343	.4
.7	.1857	.9826	.1890	5.292	.3
.8	.1874	.9823	.1908	5.242	.2
.9	.1891	.9820	.1926	5.193	.1
11.0	.1908	0.9816	.1944	5.145	79.0
.1	.1925	.9813	.1962	5.097	.9
.2	.1942	.9810	.1980	5.050	.8
.3	.1959	.9806	.1998	5.005	.7
.4	.1977	.9803	.2016	4.959	.6
.5	.1994	.9799	.2035	4.915	.5
.6	.2011	.9796	.2053	4.872	.4
.7	.2028	.9792	.2071	4.829	.3
.8	.2045	.9789	.2089	4.787	.2
.9	.2062	.9785	.2107	4.745	.1
12.0	2079	0.9781	.2126	4.705	78.0
Deg.	Cos	Sin	Cot	Tan	Deg.

Deg.	Sin	Cos	Tan	Cot	Deg.
12.0	0.2079	0.9781	0.2126	4.705	**78.0**
.1	.2096	.9778	.2144	4.665	.9
.2	.2113	.9774	.2162	4.625	.8
.3	.2130	.9770	.2180	4.586	.7
.4	.2147	.9767	.2199	4.548	.6
.5	.2164	.9763	.2217	4.511	.5
.6	.2181	.9759	.2235	4.474	.4
.7	.2198	.9755	.2254	4.437	.3
.8	.2215	.9751	.2272	4.402	.2
.9	.2233	.9748	.2290	4.366	.1
13.0	0.2250	0.9744	0.2309	4.331	**77.0**
.1	.2267	.9740	.2327	4.297	.9
.2	.2284	.9736	.2345	4.264	.8
.3	.2300	.9732	.2364	4.230	.7
.4	.2317	.9728	.2382	4.198	.6
.5	.2334	.9724	.2401	4.165	.5
.6	.2351	.9720	.2419	4.134	.4
.7	.2368	.9715	.2438	4.102	.3
.8	.2385	.9711	.2456	4.071	.2
.9	.2402	.9707	.2475	4.041	.1
14.0	0.2419	0.9703	0.2493	4.011	**76.0**
.1	.2436	.9699	.2512	3.981	.9
.2	.2453	.9694	.2530	3.952	.8
.3	.2470	.9690	.2549	3.923	.7
.4	.2487	.9686	.2568	3.895	.6
.5	.2504	.9681	.2586	3.867	.5
.6	.2521	.9677	.2605	3.839	.4
.7	.2538	.9673	.2623	3.812	.3
.8	.2554	.9668	.2642	3.785	.2
.9	.2571	.9664	.2661	3.758	.1
15.0	0.2588	0.9659	0.2679	3.732	**75.0**
.1	.2605	.9655	.2698	3.706	.9
.2	.2622	.9650	.2717	3.681	.8
.3	.2639	.9646	.2736	3.655	.7
.4	.2656	.9641	.2754	3.630	.6
.5	.2672	.9636	.2773	3.606	.5
.6	.2689	.9632	.2792	3.582	.4
.7	.2706	.9627	.2811	3.558	.3
.8	.2723	.9622	.2830	3.534	.2
.9	.2740	.9617	.2849	3.511	.1
16.0	0.2756	0.9613	0.2867	3.487	**74.0**
.1	.2773	.9608	.2886	3.465	.9
.2	.2790	.9603	.2905	3.442	.8
.3	.2807	.9598	.2924	3.420	.7
.4	.2823	.9593	.2943	3.398	.6
.5	.2840	.9588	.2962	3.376	.5
.6	.2857	.9583	.2981	3.354	4
.7	.2874	.9578	.3000	3.333	.3
.8	.2890	.9573	.3019	3.312	.2
.9	.2907	.9568	.3038	3.291	.1
17.0	0.2924	0.9563	0.3057	3.271	**73.0**
.1	.2940	.9558	.3076	3.251	.9
.2	.2957	.9553	.3096	3.230	.8
.3	.2974	.9548	.3115	3.211	.7
.4	.2990	.9542	.3134	3.191	.6
.5	.3007	.9537	.3153	3.172	.5
.6	.3024	.9532	.3172	3.152	.4
.7	.3040	.9527	.3191	3.133	.3
.8	.3057	.9521	.3211	3.115	.2
.9	.3074	.9516	.3230	3.096	.1
18.0	0.3090	0 9511	0.3249	3.078	**72.0**
Deg.	Cos	Sin	Cot	Tan	Deg.

Deg.	Sin	Cos	Tan	Cot	Deg.
18.0	0.3090	0.9511	0.3249	3.078	**72.0**
.1	.3107	.9505	.3269	3.060	.9
.2	.3123	.9500	.3288	3.042	.8
.3	.3140	.9494	.3307	3.024	.7
.4	.3156	.9489	.3327	3.006	.6
.5	.3173	.9483	.3346	2.989	.5
.6	.3190	.9478	.3365	2.971	.4
.7	.3206	.9472	.3385	2.954	.3
.8	.3223	.9466	.3404	2.937	.2
.9	.3239	.9461	.3424	2.921	.1
19.0	0.3256	0.9455	0.3443	2.904	**71.0**
.1	.3272	.9449	.3463	2.888	.9
.2	.3289	.9444	.3482	2.872	.8
.3	.3305	.9438	.3502	2.856	.7
.4	.3322	.9432	.3522	2.840	.6
.5	.3338	.9426	.3541	2.824	.5
.6	.3355	.9421	.3561	2.808	.4
.7	.3371	.9415	.3581	2.793	.3
.8	.3387	.9409	.3600	2.778	.2
.9	.3404	.9403	.3620	2.762	.1
20.0	0.3420	0.9397	0.3640	2.747	**70.0**
.1	.3437	.9391	.3659	2.733	.9
.2	.3453	.9385	.3679	2.718	.8
.3	.3469	.9379	.3699	2.703	.7
.4	.3486	.9373	.3719	2.689	.6
.5	.3502	.9367	.3739	2.675	.5
.6	.3518	.9361	.3759	2.660	.4
.7	.3535	.9354	.3779	2.646	.3
.8	.3551	.9348	.3799	2.633	.2
.9	.3567	.9342	.3819	2.619	.1
21.0	0.3584	0.9336	0.3839	2.605	**69.0**
.1	.3600	.9330	.3859	2.592	.9
.2	.3616	.9323	.3879	2.578	.8
.3	.3633	.9317	.3899	2.565	.7
.4	.3649	.9311	.3919	2.552	.6
.5	.3665	.9304	.3939	2.539	.5
.6	.3681	.9298	.3959	2.526	.4
.7	.3697	.9291	.3979	2.513	.3
.8	.3714	.9285	.4000	2.500	.2
.9	.3730	.9278	.4020	2.488	.1
22.0	0.3746	0.9272	0.4040	2.475	**68.0**
.1	.3762	.9265	.4061	2.463	.9
.2	.3778	.9259	.4081	2.450	.8
.3	.3795	.9252	.4101	2.438	.7
.4	.3811	.9245	.4122	2.426	.6
.5	.3827	.9239	.4142	2.414	.5
.6	.3843	.9232	.4163	2.402	.4
.7	.3859	.9225	.4183	2.391	.3
.8	.3875	.9219	.4204	2.379	.2
.9	.3891	.9212	.4224	2.367	.1
23.0	0.3907	0.9205	0.4245	2.356	**67.0**
.1	.3923	.9198	.4265	2.344	.9
.2	.3939	.9191	.4286	2.333	.8
.3	.3955	.9184	.4307	2.322	.7
.4	.3971	.9178	.4327	2.311	.6
.5	.3987	.9171	.4348	2.300	.5
.6	.4003	.9164	.4369	2.289	.4
.7	.4019	.9157	.4390	2.278	.3
.8	.4035	.9150	.4411	2.267	.2
.9	.4051	.9143	.4431	2.257	.1
24.0	0.4067	0.9135	0.4452	2.246	**66.0**
Deg.	Cos	Sin	Cot	Tan	Deg.

Deg.	Sin	Cos	Tan	Cot	Deg.
24.0	0.4067	0.9135	0.4452	2.246	66.0
.1	.4083	.9128	.4473	2.236	.9
.2	.4099	.9121	.4494	2.225	.8
.3	.4115	.9114	.4515	2.215	.7
.4	.4131	.9107	.4536	2.204	.6
.5	.4147	.9100	.4557	2.194	.5
.6	.4163	.9092	.4578	2.184	.4
.7	.4179	.9085	.4599	2.174	.3
.8	.4195	.9078	.4621	2.164	.2
.9	.4210	.9070	.4642	2.154	.1
25.0	0.4226	0.9063	0.4663	2.145	65.0
.1	.4242	.9056	.4684	2.135	.9
.2	.4258	.9048	.4706	2.125	.8
.3	.4274	.9041	.4727	2.116	.7
.4	.4289	.9033	.4748	2.106	.6
.5	.4305	.9026	.4770	2.097	.5
.6	.4321	.9018	.4791	2.087	.4
.7	.4337	.9011	.4813	2.078	.3
.8	.4352	.9003	.4834	2.069	.2
.9	.4368	.8996	.4856	2.059	.1
26.0	0.4384	0.8988	0.4877	2.050	64.0
.1	.4399	.8980	.4899	2.041	.9
.2	.4415	.8973	.4921	2.032	.8
.3	.4431	.8965	.4942	2.023	.7
.4	.4446	.8957	.4964	2.014	.6
.5	.4462	.8949	.4986	2.006	.5
.6	.4478	.8942	.5008	1.997	.4
.7	.4493	.8934	.5029	1.988	.3
.8	.4509	.8926	.5051	1.980	.2
.9	.4524	.8918	.5073	1.971	.1
27.0	0.4540	0.8910	0.5095	1.963	63.0
.1	.4555	.8902	.5117	1.954	.9
.2	.4571	.8894	.5139	1.946	.8
.3	.4586	.8886	.5161	1.937	.7
.4	.4602	.8878	.5184	1.929	.6
.5	.4617	.8870	.5206	1.921	.5
.6	.4633	.8862	.5228	1.913	.4
.7	.4648	.8854	.5250	1.905	.3
.8	.4664	.8846	.5272	1.897	.2
.9	.4679	.8838	.5295	1.889	.1
28.0	0.4695	0.8829	0.5317	1.881	62.0
.1	.4710	.8821	.5340	1.873	.9
.2	.4726	.8813	.5362	1.865	.8
.3	.4741	.8805	.5384	1.857	.7
.4	.4756	.8796	.5407	1.849	.6
.5	.4772	.8788	.5430	1.842	.5
.6	.4787	.8780	.5452	1.834	.4
.7	.4802	.8771	.5475	1.827	.3
.8	.4818	.8763	.5498	1.819	.2
.9	.4833	.8755	.5520	1.811	.1
29.0	0.4848	0.8746	0.5543	1.804	61.0
.1	.4863	.8738	.5566	1.797	.9
.2	.4879	.8729	.5589	1.789	.8
.3	.4894	.8721	.5612	1.782	.7
.4	.4909	.8712	.5635	1.775	.6
.5	.4924	.8704	.5658	1.767	.5
.6	.4939	.8695	.5681	1.760	.4
.7	.4955	.8686	.5704	1.753	.3
.8	.4970	.8678	.5727	1.746	.2
.9	.4985	.8669	.5750	1.739	.1
30.0	0.5000	0.8660	0.5774	1.732	60.0
Deg.	Cos	Sin	Cot	Tan	Deg.

Deg.	Sin	Cos	Tan	Cot	Deg.
30.0	0.5000	0.8660	0.5774	1.7321	60.0
.1	.5015	.8652	.5797	1.7251	.9
.2	.5030	.8643	.5820	1.7182	.8
.3	.5045	.8634	.5844	1.7113	.7
.4	.5060	.8625	.5867	1.7045	.6
.5	.5075	.8616	.5890	1.6977	.5
.6	.5090	.8607	.5914	1.6909	.4
.7	.5105	.8599	.5938	1.6842	.3
.8	.5120	.8590	.5961	1.6775	.2
.9	.5135	.8581	.5985	1.6709	.1
31.0	0.5150	0.8572	0.6009	1.6643	59.0
.1	.5165	.8563	.6032	1.6577	.9
.2	.5180	.8554	.6056	1.6512	.8
.3	.5195	.8545	.6080	1.6447	.7
.4	.5210	.8536	.6104	1.6383	.6
.5	.5225	.8526	.6128	1.6319	.5
.6	.5240	.8517	.6152	1.6255	.4
.7	.5255	.8508	.6176	1.6191	.3
.8	.5270	.8499	.6200	1.6128	.2
.9	.5284	.8490	.6224	1.6066	.1
32.0	0.5299	0.8480	0.6249	1.6003	58.0
.1	.5314	.8471	.6273	1.5941	.9
.2	.5329	.8462	.6297	1.5880	.8
.3	.5344	.8453	.6322	1.5818	.7
.4	.5358	.8443	.6346	1.5757	.6
.5	.5373	.8434	.6371	1.5697	.5
.6	.5388	.8425	.6395	1.5637	.4
.7	.5402	.8415	.6420	1.5577	.3
.8	.5417	.8406	.6445	1.5517	.2
.9	.5432	.8396	.6469	1.5458	.1
33.0	0.5446	0.8387	0.6494	1.5399	57.0
.1	.5461	.8377	.6519	1.5340	.9
.2	.5476	.8368	.6544	1.5282	.8
.3	.5490	.8358	.6569	1.5224	.7
.4	.5505	.8348	.6594	1.5166	.6
.5	.5519	.8339	.6619	1.5108	.5
.6	.5534	.8329	.6644	1.5051	.4
.7	.5548	.8320	.6669	1.4994	.3
.8	.5563	.8310	.6694	1.4938	.2
.9	.5577	.8300	.6720	1.4882	.1
34.0	0.5592	0.8290	0.6745	1.4826	56.0
.1	.5606	.8281	.6771	1.4770	.9
.2	.5621	.8271	.6796	1.4715	.8
.3	.5635	.8261	.6822	1.4659	.7
.4	.5650	.8251	.6847	1.4605	.6
.5	.5664	.8241	.6873	1.4550	.5
.6	.5678	.8231	.6899	1.4496	.4
.7	.5693	.8221	.6924	1.4442	.3
.8	.5707	.8211	.6950	1.4388	.2
.9	.5721	.8202	.6976	1.4335	.1
35.0	0.5736	0.8192	0.7002	1.4281	55.0
.1	.5750	.8181	.7028	1.4229	.9
.2	.5764	.8171	.7054	1.4176	.8
.3	.5779	.8161	.7080	1.4124	.7
.4	.5793	.8151	.7107	1.4071	.6
.5	.5807	.8141	.7133	1.4019	.5
.6	.5821	.8131	.7159	1.3968	.4
.7	.5835	.8121	.7186	1.3916	.3
.8	.5850	.8111	.7212	1.3865	.2
.9	.5864	.8100	.7239	1.3814	.1
36.0	0.5878	0.8090	0.7265	1.3764	54.0
Deg.	Cos	Sin	Cot	Tan	Deg.

Deg.	Sin	Cos	Tan	Cot	Deg.
36.0	0.5878	0.8090	0.7265	1.3764	**54.0**
.1	.5892	.8080	.7292	1.3713	.9
.2	.5906	.8070	.7319	1.3663	.8
.3	.5920	.8059	.7346	1.3613	.7
.4	.5934	.8049	.7373	1.3564	.6
.5	.5948	.8039	.7400	1.3514	.5
.6	.5962	.8028	.7427	1.3465	.4
.7	.5976	.8018	.7454	1.3416	.3
.8	.5990	.8007	.7481	1.3367	.2
.9	.6004	.7997	.7508	1.3319	.1
37.0	0.6018	0.7986	0.7536	1.3270	**53.0**
.1	.6032	.7976	.7563	1.3222	.9
.2	.6046	.7965	.7590	1.3175	.8
.3	.6060	.7955	.7618	1.3127	.7
.4	.6074	.7944	.7646	1.3079	.6
.5	.6088	.7934	.7673	1.3032	.5
.6	.6101	.7923	.7701	1.2985	.4
.7	.6115	.7912	.7729	1.2938	.3
.8	.6129	.7902	.7757	1.2892	.2
.9	.6143	.7891	.7785	1.2846	.1
38.0	0.6157	0.7880	0.7813	1.2799	**52.0**
.1	.6170	.7869	.7841	1.2753	.9
.2	.6184	.7859	.7869	1.2708	.8
.3	.6198	.7848	.7898	1.2662	.7
.4	.6211	.7837	.7926	1.2617	.6
.5	.6225	.7826	.7954	1.2572	.5
.6	.6239	.7815	.7983	1.2527	.4
.7	.6252	.7804	.8012	1.2482	.3
.8	.6266	.7793	.8040	1.2437	.2
.9	.6280	.7782	.8069	1.2393	.1
39.0	0.6293	0.7771	0.8098	1.2349	**51.0**
.1	.6307	.7760	.8127	1.2305	.9
.2	.6320	.7749	.8156	1.2261	.8
.3	.6334	.7738	.8185	1.2218	.7
.4	.6347	.7727	.8214	1.2174	.6
.5	.6361	.7716	.8243	1.2131	.5
.6	.6374	.7705	.8273	1.2088	.4
.7	.6388	.7694	.8302	1.2045	.3
.8	.6401	.7683	.8332	1.2002	.2
.9	.6414	.7672	.8361	1.1960	.1
40.0	0.6428	0.7660	0.8391	1.1918	**50.0**
.1	.6441	.7649	.8421	1.1875	.9
.2	.6455	.7638	.8451	1.1833	.8
.3	.6468	.7627	.8481	1.1792	.7
.4	.6481	.7615	.8511	1.1750	.6
40.5	0.6494	0.7604	0.8541	1.1708	**49.5**
Deg.	Cos	Sin	Cot	Tan	Deg.

Deg.	Sin	Cos	Tan	Cot	Deg.
40.5	0.6494	0.7604	0.8541	1.1708	**49.5**
.6	.6508	.7593	.8571	1.1667	.4
.7	.6521	.7581	.8601	1.1626	.3
.8	.6534	.7570	.8632	1.1585	.2
.9	.6547	.7559	.8662	1.1544	.1
41.0	0.6561	0.7547	0.8693	1.1504	**49.0**
.1	.6574	.7536	.8724	1.1463	.9
.2	.6587	.7524	.8754	1.1423	.8
.3	.6600	.7513	.8785	1.1383	.7
.4	.6613	.7501	.8816	1.1343	.6
.5	.6626	.7490	.8847	1.1303	.5
.6	.6639	.7478	.8878	1.1263	.4
.7	.6652	.7466	.8910	1.1224	.3
.8	.6665	.7455	.8941	1.1184	.2
.9	.6678	.7443	.8972	1.1145	.1
42.0	0.6691	0.7431	0.9004	1.1106	**48.0**
.1	.6704	.7420	.9036	1.1067	.9
.2	.6717	.7408	.9067	1.1028	.8
.3	.6730	.7396	.9099	1.0990	.7
.4	.6743	.7385	.9131	1.0951	.6
.5	.6756	.7373	.9163	1.0913	.5
.6	.6769	.7361	.9195	1.0875	.4
.7	.6782	.7349	.9228	1.0837	.3
.8	.6794	.7337	.9260	1.0799	.2
.9	.6807	.7325	.9393	1.0761	.1
43.0	0.6820	0.7314	0.9325	1.0724	**47.0**
.1	.6833	.7302	.9358	1.0686	.9
.2	.6845	.7290	.9391	1.0649	.8
.3	.6858	.7278	.9424	1.0612	.7
.4	.6871	.7266	.9457	1.0575	.6
.5	.6884	.7254	.9490	1.0538	.5
.6	.6896	.7242	.9523	1.0501	.4
.7	.6909	.7230	.9556	1.0464	.3
.8	.6921	.7218	.9590	1.0428	.2
.9	.6934	.7206	.9623	1.0392	.1
44.0	0.6947	0.7193	0.9657	1.0355	**46.0**
.1	.6959	.7181	.9691	1.0319	.9
.2	.6972	.7169	.9725	1.0283	.8
.3	.6984	.7157	.9759	1.0247	.7
.4	.6997	.7145	.9793	1.0212	.6
.5	.7009	.7133	.9827	1.0176	.5
.6	.7022	.7120	.9861	1.0141	.4
.7	.7034	.7108	.9896	1.0105	.3
.8	.7046	.7096	.9930	1.0070	.2
.9	.7059	.7083	.9965	1.0035	.1
45.0	0.7071	0.7071	1.0000	1.0000	**45.0**
Deg.	Cos	Sin	Cot	Tan	Deg.

LOGARITHMS OF TRIGONOMETRIC FUNCTIONS FOR DECIMAL FRACTIONS OF A DEGREE

Deg.	L. Sin	L. Cos	L. Tan	L. Cot	Deg.
0.0	— ∞	0.0000	— ∞	∞	**90.0**
.1	7.2419	0.0000	7.2419	2.7581	.9
.2	7.5429	0.0000	7.5429	2.4571	.8
.3	7.7190	0.0000	7.7190	2.2810	.7
.4	7.8439	0.0000	7.8439	2.1561	.6
.5	7.9408	0.0000	7.9409	2.0591	.5
.6	8.0200	0.0000	8.0200	1.9800	.4
.7	8.0870	0.0000	8.0870	1.9130	.3
.8	8.1450	0.0000	8.1450	1.8550	.2
.9	8.1961	9.9999	8.1962	1.8038	.1
1.0	8.2419	9.9999	8.2419	1.7581	**89.0**
.1	8.2832	9.9999	8.2833	1.7167	.9
.2	8.3210	9.9999	8.3211	1.6789	.8
.3	8.3558	9.9999	8.3559	1.6441	.7
.4	8.3880	9.9999	8.3881	1.6119	.6
.5	8.4179	9.9999	8.4181	1.5819	.5
.6	8.4459	9.9998	8.4461	1.5539	.4
.7	8.4723	9.9998	8.4725	1.5275	.3
.8	8.4971	9.9998	8.4973	1.5027	.2
.9	8.5206	9.9998	8.5208	1.4792	.1
2.0	8.5428	9.9997	8.5431	1.4569	**88.0**
.1	8.5640	9.9997	8.5643	1.4357	.9
.2	8.5842	9.9997	8.5845	1.4155	.8
.3	8.6035	9.9996	8.6038	1.3962	.7
.4	8.6220	9.9996	8.6223	1.3777	.6
.5	8.6397	9.9996	8.6401	1.3599	.5
.6	8.6567	9.9996	8.6571	1.3429	.4
.7	8.6731	9.9995	8.6736	1.3264	.3
.8	8.6889	9.9995	8.6894	1.3106	.2
.9	8.7041	9.9994	8.7046	1.2954	.1
3.0	8.7188	9.9994	8.7194	1.2806	**87.0**
.1	8.7330	9.9994	8.7337	1.2663	.9
.2	8.7468	9.9993	8.7475	1.2525	.8
.3	8.7602	9.9993	8.7609	1.2391	.7
.4	8.7731	9.9992	8.7739	1.2261	.6
.5	8.7857	9.9992	8.7865	1.2135	.5
.6	8.7979	9.9991	8.7988	1.2012	.4
.7	8.8098	9.9991	8.8107	1.1893	.3
.8	8.8213	9.9990	8.8223	1.1777	.2
.9	8.8326	9.9990	8.8336	1.1664	.1
4.0	8.8436	9.9989	8.8446	1.1554	**86.0**
.1	8.8543	9.9989	8.8554	1.1446	.9
.2	8.8647	9.9988	8.8659	1.1341	.8
.3	8.8749	9.9988	8.8762	1.1238	.7
.4	8.8849	9.9987	8.8862	1.1138	.6
.5	8.8946	9.9987	8.8960	1.1040	.5
.6	8.9042	9.9986	8.9056	1.0944	.4
.7	8.9135	9.9985	8.9150	1.0850	.3
.8	8.9226	9.9985	8.9241	1.0759	.2
.9	8.9315	9.9984	8.9331	1.0669	.1
5.0	8.9403	9.9983	8.9420	1.0580	**85.0**
.1	8.9489	9.9983	8.9506	1.0494	.9
.2	8.9573	9.9982	8.9591	1.0409	.8
.3	8.9655	9·9981	8.9674	1.0326	.7
.4	8.9736	9.9981	8.9756	1.0244	.6
.5	8.9816	9.9980	8.9836	1.0164	.5
.6	8.9894	9.9979	8.9915	1.0085	.4
.7	8.9970	9.9978	8.9992	1.0008	.3
.8	9.0046	9.9978	9.0068	0.9932	.2
.9	9.0120	9.9977	9.0143	0.9857	.1
6.0	9.0192	9.9976	9.0216	0.9784	**84.0**
Deg.	L. Cos	L. Sin	L. Cot	L. Tan	Deg.

Deg.	L. Sin	L. Cos	L. Tan	L. Cot	Deg.
6.0	9.0192	9.9976	9.0216	0.9784	**84.0**
.1	9.0264	9.9975	9.0289	0.9711	.9
.2	9.0334	9.9975	9.0360	0.9640	.8
.3	9.0403	9.9974	9.0430	0.9570	.7
.4	9.0472	9.9973	9.0499	0.9501	.6
.5	9.0539	9.9972	9.0567	0.9433	.5
.6	9.0605	9.9971	9.0633	0.9367	.4
.7	9.0670	9.9970	9.0699	0.9301	.3
.8	9.0734	9.9969	9.0764	0.9236	.2
.9	9.0797	9.9968	9.0828	0.9172	.1
7.0	9.0859	9.9968	9.0891	0.9109	**83.0**
.1	9.0920	9.9967	9.0954	0.9046	.9
.2	9.0981	9.9966	9.1015	0.8985	.8
.3	9·1040	9·9965	9.1076	0.8924	.7
.4	9 1099	9.9964	9.1135	0.8865	.6
.5	9.1157	9.9963	9.1194	0.8806	.5
.6	9.1214	9.9962	9.1252	0.8748	.4
.7	9.1271	9.9961	9.1310	0.8690	.3
.8	9.1326	9.9960	9.1367	0.8633	.2
.9	9.1381	9.9959	9.1423	0.8577	.1
8.0	9.1436	9.9958	9.1478	0.8522	**82.0**
.1	9.1489	9.9956	9.1533	0.8467	.9
.2	9.1542	9.9955	9.1587	0.8413	.8
.3	9.1594	9.9954	9.1640	0.8360	.7
.4	9.1646	9.9953	9.1693	0.8307	.6
.5	9.1697	9.9952	9.1745	0.8255	.5
.6	9.1747	9.9951	9.1797	0.8203	.4
.7	9.1797	9.9950	9.1848	0.8152	.3
.8	9.1847	9.9949	9.1898	0.8102	.2
.9	9.1895	9.9947	9.1948	0.8052	.1
9.0	9.1943	9.9946	9.1997	0.8003	**81.0**
.1	9.1991	9.9945	9.2046	0.7954	.9
.2	9.2038	9.9944	9.2094	0.7906	.8
.3	9.2085	9.9943	9.2142	0.7858	.7
.4	9.2131	9.9941	9.2189	0.7811	.6
.5	9.2176	9.9940	9.2236	0.7764	.5
.6	9.2221	9.9939	9.2282	0.7718	.4
.7	9.2266	9.9937	9.2328	0.7672	.3
.8	9.2310	9.9936	9.2374	0.7626	.2
.9	9.2353	9.9935	9.2419	0.7581	.1
10.0	9.2397	9.9934	9.2463	0.7537	**80.0**
.1	9.2439	9.9932	9.2507	C 7493	.9
.2	9.2482	9.9931	9.2551	0.7449	.8
.3	9.2524	9.9929	9.2594	0.7406	.7
.4	9.2565	9.9928	9.2637	0.7363	.6
.5	9.2606	9.9927	9.2680	0.7320	.5
.6	9.2647	9.9925	9.2722	0.7278	.4
.7	9.2687	9·9924	9.2764	0.7236	.3
.8	9.2727	9.9922	9.2805	0.7195	.2
.9	9.2767	9.9921	9.2846	0.7154	.1
11.0	9.2806	9.9919	9.2887	0.7113	**79.0**
.1	9.2845	9.9918	9.2927	0.7073	.9
.2	9.2883	9.9916	9.2967	0.7033	.8
.3	9.2921	9.9915	9.3006	0.6994	.7
.4	9.2959	9.9913	9.3046	0.6954	.6
.5	9.2997	9.9912	9.3085	0.6915	.5
.6	9.3034	9.9910	9.3123	0.6877	.4
.7	9.3070	9.9909	9.3162	0.6838	.3
.8	9.3107	9.9907	9.3200	0.6800	.2
.9	9.3143	9.9906	9.3237	0.6763	.1
12.0	9.3179	9.9904	9.3275	0.6725	**78.0**
Deg.	L. Cos	L. Sin	L. Cot	L. Tan	Deg.

Deg.	L. Sin	L. Cos	L. Tan	L. Cot	Deg.
12.0	9.3179	9.9904	9.3275	0.6725	**78.0**
.1	9.3214	9.9902	9.3312	0.6688	.9
.2	9.3250	9.9901	9.3349	0.6651	.8
.3	9.3284	9.9899	9.3385	0.6615	.7
.4	9.3319	9.9897	9.3422	0.6578	.6
.5	9.3353	9.9896	9.3458	0.6542	.5
.6	9.3387	9.9894	9.3493	0.6507	.4
.7	9.3421	9.9892	9.3529	0.6471	.3
.8	9.3455	9.9891	9.3564	0.6436	.2
.9	9.3488	9.9889	9.3599	0.6401	.1
13.0	9.3521	9.9887	9.3634	0.6366	**77.0**
.1	9.3554	9.9885	9.3668	0.6332	.9
.2	9.3586	9.9884	9.3702	0.6298	.8
.3	9.3618	9.9882	9.3736	0.6264	.7
.4	9.3650	9.9880	9.3770	0.6230	.6
.5	9.3682	9.9878	9.3804	0.6196	.5
.6	9.3713	9.9876	9.3837	0.6163	.4
.7	9.3745	9.9875	9.3870	0.6130	.3
.8	9.3775	9.9873	9.3903	0.6097	.2
.9	9.3806	9.9871	9.3935	0.6065	.1
14.0	9.3837	9.9869	9.3968	0.6032	**76.0**
.1	9.3867	9.9867	9.4000	0.6000	.9
.2	9.3897	9.9865	9.4032	0.5968	.8
.3	9.3927	9.9863	9.4064	0.5936	.7
.4	9.3957	9.9861	9.4095	0.5905	.6
.5	9.3986	9.9859	9.4127	0.5873	.5
.6	9.4015	9.9857	9.4158	0.5842	.4
.7	9.4044	9.9855	9.4189	0.5811	.3
.8	9.4073	9.9853	9.4220	0.5780	.2
.9	9.4102	9.9851	9.4250	0.5750	.1
15.0	9.4130	9.9849	9.4281	0.5719	**75.0**
.1	9.4158	9.9847	9.4311	0.5689	.9
.2	9.4186	9.9845	9.4341	0.5659	.8
.3	9.4214	9.9843	9.4371	0.5629	.7
.4	9.4242	9.9841	9.4400	0.5600	.6
.5	9.4269	9.9839	9.4430	0.5570	.5
.6	9.4296	9.9837	9.4459	0.5541	.4
.7	9.4323	9.9835	9.4488	0.5512	.3
.8	9.4350	9.9833	9.4517	0.5483	.2
.9	9.4377	9.9831	9.4546	0.5454	.1
16.0	9.4403	9.9828	9.4575	0.5425	**74.0**
.1	9.4430	9.9826	9.4603	0.5397	.9
.2	9.4456	9.9824	9.4632	0.5368	.8
.3	9.4482	9.9822	9.4660	0.5340	.7
.4	9.4508	9.9820	9.4688	0.5312	.6
.5	9.4533	9.9817	9.4716	0.5284	.5
.6	9.4559	9.9815	9.4744	0.5256	.4
.7	9.4584	9.9813	9.4771	0.5229	.3
.8	9.4609	9.9811	9.4799	0.5201	.2
.9	9.4634	9.9808	9.4826	0.5174	.1
17.0	9.4659	9.9806	9.4853	0.5147	**73.0**
.1	9.4684	9.9804	9.4880	0.5120	.9
.2	9.4709	9.9801	9.4907	0.5093	.8
.3	9.4733	9.9799	9.4934	0.5066	.7
.4	9.4757	9.9797	9.4961	0.5039	.6
.5	9.4781	9.9794	9.4987	0.5013	.5
.6	9.4805	9.9792	9.5014	0.4986	.4
.7	9.4829	9.9789	9.5040	0.4960	.3
.8	9.4853	9.9787	9.5066	0.4934	.2
.9	9.4876	9.9785	9.5092	0.4908	.1
18.0	9.4900	9.9782	9.5118	0.4882	**72.0**
Deg.	L. Cos	L. Sin	L. Cot	L. Tan	Deg.

Deg.	L. Sin	L. Cos	L. Tan	L. Cot	Deg.
18.0	9.4900	9.9782	9.5118	0.4882	**72.0**
.1	9.4923	9.9780	9.5143	0.4857	.9
.2	9.4946	9.9777	9.5169	0.4831	.8
.3	9.4969	9.9775	9.5195	0.4805	.7
.4	9.4992	9.9772	9.5220	0.4780	.6
.5	9.5015	9.9770	9.5245	0.4755	.5
.6	9.5037	9.9767	9.5270	0.4730	.4
.7	9.5060	9.9764	9.5295	0.4705	.3
.8	9.5082	9.9762	9.5320	0.4680	.2
.9	9.5104	9.9759	9.5345	0.4655	.1
19.0	9.5126	9.9757	9.5370	0.4630	**71.0**
.1	9.5148	9.9754	9.5394	0.4606	.9
.2	9.5170	9.9751	9.5419	0.4581	.8
.3	9.5192	9.9749	9.5443	0.4557	.7
.4	9.5213	9.9746	9.5467	0.4533	.6
.5	9.5235	9.9743	9.5491	0.4509	.5
.6	9.5256	9.9741	9.5516	0.4484	.4
.7	9.5278	9.9738	9.5539	0.4461	.3
.8	9.5299	9.9735	9.5563	0.4437	.2
.9	9.5320	9.9733	9.5587	0.4413	.1
20.0	9.5341	9.9730	9.5611	0.4389	**70.0**
.1	9.5361	9.9727	9.5634	0.4366	.9
.2	9.5382	9.9724	9.5658	0.4342	.8
.3	9.5402	9.9722	9.5681	0.4319	.7
.4	9.5423	9.9719	9.5704	0.4296	.6
.5	9.5443	9.9716	9.5727	0.4273	.5
.6	9.5463	9.9713	9.5750	0.4250	.4
.7	9.5484	9.9710	9.5773	0.4227	.3
.8	9.5504	9.9707	9.5796	0.4204	.2
.9	9.5523	9.9704	9.5819	0.4181	.1
21.0	9.5543	9.9702	9.5842	0.4158	**69.0**
.1	9.5563	9.9699	9.5864	0.4136	.9
.2	9.5583	9.9696	9.5887	0.4113	.8
.3	9.5602	9.9693	9.5909	0.4091	.7
.4	9.5621	9.9690	9.5932	0.4068	.6
.5	9.5641	9.9687	9.5954	0.4046	.5
.6	9.5660	9.9684	9.5976	0.4024	.4
.7	9.5679	9.9681	9.5998	0.4002	.3
.8	9.5698	9.9678	9.6020	0.3980	.2
.9	9.5717	9.9675	9.6042	0.3958	.1
22.0	9.5736	9.9672	9.6064	0.3936	**68.0**
.1	9.5754	9.9669	9.6086	0.3914	.9
.2	9.5773	9.9666	9.6108	0.3892	.8
.3	9.5792	9.9662	9.6129	0.3871	.7
.4	9.5810	9.9659	9.6151	0.3849	.6
.5	9.5828	9.9656	9.6172	0.3828	.5
.6	9.5847	9.9653	9.6194	0.3806	.4
.7	9.5865	9.9650	9.6215	0.3785	.3
.8	9.5883	9.9647	9.6236	0.3764	.2
.9	9.5901	9.9643	9.6257	0.3743	.1
23.0	9.5919	9.9640	9.6279	0.3721	**67.0**
.1	9.5937	9.9637	9.6300	0.3700	.9
.2	9.5954	9.9634	9.6321	0.3679	.8
.3	9.5972	9.9631	9.6341	0.3659	.7
.4	9.5990	9.9627	9.6362	0.3638	.6
.5	9.6007	9.9624	9.6383	0.3617	.5
.6	9.6024	9.9621	9.6404	0.3596	.4
.7	9.6042	9.9617	9.6424	0.3576	.3
.8	9.6059	9.9614	9.6445	0.3555	.2
.9	9.6076	9.9611	9.6465	0.3535	.1
24.0	9.6093	9.9607	9.6486	0.3514	**66.0**
Deg.	L. Cos	L. Sin	L. Cot	L. Tan	Deg.

Deg.	L. Sin	L. Cos	L. Tan	L. Cot	Deg.
24.0	9.6093	9.9607	9.6486	0.3514	**66.0**
.1	9.6110	9.9604	9.6506	0.3494	.9
.2	9.6127	9.9601	9.6527	0.3473	.8
.3	9.6144	9.9597	9.6547	0.3453	.7
.4	9.6161	9.9594	9.6567	0.3433	.6
.5	9.6177	9.9590	9.6587	0.3413	.5
.6	9.6194	9.9587	9.6607	0.3393	.4
.7	9.6210	9.9583	9.6627	0.3373	.3
.8	9.6227	9.9580	9.6647	0.3353	.2
.9	9.6243	9.9576	9.6667	0.3333	.1
25.0	9.6259	9.9573	9.6687	0.3313	**65.0**
.1	9.6276	9.9569	9.6706	0.3294	.9
.2	9.6292	9.9566	9.6726	0.3274	.8
.3	9.6308	9.9562	9.6746	0.3254	.7
.4	9.6324	9.9558	9.6765	0.3235	.6
.5	9.6340	9.9555	9.6785	0.3215	.5
.6	9.6356	9.9551	9.6804	0.3196	.4
.7	9.6371	9.9548	9.6824	0.3176	.3
.8	9.6387	9.9544	9.6843	0.3157	.2
.9	9.6403	9.9540	9.6863	0.3137	.1
26.0	9.6418	9.9537	9.6882	0.3118	**64.0**
.1	9.6434	9.9533	9.6901	0.3099	.9
.2	9.6449	9.9529	9.6920	0.3080	.8
.3	9.6465	9.9525	9.6939	0.3061	.7
.4	9.6480	9.9522	9.6958	0.3042	.6
.5	9.6495	9.9518	9.6977	0.3023	.5
.6	9.6510	9.9514	9.6996	0.3004	.4
.7	9.6526	9.9510	9.7015	0.2985	.3
.8	9.6541	9.9506	9.7034	0.2966	.2
.9	9.6556	9.9503	9.7053	0.2947	.1
27.0	9.6570	9.9499	9.7072	0.2928	**63.0**
.1	9.6585	9.9495	9.7090	0.2910	.9
.2	9.6600	9.9491	9.7109	0.2891	.8
.3	9.6615	9.9487	9.7128	0.2872	.7
.4	9.6629	9.9483	9.7146	0.2854	.6
.5	9.6644	9.9479	9.7165	0.2835	.5
.6	9.6659	9.9475	9.7183	0.2817	.4
.7	9.6673	9.9471	9.7202	0.2798	.3
.8	9.6687	9.9467	9.7220	0.2780	.2
.9	9.6702	9.9463	9.7238	0.2762	.1
28.0	9.6716	9.9459	9.7257	0.2743	**62.0**
.1	9.6730	9.9455	9.7275	0.2725	.9
.2	9.6744	9.9451	9.7293	0.2707	.8
.3	9.6759	9.9447	9.7311	0.2689	.7
.4	9.6773	9.9443	9.7330	0.2670	.6
.5	9.6787	9.9439	9.7348	0.2652	.5
.6	9.6801	9.9435	9.7366	0.2634	.4
.7	9.6814	9.9431	9.7384	0.2616	.3
.8	9.6828	9.9427	9.7402	0.2598	.2
.9	9.6842	9.9422	9.7420	0.2580	.1
29.0	9.6856	9.9418	9.7438	0.2562	**61.0**
.1	9.6869	9.9414	9 7455	0.2545	.9
.2	9.6883	9.9410	9.7473	0.2527	.8
.3	9.6896	9.9406	9.7491	0.2509	.7
.4	9.6910	9.9401	9.7509	0.2491	.6
.5	9.6923	9.9397	9.7526	0.2474	.5
.6	9.6937	9.9393	9.7544	0.2456	.4
.7	9.6950	9.9388	9.7562	0.2438	.3
.8	9.6963	9.9384	9.7579	0.2421	.2
.9	9.6977	9.9380	9.7597	0.2403	.1
30.0	9.6990	9.9375	9.7614	0.2386	**60.0**
Deg.	L. Cos	L. Sin	L. Cot	L. Tan	Deg.

Deg.	L. Sin	L. Cos	L. Tan	L. Cot	Deg
30.0	9.6990	9.9375	9.7614	0.2386	**60.0**
.1	9.7003	9.9371	9.7632	0.2368	.9
.2	9.7016	9.9367	9.7649	0.2351	.8
.3	9.7029	9.9362	9.7667	0.2333	.7
.4	9.7042	9.9358	9.7684	0.2316	.6
.5	9.7055	9.9353	9.7701	0.2299	.5
.6	9.7068	9.9349	9.7719	0.2281	.4
.7	9.7080	9.9344	9.7736	0.2264	.3
.8	9.7093	9.9340	9.7753	0.2247	.2
.9	9.7106	9.9335	9.7771	0.2229	.1
31.0	9.7118	9.9331	9.7788	0.2212	**59.0**
.1	9.7131	9.9326	9.7805	0.2195	.9
.2	9.7144	9.9322	9.7822	0.2178	.8
.3	9.7156	9.9317	9.7839	0.2161	.7
.4	9.7168	9.9312	9.7856	0.2144	.6
.5	9.7181	9.9308	9.7873	0.2127	.5
.6	9.7193	9.9303	9.7890	0.2110	.4
.7	9.7205	9.9298	9.7907	0.2093	.3
.8	9.7218	9.9294	9.7924	0.2076	.2
.9	9.7230	9.9289	9.7941	0.2059	.1
32.0	9.7242	9.9284	9.7958	0.2042	**58.0**
.1	9.7254	9.9279	9.7975	0.2025	.9
.2	9.7266	9.9275	9.7992	0.2008	.8
.3	9.7278	9.9270	9.8008	0.1992	.7
.4	9.7290	9.9265	9.8025	0.1975	.6
.5	9.7302	9.9260	9.8042	0.1958	.5
.6	9.7314	9.9255	9.8059	0.1941	.4
.7	9.7326	9·9251	9.8075	0.1925	.3
.8	9.7338	9.9246	9.8092	0.1908	.2
.9	9.7349	9.9241	9.8109	0.1891	.1
33.0	9.7361	9.9236	9.8125	0.1875	**57.0**
.1	9.7373	9.9231	9.8142	0.1858	.9
.2	9.7384	9.9226	9.8158	0.1842	.8
.3	9.7396	9.9221	9.8175	0.1825	.7
.4	9.7407	9.9216	9.8191	0.1809	.6
.5	9.7419	9.9211	9.8208	0.1792	.5
.6	9.7430	9.9206	9.8224	0.1776	.4
.7	9.7442	9.9201	9.8241	0.1759	.3
.8	9.7453	9.9196	9.8257	0.1743	.2
.9	9.7464	9.9191	9.8274	0.1726	.1
34.0	9.7476	9.9186	9.8290	0.1710	**56.0**
.1	9.7487	9.9181	9.8306	0.1694	.9
.2	9.7498	9.9175	9.8323	0.1677	.8
.3	9.7509	9.9170	9.8339	0.1661	.7
.4	9.7520	9.9165	9.8355	0.1645	.6
.5	9.7531	9.9160	9.8371	0.1629	.5
.6	9.7542	9.9155	9.8388	0.1612	.4
.7	9.7553	9.9149	9.8404	0.1596	.3
.8	9.7564	9.9144	9.8420	0.1580	.2
.9	9.7575	9.9139	9.8436	0.1564	.1
35.0	9.7586	9.9134	9·8452	0.1548	**55.0**
.1	9.7597	9.9128	9.8468	0.1532	.9
.2	9.7607	9.9123	9.8484	0.1516	.8
.3	9.7618	9.9118	9.8501	0.1499	.7
.4	9.7629	9.9112	9.8517	0.1483	.6
.5	9.7640	9.9107	9.8533	0.1467	.5
.6	9.7650	9.9101	9.8549	0.1451	.4
.7	9.7661	9.9096	9.8565	0.1435	.3
.8	9.7671	9.9091	9.8581	0.1419	.2
.9	9.7682	9.9085	9.8597	0.1403	.1
36.0	9.7692	9.9080	9.8613	0.1387	**54.0**
Deg.	L. Cos	L. Sin	L. Cot	L. Tan	Deg.

Deg.	L. Sin	L. Cos	L. Tan	L. Cot	Deg.
36.0	9.7692	9.9080	9.8613	0.1387	**54.0**
.1	9.7703	9.9074	9.8629	0.1371	.9
.2	9.7713	9.9069	9.8644	0.1356	.8
.3	9.7723	9.9063	9.8660	0.1340	.7
.4	9.7734	9.9057	9.8676	0.1324	.6
.5	9.7744	9.9052	9.8692	0.1308	.5
.6	9.7754	9.9046	9.8708	0.1292	.4
.7	9.7764	9.9041	9.8724	0.1276	.3
.8	9.7774	9.9035	9.8740	0.1260	.2
.9	9.7785	9.9029	9.8755	0.1245	.1
37.0	9.7795	9.9023	9.8771	0.1229	**53.0**
.1	9.7805	9.9018	9.8787	0.1213	.9
.2	9.7815	9.9012	9.8803	0.1197	.8
.3	9.7825	9.9006	9.8818	0.1182	.7
.4	9.7835	9.9000	9.8834	0.1166	.6
.5	9.7844	9.8995	9.8850	0.1150	.5
.6	9.7854	9.8989	9.8865	0.1135	.4
.7	9.7864	9.8983	9.8881	0.1119	.3
.8	9.7874	9.8977	9.8897	0.1103	.2
.9	9.7884	9.8971	9.8912	0.1088	.1
38.0	9.7893	9.8965	9.8928	0.1072	**52.0**
.1	9.7903	9.8959	9.8944	0.1056	.9
.2	9.7913	9.8953	9.8959	0.1041	.8
.3	9.7922	9.8947	9.8975	0.1025	.7
.4	9.7932	9.8941	9.8990	0.1010	.6
.5	9.7941	9.8935	9.9006	0.0994	.5
.6	9.7951	9.8929	9.9022	0.0978	.4
.7	9.7960	9.8923	9.9037	0.0963	.3
.8	9.7970	9.8917	9.9053	0.0947	.2
.9	9.7979	9.8911	9.9068	0.0932	.1
39.0	9.7989	9.8905	9.9084	0.0916	**51.0**
.1	9.7998	9.8899	9.9099	0.0901	.9
.2	9.8007	9.8893	9.9115	0.0885	.8
.3	9.8017	9.8887	9.9130	0.0870	.7
.4	9.8026	9.8880	9.9146	0.0854	.6
.5	9.8035	9.8874	9.9161	0.0839	.5
.6	9.8044	9.8868	9.9176	0.0824	.4
.7	9.8053	9.8862	9.9192	0.0808	.3
.8	9.8063	9.8855	9.9207	0.0793	.2
.9	9.8072	9.8849	9.9223	0.0777	.1
40.0	9.8081	9.8843	9.9238	0.0762	**50.0**
.1	9.8090	9.8836	9.9254	0.0746	.9
.2	9.8099	9.8830	9.9269	0.0731	.8
.3	9.8108	9.8823	9.9284	0.0716	.7
.4	9.8117	9.8817	9.9300	0.0700	.6
.5	9.8125	9.8810	9.9315	0.0685	.5
.6	9.8134	9.8804	9.9330	0.0670	.4
.7	9.8143	9.8797	9.9346	0.0654	.3
.8	9.8152	9.8791	9.9361	0.0639	.2
.9	9.8161	9.8784	9.9376	0.0624	.1
41.0	9.8169	9.8778	9.9392	0.0608	**49.0**
Deg.	L. Cos	L. Sin	L. Cot	L. Tan	Deg.

Deg.	L. Sin	L. Cos	L. Tan	L. Cot	Deg.
41.0	9.8169	9.8778	9.9392	0.0608	**49.0**
.1	9.8178	9.8771	9.9407	0.0593	.9
.2	9.8187	9.8765	9.9422	0.0678	.8
.3	9.8195	9.8758	9.9438	0.0562	.7
.4	9.8204	9.8751	9.9453	0.0647	.6
.5	9.8213	9.8745	9.9468	0.0532	.5
.6	9.8221	9.8738	9.9483	0.0517	.4
.7	9.8230	9.8731	9.9499	0.0501	.3
.8	9.8238	9.8724	9.9514	0.0486	.2
.9	9.8247	9.8718	9.9529	0.0471	.1
42.0	9.8255	9.8711	9.9544	0.0456	**48.0**
.1	9.8264	9.8704	9.9560	0.0440	.9
.2	9.8272	9.8697	9.9575	0.0425	.8
.3	9.8280	9.8690	9.9590	0.0410	.7
.4	9.8289	9.8683	9.9605	0.0395	.6
.5	9.8297	9.8676	9.9621	0.0379	.5
.6	9.8305	9.8669	9.9636	0.0364	.4
.7	9.8313	9.8662	9.9651	0.0349	.3
.8	9.8322	9.8655	9.9666	0 0334	.2
.9	9.8330	9.8648	9.9681	0.0319	.1
43.0	9.8338	9.8641	9.9697	0.0303	**47.0**
.1	9.8346	9.8634	9.9712	0.0288	.9
.2	9.8354	9.8627	9.9727	0.0273	.8
.3	9.8362	9.8620	9.9742	0.0258	.7
.4	9.8370	9.8613	9.9757	0.0243	.6
.5	9.8378	9.8606	9.9772	0.0228	.5
.6	9.8386	9.8598	9.9788	0.0212	.4
.7	9.8394	9.8591	9.9803	0.0197	.3
.8	9.8402	9.8584	9.9818	0.0182	.2
.9	9.8410	9.8577	9.9833	0.0167	.1
44.0	9.8418	9.8569	9.9848	0.0152	**46.0**
.1	9.8426	9.8562	9.9864	0.0136	.9
.2	9.8433	9.8555	9.9879	0.0121	.8
.3	9.8441	9.8547	9.9894	0.0106	.7
.4	9.8449	9.8540	9.9909	0.0091	.6
.5	9 8457	9.8532	9.9924	0.0076	.5
.6	9.8464	9 8525	9.9939	0.0061	.4
.7	9.8472	9.8517	9.9955	0.0045	.3
.8	9.8480	9.8510	9.9970	0.0030	.2
.9	9.8487	9.8502	9.9985	0.0015	.1
45.0	9.8495	9.8495	0.0000	0.0000	**45.0**
Deg.	L. Cos	L. Sin	L. Cot	L. Tan	Deg.

NATURAL FUNCTIONS FOR ANGLES IN RADIANS

Rad.	Sin	Tan	Cot	Cos
.00	.00000	.00000	∞	1.0000
.01	.01000	.01000	99.997	.99995
.02	.02000	.02000	49.993	.99980
.03	.03000	.03001	33.323	.99955
.04	.03999	.04002	24.987	.99920
.05	.04998	.05004	19.983	.99875
.06	.05996	.06007	16.647	.99820
.07	.06994	.07011	14.262	.99755
.08	.07991	.08017	12.473	.99680
.09	.08988	.09024	11.081	.99595
.10	.09983	.10033	9.9666	.99500
.11	.10978	.11045	9.0542	.99396
.12	.11971	.12058	8.2933	.99281
.13	.12963	.13074	7.6489	.99156
.14	.13954	.14092	7.0961	.99022
.15	.14944	.15114	6.6166	.98877
.16	.15932	.16138	6.1966	.98723
.17	.16918	.17166	5.8256	.98558
.18	.17903	.18197	5.4954	.98384
.19	.18886	.19232	5.1997	.98200
.20	.19867	.20271	4.9332	.98007
.21	.20846	.21314	4.6917	.97803
.22	.21823	.22362	4.4719	.97590
.23	.22798	.23414	4.2709	.97367
.24	.23770	.24472	4.0864	.97134
.25	.24740	.25534	3.9163	.96891
.26	.25708	.26602	3.7591	.96639
.27	.26673	.27676	3.6133	.96377
.28	.27636	.28755	3.4776	.96106
.29	.28595	.29841	3.3511	.95824
.30	.29552	.30934	3.2327	.95534
.31	.30506	.32033	3.1218	.95233
.32	.31457	.33139	3.0176	.94924
.33	.32404	.34252	2.9195	.94604
.34	.33349	.35374	2.8270	.94275
.35	.34290	.36503	2.7395	.93937
.36	.35227	.37640	2.6567	.93590
.37	.36162	.38786	2.5782	.93233
.38	.37092	.39941	2.5037	.92866
.39	.38019	.41105	2.4328	.92491
.40	.38942	.42279	2.3652	.92106
.41	.39861	.43463	2.3008	.91712
.42	.40776	.44657	2.2393	.91309
.43	.41687	.45862	2.1804	.90897
.44	.42594	.47078	2.1241	.90475
.45	.43497	.48306	2.0702	.90045
.46	.44395	.49545	2.0184	.89605
.47	.45289	.50797	1.9686	.89157
.48	.46178	.52061	1.9208	.88699
.49	.47063	.53339	1.8748	.88233
.50	.47943	.54630	1.8305	.87758
Rad.	Sin	Tan	Cot	Cos

Rad.	Sin	Tan	Cot	Cos
.50	.47943	.54630	1.8305	.87758
.51	.48818	.55936	1.7878	.87274
.52	.49688	.57256	1.7465	.86782
.53	.50553	.58592	1.7067	.86281
.54	.51414	.59943	1.6683	.85771
.55	.52269	.61311	1.6310	.85252
.56	.53119	.62695	1.5950	.84726
.57	.53963	.64097	1.5601	.84190
.58	.54802	.65517	1.5263	.83646
.59	.55636	.66956	1.4935	.83094
.60	.56464	.68414	1.4617	.82534
.61	.57287	.69892	1.4308	.81965
.62	.58104	.71391	1.4007	.81388
.63	.58914	.72911	1.3715	.80803
.64	.59720	.74454	1.3431	.80210
.65	.60519	.76020	1.3154	.79608
.66	.61312	.77610	1.2885	.78999
.67	.62099	.79225	1.2622	.78382
.68	.62879	.80866	1.2366	.77757
.69	.63654	.82534	1.2116	.77125
.70	.64422	.84229	1.1872	.76484
.71	.65183	.85953	1.1634	.75836
.72	.65938	.87707	1.1402	.75181
.73	.66687	.89492	1.1174	.74517
.74	.67429	.91309	1.0952	.73847
.75	.68164	.93160	1.0734	.73169
.76	.68892	.95045	1.0521	.72484
.77	.69614	.96967	1.0313	.71791
.78	.70328	.98926	1.0109	.71091
.79	.71035	1.0092	.99084	.70385
.80	.71736	1.0296	.97121	.69671
.81	.72429	1.0505	.95197	.68950
.82	.73115	1.0717	.93309	.68222
.83	.73793	1.0934	.91455	.67488
.84	.74464	1.1156	.89635	.66746
.85	.75128	1.1383	.87848	.65998
.86	.75784	1.1616	.86091	.65244
.87	.76433	1.1853	.84365	.64483
.88	.77074	1.2097	.82668	.63715
.89	.77707	1.2346	.80998	.62941
.90	.78333	1.2602	.79355	.62161
.91	.78950	1.2864	.77738	.61375
.92	.79560	1.3133	.76146	.60582
.93	.80162	1.3409	.74578	.59783
.94	.80756	1.3692	.73034	.58979
.95	.81342	1.3984	.71511	.58168
.96	.81919	1.4284	.70010	.57352
.97	.82489	1.4592	.68531	.56530
.98	.83050	1.4910	.67071	.55702
.99	.83603	1.5237	.65631	.54869
1.00	.84147	1.5574	.64209	.54030
Rad.	Sin	Tan	Cot	Cos

Rad.	Sin	Tan	Cot	Cos
1.00	.84147	1.5574	.64209	.54030
1.01	.84683	1.5922	.62806	.53186
1.02	.85211	1.6281	.61420	.52337
1.03	.85730	1.6652	.60051	.51482
1.04	.86240	1.7036	.58699	.50622
1.05	.86742	1.7433	.57362	.49757
1.06	.87236	1.7844	.56040	.48887
1.07	.87720	1.8270	.54734	.48012
1.08	.88196	1.8712	.53441	.47133
1.09	.88663	1.9171	.52162	.46249
1.10	.89121	1.9648	.50897	.45360
1.11	.89570	2.0143	.49644	.44466
1.12	.90010	2.0660	.48404	.43568
1.13	.90441	2.1198	.47175	.42666
1.14	.90863	2.1759	.45959	.41759
1.15	.91276	2.2345	.44753	.40849
1.16	.91680	2.2958	.43558	.39934
1.17	.92075	2.3600	.42373	.39015
1.18	.92461	2.4273	.41199	.38092
1.19	.92837	2.4979	.40034	.37166
1.20	.93204	2.5722	.38878	.36236
1.21	.93562	2.6503	.37731	.35302
1.22	.93910	2.7328	.36593	.34365
1.23	.94249	2.8198	.35463	.33424
1.24	.94578	2.9119	.34341	.32480
1.25	.94898	3.0096	.33227	.31532
1.26	.95209	3.1133	.32121	.30582
1.27	.95510	3.2236	.31021	.29628
1.28	.95802	3.3413	.29928	.28672
1.29	.96084	3.4672	.28842	.27712
1.30	.96356	3.6021	.27762	.26750
1.31	.96618	3.7471	.26687	.25785
1.32	.96872	3.9033	.25619	.24818
1.33	.97115	4.0723	.24556	.23848
1.34	.97348	4.2556	.23498	.22875
1.35	.97572	4.4552	.22446	.21901
1.36	.97786	4.6734	.21398	.20924
1.37	.97991	4.9131	.20354	.19945
1.38	.98185	5.1774	.19315	.18964
1.39	.98370	5.4707	.18279	.17981
1.40	.98545	5.7979	.17248	.16997
1.41	.98710	6.1654	.16220	.16010
1.42	.98865	6.5811	.15195	.15023
1.43	.99010	7.0555	.14173	.14033
1.44	.99146	7.6018	.13155	.13042
1.45	.99271	8.2381	.12139	.12050
1.46	.99387	8.9886	.11125	.11057
1.47	.99492	9.8874	.10114	.10063
1.48	.99588	10.983	.09105	.09067
1.49	.99674	12.350	.08097	.08071
1.50	.99749	14.101	.07091	.07074
Rad.	Sin	Tan	Cot	Cos

Rad.	Sin	Tan	Cot	Cos
1.50	.99749	14.101	.07091	.07074
1.51	.99815	16.428	.06087	.06076
1.52	.99871	19.670	.05084	.05077
1.53	.99917	24.498	.04082	.04079
1.54	.99953	32.461	.03081	.03079
1.55	.99978	48.078	.02080	.02079
1.56	.99994	92.621	.01080	.01080
1.57	1.0000	1255.8	.00080	.00080
1.58	.99996	−108.65	−.00920	−.00920
1.59	.99982	−52.067	−.01921	−.01920
1.60	.99957	−34.233	−.02921	−.02920
1.61	.99923	−25.495	−.03922	−.03919
1.62	.99879	−20.307	−.04924	−.04918
1.63	.99825	−16.871	−.05927	−.05917
1.64	.99761	−14.427	−.06931	−.06915
1.65	.99687	−12.599	−.07937	−.07912
1.66	.99602	−11.181	−.08944	−.08909
1.67	.99508	−10.047	−.09953	−.09904
1.68	.99404	−9.1208	−.10964	−.10899
1.69	.99290	−8.3492	−.11977	−.11892
1.70	.99166	−7.6966	−.12993	−.12884
1.71	.99033	−7.1373	−.14011	−.13875
1.72	.98889	−6.6524	−.15032	−.14865
1.73	.98735	−6.2281	−.16056	−.15853
1.74	.98572	−5.8535	−.17084	−.16840
1.75	.98399	−5.5204	−.18115	−.17825
1.76	.98215	−5.2221	−.19149	−.18808
1.77	.98022	−4.9534	−.20188	−.19789
1.78	.97820	−4.7101	−.21231	−.20768
1.79	.97607	−4.4887	−.22278	−.21745
1.80	.97385	−4.2863	−.23330	−.22720
1.81	.97153	−4.1005	−.24387	−.23693
1.82	.96911	−3.9294	−.25449	−.24663
1.83	.96659	−3.7712	−.26517	−.25631
1.84	.96398	−3.6245	−.27590	−.26596
1.85	.96128	−3.4881	−.28669	−.27559
1.86	.95847	−3.3608	−.29755	−.28519
1.87	.95557	−3.2419	−.30846	−.29476
1.88	.95258	−3.1304	−.31945	−.30430
1.89	.94949	−3.0257	−.33051	−.31381
1.90	.94630	−2.9271	−.34164	−.32329
1.91	.94302	−2.8341	−.35284	−.33274
1.92	.93965	−2.7463	−.36413	−.34215
1.93	.93618	−2.6632	−.37549	−.35153
1.94	.93262	−2.5843	−.38695	−.36087
1.95	.92896	−2.5095	−.39849	−.37018
1.96	.92521	−2.4383	−.41012	−.37945
1.97	.92137	−2.3705	−.42185	−.38868
1.98	.91744	−2.3058	−.43368	−.39788
1.99	.91341	−2.2441	−.44562	−.40703
2.00	.90930	−2.1850	−.45766	−.41615
Rad.	Sin	Tan	Cot	Cos

LOGARITHMS OF THE FUNCTIONS FOR ANGLES IN RADIANS

Rad.	L. Sin	L. Tan	L. Cot	L. Cos
.00	— ∞	— ∞	∞	0.00000
.01	7.99999	8.00001	1.99999	9.99998
.02	8.30100	8.30109	1.69891	9.99991
.03	8.47706	8.47725	1.52275	9.99980
.04	8.60194	8.60229	1.39771	9.99965
.05	8.69879	8.69933	1.30067	9.99946
.06	8.77789	8.77867	1.22133	9.99922
.07	8.84474	8.84581	1.15419	9.99894
.08	8.90263	8.90402	1.09598	9.99861
.09	8.95366	8.95542	1.04458	9.99824
.10	8.99928	9.00145	0.99855	9.99782
.11	9.04052	9.04315	0.95685	9.99737
.12	9.07814	9.08127	0.91873	9.99687
.13	9.11272	9.11640	0.88360	9.99632
.14	9.14471	9.14898	0.85102	9.99573
.15	9.17446	9.17937	0.82063	9.99510
.16	9.20227	9.20785	0.79215	9.99442
.17	9.22836	9.23466	0.76534	9.99369
.18	9.25292	9.26000	0.74000	9.99293
.19	9.27614	9.28402	0.71598	9.99211
.20	9.29813	9.30688	0.69312	9.99126
.21	9.31902	9.32867	0.67133	9.99035
.22	9.33891	9.34951	0.65049	9.98940
.23	9.35789	9.36948	0.63052	9.98841
.24	9.37603	9.38866	0.61134	9.98737
.25	9.39341	9.40712	0.59288	9.98628
.26	9.41007	9.42492	0.57508	9.98515
.27	9.42607	9.44210	0.55790	9.98397
.28	9.44147	9.45872	0.54128	9.98275
.29	9.45629	9.47482	0.52518	9.98148
.30	9.47059	9.49043	0.50957	9.98016
.31	9.48438	9.50559	0.49441	9.97879
.32	9.49771	9.52034	0.47966	9.97737
.33	9.51060	9.53469	0.46531	9.97591
.34	9.52308	9.54868	0.45132	9.97440
.35	9.53516	9.56233	0.43767	9.97284
.36	9.54688	9.57565	0.42435	9.97123
.37	9.55825	9.58868	0.41132	9.96957
.38	9.56928	9.60142	0.39858	9.96786
.39	9.58000	9.61390	0.38610	9.96610
.40	9.59042	9.62613	0.37387	9.96429
.41	9.60055	9.63812	0.36188	9.96243
.42	9.61041	9.64989	0.35011	9.96051
.43	9.62000	9.66145	0.33855	9.95855
.44	9.62935	9.67282	0.32718	9.95653
.45	9.63845	9.68400	0.31600	9.95446
.46	9.64733	9.69500	0.30500	9.95233
.47	9.65599	9.70583	0.29417	9.95015
.48	9.66443	9.71651	0.28349	9.94792
.49	9.67268	9.72704	0.27296	9.94563
.50	9.68072	9.73743	0.26257	9.94329
Rad.	L. Sin	L. Tan	L. Cot	L. Cos

Rad.	L. Sin	L. Tan	L. Cot	L. Cos
.50	9.68072	9.73743	0.26257	9.94329
.51	9.68858	9.74769	0.25231	9.94089
.52	9.69625	9.75782	0.24218	9.93843
.53	9.70375	9.76784	0.23216	9.93591
.54	9.71108	9.77774	0.22226	9.93334
.55	9.71824	9.78754	0.21246	9.93071
.56	9.72525	9.79723	0.20277	9.92801
.57	9.73210	9.80684	0.19316	9.92526
.58	9.73880	9.81635	0.18365	9.92245
.59	9.74536	9.82579	0.17421	9.91957
.60	9.75177	9.83514	0.16486	9.91663
.61	9.75805	9.84443	0.15557	9.91363
.62	9.76420	9.85364	0.14636	9.91056
.63	9.77022	9.86280	0.13720	9.90743
.64	9.77612	9.87189	0.12811	9.90423
.65	9.78189	9.88093	0.11907	9.90096
.66	9.78754	9.88992	0.11008	9.89762
.67	9.79308	9.89886	0.10114	9.89422
.68	9.79851	9.90777	0.09223	9.89074
.69	9.80382	9.91663	0.08337	9.88719
.70	9.80903	9.92546	0.07454	9.88357
.71	9.81414	9.93426	0.06574	9.87988
.72	9.81914	9.94303	0.05697	9.87611
.73	9.82404	9.95178	0.04822	9.87226
.74	9.82885	9.96051	0.03949	9.86833
.75	9.83355	9.96923	0.03077	9.86433
.76	9.83817	9.97793	0.02207	9.86024
.77	9.84269	9.98662	0.01338	9.85607
.78	9.84713	9.99531	0.00469	9.85182
.79	9.85147	0.00400	9.99600	9.84748
.80	9.85573	0.01268	9.98732	9.84306
.81	9.85991	0.02138	9.97862	9.83853
.82	9.86400	0.03008	9.96992	9.83393
.83	9.86802	0.03879	9.96121	9.82922
.84	9.87195	0.04752	9.95248	9.82443
.85	9.87580	0.05627	9.94373	9.81953
.86	9.87958	0.06504	9.93496	9.81454
.87	9.88328	0.07384	9.92616	9.80944
.88	9.88691	0.08266	9.91734	9.80424
.89	9.89046	0.09153	9.90847	9.79894
.90	9.89394	0.10043	9.89957	9.79352
.91	9.89735	0.10937	9.89063	9.78799
.92	9.90070	0.11835	9.88165	9.78234
.93	9.90397	0.12739	9.87261	9.77658
.94	9.90717	0.13648	9.86352	9 77070
.95	9.91031	0.14563	9.85437	9.76469
.96	9.91339	0.15484	9.84516	9.75855
.97	9.91639	0.16412	9.83588	9.75228
.98	9.91934	0.17347	9.82653	9.74587
.99	9.92222	0.18289	9.81711	9.73933
1.00	9.92504	0.19240	9.80760	9.73264
Rad.	L. Sin	L. Tan	L. Cot	L. Cos

Rad.	L. Sin	L. Tan	L. Cot	L. Cos
1.00	9.92504	0.19240	9.80760	9.73264
1.01	9.92780	0.20200	9.79800	9.72580
1.02	9.93049	0.21169	9.78831	9.71881
1.03	9.93313	0.22148	9.77852	9.71165
1.04	9.93571	0.23137	9.76863	9.70434
1.05	9.93823	0.24138	9.75862	9.69686
1.06	9.94069	0.25150	9.74850	9.68920
1.07	9.94310	0.26175	9.73825	9.68135
1.08	9.94545	0.27212	9.72788	9.67332
1.09	9.94774	0.28264	9.71736	9.66510
1.10	9.94998	0.29331	9.70669	9.65667
1.11	9.95216	0.30413	9.69587	9.64803
1.12	9.95429	0.31512	9.68488	9.63917
1.13	9.95637	0.32628	9.67372	9.63008
1.14	9.95839	0.33763	9.66237	9.62075
1.15	9.96036	0.34918	9.65082	9.61118
1.16	9.96228	0.36093	9.63907	9.60134
1.17	9.96414	0.37291	9.62709	9,59123
1.18	9.96596	0.38512	9.61488	9.58084
1.19	9.96772	0.39757	9.60243	9.57015
1.20	9.96943	0.41030	9.58970	9.55914
1.21	9.97110	0.42330	9.57670	9.54780
1.22	9.97271	0.43660	9.56340	9.53611
1.23	9.97428	0.45022	9.54978	9.52406
1.24	9.97579	0.46418	9.53582	9.51161
1.25	9.97726	0.47850	9.52150	9.49875
1.26	9.97868	0.49322	9.50678	9.48546
1.27	9.98005	0.50835	9.49165	9.47170
1.28	9.98137	0.52392	9.47608	9.45745
1.29	9.98265	0.53998	9.46002	9.44267
1.30	9.98388	0.55656	9.44344	9.42732
1.31	9.98506	0.57369	9.42631	9.41137
1.32	9.98620	0.59144	9.40856	9.39476
1.33	9.98729	0.60984	9.39016	9.37744
1.34	9.98833	0.62896	9.37104	9.35937
1.35	9.98933	0.64887	9.35113	9.34046
1.36	9.99028	0.66964	9.33036	9.32064
1.37	9.99119	0.69135	9.30865	9.29983
1.38	9.99205	0.71411	9.28589	9.27793
1.39	9.99286	0.73804	9.26196	9.25482
1.40	9.99363	0.76327	9.23673	9.23036
1.41	9.99436	0.78996	9.21004	9.20440
1.42	9.99504	0.81830	9.18170	9.17674
1.43	9.99568	0.84853	9.15147	9.14716
1.44	9.99627	0.88092	9.11908	9.11536
1.45	9.99682	0.91583	9.08417	9.08100
1.46	9.99733	0.95369	9.04631	9.04364
1.47	9.99779	0.99508	9.00492	9.00271
1.48	9.99821	1.04074	8.95926	8.95747
1.49	9.99858	1.09166	8.90834	8.90692
1.50	9.99891	1.14926	8.85074	8.84965
Rad.	L. Sin	L. Tan	L. Cot	L. Cos

Rad.	L. Sin	L. Tan	L. Cot	L. Cos
1.50	9.99891	1.14926	8.85074	8.84965
1.51	9.99920	1.21559	8.78441	8.78361
1.52	9.99944	1.29379	8.70621	8.70565
1.53	9.99964	1.38914	8.61086	8.61050
1.54	9.99979	1.51136	8.48864	8.48843
1.55	9.99991	1.68195	8.31805	8.31796
1.56	9.99997	1.96671	8.03329	8.03327
1.57	0.00000	3.09891	6.90109	6.90109
1.58	9.99998	2.03603*	7.96397*	7.96396*
1.59	9.99992	1.71656	8.28344	8.28336
1.60	9.99981	1.53444	8.46556	8.46538
1.61	9.99967	1.40645	8.59355	8.59323
1.62	9.99947	1.30765	8.69235	8.69182
1.63	9.99924	1.22714	8.77286	8.77209
1.64	9.99896	1.15918	8.84082	8.83978
1.65	9.99864	1.10035	8.89965	8.89829
1.66	9.99827	1.04847	8.95154	8.94981
1.67	9.99786	1.00204	8.99796	8.99582
1.68	9.99741	0.96003	9.03997	9.03737
1.69	9.99691	0.92165	9.07835	9.07526
1.70	9.99636	0.88630	9.11370	9.11007
1.71	9.99578	0.85353	9.14647	9.14225
1.72	9.99515	0.82298	9.17702	9.17217
1.73	9.99447	0.79436	9.20564	9.20012
1.74	9.99375	0.76742	9.23258	9.22634
1.75	9.99299	0.74197	9.25803	9.25102
1.76	9.99218	0.71784	9.28216	9.27434
1.77	9.99133	0.69490	9.30510	9.29642
1.78	9.99043	0.67303	9.32697	9.31740
1.79	9.98948	0.65212	9.34788	9.33736
1.80	9.98849	0.63208	9.36792	9.35641
1.81	9.98745	0.61284	9.38716	9.37462
1.82	9.98637	0.59432	9.40568	9.39205
1.83	9.98524	0.57648	9.42352	9.40877
1.84	9.98407	0.55925	9.44075	9.42482
1.85	9.98285	0.54258	9.45742	9.44026
1.86	9.98158	0.52645	9.47355	9.45513
1.87	9.98026	0.51080	9.48920	9.46947
1.88	9.97890	0.49560	9.50440	9.48330
1.89	9.97749	0.48082	9.51918	9.49667
1.90	9.97603	0.46644	9.53356	9.50959
1.91	9.97452	0.45242	9.54758	9.52210
1.92	9.97296	0.43875	9.56125	9.53422
1.93	9.97136	0.42540	9.57460	9.54597
1.94	9.96970	0.41235	9.58765	9.55735
1.95	9.96800	0.39958	9.60042	9.56841
1.96	9.96624	0.38708	9.61292	9.57916
1.97	9.96443	0.37484	9.62516	9.58960
1.98	9.96258	0.36283	9.63717	9.59975
1.99	9.96067	0.35104	9.64896	9.60963
2.00	9.95871	0.33946	9.66054	9.61925
Rad.	L. Sin	L. Tan	L. Cot	L. Cos

* Values of the cosine, tangent and cotangent for angles in the table, 1.58 radians and above, are negative.

HAVERSINES

The following table gives the values of the haversines and their logarithms for angles from 0 to 180° at 10 minute intervals. Characteristics of the logarithms are omitted.

°	0′ Value	0′ Log	10′ Value	10′ Log	20′ Value	20′ Log	30′ Value	30′ Log	40′ Value	40′ Log	50′ Value	50′ Log
0	.0000	—	.0000	$\bar{6}$.3254	.0000	$\bar{6}$.9275	.0000	$\bar{5}$.2796	.0000	$\bar{5}$.5295	.0001	$\bar{5}$.7233
1	.0001	$\bar{5}$.8817	.0001	.0156	.0001	.1316	.0002	.2339	.0002	.3254	.0003	.4081
2	.0003	.4837	.0004	.5532	.0004	.6176	.0005	.6775	.0005	.7336	.0006	.7862
3	.0007	.8358	.0008	.8828	.0008	.9273	.0009	.9697	.0010	.0101	.0011	.0487
4	.0012	.0856	.0013	.1211	.0014	.1551	.0015	.1879	.0017	.2195	.0018	.2499
5	.0019	.2794	.0020	.3078	.0022	.3354	.0023	.3621	.0024	.3880	.0026	.4132
6	.0027	.4376	.0029	.4614	.0031	.4845	.0032	.5071	.0034	.5290	.0036	.5504
7	.0037	.5714	.0039	.5918	.0041	.6117	.0043	.6312	.0045	.6503	.0047	.6689
8	.0049	.6872	.0051	.7051	.0053	.7226	.0055	.7397	.0057	.7566	.0059	.7731
9	.0062	.7893	.0064	.8052	.0066	.8208	.0069	.8361	.0071	.8512	.0073	.8660
10	.0076	.8806	.0079	.8949	.0081	.9090	.0084	.9229	.0086	.9365	.0089	.9499
11	.0092	.9631	.0095	.9762	.0097	.9890	.0100	.0016	.0103	.0141	.0106	.0264
12	.0109	.0385	.0112	.0504	.0115	.0622	.0119	.0738	.0122	.0852	.0125	.0966
13	.0128	.1077	.0131	.1187	.0135	.1296	.0138	.1404	.0142	.1510	.0145	.1614
14	.0149	.1718	.0152	.1820	.0156	.1921	.0159	.2021	.0163	.2120	.0167	.221[illegible]
15	.0170	.2314	.0174	.2409	.0178	.2504	.0182	.2597	.0186	.2689	.0190	.278[illegible]
16	.0194	.2871	.0198	.2961	.0202	.3049	.0206	.3137	.0210	.3223	.0214	.3309
17	.0218	.3394	.0223	.3478	.0227	.3561	.0231	.3644	.0236	.3726	.0240	.3807
18	.0245	.3887	.0249	.3966	.0254	.4045	.0258	.4123	.0263	.4200	.0268	.4276
19	.0272	.4352	.0277	.4427	.0282	.4502	.0287	.4576	.0292	.4649	.0297	.4721
20	.0302	.4793	.0307	.4865	.0312	.4935	.0317	.5006	.0322	.5075	.0327	.5144
21	.0332	.5213	.0337	.5281	.0343	.5348	.0348	.5415	.0353	.5481	.0359	.5547
22	.0364	.5612	.0370	.5677	.0375	.5741	.0381	.5805	.0386	.5868	.0392	.5931
23	.0397	.5993	.0403	.6055	.0409	.6116	.0415	.6177	.0421	.6238	.0426	.6298
24	.0432	.6358	.0438	.6417	.0444	.6476	.0450	.6534	.0456	.6592	.0462	.6650
25	.0468	.6707	.0475	.6764	.0481	.6820	.0487	.6876	.0493	.6932	.0500	.6987
26	.0506	.7042	.0512	.7096	.0519	.7150	.0525	.7204	.0532	.7258	.0538	.7311
27	.0545	.7364	.0552	.7416	.0558	.7468	.0565	.7520	.0572	.7572	.0578	.7623
28	.0585	.7674	.0592	.7724	.0599	.7774	.0606	.7824	.0613	.7874	.0620	.7923
29	.0627	.7972	.0634	.8021	.0641	.8069	.0648	.8117	.0655	.8165	.0663	.8213
30	.0670	.8260	.0677	.8307	.0684	.8354	.0692	.8400	.0699	.8446	.0707	.8492
31	.0714	.8538	.0722	.8583	.0729	.8629	.0737	.8673	.0744	.8718	.0752	.8763
32	.0760	.8807	.0767	.8851	.0775	.8894	.0783	.8938	.0791	.8981	.0799	.9024
33	.0807	.9067	.0815	.9109	.0823	.9152	.0831	.9194	.0839	.9236	.0847	.9277
34	.0855	.9319	.0863	.9360	.0871	.9401	.0879	.9442	.0888	.9482	.0896	.9523
35	.0904	.9563	.0913	.9603	.0921	.9643	.0929	.9682	.0938	.9721	.0946	.9761
36	.0955	.9800	.0963	.9838	.0972	.9877	.0981	.9915	.0989	.9954	.0998	.9992
37	.1007	.0030	.1016	.0067	.1024	.0105	.1033	.0142	.1042	.0179	.1051	.0216
38	.1060	.0253	.1069	.0289	.1078	.0326	.1087	.0362	.1096	.0398	.1105	.0434
39	.1114	.0470	.1123	.0505	.1133	.0541	.1142	.0576	.1151	.0611	.1160	.0646
40	.1170	.0681	.1179	.0716	.1189	.0750	.1198	.0784	.1207	.0819	.1217	.0853
41	.1226	.0887	.1236	.0920	.1246	.0954	.1255	.0987	.1265	.1020	.1275	.1054
42	.1284	.1087	.1294	.1119	.1304	.1152	.1314	.1185	.1323	.1217	.1333	.1249
43	.1343	.1282	.1353	.1314	.1363	.1345	.1373	.1377	.1383	.1409	.1393	.1440
44	.1403	.1472	.1413	.1503	.1424	.1534	.1434	.1565	.1444	.1596	.1454	.1626
45	.1464	.1657	.1475	.1687	.1485	.1718	.1495	.1748	.1506	.1778	.1516	.1808
46	.1527	.1838	.1537	.1867	.1548	.1897	.1558	.1926	.1569	.1956	.1579	.1985
47	.1590	.2014	.1601	.2043	.1611	.2072	.1622	.2101	.1633	.2129	.1644	.2158
48	.1654	.2186	.1665	.2215	.1676	.2243	.1687	.2271	.1698	.2299	.1709	.2327
49	.1720	.2355	.1731	.2382	.1742	.2410	.1753	.2437	.1764	.2465	.1775	.2492
50	.1786	.2519	.1797	.2546	.1808	.2573	.1820	.2600	.1831	.2627	.1842	.2653
51	.1853	.2680	.1865	.2706	.1876	.2732	.1887	.2759	.1899	.2785	.1910	.2811
52	.1922	.2837	.1933	.2863	.1945	.2888	.1956	.2914	.1968	.2940	.1979	.2965
53	.1991	.2991	.2003	.3016	.2014	.3041	.2026	.3066	.2038	.3091	.2049	.3116
54	.2061	.3141	.2073	.3166	.2085	.3190	.2096	.3215	.2108	.3239	.2120	.3264
55	.2132	.3288	.2144	.3312	.2156	.3336	.2168	.3361	.2180	.3384	.2192	.3408
56	.2204	.3432	.2216	.3456	.2228	.3480	.2240	.3503	.2252	.3527	.2265	.3550
57	.2277	.3573	.2289	.3596	.2301	.3620	.2314	.3643	.2326	.3666	.2338	.3689
58	.2350	.3711	.2363	.3734	.2375	.3757	.2388	.3779	.2400	.3802	.2412	.3824
59	.2425	.3847	.2437	.3869	.2450	.3891	.2462	.3913	.2475	.3935	.2487	.3957

HAVERSINES (Continued)

Characteristics of the logarithms are omitted.

°	0′ Value	0′ Log	10′ Value	10′ Log	20′ Value	20′ Log	30′ Value	30′ Log	40′ Value	40′ Log	50′ Value	50′ Log
60	.2500	.3979	.2513	.4001	.2525	.4023	.2538	.4045	.2551	.4066	.2563	.4088
61	.2576	.4109	.2589	.4131	.2601	.4152	.2614	.4173	.2627	.4195	.2640	.4216
62	.2653	.4237	.2665	.4258	.2678	.4279	.2691	.4300	.2704	.4320	.2717	.4341
63	.2730	.4362	.2743	.4382	.2756	.4403	.2769	.4423	.2782	.4444	.2795	.4464
64	.2808	.4484	.2821	.4504	.2834	.4524	.2847	.4545	.2861	.4565	.2874	.4584
65	.2887	.4604	.2900	.4624	.2913	.4644	.2927	.4664	.2940	.4683	.2953	.4703
66	.2966	.4722	.2980	.4742	.2993	.4761	.3006	.4780	.3020	.4799	.3033	.4819
67	.3046	.4838	.3060	.4857	.3073	.4876	.3087	.4895	.3100	.4914	.3113	.4932
68	.3127	.4951	.3140	.4970	.3154	.4989	.3167	.5007	.3181	.5026	.3195	.5044
69	.3208	.5063	.3222	.5081	.3235	.5099	.3249	.5117	.3263	.5136	.3276	.5154
70	.3290	.5172	.3304	.5190	.3317	.5208	.3331	.5226	.3345	.5244	.3358	.5261
71	.3372	.5279	.3386	.5297	.3400	.5314	.3413	.5332	.3427	.5349	.3441	.5367
72	.3455	.5384	.3469	.5402	.3483	.5419	.3496	.5436	.3510	.5454	.3524	.5471
73	.3538	.5488	.3552	.5505	.3566	.5522	.3580	.5539	.3594	.5556	.3608	.5572
74	.3622	.5589	.3636	.5606	.3650	.5623	.3664	.5639	.3678	.5656	.3692	.5672
75	.3706	.5689	.3720	.5705	.3734	.5722	.3748	.5738	.3762	.5754	.3776	.5771
76	.3790	.5787	.3805	.5803	.3819	.5819	.3833	.5835	.3847	.5851	.3861	.5867
77	.3875	.5883	.3889	.5899	.3904	.5915	.3918	.5930	.3932	.5946	.3946	.5962
78	.3960	.5977	.3975	.5993	.3989	.6009	.4003	.6024	.4017	.6039	.4032	.6055
79	.4046	.6070	.4060	.6086	.4075	.6101	.4089	.6116	.4103	.6131	.4117	.6146
80	.4132	.6161	.4146	.6176	.4160	.6191	.4175	.6206	.4189	.6221	.4203	.6236
81	.4218	.6251	.4232	.6266	.4247	.6280	.4261	.6295	.4275	.6310	.4290	.6324
82	.4304	.6339	.4319	.6353	.4333	.6368	.4347	.6382	.4362	.6397	.4376	.6411
83	.4391	.6425	.4405	.6440	.4420	.6454	.4434	.6468	.4448	.6482	.4463	.6496
84	.4477	.6510	.4492	.6524	.4506	.6538	.4521	.6552	.4535	.6566	.4550	.6580
85	.4564	.6594	.4579	.6607	.4593	.6621	.4608	.6635	.4622	.6648	.4637	.6662
86	.4651	.6676	.4666	.6689	.4680	.6703	.4695	.6716	.4709	.6730	.4724	.6743
87	.4738	.6756	.4753	.6770	.4767	.6783	.4782	.6796	.4796	.6809	.4811	.6822
88	.4826	.6835	.4840	.6848	.4855	.6862	.4869	.6875	.4884	.6887	.4898	.6900
89	.4913	.6913	.4927	.6926	.4942	.6939	.4956	.6952	.4971	.6964	.4985	.6977
90	.5000	.6990	.5015	.7002	.5029	.7015	.5044	.7027	.5058	.7040	.5073	.7052
91	.5087	.7065	.5102	.7077	.5116	.7090	.5131	.7102	.5145	.7114	.5160	.7126
92	.5174	.7139	.5189	.7151	.5204	.7163	.5218	.7175	.5233	.7187	.5247	.7199
93	.5232	.7211	.5276	.7223	.5291	.7235	.5305	.7247	.5320	.7259	.5334	.7271
94	.5349	.7283	.5363	.7294	.5378	.7306	.5392	.7318	.5407	.7329	.5421	.7341
95	.5436	.7353	.5450	.7364	.5465	.7376	.5479	.7387	.5494	.7399	.5508	.7410
96	.5523	.7421	.5537	.7433	.5552	.7444	.5566	.7455	.5580	.7467	.5595	.7478
97	.5609	.7489	.5624	.7500	.5638	.7511	.5653	.7523	.5667	.7534	.5681	.7545
98	.5696	.7556	.5710	.7567	.5725	.7577	.5739	.7588	.5753	.7599	.5768	.7610
99	.5782	.7621	.5797	.7632	.5811	.7642	.5825	.7653	.5840	.7664	.5854	.7674
100	.5868	.7685	.5883	.7696	.5897	.7706	.5911	.7717	.5925	.7727	.5940	.7738
101	.5954	.7748	.5968	.7759	.5983	.7769	.5997	.7779	.6011	.7790	.6025	.7800
102	.6040	.7810	.6054	.7820	.6068	.7830	.6082	.7841	.6096	.7851	.6111	.7861
103	.6125	.7871	.6139	.7881	.6153	.7891	.6167	.7901	.6181	.7911	.6195	.7921
104	.6210	.7931	.6224	.7940	.6238	.7950	.6252	.7960	.6266	.7970	.6280	.7980
105	.6294	.7989	.6308	.7999	.6322	.8009	.6336	.8018	.6350	.8028	.6364	.8037
106	.6378	.8047	.6392	.8056	.6406	.8066	.6420	.8075	.6434	.8085	.6448	.8094
107	.6462	.8104	.6476	.8113	.6490	.8122	.6504	.8131	.6517	.8141	.6531	.8150
108	.6545	.8159	.6559	.8168	.6573	.8177	.6587	.8187	.6600	.8196	.6614	.8205
109	.6628	.8214	.6642	.8223	.6655	.8232	.6669	.8241	.6683	.8250	.6696	.8258
110	.6710	.8267	.6724	.8276	.6737	.8285	.6751	.8294	.6765	.8302	.6778	.8311
111	.6792	.8320	.6805	.8329	.6819	.8337	.6833	.8346	.6846	.8354	.6860	.8363
112	.6873	.8371	.6887	.8380	.6900	.8388	.6913	.8397	.6927	.8405	.6940	.8414
113	.6954	.8422	.6967	.8430	.6980	.8439	.6994	.8447	.7007	.8455	.7020	.8464
114	.7034	.8472	.7047	.8480	.7060	.8488	.7073	.8496	.7087	.8504	.7100	.8513
115	.7113	.8521	.7126	.8529	.7139	.8537	.7153	.8545	.7166	.8553	.7179	.8561
116	.7192	.8568	.7205	.8576	.7218	.8584	.7231	.8592	.7244	.8600	.7257	.8608
117	.7270	.8615	.7283	.8623	.7296	.8631	.7309	.8638	.7322	.8646	.7335	.8654
118	.7347	.8661	.7360	.8669	.7373	.8676	.7386	.8684	.7399	.8691	.7411	.8699
119	.7424	.8706	.7437	.8714	.7449	.8721	.7462	.8929	.7475	.8736	.7487	.8743

HAVERSINES (Continued)

Characteristics of the logarithms are omitted.

°	0′ Value	0′ Log	10′ Value	10′ Log	20′ Value	20′ Log	30′ Value	30′ Log	40′ Value	40′ Log	50′ Value	50′ Log
120	.7500	.8751	.7513	.8758	.7525	.8765	.7538	.8772	.7550	.8780	.7563	.8787
121	.7575	.8794	.7588	.8801	.7600	.8808	.7612	.8815	.7625	.8822	.7637	.8829
122	.7650	.8836	.7662	.8843	.7674	.8850	.7686	.8857	.7699	.8864	.7711	.8871
123	.7723	.8878	.7735	.8885	.7748	.8892	.7760	.8898	.7772	.8905	.7784	.8912
124	.7796	.8919	.7808	.8925	.7820	.8932	.7832	.8939	.7844	.8945	.7856	.8952
125	.7868	.8959	.7880	.8965	.7892	.8972	.7904	.8978	.7915	.8985	.7927	.8991
126	.7939	.8998	.7951	.9004	.7962	.9010	.7974	.9017	.7986	.9023	.7997	.9030
127	.8009	.9036	.8021	.9042	.8032	.9048	.8044	.9055	.8055	.9061	.8067	.9067
128	.8078	.9073	.8090	.9079	.8101	.9085	.8113	.9092	.8124	.9098	.8135	.9104
129	.8147	.9110	.8158	.9116	.8169	.9122	.8180	.9128	.8192	.9134	.8203	.9140
130	.8214	.9146	.8225	.9151	.8236	.9157	.8247	.9163	.8258	.9169	.8269	.9175
131	.8280	.9180	.8291	.9186	.8302	.9192	.8313	.9198	.8324	.9203	.8335	.9209
132	.8346	.9215	.8356	.9220	.8367	.9226	.8378	.9231	.8389	.9237	.8399	.9242
133	.8410	.9248	.8421	.9253	.8431	.9259	.8442	.9264	.8452	.9270	.8463	.9275
134	.8473	.9281	.8484	.9286	.8494	.9291	.8505	.9297	.8515	.9302	.8525	.9307
135	.8536	.9312	.8546	.9318	.8556	.9323	.8566	.9328	.8576	.9333	.8587	.9338
136	.8597	.9343	.8607	.9348	.8617	.9353	.8627	.9359	.8637	.9364	.8647	.9369
137	.8657	.9374	.8667	.9379	.8677	.9383	.8686	.9388	.8696	.9393	.8706	.9398
138	.8716	.9403	.8725	.9408	.8735	.9413	.8745	.9417	.8754	.9422	.8764	.9427
139	.8774	.9432	.8783	.9436	.8793	.9441	.8802	.9446	.8811	.9450	.8821	.9455
140	.8830	.9460	.8840	.9464	.8849	.9469	.8858	.9473	.8867	.9478	.8877	.9482
141	.8886	.9487	.8895	.9491	.8904	.9496	.8913	.9500	.8922	.9505	.8931	.9509
142	.8940	.9513	.8949	.9518	.8958	.9522	.8967	.9526	.8976	.9531	.8984	.9535
143	.8993	.9539	.9002	.9543	.9011	.9548	.9019	.9552	.9028	.9556	.9037	.9560
144	.9045	.9564	.9054	.9568	.9062	.9572	.9071	.9576	.9079	.9580	.9087	.9584
145	.9096	.9588	.9104	.9592	.9112	.9596	.9121	.9600	.9129	.9604	.9137	.9608
146	.9145	.9612	.9153	.9616	.9161	.9620	.9169	.9623	.9177	.9627	.9185	.9631
147	.9193	.9635	.9201	.9638	.9209	.9642	.9217	.9646	.9225	.9650	.9233	.9653
148	.9240	.9657	.9248	.9660	.9256	.9664	.9263	.9668	.9271	.9671	.9278	.9675
149	.9286	.9678	.9293	.9682	.9301	.9685	.9308	.9689	.9316	.9692	.9323	.9695
150	.9330	.9699	.9337	.9702	.9345	.9706	.9352	.9709	.9359	.9712	.9366	.9716
151	.9373	.9719	.9380	.9722	.9387	.9725	.9394	.9729	.9401	.9732	.9408	.9735
152	.9415	.9738	.9422	.9741	.9428	.9744	.9435	.9747	.9442	.9751	.9448	.9754
153	.9455	.9757	.9462	.9760	.9468	.9763	.9475	.9766	.9481	.9769	.9488	.9772
154	.9494	.9774	.9500	.9777	.9507	.9780	.9513	.9783	.9519	.9786	.9525	.9789
155	.9532	.9792	.9538	.9794	.9544	.9797	.9550	.9800	.9556	.9803	.9562	.9805
156	.9568	.9808	.9574	.9811	.9579	.9813	.9585	.9816	.9591	.9819	.9597	.9821
157	.9603	.9824	.9608	.9826	.9614	.9829	.9619	.9831	.9625	.9834	.9630	.9836
158	.9636	.9839	.9641	.9841	.9647	.9844	.9652	.9846	.9657	.9849	.9663	.9851
159	.9668	.9853	.9673	.9856	.9678	.9858	.9683	.9860	.9688	.9863	.9693	.9865
160	.9698	.9867	.9703	.9869	.9708	.9871	.9713	.9874	.9718	.9876	.9723	.9878
161	.9728	.9880	.9732	.9882	.9737	.9884	.9742	.9886	.9746	.9888	.9751	.9890
162	.9755	.9892	.9760	.9894	.9764	.9896	.9769	.9898	.9773	.9900	.9777	.9902
163	.9782	.9904	.9786	.9906	.9790	.9908	.9794	.9910	.9798	.9911	.9802	.9913
164	.9806	.9915	.9810	.9917	.9814	.9919	.9818	.9920	.9822	.9922	.9826	.9924
165	.9830	.9925	.9833	.9927	.9837	.9929	.9841	.9930	.9844	.9932	.9848	.9933
166	.9851	.9935	.9855	.9937	.9858	.9938	.9862	.9940	.9865	.9941	.9869	.9943
167	.9872	.9944	.9875	.9945	.9878	.9947	.9881	.9948	.9885	.9950	.9888	.9951
168	.9891	.9952	.9894	.9954	.9897	.9955	.9900	.9956	.9903	.9957	.9905	.9959
169	.9908	.9960	.9911	.9961	.9914	.9962	.9916	.9963	.9919	.9965	.9921	.9966
170	.9924	.9967	.9927	.9968	.9929	.9969	.9931	.9970	.9934	.9971	.9936	.9972
171	.9938	.9973	.9941	.9974	.9943	.9975	.9945	.9976	.9947	.9977	.9949	.9978
172	.9951	.9979	.9953	.9980	.9955	.9981	.9957	.9981	.9959	.9982	.9961	.9983
173	.9963	.9984	.9964	.9985	.9966	.9985	.9968	.9986	.9969	.9987	.9971	.9987
174	.9973	.9988	.9974	.9989	.9976	.9989	.9977	.9990	.9978	.9991	.9980	.9991
175	.9981	.9992	.9982	.9992	.9983	.9993	.9985	.9993	.9986	.9994	.9987	.9994
176	.9988	.9995	.9989	.9995	.9990	.9996	.9991	.9996	.9992	.9996	.9992	.9997
177	.9993	.9997	.9994	.9997	.9995	.9998	.9995	.9998	.9996	.9998	.9996	.9998
178	.9997	.9999	.9997	.9999	.9998	.9999	.9998	.9999	.9999	.9999	.9999	.9999
179	.9999	.9999	.9999	.9999	1.0000	.0000	1.0000	.0000	1.0000	.0000	1.0000	.0000
180	1.0000	.0000										

NATURAL OR NAPERIAN LOGARITHMS

To find the natural logarithm of a number which is 1/10 or 10 times a number whose logarithm is given, subtract from or add to the given logarithm the logarithm of 10.

A 0.00–0.99

-10 should be appended to each logarithm

N	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		5.395	6.088	6.493	6.781	7.004	7.187	7.341	7.474	7.592
0.1	7.697	7.793	7.880	7.960	8.034	8.103	8.167	8.228	8.285	8.339
0.2	8.391	8.439	8.486	8.530	8.573	8.614	8.653	8.691	8.727	8.762
0.3	8.796	8.829	8.861	8.891	8.921	8.950	8.978	9.006	9.032	9.058
0.4	9.084	9.108	9.132	9.156	9.179	9.201	9.223	9.245	9.266	9.287
0.5	9.307	9.327	9.346	9.365	9.384	9.402	9.420	9.438	9.455	9.472
0.6	9.489	9.506	9.522	9.538	9.554	9.569	9.584	9.600	9.614	9.629
0.7	9.643	9.658	9.671	9.685	9.699	9.712	9.726	9.739	9.752	9.764
0.8	9.777	9.789	9.802	9.814	9.826	9.837	9.849	9.861	9.872	9.883
0.9	9.895	9.906	9.917	9.927	9.938	9.949	9.959	9.970	9.980	9.990

B 1.00–10.09

N		.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
1.0	0.0	0000	0995	1980	2956	3922	4879	5827	6766	7696	8618
1.1		9531	*0436	*1333	*2222	*3103	*3976	*4842	*5700	*6551	*7395
1.2	0.1	8232	9062	9885	*0701	*1511	*2314	*3111	*3902	*4686	*5464
1.3	0.2	6236	7003	7763	8518	9267	*0010	*0748	*1481	*2208	*2930
1.4	0.3	3647	4359	5066	5767	6464	7156	7844	8526	9204	9878
1.5	0.4	0547	1211	1871	2527	3178	3825	4469	5108	5742	6373
1.6		7000	7623	8243	8858	9470	*0078	*0682	*1282	*1879	*2473
1.7	0.5	3063	3649	4232	4812	5389	5962	6531	7098	7661	8222
1.8		8779	9333	9884	*0432	*0977	*1519	*2058	*2594	*3127	*3658
1.9	0.6	4185	4710	5233	5752	6269	6783	7294	7803	8310	8813
2.0		9315	9813	*0310	*0804	*1295	*1784	*2271	*2755	*3237	*3716
2.1	0.7	4194	4669	5142	5612	6081	6547	7011	7473	7932	8390
2.2		8846	9299	9751	*0200	*0648	*1093	*1536	*1978	*2418	*2855
2.3	0.8	3291	3725	4157	4587	5015	5442	5866	6289	6710	7129
2.4		7547	7963	8377	8789	9200	9609	*0016	*0422	*0826	*1228
2.5	0.9	1629	2028	2426	2822	3216	3609	4001	4391	4779	5166
2.6		5551	5935	6317	6698	7078	7456	7833	8208	8582	8954
2.7		9325	9695	*0063	*0430	*0796	*1160	*1523	*1885	*2245	*2604
2.8	1.0	2962	3318	3674	4028	4380	4732	5082	5431	5779	6126
2.9		6471	6815	7158	7500	7841	8181	8519	8856	9192	9527
3.0		9861	*0194	*0526	*0856	*1186	*1514	*1841	*2168	*2493	*2817
3.1	1.1	3140	3462	3783	4103	4422	4740	5057	5373	5688	6002
3.2		6315	6627	6938	7248	7557	7865	8173	8479	8784	9089
3.3		9392	9695	9996	*0297	*0597	*0896	*1194	*1491	*1788	*2083
3.4	1.2	2378	2671	2964	3256	3547	3837	4127	4415	4703	4990
3.5		5276	5562	5846	6130	6413	6695	6976	7257	7536	7815
3.6		8093	8371	8647	8923	9198	9473	9746	*0019	*0291	*0563
3.7	1.3	0833	1103	1372	1641	1909	2176	2442	2708	2972	3237
3.8		3500	3763	4025	4286	4547	4807	5067	5325	5584	5841
3.9		6098	6354	6609	6864	7118	7372	7624	7877	8128	8379
4.0		8629	8879	9128	9377	9624	9872	*0118	*0364	*0610	*0854
4.1	1.4	1099	1342	1585	1828	2070	2311	2552	2792	3031	3270
4.2		3508	3746	3984	4220	4456	4692	4927	5161	5395	5629
4.3		5862	6094	6326	6557	6787	7018	7247	7476	7705	7933
4.4		8160	8387	8614	8840	9065	9290	9515	9739	9962	0185
4.5	1.5	0408	0630	0851	1072	1293	1513	1732	1951	2170	2388
4.6		2606	2823	3039	3256	3471	3687	3902	4116	4330	4543
4.7		4756	4969	5181	5393	5604	5814	6025	6235	6444	6653
4.8		6862	7070	7277	7485	7691	7898	8104	8309	8515	8719
4.9		8924	9127	9331	9534	9737	9939	*0141	*0342	*0543	*0744
5.0	1.6	0944	1144	1343	1542	1741	1939	2137	2334	2531	2728
5.1		2924	3120	3315	3511	3705	3900	4094	4287	4481	4673
5.2		4866	5058	5250	5441	5632	5823	6013	6203	6393	6582
5.3		6771	6959	7147	7335	7523	7710	7896	8083	8269	8455
5.4		8640	8825	9010	9194	9378	9562	9745	9928	*0111	*0293

NATURAL LOGARITHMS

B 1.00-10.09 (Concluded)

N		.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
5.5	1.7	0475	0656	0838	1019	1199	1380	1560	1740	1919	2098
5.6		2277	2455	2633	2811	2988	3166	3342	3519	3695	3871
5.7		4047	4222	4397	4572	4746	4920	5094	5267	5440	5613
5.8		5786	5958	6130	6302	6473	6644	6815	6985	7156	7326
5.9		7495	7665	7834	8002	8171	8339	8507	8675	8842	9009
6.0		9176	9342	9509	9675	9840	*0006	*0171	*0336	*0500	*0665
6.1	1.8	0829	0993	1156	1319	1482	1645	1808	1970	2132	2294
6.2		2455	2616	2777	2938	3098	3258	3418	3578	3737	3896
6.3		4055	4214	4372	4530	4688	4845	5003	5160	5317	5473
6.4		5630	5786	5942	6097	6253	6408	6563	6718	6872	7026
6.5		7180	7334	7487	7641	7794	7947	8099	8251	8403	8555
6.6		8707	8858	9010	9160	9311	9462	9612	9762	9912	*0061
6.7	1.9	0211	0360	0509	0658	0806	0954	1102	1250	1398	1545
6.8		1692	1839	1986	2132	2279	2425	2571	2716	2862	3007
6.9		3152	3297	3442	3586	3730	3874	4018	4162	4305	4448
7.0		4591	4734	4876	5019	5161	5303	5445	5586	5727	5869
7.1		6009	6150	6291	6431	6571	6711	6851	6991	7130	7269
7.2		7408	7547	7685	7824	7962	8100	8238	8376	8513	8650
7.3		8787	8924	9061	9198	9334	9470	9606	9742	9877	*0013
7.4	2.0	0148	0283	0418	0553	0687	0821	0956	1089	1223	1357
7.5		1490	1624	1757	1890	2022	2155	2287	2419	2551	2683
7.6		2815	2946	3078	3209	3340	3471	3601	3732	3862	3992
7.7		4122	4252	4381	4511	4640	4769	4898	5027	5156	5284
7.8		5412	5540	5668	5796	5924	6051	6179	6306	6433	6560
7.9		6686	6813	6939	7065	7191	7317	7443	7568	7694	7819
8.0		7944	8069	8194	8318	8443	8567	8691	8815	8939	9063
8.1		9186	9310	9433	9556	9679	9802	9924	*0047	*0169	*0291
8.2	2.1	0413	0535	0657	0779	0900	1021	1142	1263	1384	1505
8.3		1626	1746	1866	1986	2106	2226	2346	2465	2585	2704
8.4		2823	2942	3061	3180	3298	3417	3535	3653	3771	3889
8.5		4007	4124	4242	4359	4476	4593	4710	4827	4943	5060
8.6		5176	5292	5409	5524	5640	5756	5871	5987	6102	6217
8.7		6332	6447	6562	6677	6791	6905	7020	7134	7248	7361
8.8		7475	7589	7702	7816	7929	8042	8155	8267	8380	8493
8.9		8605	8717	8830	8942	9054	9165	9277	9389	9500	9611
9.0		9722	9834	9944	*0055	*0166	*0276	*0387	*0497	*0607	*0717
9.1	2.2	0827	0937	1047	1157	1266	1375	1485	1594	1703	1812
9.2		1920	2029	2138	2246	2354	2462	2570	2678	2786	2894
9.3		3001	3109	3216	3324	3431	3538	3645	3751	3858	3965
9.4		4071	4177	4284	4390	4496	4601	4707	4813	4918	5024
9.5		5129	5234	5339	5444	5549	5654	5759	5863	5968	6072
9.6		6176	6280	6384	6488	6592	6696	6799	6903	7006	7109
9.7		7213	7316	7419	7521	7624	7727	7829	7932	8034	8136
9.8		8238	8340	8442	8544	8646	8747	8849	8950	9051	9152
9.9		9253	9354	9455	9556	9657	9757	9858	9958	*0058	*0158
10.0	2.3	0259	0358	0458	0558	0658	0757	0857	0956	1055	1154

C 10.0-99

N	0	1	2	3	4	5	6	7	8	9
1	2.30259	39790	48491	56495	63906	70805	77259	83321	89037	94444
2	99573	*04452	*09104	*13549	*17805	*21888	*25810	*29584	*33220	*36730
3	3.40120	43399	46574	49651	52636	55535	58352	61092	63759	66356
4	68888	71357	73767	76120	78419	80666	82864	85015	87120	89182
5	91202	93183	95124	97029	98898	*00733	*02535	*04305	*06044	*07754
6	4.09434	11087	12713	14313	15888	17439	18965	20469	21951	23411
7	24850	26268	27667	29046	30407	31749	33073	34381	35671	36945
8	38203	39445	40672	41884	43082	44265	45435	46591	47734	48864
9	49981	51086	52179	53260	54329	55388	56435	57471	58497	59512

NATURAL LOGARITHMS
D 100-1109

N	0	1	2	3	4	5	6	7	8	9
10	4.6 0517	1512	2497	3473	4439	5396	6344	7283	8213	9135
11	4.7 0048	0953	1850	2739	3620	4493	5359	6217	7068	7912
12	8749	9579	*0402	*1218	*2028	*2831	*3628	*4419	*5203	*5981
13	4.8 6753	7520	8280	9035	9784	*0527	*1265	*1998	*2725	*3447
14	4.9 4164	4876	5583	6284	6981	7673	8361	9043	9721	*0395
15	5.0 1064	1728	2388	3044	3695	4343	4986	5625	6260	6890
16	7517	8140	8760	9375	9987	*0595	*1199	*1799	*2396	*2990
17	5.1 3580	4166	4749	5329	5906	6479	7048	7615	8178	8739
18	9296	9850	*0401	*0949	*1494	*2036	*2575	*3111	*3644	*4175
19	5.2 4702	5227	5750	6269	6786	7300	7811	8320	8827	9330
20	9832	*0330	*0827	*1321	*1812	*2301	*2788	*3272	*3754	*4233
21	5.3 4711	5186	5659	6129	6598	7064	7528	7990	8450	8907
22	9363	9816	*0268	*0717	*1165	*1610	*2053	*2495	*2935	*3372
23	5.4 3808	4242	4674	5104	5532	5959	6383	6806	7227	7646
24	8064	8480	8894	9306	9717	*0126	*0533	*0939	*1343	*1745
25	5.5 2146	2545	2943	3339	3733	4126	4518	4908	5296	5683
26	6068	6452	6834	7215	7595	7973	8350	8725	9099	9471
27	9842	*0212	*0580	*0947	*1313	*1677	*2040	*2402	*2762	*3121
28	5.6 3479	3835	4191	4545	4897	5249	5599	5948	6296	6643
29	6988	7332	7675	8017	8358	8698	9036	9373	9709	*0044
30	5.7 0378	0711	1043	1373	1703	2031	2359	2685	3010	3334
31	3657	3979	4300	4620	4939	5257	5574	5890	6205	6519
32	6832	7144	7455	7765	8074	8383	8690	8996	9301	9606
33	9909	*0212	*0513	*0814	*1114	*1413	*1711	*2008	*2305	*2600
34	5.8 2895	3188	3481	3773	4064	4354	4644	4932	5220	5507
35	5793	6079	6363	6647	6930	7212	7493	7774	8053	8332
36	8610	8888	9164	9440	9715	9990	*0263	*0536	*0808	*1080
37	5.9 1350	1620	1889	2158	2426	2693	2959	3225	3489	3754
38	4017	4280	4542	4803	5064	5324	5584	5842	6101	6358
39	6615	6871	7126	7381	7635	7889	8141	8394	8645	8896
40	9146	9396	9645	9894	*0141	*0389	*0635	*0881	*1127	*1372
41	6.0 1616	1859	2102	2345	2587	2828	3069	3309	3548	3787
42	4025	4263	4501	4737	4973	5209	5444	5678	5912	6146
43	6379	6611	6843	7074	7304	7535	7764	7993	8222	8450
44	8677	8904	9131	9357	9582	9807	*0032	*0256	*0479	*0702
45	6.1 0925	1147	1368	1589	1810	2030	2249	2468	2687	2905
46	3123	3340	3556	3773	3988	4204	4419	4633	4847	5060
47	5273	5486	5698	5910	6121	6331	6542	6752	6961	7170
48	7379	7587	7794	8002	8208	8415	8621	8826	9032	9236
49	9441	9644	9848	*0051	*0254	*0456	*0658	*0859	*1060	*1261
50	6.2 1461	1661	1860	2059	2258	2456	2654	2851	3048	3245
51	3441	3637	3832	4028	4222	4417	4611	4804	4998	5190
52	5383	5575	5767	5958	6149	6340	6530	6720	6910	7099
53	7288	7476	7664	7852	8040	8227	8413	8600	8786	8972
54	9157	9342	9527	9711	9895	*0079	*0262	*0445	*0628	*0810
55	6.3 0992	1173	1355	1536	1716	1897	2077	2257	2436	2615
56	2794	2972	3150	3328	3505	3683	3859	4036	4212	4388
57	4564	4739	4914	5089	5263	5437	5611	5784	5957	6130
58	6303	6475	6647	6819	6990	7161	7332	7502	7673	7843
59	8012	8182	8351	8519	8688	8856	9024	9192	9359	9526
60	9693	9859	*0026	*0192	*0357	*0523	*0688	*0853	*1017	*1182
N	0	1	2	3	4	5	6	7	8	9

NATURAL LOGARITHMS
D 100-1109 (Concluded)

N		0	1	2	3	4	5	6	7	8	9
60	6.3	9693	9859	*0026	*0192	*0357	*0523	*0688	*0853	*1017	*1182
61	6.4	1346	1510	1673	1836	1999	2162	2325	2487	2649	2811
62		2972	3133	3294	3455	3615	3775	3935	4095	4254	4413
63		4572	4731	4889	5047	5205	5362	5520	5677	5834	5990
64		6147	6303	6459	6614	6770	6925	7080	7235	7389	7543
65		7697	7851	8004	8158	8311	8464	8616	8768	8920	9072
66		9224	9375	9527	9677	9828	9979	*0129	*0279	*0429	*0578
67	6.5	0728	0877	1026	1175	1323	1471	1619	1767	1915	2062
68		2209	2356	2503	2649	2796	2942	3088	3233	3379	3524
69		3669	3814	3959	4103	4247	4391	4535	4679	4822	4965
70		5108	5251	5393	5536	5678	5820	5962	6103	6244	6386
71		6526	6667	6808	6948	7088	7228	7368	7508	7647	7786
72		7925	8064	8203	8341	8479	8617	8755	8893	9030	9167
73		9304	9441	9578	9715	9851	9987	*0123	*0259	*0394	*0530
74	6.6	0665	0800	0935	1070	1204	1338	1473	1607	1740	1874
75		2007	2141	2274	2407	2539	2672	2804	2936	3068	3200
76		3332	3463	3595	3726	3857	3988	4118	4249	4379	4509
77		4639	4769	4898	5028	5157	5286	5415	5544	5673	5801
78		5929	6058	6185	6313	6441	6568	6696	6823	6950	7077
79		7203	7330	7456	7582	7708	7834	7960	8085	8211	8336
80		8461	8586	8711	8835	8960	9084	9208	9332	9456	9580
81		9703	9827	9950	*0073	*0196	*0319	*0441	*0564	*0686	*0808
82	6.7	0930	1052	1174	1296	1417	1538	1659	1780	1901	2022
83		2143	2263	2383	2503	2623	2743	2863	2982	3102	3221
84		3340	3459	3578	3697	3815	3934	4052	4170	4288	4406
85		4524	4641	4759	4876	4993	5110	5227	5344	5460	5577
86		5693	5809	5926	6041	6157	6273	6388	6504	6619	6734
87		6849	6964	7079	7194	7308	7422	7537	7651	7765	7878
88		7992	8106	8219	8333	8446	8559	8672	8784	8897	9010
89		9122	9234	9347	9459	9571	9682	9794	9906	*0017	*0128
90	6.8	0239	0351	0461	0572	0683	0793	0904	1014	1124	1235
91		1344	1454	1564	1674	1783	1892	2002	2111	2220	2329
92		2437	2546	2655	2763	2871	2979	3087	3195	3303	3411
93		3518	3626	3733	3841	3948	4055	4162	4268	4375	4482
94		4588	4694	4801	4907	5013	5118	5224	5330	5435	5541
95		5646	5751	5857	5961	6066	6171	6276	6380	6485	6589
96		6693	6797	6901	7005	7109	7213	7316	7420	7523	7626
97		7730	7833	7936	8038	8141	8244	8346	8449	8551	8653
98		8755	8857	8959	9061	9163	9264	9366	9467	9568	9669
99		9770	9871	9972	*0073	*0174	*0274	*0375	*0475	*0575	*0675
100	6.9	0776	0875	0975	1075	1175	1274	1374	1473	1572	1672
101		1771	1870	1968	2067	2166	2264	2363	2461	2560	2658
102		2756	2854	2952	3049	3147	3245	3342	3440	3537	3634
103		3731	3828	3925	4022	4119	4216	4312	4409	4505	4601
104		4698	4794	4890	4986	5081	5177	5273	5368	5464	5559
105		5655	5750	5845	5940	6035	6130	6224	6319	6414	6508
106		6602	6697	6791	6885	6979	7073	7167	7261	7354	7448
107		7541	7635	7728	7821	7915	8008	8101	8193	8286	8379
108		8472	8564	8657	8749	8841	8934	9026	9118	9210	9302
109		9393	9485	9577	9668	9760	9851	9942	*0033	*0125	*0216
110	7.0	0307	0397	0488	0579	0670	0760	0851	0941	1031	1121
N		0	1	2	3	4	5	6	7	8	9

EXPONENTIAL FUNCTIONS

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
0.00	1.0000	0.00000	1.000000	**0.50**	1.6487	0.21715	0.606531
0.01	1.0101	.00434	0.990050	0.51	1.6653	.22149	.600496
0.02	1.0202	.00869	.980199	0.52	1.6820	.22583	.594521
0.03	1.0305	.01303	.970446	0.53	1.6989	.23018	.588605
0.04	1.0408	.01737	.960789	0.54	1.7160	.23452	.582748
0.05	1.0513	0.02171	0.951229	**0.55**	1.7333	0.23886	0.576950
0.06	1.0618	.02606	.941765	0.56	1.7507	.24320	.571209
0.07	1.0725	.03040	.932394	0.57	1.7683	.24755	.565525
0.08	1.0833	.03474	.923116	0.58	1.7860	.25189	.559898
0.09	1.0942	.03909	.913931	0.59	1.8040	.25623	.554327
0.10	1.1052	0.04343	0.904837	**0.60**	1.8221	0.26058	0.548812
0.11	1.1163	.04777	.895834	0.61	1.8404	.26492	.543351
0.12	1.1275	.05212	.886920	0.62	1.8589	.26926	.537944
0.13	1.1388	.05646	.878095	0.63	1.8776	.27361	.532592
0.14	1.1503	.06080	.869358	0.64	1.8965	.27795	.527292
0.15	1.1618	0.06514	0.860708	**0.65**	1.9155	0.28229	0.522046
0.16	1.1735	.06949	.852144	0.66	1.9348	.28663	.516851
0.17	1.1853	.07383	.843665	0.67	1.9542	.29098	.511709
0.18	1.1972	.07817	.835270	0.68	1.9739	.29532	.506617
0.19	1.2092	.08252	.826959	0.69	1.9937	.29966	.501576
0.20	1.2214	0.08686	0.818731	**0.70**	2.0138	0.30401	0.496585
0.21	1.2337	.09120	.810584	0.71	2.0340	.30835	.491644
0.22	1.2461	.09554	.802519	0.72	2.0544	.31269	.486752
0.23	1.2586	.09989	.794534	0.73	2.0751	.31703	.481909
0.24	1.2712	.10423	.786628	0.74	2.0959	.32138	.477114
0.25	1.2840	0.10857	0.778801	**0.75**	2.1170	0.32572	0.472367
0.26	1.2969	.11292	.771052	0.76	2.1383	.33006	.467666
0.27	1.3100	.11726	.763379	0.77	2.1598	.33441	.463013
0.28	1.3231	.12160	.755784	0.78	2.1815	.33875	.458406
0.29	1.3364	.12595	.748264	0.79	2.2034	.34309	.453845
0.30	1.3499	0.13029	0.740818	**0.80**	2.2255	0.34744	0.449329
0.31	1.3634	.13463	.733447	0.81	2.2479	.35178	.444858
0.32	1.3771	.13897	.726149	0.82	2.2705	.35612	.440432
0.33	1.3910	.14332	.718924	0.83	2.2933	.36046	.436049
0.34	1.4049	.14766	.711770	0.84	2.3164	.36481	.431711
0.35	1.4191	0.15200	0.704688	**0.85**	2.3396	0.36915	0.427415
0.36	1.4333	.15635	.697676	0.86	2.3632	.37349	.423162
0.37	1.4477	.16069	.690734	0.87	2.3869	.37784	.418952
0.38	1.4623	.16503	.683861	0.88	2.4109	.38218	.414783
0.39	1.4770	.16937	.677057	0.89	2.4351	.38652	.410656
0.40	1.4918	0.17372	0.670320	**0.90**	2.4596	0.39087	0.406570
0.41	1.5068	.17806	.663650	0.91	2.4843	.39521	.402524
0.42	1.5220	.18240	.657047	0.92	2.5093	.39955	.398519
0.43	1.5373	.18675	.650509	0.93	2.5345	.40389	.394554
0.44	1.5527	.19109	.644036	0.94	2.5600	.40824	.390628
0.45	1.5683	0.19543	0.637628	**0.95**	2.5857	0.41258	0.386741
0.46	1.5841	.19978	.631284	0.96	2.6117	.41692	.382893
0.47	1.6000	.20412	.625002	0.97	2.6379	.42127	.379083
0.48	1.6161	.20846	.618783	0.98	2.6645	.42561	.375311
0.49	1.6323	.21280	.612626	0.99	2.6912	.42995	.371577
0.50	1.6487	0.21715	0.606531	**1.00**	2.7183	0.43429	0.367879

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}\, e^x$	e^{-x}	x	e^x	$\text{Log}_{10}\, e^x$	e^{-x}
1.00	2.7183	0.43429	0.367879	**1.50**	4.4817	0.65144	0.223130
1.01	2.7456	.43864	.364219	1.51	4.5267	.65578	.220910
1.02	2.7732	.44298	.360595	1.52	4.5722	.66013	.218712
1.03	2.8011	.44732	.357007	1.53	4.6182	.66447	.216536
1.04	2.8292	.45167	.353455	1.54	4.6646	.66881	.214381
1.05	2.8577	0.45601	0.349938	**1.55**	4.7115	0.67316	0.212248
1.06	2.8864	.46035	.346456	1.56	4.7588	.67750	.210136
1.07	2.9154	.46470	.343009	1.57	4.8066	.68184	.208045
1.08	2.9447	.46904	.339596	1.58	4.8550	.68619	.205975
1.09	2.9743	.47338	.336216	1.59	4.9037	.69053	.203926
1.10	3.0042	0.47772	0.332871	**1.60**	4.9530	0.69487	0.201897
1.11	3.0344	.48207	.329559	1.61	5.0028	.69921	.199888
1.12	3.0649	.48641	.326280	1.62	5.0531	.70356	.197899
1.13	3.0957	.49075	.323033	1.63	5.1039	.70790	.195930
1.14	3.1268	.49510	.319819	1.64	5.1552	.71224	.193980
1.15	3.1582	0.49944	0.316637	**1.65**	5.2070	0.71659	0.192050
1.16	3.1899	.50378	.313486	1.66	5.2593	.72093	.190139
1.17	3.2220	.50812	.310367	1.67	5.3122	.72527	.188247
1.18	3.2544	.51247	.307279	1.68	5.3656	.72961	.186374
1.19	3.2871	.51681	.304221	1.69	5.4195	.73396	.184520
1.20	3.3201	0.52115	0.301194	**1.70**	5.4739	0.73830	0.182684
1.21	3.3535	.52550	.298197	1.71	5.5290	.74264	.180866
1.22	3.3872	.52984	.295230	1.72	5.5845	.74699	.179066
1.23	3.4212	.53418	.292293	1.73	5.6407	.75133	.177284
1.24	3.4556	.53853	.289384	1.74	5.6973	.75567	.175520
1.25	3.4903	0.54287	0.286505	**1.75**	5.7546	0.76002	0.173774
1.26	3.5254	.54721	.283654	1.76	5.8124	.76436	.172045
1.27	3.5609	.55155	.280832	1.77	5.8709	.76870	.170333
1.28	3.5966	.55590	.278037	1.78	5.9299	.77304	.168638
1.29	3.6328	.56024	.275271	1.79	5.9895	.77739	.166960
1.30	3.6693	0.56458	0.272532	**1.80**	6.0496	0.78173	0.165299
1.31	3.7062	.56893	.269820	1.81	6.1104	.78607	.163654
1.32	3.7434	.57327	.267135	1.82	6.1719	.79042	.162026
1.33	3.7810	.57761	.264477	1.83	6.2339	.79476	.160414
1.34	3.8190	.58195	.261846	1.84	6.2965	.79910	.158817
1.35	3.8574	0.58630	0.259240	**1.85**	6.3598	0.80344	0.157237
1.36	3.8962	.59064	.256661	1.86	6.4237	.80779	.155673
1.37	3.9354	.59498	.254107	1.87	6.4883	.81213	.154124
1.38	3.9749	.59933	.251579	1.88	6.5535	.81647	.152590
1.39	4.0149	.60367	.249075	1.89	6.6194	.82082	.151072
1.40	4.0552	0.60801	0.246597	**1.90**	6.6859	0.82516	0.149569
1.41	4.0960	.61236	.244143	1.91	6.7531	.82950	.148080
1.42	4.1371	.61670	.241714	1.92	6.8210	.83385	.146607
1.43	4.1787	.62104	.239309	1.93	6.8895	.83819	.145148
1.44	4.2207	.62538	.236928	1.94	6.9588	.84253	.143704
1.45	4.2631	0.62973	0.234570	**1.95**	7.0287	0.84687	0.142274
1.46	4.3060	.63407	.232236	1.96	7.0993	.85122	.140858
1.47	4.3492	.63841	.229925	1.97	7.1707	.85556	.139457
1.48	4.3929	.64276	.227638	1.98	7.2427	.85990	.138069
1.49	4.4371	.64710	.225373	1.99	7.3155	.86425	.136695
1.50	4.4817	0.65144	0.223130	**2.00**	7.3891	0.86859	0.135335

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
2.00	7.3891	0.86859	0.135335	**2.50**	12.182	1.08574	0.082085
2.01	7.4633	.87293	.133989	2.51	12.305	1.09008	.081268
2.02	7.5383	.87727	.132655	2.52	12.429	1.09442	.080460
2.03	7.6141	.88162	.131336	2.53	12.554	1.09877	.079659
2.04	7.6906	.88596	.130029	2.54	12.680	1.10311	.078866
2.05	7.7679	0.89030	0.128735	**2.55**	12.807	1.10745	0.078082
2.06	7.8460	.89465	.127454	2.56	12.936	1.11179	.077305
2.07	7.9248	.89899	.126186	2.57	13.066	1.11614	.076536
2.08	8.0045	.90333	.124930	2.58	13.197	1.12048	.075774
2.09	8.0849	.90768	.123687	2.59	13.330	1.12482	.075020
2.10	8.1662	0.91202	0.122456	**2.60**	13.464	1.12917	0.074274
2.11	8.2482	.91636	.121238	2.61	13.599	1.13351	.073535
2.12	8.3311	.92070	.120032	2.62	13.736	1.13785	.072803
2.13	8.4149	.92505	.118837	2.63	13.874	1.14219	.072078
2.14	8.4994	.92939	.117655	2.64	14.013	1.14654	.071361
2.15	8.5849	0.93373	0.116484	**2.65**	14.154	1.15088	0.070651
2.16	8.6711	.93808	.115325	2.66	14.296	1.15522	.069948
2.17	8.7583	.94242	.114178	2.67	14.440	1.15957	.069252
2.18	8.8463	.94676	.113042	2.68	14.585	1.16391	.068563
2.19	8.9352	.95110	.111917	2.69	14.732	1.16825	.067881
2.20	9.0250	0.95545	0.110803	**2.70**	14.880	1.17260	0.067206
2.21	9.1157	.95979	.109701	2.71	15.029	1.17694	.066537
2.22	9.2073	.96413	.108609	2.72	15.180	1.18128	.065875
2.23	9.2999	.96848	.107528	2.73	15.333	1.18562	.065219
2.24	9.3933	.97282	.106459	2.74	15.487	1.18997	.064570
2.25	9.4877	0.97716	0.105399	**2.75**	15.643	1.19431	0.063928
2.26	9.5831	.98151	.104350	2.76	15.800	1.19865	.063292
2.27	9.6794	.98585	.103312	2.77	15.959	1.20300	.062662
2.28	9.7767	.99019	.102284	2.78	16.119	1.20734	.062039
2.29	9.8749	.99453	.101266	2.79	16.281	1.21168	.061421
2.30	9.9742	0.99888	0.100259	**2.80**	16.445	1.21602	0.060810
2.31	10.074	1.00322	.099261	2.81	16.610	1.22037	.060205
2.32	10.176	1.00756	.098274	2.82	16.777	1.22471	.059606
2.33	10.278	1.01191	.097296	2.83	16.945	1.22905	.059013
2.34	10.381	1.01625	.096328	2.84	17.116	1.23340	.058426
2.35	10.486	1.02059	0.095369	**2.85**	17.288	1.23774	0.057844
2.36	10.591	1.02493	.094420	2.86	17.462	1.24208	.057269
2.37	10.697	1.02928	.093481	2.87	17.637	1.24643	.056699
2.38	10.805	1.03362	.092551	2.88	17.814	1.25077	.056135
2.39	10.913	1.03796	.091630	2.89	17.993	1.25511	.055576
2.40	11.023	1.04231	0.090718	**2.90**	18.174	1.25945	0.055023
2.41	11.134	1.04665	.089815	2.91	18.357	1.26380	.054476
2.42	11.246	1.05099	.088922	2.92	18.541	1.26814	.053934
2.43	11.359	1.05534	.088037	2.93	18.728	1.27248	.053397
2.44	11.473	1.05968	.087161	2.94	18.916	1.27683	.052866
2.45	11.588	1.06402	0.086294	**2.95**	19.106	1.28117	0.052340
2.46	11.705	1.06836	.085435	2.96	19.298	1.28551	.051819
2.47	11.822	1.07271	.084585	2.97	19.492	1.28985	.051303
2.48	11.941	1.07705	.083743	2.98	19.688	1.29420	.050793
2.49	12.061	1.08139	.082910	2.99	19.886	1.29854	.050287
2.50	12.182	1.08574	0.082085	**3.00**	20.086	1.30288	0.049787

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
3.00	20.086	1.30288	0.049787	**3.50**	33.115	1.52003	0.030197
3.01	20.287	1.30723	.049292	3.51	33.448	1.52437	.029897
3.02	20.491	1.31157	.048801	3.52	33.784	1.52872	.029599
3.03	20.697	1.31591	.048316	3.53	34.124	1.53306	.029305
3.04	20.905	1.32026	.047835	3.54	34.467	1.53740	.029013
3.05	21.115	1.32460	0.047359	**3.55**	34.813	1.54175	0.028725
3.06	21.328	1.32894	.046888	3.56	35.163	1.54609	.028439
3.07	21.542	1.33328	.046421	3.57	35.517	1.55043	.028156
3.08	21.758	1.33763	.045959	3.58	35.874	1.55477	.027876
3.09	21.977	1.34197	.045502	3.59	36.234	1.55912	.027598
3.10	22.198	1.34631	0.045049	**3.60**	36.598	1.56346	0.027324
3.11	22.421	1.35066	.044601	3.61	36.966	1.56780	.027052
3.12	22.646	1.35500	.044157	3.62	37.338	1.57215	.026783
3.13	22.874	1.35934	.043718	3.63	37.713	1.57649	.026516
3.14	23.104	1.36368	.043283	3.64	38.092	1.58083	.026252
3.15	23.336	1.36803	0.042852	**3.65**	38.475	1.58517	0.025991
3.16	23.571	1.37237	.042426	3.66	38.861	1.58952	.025733
3.17	23.807	1.37671	.042004	3.67	39.252	1.59386	.025476
3.18	24.047	1.38106	.041586	3.68	39.646	1.59820	.025223
3.19	24.288	1.38540	.041172	3.69	40.045	1.60255	.024972
3.20	24.533	1.38974	0.040762	**3.70**	40.447	1.60689	0.024724
3.21	24.779	1.39409	.040357	3.71	40.854	1.61123	.024478
3.22	25.028	1.39843	.039955	3.72	41.264	1.61558	.024234
3.23	25.280	1.40277	.039557	3.73	41.679	1.61992	.023993
3.24	25.534	1.40711	.039164	3.74	42.098	1.62426	.023754
3.25	25.790	1.41146	0.038774	**3.75**	42.521	1.62860	0.023518
3.26	26.050	1.41580	.038388	3.76	42.948	1.63295	.023284
3.27	26.311	1.42014	.038006	3.77	43.380	1.63729	.023052
3.28	26.576	1.42449	.037628	3.78	43.816	1.64163	.022823
3.29	26.843	1.42883	.037254	3.79	44.256	1.64598	.022596
3.30	27.113	1.43317	0.036883	**3.80**	44.701	1.65032	0.022371
3.31	27.385	1.43751	.036516	3.81	45.150	1.65466	.022148
3.32	27.660	1.44186	.036153	3.82	45.604	1.65900	.021928
3.33	27.938	1.44620	.035793	3.83	46.063	1.66335	.021710
3.34	28.219	1.45054	.035437	3.84	46.525	1.66769	.021494
3.35	28.503	1.45489	0.035084	**3.85**	46.993	1.67203	0.021280
3.36	28.789	1.45923	.034735	3.86	47.465	1.67638	.021068
3.37	29.079	1.46357	.034390	3.87	47.942	1.68072	.020858
3.38	29.371	1.46792	.034047	3.88	48.424	1.68506	.020651
3.39	29.666	1.47226	.033709	3.89	48.911	1.68941	.020445
3.40	29.964	1.47660	0.033373	**3.90**	49.402	1.69375	0.020242
3.41	30.265	1.48094	.033041	3.91	49.899	1.69809	.020041
3.42	30.569	1.48529	.032712	3.92	50.400	1.70243	.019841
3.43	30.877	1.48963	.032387	3.93	50.907	1.70678	.019644
3.44	31.187	1.49397	.032065	3.94	51.419	1.71112	.019448
3.45	31.500	1.49832	0.031746	**3.95**	51.935	1.71546	0.019255
3.46	31.817	1.50266	.031430	3.96	52.457	1.71981	.019063
3.47	32.137	1.50700	.031117	3.97	52.985	1.72415	.018873
3.48	32.460	1.51134	.030807	3.98	53.517	1.72849	.018686
3.49	32.786	1.51569	.030501	3.99	54.055	1.73283	.018500
3.50	33.115	1.52003	0.030197	**4.00**	54.598	1.73718	0.018316

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
4.00	54.598	1.73718	0.018316	**4.50**	90.017	1.95433	0.011109
4.01	55.147	1.74152	.018133	4.51	90.922	1.95867	.010998
4.02	55.701	1.74586	.017953	4.52	91.836	1.96301	.010889
4.03	56.261	1.75021	.017774	4.53	92.759	1.96735	.010781
4.04	56.826	1.75455	.017597	4.54	93.691	1.97170	.010673
4.05	57.397	1.75889	0.017422	**4.55**	94.632	1.97604	0.010567
4.06	57.974	1.76324	.017249	4.56	95.583	1.98038	.010462
4.07	58.557	1.76758	.017077	4.57	96.544	1.98473	.010358
4.08	59.145	1.77192	.016907	4.58	97.514	1.98907	.010255
4.09	59.740	1.77626	.016739	4.59	98.494	1.99341	.010153
4.10	60.340	1.78061	0.016573	**4.60**	99.484	1.99775	0.010052
4.11	60.947	1.78495	.016408	4.61	100.48	2.00210	.009952
4.12	61.559	1.78929	.016245	4.62	101.49	2.00644	.009853
4.13	62.178	1.79364	.016083	4.63	102.51	2.01078	.009755
4.14	62.803	1.79798	.015923	4.64	103.54	2.01513	.009658
4.15	63.434	1.80232	0.015764	**4.65**	104.58	2.01947	0.009562
4.16	64.072	1.80667	.015608	4.66	105.64	2.02381	.009466
4.17	64.715	1.81101	.015452	4.67	106.70	2.02816	.009372
4.18	65.366	1.81535	.015299	4.68	107.77	2.03250	.009279
4.19	66.023	1.81969	.015146	4.69	108.85	2.03684	.009187
4.20	66.686	1.82404	0.014996	**4.70**	109.95	2.04118	0.009095
4.21	67.357	1.82838	.014846	4.71	111.05	2.04553	.009005
4.22	68.033	1.83272	.014699	4.72	112.17	2.04987	.008915
4.23	68.717	1.83707	.014552	4.73	113.30	2.05421	.008826
4.24	69.408	1.84141	.014408	4.74	114.43	2.05856	.008739
4.25	70.105	1.84575	0.014264	**4.75**	115.58	2.06290	0.008652
4.26	70.810	1.85009	.014122	4.76	116.75	2.06724	.008566
4.27	71.522	1.85444	.013982	4.77	117.92	2.07158	.008480
4.28	72.240	1.85878	.013843	4.78	119.10	2.07593	.008396
4.29	72.966	1.86312	.013705	4.79	120.30	2.08027	.008312
4.30	73.700	1.86747	0.013569	**4.80**	121.51	2.08461	0.008230
4.31	74.440	1.87181	.013434	4.81	122.73	2.08896	.008148
4.32	75.189	1.87615	.013300	4.82	123.97	2.09330	.008067
4.33	75.944	1.88050	.013168	4.83	125.21	2.09764	.007987
4.34	76.708	1.88484	.013037	4.84	126.47	2.10199	.007907
4.35	77.478	1.88918	0.012907	**4.95**	127.74	2.10633	0.007828
4.36	78.257	1.89352	.012778	4.86	129.02	2.11067	.007750
4.37	79.044	1.89787	.012651	4.87	130.32	2.11501	.007673
4.38	79.838	1.90221	.012525	4.88	131.63	2.11936	.007597
4.39	80.640	1.90655	.012401	4.89	132.95	2.12370	.007521
4.40	81.451	1.91090	0.012277	**4.90**	134.29	2.12804	0.007447
4.41	82.269	1.91524	.012155	4.91	135.64	2.13239	.007372
4.42	83.096	1.91958	.012034	4.92	137.00	2.13673	.007299
4.43	83.931	1.92392	.011914	4.93	138.38	2.14107	.007227
4.44	84.775	1.92827	.011796	4.94	139.77	2.14541	.007155
4.45	85.627	1.93261	0.011679	**4.95**	141.17	2.14976	0.007083
4.46	86.488	1.93695	.011562	4.96	142.59	2.15410	.007013
4.47	87.357	1.94130	.011447	4.97	144.03	2.15844	.006943
4.48	88.235	1.94564	.011333	4.98	145.47	2.16279	.006874
4.49	89.121	1.94998	.011221	4.99	146.94	2.16713	.006806
4.50	90.017	1.95433	0.011109	**5.00**	148.41	2.17147	0.006738

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
5.00	148.41	2.17147	0.006738	**5.0**	148.41	2.17147	0.006738
5.01	149.90	2.17582	.006671	5.1	164.02	2.21490	.006097
5.02	151.41	2.18016	.006605	5.2	181.27	2.25833	.005517
5.03	152.93	2.18450	.006539	5.3	200.34	2.30176	.004992
5.04	154.47	2.18884	.006474	5.4	221.41	2.34519	.004517
5.05	156.02	2.19319	0.006409	**5.5**	244.69	2.38862	0.004087
5.06	157.59	2.19753	.006346	5.6	270.43	2.43205	.003698
5.07	159.17	2.20187	.006282	5.7	298.87	2.47548	.003346
5.08	160.77	2.20622	.006220	5.8	330.30	2.51891	.003028
5.09	162.39	2.21056	.006158	5.9	365.04	2.56234	.002739
5.10	164.02	2.21490	0.006097	**6.0**	403.43	2.60577	0.002479
5.11	165.67	2.21924	.006036	6.1	445.86	2.64920	.002243
5.12	167.34	2.22359	.005976	6.2	492.75	2.69263	.002029
5.13	169.02	2.22793	.005917	6.3	544.57	2.73606	.001836
5.14	170.72	2.23227	.005858	6.4	601.85	2.77948	.001662
5.15	172.43	2.23662	0.005799	**6.5**	665.14	2.82291	0.001503
5.16	174.16	2.24096	.005742	6.6	735.10	2.86634	.001360
5.17	175.91	2.24530	.005685	6.7	812.41	2.90977	.001231
5.18	177.68	2.24965	.005628	6.8	897.85	2.95320	.001114
5.19	179.47	2.25399	.005572	6.9	992.27	2.99663	.001008
5.20	181.27	2.25833	0.005517	**7.0**	1096.6	3.04006	0.000912
5.21	183.09	2.26267	.005462	7.1	1212.0	3.08349	.000825
5.22	184.93	2.26702	.005407	7.2	1339.4	3.12692	.000747
5.23	186.79	2.27136	.005354	7.3	1480.3	3.17035	.000676
5.24	188.67	2.27570	.005300	7.4	1636.0	3.21378	.000611
5.25	190.57	2.28005	0.005248	**7.5**	1808.0	3.25721	0.000553
5.26	192.48	2.28439	.005195	7.6	1998.2	3.30064	.000500
5.27	194.42	2.28873	.005144	7.7	2208.3	3.34407	.000453
5.28	196.37	2.29307	.005092	7.8	2440.6	3.38750	.000410
5.29	198.34	2.29742	.005042	7.9	2697.3	3.43093	.000371
5.30	200.34	2.30176	0.004992	**8.0**	2981.0	3.47436	0.000335
5.31	202.35	2.30610	.004942	8.1	3294.5	3.51779	.000304
5.32	204.38	2.31045	.004893	8.2	3641.0	3.56121	.000275
5.33	206.44	2.31479	.004844	8.3	4023.9	3.60464	.000249
5.34	208.51	2.31913	.004796	8.4	4447.1	3.64807	.000225
5.35	210.61	2.32348	0.004748	**8.5**	4914.8	3.69150	0.000203
5.36	212.72	2.32782	.004701	8.6	5431.7	3.73493	.000184
5.37	214.86	2.33216	.004654	8.7	6002.9	3.77836	.000167
5.38	217.02	2.33650	.004608	8.8	6634.2	3.82179	.000151
5.39	219.20	2.34085	.004562	8.9	7332.0	3.86522	.000136
5.40	221.41	2.34519	0.004517	**9.0**	8103.1	3.90865	0.000123
5.41	223.63	2.34953	.004472	9.1	8955.3	3.95208	.000112
5.42	225.88	2.35388	.004427	9.2	9897.1	3.99551	.000101
5.43	228.15	2.35822	.004383	9.3	10938	4.03894	.000091
5.44	230.44	2.36256	.004339	9.4	12088	4.08237	.000083
5.45	232.76	2.36690	0.004296	**9.5**	13360	4.12580	0.000075
5.46	235.10	2.37125	.004254	9.6	14765	4.16923	.000068
5.47	237.46	2.37559	.004211	9.7	16318	4.21266	.000061
5.48	239.85	2.37993	.004169	9.8	18034	4.25609	.000055
5.49	242.26	2.38428	.004128	9.9	19930	4.29952	.000050
5.50	244.69	2.38862	0.004087	**10.0**	22026	4.34294	0.000045

HYPERBOLIC FUNCTIONS

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
0.00	0.00000	$-\infty$	1.00000	.00000	0.00000	$-\infty$	∞	∞
0.01	.01000	.00001	1.00005	.00002	.01000	.99999	100.003	.00001
0.02	.02000	.30106	1.00020	.00009	.02000	.30097	50.007	.69903
0.03	.03000	.47719	1.00045	.00020	.02999	.47699	33.343	.52301
0.04	.04001	.60218	1.00080	.00035	.03998	.60183	25.013	.39817
0.05	0.05002	.69915	1.00125	.00054	0.04996	.69861	20.017	.30139
0.06	.06004	.77841	1.00180	.00078	.05993	.77763	16.687	.22237
0.07	.07006	.84545	1.00245	.00106	.06989	.84439	14.309	.15561
0.08	.08009	.90355	1.00320	.00139	.07983	.90216	12.527	.09784
0.09	.09012	.95483	1.00405	.00176	.08976	.95307	11.141	.04693
0.10	0.10017	.00072	1.00500	.00217	0.09967	.99856	10.0333	.00144
0.11	.11022	.04227	1.00606	.00262	.10956	.03965	9.1275	.96035
0.12	.12029	.08022	1.00721	.00312	.11943	.07710	8.3733	.92290
0.13	.13037	.11517	1.00846	.00366	.12927	.11151	7.7356	.88849
0.14	.14046	.14755	1.00982	.00424	.13909	.14330	7.1895	.85670
0.15	0.15056	.17772	1.01127	.00487	0.14889	.17285	6.7166	.82715
0.16	.16068	.20597	1.01283	.00554	.15865	.20044	6.3032	.79956
0.17	.17082	.23254	1.01448	.00625	.16838	.22629	5.9389	.77371
0.18	.18097	.25762	1.01624	.00700	.17808	.25062	5.6154	.74938
0.19	.19115	.28136	1.01810	.00779	.18775	.27357	5.3263	.72643
0.20	0.20134	.30392	1.02007	.00863	0.19738	.29529	5.0665	.70471
0.21	.21155	.32541	1.02213	.00951	.20697	.31590	4.8317	.68410
0.22	.22178	.34592	1.02430	.01043	.21652	.33549	4.6186	.66451
0.23	.23203	.36555	1.02657	.01139	.22603	.35416	4.4242	.64584
0.24	.24231	.38437	1.02894	.01239	.23550	.37198	4.2464	.62802
0.25	0.25261	.40245	1.03141	.01343	0.24492	.38902	4.0830	.61098
0.26	.26294	.41986	1.03399	.01452	.25430	.40534	3.9324	.59466
0.27	.27329	.43663	1.03667	.01564	.26362	.42099	3.7933	.57901
0.28	.28367	.45282	1.03946	.01681	.27291	.43601	3.6643	.56399
0.29	.29408	.46847	1.04235	.01801	.28213	.45046	3.5444	.54954
0.30	0.30452	.48362	1.04534	.01926	0.29131	.46436	3.4327	.53564
0.31	.31499	.49830	1.04844	.02054	.30044	.47775	3.3285	.52225
0.32	.32549	.51254	1.05164	.02187	.30951	.49067	3.2309	.50933
0.33	.33602	.52637	1.05495	.02323	.31852	.50314	3.1395	.49686
0.34	.34659	.53981	1.05836	.02463	.32748	.51518	3.0536	.48482
0.35	0.35719	.55290	1.06188	.02607	0.33638	.52682	2.9729	.47318
0.36	.36783	.56564	1.06550	.02755	.34521	.53809	2.8968	.46191
0.37	.37850	.57807	1.06923	.02907	.35399	.54899	2.8249	.45101
0.38	.38921	.59019	1.07307	.03063	.36271	.55956	2.7570	.44044
0.39	.39996	.60202	1.07702	.03222	.37136	.56980	2.6928	.43020
0.40	0.41075	.61358	1.08107	.03385	0.37995	.57973	2.6319	.42027
0.41	.42158	.62488	1.08523	.03552	.38847	.58936	2.5742	.41064
0.42	.43246	.63594	1.08950	.03723	.39693	.59871	2.5193	.40129
0.43	.44337	.64677	1.09388	.03897	.40532	.60780	2.4672	.39220
0.44	.45434	.65738	1.09837	.04075	.41364	.61663	2.4175	.38337
0.45	0.46534	.66777	1.10297	.04256	0.42190	.62521	2.3702	.37479
0.46	.47640	.67797	1.10768	.04441	.43008	.63355	2.3251	.36645
0.47	.48750	.68797	1.11250	.04630	.43820	.64167	2.2821	.35833
0.48	.49865	.69779	1.11743	.04822	.44624	.64957	2.2409	.35043
0.49	.50984	.70744	1.12247	.05018	.45422	.65726	2.2016	.34274

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
0.50	0.52110	.71692	1.12763	.05217	0.46212	.66475	2.1640	.33525
0.51	.53240	.72624	1.13289	.05419	.46995	.67205	2.1279	.32795
0.52	.54375	.73540	1.13827	.05625	.47770	.67916	2.0934	.32084
0.53	.55516	.74442	1.14377	.05834	.48538	.68608	2.0602	.31392
0.54	.56663	.75330	1.14938	.06046	.49299	.69284	2.0284	.30716
0.55	0.57815	.76204	1.15510	.06262	0.50052	.69942	1.9979	.30058
0.56	.58973	.77065	1.16094	.06481	.50798	.70584	1.9686	.29416
0.57	.60137	.77914	1.16690	.06703	.51536	.71211	1.9404	.28789
0.58	.61307	.78751	1.17297	.06929	.52267	.71822	1.9133	.28178
0.59	.62483	.79576	1.17916	.07157	.52990	.72419	1.8872	.27581
0.60	0.63665	.80390	1.18547	.07389	0.53705	.73001	1.8620	.26999
0.61	.64854	.81194	1.19189	.07624	.54413	.73570	1.8378	.26430
0.62	.66049	.81987	1.19844	.07861	.55113	.74125	1.8145	.25875
0.63	.67251	.82770	1.20510	.08102	.55805	.74667	1.7919	.25333
0.64	.68459	.83543	1.21189	.08346	.56490	.75197	1.7702	.24803
0.65	0.69675	.84308	1.21879	.08593	0.57167	.75715	1.7493	.24285
0.66	.70897	.85063	1.22582	.08843	.57836	.76220	1.7290	.23780
0.67	.72126	.85809	1.23297	.09095	.58498	.76714	1.7095	.23286
0.68	.73363	.86548	1.24025	.09351	.59152	.77197	1.6906	.22803
0.69	.74607	.87278	1.24765	.09609	.59798	.77669	1.6723	.22331
0.70	0.75858	.88000	1.25517	.09870	0.60437	.78130	1.6546	.21870
0.71	.77117	.88715	1.26282	.10134	.61068	.78581	1.6375	.21419
0.72	.78384	.89423	1.27059	.10401	.61691	.79022	1.6210	.20978
0.73	.79659	.90123	1.27849	.10670	.62307	.79453	1.6050	.20547
0.74	.80941	.90817	1.28652	.10942	.62915	.79875	1.5895	.20125
0.75	0.82232	.91504	1.29468	.11216	0.63515	.80288	1.5744	.19712
0.76	.83530	.92185	1.30297	.11493	.64108	.80691	1.5599	.19309
0.77	.84838	.92859	1.31139	.11773	.64693	.81086	1.5458	.18914
0.78	.86153	.93527	1.31994	.12055	.65271	.81472	1.5321	.18528
0.79	.87478	.94190	1.32862	.12340	.65841	.81850	1.5188	.18150
0.80	0.88811	.94846	1.33743	.12627	0.66404	.82219	1.5059	.17781
0.81	.90152	.95498	1.34638	.12917	.66959	.82581	1.4935	.17419
0.82	.91503	.96144	1.35547	.13209	.67507	.82935	1.4813	.17065
0.83	.92863	.96784	1.36468	.13503	.68048	.83281	1.4696	.16719
0.84	.94233	.97420	1.37404	.13800	.68581	.83620	1.4581	.16380
0.85	0.95612	.98051	1.38353	.14099	0.69107	.83952	1.4470	.16048
0.86	.97000	.98677	1.39316	.14400	.69626	.84277	1.4362	.15723
0.87	.98398	.99299	1.40293	.14704	.70137	.84595	1.4258	.15405
0.88	.99806	.99916	1.41284	.15009	.70642	.84906	1.4156	.15094
0.89	1.01224	.00528	1.42289	.15317	.71139	.85211	1.4057	.14789
0.90	1.02652	.01137	1.43309	.15627	0.71630	.85509	1.3961	.14491
0.91	1.04090	.01741	1.44342	.15939	.72113	.85801	1.3867	.14199
0.92	1.05539	.02341	1.45390	.16254	.72590	.86088	1.3776	.13912
0.93	1.06998	.02937	1.46453	.16570	.73059	.86368	1.3687	.13632
0.94	1.08468	.03530	1.47530	.16888	.73522	.86642	1.3601	.13358
0.95	1.09948	.04119	1.48623	.17208	0.73978	.86910	1.3517	.13090
0.96	1.11440	.04704	1.49729	.17531	.74428	.87173	1.3436	.12827
0.97	1.12943	.05286	1.50851	.17855	.74870	.87431	1.3356	.12569
0.98	1.14457	.05864	1.51988	.18181	.75307	.87683	1.3279	.12317
0.99	1.15983	.06439	1.53141	.18509	.75736	.87930	1.3204	.12070

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value	Tanh x $\log_{10}$	Coth x Value	Coth x $\log_{10}$
1.00	1.17520	.07011	1.54308	.18839	0.76159	.88172	1.3130	.11828
1.01	1.19069	.07580	1.55491	.19171	.76576	.88409	1.3059	.11591
1.02	1.20630	.08146	1.56689	.19504	.76987	.88642	1.2989	.11358
1.03	1.22203	.08708	1.57904	.19839	.77391	.88869	1.2921	.11131
1.04	1.23788	.09268	1.59134	.20176	.77789	.89092	1.2855	.10908
1.05	1.25386	.09825	1.60379	.20515	0.78181	.89310	1.2791	.10690
1.06	1.26996	.10379	1.61641	.20855	.78566	.89524	1.2728	.10476
1.07	1.28619	.10930	1.62919	.21197	.78946	.89733	1.2667	.10267
1.08	1.30254	.11479	1.64214	.21541	.79320	.89938	1.2607	.10062
1.09	1.31903	.12025	1.65525	.21886	.79688	.90139	1.2549	.09861
1.10	1.33565	.12569	1.66852	.22233	0.80050	.90336	1.2492	.09664
1.11	1.35240	.13111	1.68196	.22582	.80406	.90529	1.2437	.09471
1.12	1.36929	.13649	1.69557	.22931	.80757	.90718	1.2383	.09282
1.13	1.38631	.14186	1.70934	.23283	.81102	.90903	1.2330	.09097
1.14	1.40347	.14720	1.72329	.23636	.81441	.91085	1.2279	.08915
1.15	1.42078	.15253	1.73741	.23990	0.81775	.91262	1.2229	.08738
1.16	1.43822	.15783	1.75171	.24346	.82104	.91436	1.2180	.08564
1.17	1.45581	.16311	1.76618	.24703	.82427	.91607	1.2132	.08393
1.18	1.47355	.16836	1.78083	.25062	.82745	.91774	1.2085	.08226
1.19	1.49143	.17360	1.79565	.25422	.83058	.91938	1.2040	.08062
1.20	1.50946	.17882	1.81066	.25784	0.83365	.92099	1.1995	.07901
1.21	1.52764	.18402	1.82584	.26146	.83668	.92256	1.1952	.07744
1.22	1.54598	.18920	1.84121	.26510	.83965	.92410	1.1910	.07590
1.23	1.56447	.19437	1.85676	.26876	.84258	.92561	1.1868	.07439
1.24	1.58311	.19951	1.87250	.27242	.84546	.92709	1.1828	.07291
1.25	1.60192	.20464	1.88842	.27610	0.84828	.92854	1.1789	.07146
1.26	1.62088	.20975	1.90454	.27979	.85106	.92996	1.1750	.07004
1.27	1.64001	.21485	1.92084	.28349	.85380	.93135	1.1712	.06865
1.28	1.65930	.21993	1.93734	.28721	.85648	.93272	1.1676	.06728
1.29	1.67876	.22499	1.95403	.29093	.85913	.93406	1.1640	.06594
1.30	1.69838	.23004	1.97091	.29467	0.86172	.93537	1.1605	.06463
1.31	1.71818	.23507	1.98800	.29842	.86428	.93665	1.1570	.06335
1.32	1.73814	.24009	2.00528	.30217	.86678	.93791	1.1537	.06209
1.33	1.75828	.24509	2.02276	.30594	.86925	.93914	1.1504	.06086
1.34	1.77860	.25008	2.04044	.30972	.87167	.94035	1.1472	.05965
1.35	1.79909	.25505	2.05833	.31352	0.87405	.94154	1.1441	.05846
1.36	1.81977	.26002	2.07643	.31732	.87639	.94270	1.1410	.05730
1.37	1.84062	.26496	2.09473	.32113	.87869	.94384	1.1381	.05616
1.38	1.86166	.26990	2.11324	.32495	.88095	.94495	1.1351	.05505
1.39	1.88289	.27482	2.13196	.32878	.88317	.94604	1.1323	.05396
1.40	1.90430	.27974	2.15090	.33262	0.88535	.94712	1.1295	.05288
1.41	1.92591	.28464	2.17005	.33647	.88749	.94817	1.1268	.05183
1.42	1.94770	.28952	2.18942	.34033	.88960	.94919	1.1241	.05081
1.43	1.96970	.29440	2.20900	.34420	.89167	.95020	1.1215	.04980
1.44	1.99188	.29926	2.22881	.34807	.89370	.95119	1.1189	.04881
1.45	2.01427	.30412	2.24884	.35196	0.89569	.95216	1.1165	.04784
1.46	2.03686	.30896	2.26910	.35585	.89765	.95311	1.1140	.04689
1.47	2.05965	.31379	2.28958	.35976	.89958	.95404	1.1116	.04596
1.48	2.08265	.31862	2.31029	.36367	.90147	.95495	1.1093	.04505
1.49	2.10586	.32343	2.33123	.36759	.90332	.95584	1.1070	.04416

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
1.50	2.12928	.32823	2.35241	.37151	0.90515	.95672	1.1048	.04328
1.51	2.15291	.33303	2.37382	.37545	.90694	.95758	1.1026	.04242
1.52	2.17676	.33781	2.39547	.37939	.90870	.95842	1.1005	.04158
1.53	2.20082	.34258	2.41736	.38334	.91042	.95924	1.0984	.04076
1.54	2.22510	.34735	2.43949	.38730	.91212	.96005	1.0963	.03995
1.55	2.24961	.35211	2.46186	.39126	0.91379	.96084	1.0943	.03916
1.56	2.27434	.35686	2.48448	.39524	.91542	.96162	1.0924	.03838
1.57	2.29930	.36160	2.50735	.39921	.91703	.96238	1.0905	.03762
1.58	2.32449	.36633	2.53047	.40320	.91860	.96313	1.0886	.03687
1.59	2.34991	.37105	2.55384	.40719	.92015	.96386	1.0868	.03614
1.60	2.37557	.37577	2.57746	.41119	0.92167	.96457	1.0850	.03543
1.61	2.40146	.38048	2.60135	.41520	.92316	.96528	1.0832	.03472
1.62	2.42760	.38518	2.62549	.41921	.92462	.96597	1.0815	.03403
1.63	2.45397	.38987	2.64990	.42323	.92606	.96664	1.0798	.03336
1.64	2.48059	.39456	2.67457	.42725	.92747	.96730	1.0782	.03270
1.65	2.50746	.39923	2.69951	.43129	0.92886	.96795	1.0766	.03205
1.66	2.53459	.40391	2.72472	.43532	.93022	.96858	1.0750	.03142
1.67	2.56196	.40857	2.75021	.43937	.93155	.96921	1.0735	.03079
1.68	2.58959	.41323	2.77596	.44341	.93286	.96982	1.0720	.03018
1.69	2.61748	.41788	2.80200	.44747	.93415	.97042	1.0705	.02958
1.70	2.64563	.42253	2.82832	.45153	.93541	.97100	1.0691	.02900
1.71	2.67405	.42717	2.85491	.45559	.93665	.97158	1.0676	.02842
1.72	2.70273	.43180	2.88180	.45966	.93786	.97214	1.0663	.02786
1.73	2.73168	.43643	2.90897	.46374	.93906	.97269	1.0649	.02731
1.74	2.76091	.44105	2.93643	.46782	.94023	.97323	1.0636	.02677
1.75	2.79041	.44567	2.96419	.47191	0.94138	.97376	1.0623	.02624
1.76	2.82020	.45028	2.99224	.47600	.94250	.97428	1.0610	.02572
1.77	2.85026	.45488	3.02059	.48009	.94361	.97479	1.0598	.02521
1.78	2.88061	.45948	3.04925	.48419	.94470	.97529	1.0585	.02471
1.79	2.91125	.46408	3.07821	.48830	.94576	.97578	1.0574	.02422
1.80	2.94217	.46867	3.10747	.49241	0.94681	.97626	1.0562	.02374
1.81	2.97340	.47325	3.13705	.49652	.94783	.97673	1.0550	.02327
1.82	3.00492	.47783	3.16694	.50064	.94884	.97719	1.0539	.02281
1.83	3.03674	.48241	3.19715	.50476	.94983	.97764	1.0528	.02236
1.84	3.06886	.48698	3.22768	.50889	.95080	.97809	1.0518	.02191
1.85	3.10129	.49154	3.25853	.51302	0.95175	.97852	1.0507	.02148
1.86	3.13403	.49610	3.28970	.51716	.95268	.97895	1.0497	.02105
1.87	3.16709	.50066	3.32121	.52130	.95359	.97936	1.0487	.02064
1.88	3.20046	.50521	3.35305	.52544	.95449	.97977	1.0477	.02023
1.89	3.23415	.50976	3.38522	.52959	.95537	.98017	1.0467	.01983
1.90	3.26816	.51430	3.41773	.53374	0.95624	.98057	1.0458	.01943
1.91	3.30250	.51884	3.45058	.53789	.95709	.98095	1.0448	.01905
1.92	3.33718	.52338	3.48378	.54205	.95792	.98133	1.0439	.01867
1.93	3.37218	.52791	3.51733	.54621	.95873	.98170	1.0430	.01830
1.94	3.40752	.53244	3.55123	.55038	.95953	.98206	1.0422	.01794
1.95	3.44321	.53696	3.58548	.55455	0.96032	.98242	1.0413	.01758
1.96	3.47923	.54148	3.62009	.55872	.96109	.98276	1.0405	.01724
1.97	3.51561	.54600	3.65507	.56290	.96185	.98311	1.0397	.01689
1.98	3.55234	.55051	3.69041	.56707	.96259	.98344	1.0389	.01656
1.99	3.58942	.55502	3.72611	.57126	.96331	.98377	1.0381	.01623

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value	Tanh x $\log_{10}$	Coth x Value	Coth x $\log_{10}$
2.00	3.62686	.55953	3.76220	.57544	0.96403	.98409	1.0373	.01591
2.01	3.66466	.56403	3.79865	.57963	.96473	.98440	1.0366	.01560
2.02	3.70283	.56853	3.83549	.58382	.96541	.98471	1.0358	.01529
2.03	3.74138	.57303	3.87271	.58802	.96609	.98502	1.0351	.01498
2.04	3.78029	.57753	3.91032	.59221	.96675	.98531	1.0344	.01469
2.05	3.81958	.58202	3.94832	.59641	0.96740	.98560	1.0337	.01440
2.06	3.85926	.58650	3.98671	.60061	.96803	.98589	1.0330	.01411
2.07	3.89932	.59099	4.02550	.60482	.96865	.98617	1.0324	.01383
2.08	3.93977	.59547	4.06470	.60903	.96926	.98644	1.0317	.01356
2.09	3.98061	.59995	4.10430	.61324	.96986	.98671	1.0311	.01329
2.10	4.02186	.60443	4.14431	.61745	0.97045	.98697	1.0304	.01303
2.11	4.06350	.60890	4.18474	.62167	.97103	.98723	1.0298	.01277
2.12	4.10555	.61337	4.22558	.62589	.97159	.98748	1.0292	.01252
2.13	4.14801	.61784	4.26685	.63011	.97215	.98773	1.0286	.01227
2.14	4.19089	.62231	4.30855	.63433	.97269	.98798	1.0281	.01202
2.15	4.23419	.62677	4.35067	.63856	0.97323	.98821	1.0275	.01179
2.16	4.27791	.63123	4.39323	.64278	.97375	.98845	1.0270	.01155
2.17	4.32205	.63569	4.43623	.64701	.97426	.98868	1.0264	.01132
2.18	4.36663	.64015	4.47967	.65125	.97477	.98890	1.0259	.01110
2.19	4.41165	.64460	4.52356	.65548	.97526	.98912	1.0254	.01088
2.20	4.45711	.64905	4.56791	.65972	0.97574	.98934	1.0249	.01066
2.21	4.50301	.65350	4.61271	.66396	.97622	.98955	1.0244	.01045
2.22	4.54936	.65795	4.65797	.66820	.97668	.98975	1.0239	.01025
2.23	4.59617	.66240	4.70370	.67244	.97714	.98996	1.0234	.01004
2.24	4.64344	.66684	4.74989	.67668	.97759	.99016	1.0229	.00984
2.25	4.69117	.67128	4.79657	.68093	0.97803	.99035	1.0225	.00965
2.26	4.73937	.67572	4.84372	.68518	.97846	.99054	1.0220	.00946
2.27	4.78804	.68016	4.89136	.68943	.97888	.99073	1.0216	.00927
2.28	4.83720	.68459	4.93948	.69368	.97929	.99091	1.0211	.00909
2.29	4.88684	.68903	4.98810	.69794	.97970	.99109	1.0207	.00891
2.30	4.93696	.69346	5.03722	.70219	0.98010	.99127	1.0203	.00873
2.31	4.98758	.69789	5.08684	.70645	.98049	.99144	1.0199	.00856
2.32	5.03870	.70232	5.13697	.71071	.98087	.99161	1.0195	.00839
2.33	5.09032	.70675	5.18762	.71497	.98124	.99178	1.0191	.00822
2.34	5.14245	.71117	5.23878	.71923	.98161	.99194	1.0187	.00806
2.35	5.19510	.71559	5.29047	.72349	0.98197	.99210	1.0184	.00790
2.36	5.24827	.72002	5.34269	.72776	.98233	.99226	1.0180	.00774
2.37	5.30196	.72444	5.39544	.73203	.98267	.99241	1.0176	.00759
2.38	5.35618	.72885	5.44873	.73630	.98301	.99256	1.0173	.00744
2.39	5.41093	.73327	5.50256	.74056	.98335	.99271	1.0169	.00729
2.40	5.46623	.73769	5.55695	.74484	0.98367	.99285	1.0166	.00715
2.41	5.52207	.74210	5.61189	.74911	.98400	.99299	1.0163	.00701
2.42	5.57847	.74652	5.66739	.75338	.98431	.99313	1.0159	.00687
2.43	5.63542	.75093	5.72346	.75766	.98462	.99327	1.0156	.00673
2.44	5.69294	.75534	5.78010	.76194	.98492	.99340	1.0153	.00660
2.45	5.75103	.75975	5.83732	.76621	0.98522	.99353	1.0150	.00647
2.46	5.80969	.76415	5.89512	.77049	.98551	.99366	1.0147	.00634
2.47	5.86893	.76856	5.95352	.77477	.98579	.99379	1.0144	.00621
2.48	5.92876	.77296	6.01250	.77906	.98607	.99391	1.0141	.00609
2.49	5.98918	.77737	6.07209	.78334	.98635	.99403	1.0138	.00597

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
2.50	6.05020	.78177	6.13229	.78762	0.98661	.99415	1.0136	.00585
2.51	6.11183	.78617	6.19310	.79191	.98688	.99426	1.0133	.00574
2.52	6.17407	.79057	6.25453	.79619	.98714	.99438	1.0130	.00562
2.53	6.23692	.79497	6.31658	.80048	.98739	.99449	1.0128	.00551
2.54	6.30040	.79937	6.37927	.80477	.98764	.99460	1.0125	.00540
2.55	6.36451	.80377	6.44259	.80906	0.98788	.99470	1.0123	.00530
2.56	6.42926	.80816	6.50656	.81335	.98812	.99481	1.0120	.00519
2.57	6.49464	.81256	6.57118	.81764	.98835	.99491	1.0118	.00509
2.58	6.56068	.81695	6.63646	.82194	.98858	.99501	1.0115	.00499
2.59	6.62738	.82134	6.70240	.82623	.98881	.99511	1.0113	.00489
2.60	6.69473	.82573	6.76901	.83052	0.98903	.99521	1.0111	.00479
2.61	6.76276	.83012	6.83629	.83482	.98924	.99530	1.0109	.00470
2.62	6.83146	.83451	6.90426	.83912	.98946	.99540	1.0107	.00460
2.63	6.90085	.83890	6.97292	.84341	.98966	.99549	1.0104	.00451
2.64	6.97092	.84329	7.04228	.84771	.98987	.99558	1.0102	.00442
2.65	7.04169	.84768	7.11234	.85201	0.99007	.99566	1.0100	.00434
2.66	7.11317	.85206	7.18312	.85631	.99026	.99575	1.0098	.00425
2.67	7.18536	.85645	7.25461	.86061	.99045	.99583	1.0096	.00417
2.68	7.25827	.86083	7.32683	.86492	.99064	.99592	1.0094	.00408
2.69	7.33190	.86522	7.39978	.86922	.99083	.99600	1.0093	.00400
2.70	7.40626	.86960	7.47347	.87352	0.99101	.99608	1.0091	.00392
2.71	7.48137	.87398	7.54791	.87783	.99118	.99615	1.0089	.00385
2.72	7.55722	.87836	7.62310	.88213	.99136	.99623	1.0087	.00377
2.73	7.63383	.88274	7.69905	.88644	.99153	.99631	1.0085	.00369
2.74	7.71121	.88712	7.77578	.89074	.99170	.99638	1.0084	.00362
2.75	7.78935	.89150	7.85328	.89505	0.99186	.99645	1.0082	.00355
2.76	7.86828	.89588	7.93157	.89936	.99202	.99652	1.0080	.00348
2.77	7.94799	.90026	8.01065	.90367	.99218	.99659	1.0079	.00341
2.78	8.02849	.90463	8.09053	.90798	.99233	.99666	1.0077	.00334
2.79	8.10980	.90901	8.17122	.91229	.99248	.99672	1.0076	.00328
2.80	8.19192	.91339	8.25273	.91660	0.99263	.99679	1.0074	.00321
2.81	8.27486	.91776	8.33506	.92091	.99278	.99685	1.0073	.00315
2.82	8.35862	.92213	8.41823	.92522	.99292	.99691	1.0071	.00309
2.83	8.44322	.92651	8.50224	.92953	.99306	.99698	1.0070	.00302
2.84	8.52867	.93088	8.58710	.93385	.99320	.99704	1.0069	.00296
2.85	8.61497	.93525	8.67281	.93816	0.99333	.99709	1.0067	.00291
2.86	8.70213	.93963	8.75940	.94247	.99346	.99715	1.0066	.00285
2.87	8.79016	.94400	8.84686	.94679	.99359	.99721	1.0065	.00279
2.88	8.87907	.94837	8.93520	.95110	.99372	.99726	1.0063	.00274
2.89	8.96887	.95274	9.02444	.95542	.99384	.99732	1.0062	.00268
2.90	9.05956	.95711	9.11458	.95974	0.99396	.99737	1.0061	.00263
2.91	9.15116	.96148	9.20564	.96405	.99408	.99742	1.0060	.00258
2.92	9.24368	.96584	9.29761	.96837	.99420	.99747	1.0058	.00253
2.93	9.33712	.97021	9.39051	.97269	.99431	.99752	1.0057	.00248
2.94	9.43149	.97458	9.48436	.97701	.99443	.99757	1.0056	.00243
2.95	9.52681	.97895	9.57915	.98133	0.99454	.99762	1.0055	.00238
2.96	9.62308	.98331	9.67490	.98565	.99464	.99767	1.0054	.00233
2.97	9.72031	.98768	9.77161	.98997	.99475	.99771	1.0053	.00229
2.98	9.81851	.99205	9.86930	.99429	.99485	.99776	1.0052	.00224
2.99	9.91770	.99641	9.96798	.99861	.99496	.99780	1.0051	.00220
3.00	10.01787	.00078	10.06766	.00293	0.99505	.99785	1.0050	.00215

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x Value	Sinh x $\log_{10}$	Cosh x Value	Cosh x $\log_{10}$	Tanh x Value	Tanh x $\log_{10}$	Coth x Value	Coth x $\log_{10}$
3.0	10.0179	.00078	10.0677	.00293	0.99505	.99785	1.0050	.00215
3.1	11.0765	.04440	11.1215	.04616	.99595	.99824	1.0041	.00176
3.2	12.2459	.08799	12.2866	.08943	.99668	.99856	1.0033	.00144
3.3	13.5379	.13155	13.5748	.13273	.99728	.99882	1.0027	.00118
3.4	14.9654	.17509	14.9987	.17605	.99777	.99903	1.0022	.00097
3.5	16.5426	.21860	16.5728	.21940	0.99818	.99921	1.0018	.00079
3.6	18.2855	.26211	18.3128	.26275	.99851	.99935	1.0015	.00065
3.7	20.2113	.30559	20.2360	.30612	.99878	.99947	1.0012	.00053
3.8	22.3394	.34907	22.3618	.34951	.99900	.99957	1.0010	.00043
3.9	24.6911	.39254	24.7113	.39290	.99918	.99964	1.0008	.00036
4.0	27.2899	.43600	27.3082	.43629	0.99933	.99971	1.0007	.00029
4.1	30.1619	.47946	30.1784	.47970	.99945	.99976	1.0005	.00024
4.2	33.3357	.52291	33.3507	.52310	.99955	.99980	1.0004	.00020
4.3	36.8431	.56636	36.8567	.56652	.99963	.99984	1.0004	.00016
4.4	40.7193	.60980	40.7316	.60993	.99970	.99987	1.0003	.00013
4.5	45.0030	.65324	45.0141	.65335	0.99975	.99989	1.0002	.00011
4.6	49.7371	.69668	49.7472	.69677	.99980	.99991	1.0002	.00009
4.7	54.9690	.74012	54.9781	.74019	.99983	.99993	1.0002	.00007
4.8	60.7511	.78355	60.7593	.78361	.99986	.99994	1.0001	.00006
4.9	67.1412	.82699	67.1486	.82704	.99989	.99995	1.0001	.00005
5.0	74.2032	.87042	74.2099	.87046	0.99991	.99996	1.0001	.00004

FACTORIALS, EXACT VALUES AND RECIPROCALS

n	$n!$	n	$n!$	n	$1/n!$	n	$1/n!$
1	1	11	39916800	1	1.	11	$.25052 \times 10^{-7}$
2	2	12	479001600	2	0.5	12	$.20877 \times 10^{-8}$
3	6	13	6227020800	3	.16667	13	$.16059 \times 10^{-9}$
4	24	14	87178291200	4	$.41667 \times 10^{-1}$	14	$.11471 \times 10^{-10}$
5	120	15	1307674368000	5	$.83333 \times 10^{-2}$	15	$.76472 \times 10^{-12}$
6	720	16	20922789888000	6	$.13889 \times 10^{-2}$	16	$.47795 \times 10^{-13}$
7	5040	17	355687428096000	7	$.19841 \times 10^{-3}$	17	$.28115 \times 10^{-14}$
8	40320	18	6402373705728000	8	$.24802 \times 10^{-4}$	18	$.15619 \times 10^{-15}$
9	362880	19	121645100408832000	9	$.27557 \times 10^{-5}$	19	$.82206 \times 10^{-17}$
10	3628800	20	2432902008176640000	10	$.27557 \times 10^{-6}$	20	$.41103 \times 10^{-18}$

DEGREES—RADIANS

1 radian = 57° 17′ 44″.80625

	log
1 radian = 57.29577 95131 degrees	1.75812 26324
1 radian = 3437.74677 07849 minutes	3.53627 38828
1 radian = 206264.80625 seconds	5.31442 51332
1 degree = 0.01745 32925 19943 radians	8.24187 73676–10
1 minute = 0.00029 08882 08666 radians	6.46372 61172–10
1 second = 0.00000 48481 36811 radians	4.68557 48668–10

DEGREES—RADIANS

The table gives in radians the angle which is expressed in degrees and minutes at the side and top. Angles expressed to the nearest minute and second can readily be converted to radians by adding to the equivalent of the whole number of degrees the equivalents of the minutes and seconds found on the third page of this table.

°	00′	10	20	30	40	50
0	0.00000	0.00291	0.00582	0.00873	0.01164	0.01454
1	0.01745	0.02036	0.02327	0.02618	0.02909	0.03200
2	0.03491	0.03782	0.04072	0.04363	0.04654	0.04945
3	0.05236	0.05527	0.05818	0.06109	0.06400	0.06690
4	0.06981	0.07272	0.07563	0.07854	0.08145	0.08436
5	0.08727	0.09018	0.09308	0.09599	0.09890	0.10181
6	0.10472	0.10763	0.11054	0.11345	0.11636	0.11926
7	0.12217	0.12508	0.12799	0.13090	0.13381	0.13672
8	0.13963	0.14254	0.14544	0.14835	0.15126	0.15417
9	0.15708	0.15999	0.16290	0.16581	0.16872	0.17162
10	0.17453	0.17744	0.18035	0.18326	0.18617	0.18908
11	0.19199	0.19490	0.19780	0.20071	0.20362	0.20653
12	0.20944	0.21235	0.21526	0.21817	0.22108	0.22398
13	0.22689	0.22980	0.23271	0.23562	0.23853	0.24144
14	0.24435	0.24725	0.25016	0.25307	0.25598	0.25889
15	0.26180	0.26471	0.26762	0.27053	0.27343	0.27634
16	0.27925	0.28216	0.28507	0.28798	0.29089	0.29380
17	0.29671	0.29961	0.30252	0.30543	0.30834	0.31125
18	0.31416	0.31707	0.31998	0.32289	0.32579	0.32870
19	0.33161	0.33452	0.33743	0.34034	0.34325	0.34616
20	0.34907	0.35197	0.35488	0.35779	0.36070	0.36361
21	0.36652	0.36943	0.37234	0.37525	0.37815	0.38106
22	0.38397	0.38688	0.38979	0.39270	0.39561	0.39852
23	0.40143	0.40433	0.40724	0.41015	0.41306	0.41597
24	0.41888	0.42179	0.42470	0.42761	0.43051	0.43342
25	0.43633	0.43924	0.44215	0.44506	0.44797	0.45088
26	0.45379	0.45669	0.45960	0.46251	0.46542	0.46833
27	0.47124	0.47415	0.47706	0.47997	0.48287	0.48578
28	0.48869	0.49160	0.49451	0.49742	0.50033	0.50324
29	0.50615	0.50905	0.51196	0.51487	0.51778	0.52069
30	0.52360	0.52651	0.52942	0.53233	0.53523	0.53814
31	0.54105	0.54396	0.54687	0.54978	0.55269	0.55560
32	0.55851	0.56141	0.56432	0.56723	0.57014	0.57305
33	0.57596	0.57887	0.58178	0.58469	0.58759	0.59050
34	0.59341	0.59632	0.59923	0.60214	0.60505	0.60796
35	0.61087	0.61377	0.61668	0.61959	0.62250	0.62541
36	0.62832	0.63123	0.63414	0.63705	0.63995	0.64286
37	0.64577	0.64868	0.65159	0.65450	0.65741	0.66032
38	0.66323	0.66613	0.66904	0.67195	0.67486	0.67777
39	0.68068	0.68359	0.68650	0.68941	0.69231	0.69522
40	0.69813	0.70104	0.70395	0.70686	0.70977	0.71268
41	0.71558	0.71849	0.72140	0.72431	0.72722	0.73013
42	0.73304	0.73595	0.73886	0.74176	0.74467	0.74758
43	0.75049	0.75340	0.75631	0.75922	0.76213	0.76504
44	0.76794	0.77085	0.77376	0.77667	0.77958	0.78249
45	0.78540	0.78831	0.79122	0.79412	0.79703	0.79994
46	0.80285	0.80576	0.80867	0.81158	0.81449	0.81740
47	0.82030	0.82321	0.82612	0.82903	0.83194	0.83485
48	0.83776	0.84067	0.84358	0.84648	0.84939	0.85230
49	0.85521	0.85812	0.86103	0.86394	0.86685	0.86976
50	0.87266	0.87557	0.87848	0.88139	0.88430	0.88721

DEGREES—RADIANS (Continued)

°	00′	10	20	30	40	50
50	0.87266	0.87557	0.87848	0.88139	0.88430	0.88721
51	0.89012	0.89303	0.89594	0.89884	0.90175	0.90466
52	0.90757	0.91048	0.91339	0.91630	0.91921	0.92212
53	0.92502	0.92793	0.93084	0.93375	0.93666	0.93957
54	0.94248	0.94539	0.94830	0.95120	0.95411	0.95702
55	0.95993	0.96284	0.96575	0.96866	0.97157	0.97448
56	0.97738	0.98029	0.98320	0.98611	0.98902	0.99193
57	0.99484	0.99775	1.00066	1.00356	1.00647	1.00938
58	1.01229	1.01520	1.01811	1.02102	1.02393	1.02684
59	1.02974	1.03265	1.03556	1.03847	1.04138	1.04429
60	1.04720	1.05011	1.05302	1.05592	1.05883	1.06174
61	1.06465	1.06756	1.07047	1.07338	1.07629	1.07920
62	1.08210	1.08501	1.08792	1.09083	1.09374	1.09665
63	1.09956	1.10247	1.10538	1.10828	1.11119	1.11410
64	1.11701	1.11992	1.12283	1.12574	1.12865	1.13156
65	1.13446	1.13737	1.14028	1.14319	1.14610	1.14901
66	1.15192	1.15483	1.15774	1.16064	1.16355	1.16646
67	1.16937	1.17228	1.17519	1.17810	1.18101	1.18392
68	1.18682	1.18973	1.19264	1.19555	1.19846	1.20137
69	1.20428	1.20719	1.21009	1.21300	1.21591	1.21882
70	1.22173	1.22464	1.22755	1.23046	1.23337	1.23627
71	1.23918	1.24209	1.24500	1.24791	1.25082	1.25373
72	1.25664	1.25955	1.26245	1.26536	1.26827	1.27118
73	1.27409	1.27700	1.27991	1.28282	1.28573	1.28863
74	1.29154	1.29445	1.29736	1.30027	1.30318	1.30609
75	1.30900	1.31191	1.31481	1.31772	1.32063	1.32354
76	1.32645	1.32936	1.33227	1.33518	1.33809	1.34099
77	1.34390	1.34681	1.34972	1.35263	1.35554	1.35845
78	1.36136	1.36427	1.36717	1.37008	1.37299	1.37590
79	1.37881	1.38172	1.38463	1.38754	1.39045	1.39335
80	1.39626	1.39917	1.40208	1.40499	1.40790	1.41081
81	1.41372	1.41663	1.41953	1.42244	1.42535	1.42826
82	1.43117	1.43408	1.43699	1.43990	1.44281	1.44571
83	1.44862	1.45153	1.45444	1.45735	1.46026	1.46317
84	1.46608	1.46899	1.47189	1.47480	1.47771	1.48062
85	1.48353	1.48644	1.48935	1.49226	1.49517	1.49807
86	1.50098	1.50389	1.50680	1.50971	1.51262	1.51553
87	1.51844	1.52135	1.52425	1.52716	1.53007	1.53298
88	1.53589	1.53880	1.54171	1.54462	1.54753	1.55043
89	1.55334	1.55625	1.55916	1.56207	1.56498	1.56789
90	1.57080	1.57371	1.57661	1.57952	1.58243	1.58534
91	1.58825	1.59116	1.59407	1.59698	1.59989	1.60279
92	1.60570	1.60861	1.61152	1.61443	1.61734	1.62025
93	1.62316	1.62607	1.62897	1.63188	1.63479	1.63770
94	1.64061	1.64352	1.64643	1.64934	1.65225	1.65515
95	1.65806	1.66097	1.66388	1.66679	1.66970	1.67261
96	1.67552	1.67842	1.68133	1.68424	1.68715	1.69006
97	1.69297	1.69588	1.69879	1.70170	1.70460	1.70751
98	1.71042	1.71333	1.71624	1.71915	1.72206	1.72497
99	1.72788	1.73078	1.73369	1.73660	1.73951	1.74242
100	1.74533	1.74824	1.75115	1.75406	1.75696	1.75987
101	1.76278	1.76569	1.76860	1.77151	1.77442	1.77733
102	1.78024	1.78314	1.78605	1.78896	1.79187	1.79478
103	1.79769	1.80060	1.80351	1.80642	1.80932	1.81223
104	1.81514	1.81805	1.82096	1.82387	1.82678	1.82969
105	1.83260	1.83550	1.83841	1.84132	1.84423	1.84714
106	1.85004	1.85296	1.85587	1.85878	1.86168	1.86459
107	1.86750	1.87041	1.87332	1.87623	1.87914	1.88205
108	1.88496	1.88786	1.89077	1.89368	1.89659	1.89950
109	1.90241	1.90532	1.90823	1.91114	1.91404	1.91695
110	1.91986	1.92277	1.92568	1.92859	1.93150	1.93441

DEGREES—RADIANS (Concluded)

Deg.	Radians	Deg.	Radians	Min.	Radians	Sec.	Radians
90	1.57080	**150**	2.61799	**0**	0.00000	**0**	0.00000
91	1.58825	151	2.63545	1	0.00029	1	0.00000
92	1.60570	152	2.65290	2	0.00058	2	0.00001
93	1.62316	153	2.67035	3	0.00087	3	0.00001
94	1.64061	154	2.68781	4	0.00116	4	0.00002
95	1.65806	**155**	2.70526	**5**	0.00145	**5**	0.00002
96	1.67552	156	2.72271	6	0.00175	6	0.00003
97	1.69297	157	2.74017	7	0.00204	7	0.00003
98	1.71042	158	2.75762	8	0.00233	8	0.00004
99	1.72788	159	2.77507	9	0.00262	9	0.00004
100	1.74533	**160**	2.79253	**10**	0.00291	**10**	0.00005
101	1.76278	161	2.80998	11	0.00320	11	0.00005
102	1.78024	162	2.82743	12	0.00349	12	0.00006
103	1.79769	163	2.84489	13	0.00378	13	0.00006
104	1.81514	164	2.86234	14	0.00407	14	0.00007
105	1.83260	**165**	2.87979	**15**	0.00436	**15**	0.00007
106	1.85005	166	2.89725	16	0.00465	16	0.00008
107	1.86750	167	2.91470	17	0.00495	17	0.00008
108	1.88496	168	2.93215	18	0.00524	18	0.00009
109	1.90241	169	2.94961	19	0.00553	19	0.00009
110	1.91986	**170**	2.96706	**20**	0.00582	**20**	0.00010
111	1.93732	171	2.98451	21	0.00611	21	0.00010
112	1.95477	172	3.00197	22	0.00640	22	0.00011
113	1.97222	173	3.01942	23	0.00669	23	0.00011
114	1.98968	174	3.03687	24	0.00698	24	0.00012
115	2.00713	**175**	3.05433	**25**	0.00727	**25**	0.00012
116	2.02458	176	3.07178	26	0.00756	26	0.00013
117	2.04204	177	3.08923	27	0.00785	27	0.00013
118	2.05949	178	3.10669	28	0.00814	28	0.00014
119	2.07694	179	3.12414	29	0.00844	29	0.00014
120	2.09440	**180**	3.14159	**30**	0.00873	**30**	0.00015
121	2.11185	190	3.31613	31	0.00902	31	0.00015
122	2.12930	200	3.49066	32	0.00931	32	0.00016
123	2.14676	210	3.66519	33	0.00960	33	0.00016
124	2.16421	220	3.83972	34	0.00989	34	0.00016
125	2.18166	**230**	4.01426	**35**	0.01018	**35**	0.00017
126	2.19911	240	4.18879	36	0.01047	36	0.00017
127	2.21657	250	4.36332	37	0.01076	37	0.00018
128	2.23402	260	4.53786	38	0.01105	38	0.00018
129	2.25147	270	4.71239	39	0.01134	39	0.00019
130	2.26893	**280**	4.88692	**40**	0.01164	**40**	0.00019
131	2.28638	290	5.06145	41	0.01193	41	0.00020
132	2.30383	300	5.23599	42	0.01222	42	0.00020
133	2.32129	310	5.41052	43	0.01251	43	0.00021
134	2.33874	320	5.58505	44	0.01280	44	0.00021
135	2.35619	**330**	5.75959	**45**	0.01309	**45**	0.00022
136	2.37365	340	5.93412	46	0.01338	46	0.00022
137	2.39110	350	6.10865	47	0.01367	47	0.00023
138	2.40855	360	6.28319	48	0.01396	48	0.00023
139	2.42601	370	6.45772	49	0.01425	49	0.00024
140	2.44346	**380**	6.63225	**50**	0.01454	**50**	0.00024
141	2.46091	390	6.80678	51	0.01484	51	0.00025
142	2.47837	400	6.98132	52	0.01513	52	0.00025
143	2.49582	410	7.15585	53	0.01542	53	0.00026
144	2.51327	420	7.33038	54	0.01571	54	0.00026
145	2.53073	**430**	7.50492	**55**	0.01600	**55**	0.00027
146	2.54818	440	7.67945	56	0.01629	56	0.00027
147	2.56563	450	7.85398	57	0.01658	57	0.00028
148	2.58309	460	8.02851	58	0.01687	58	0.00028
149	2.60054	470	8.20305	59	0.01716	59	0.00029
150	2.61799	**480**	8.37758	**60**	0.01745	**60**	0.00029

DEGREES AND DECIMAL FRACTIONS TO RADIANS

The table below facilitates conversion of an angle expressed in degrees and decimal fractions into radians. To convert 25.78 into radians, find the equivalents, successively, of 20°, 5°, 0°.7, 0°.08 and add.

Deg.	Radians	Deg.	Radians	Deg.	Radians	Deg.	Radians	Deg.	Radians
10	0.174533	1	0.017453	0.1	0.001745	0.01	0.000175	0.001	0.000017
20	0.349066	2	.034907	.2	.003491	.02	.000349	.002	.000035
30	0.523599	3	.052360	.3	.005236	.03	.000524	.003	.000052
40	0.698132	4	.069813	.4	.006981	.04	.000698	.004	.000070
50	0.872665	5	.087267	.5	.008727	.05	.000873	.005	.000087
60	1.047198	6	.104720	.6	.010472	.06	.001047	.006	.000105
70	1.221731	7	.122173	.7	.012217	.07	.001222	.007	.000122
80	1.396264	8	.139626	.8	.013963	.08	.001396	.008	.000140
90	1.570797	9	.157080	.9	.015708	.09	.001571	.009	.000157

RADIANS—DEGREES

Radians	Degrees	Radians	Degrees	Radians	Degrees	Radians	Degrees
1	57.2958	0.1	5.7296	0.01	0.5730	0.001	0.0573
2	114.5916	.2	11.4592	.02	1.1459	.002	.1146
3	171.8873	.3	17.1887	.03	1.7189	.003	.1719
4	229.1831	.4	22.9183	.04	2.2918	.004	.2292
5	286.4789	.5	28.6479	.05	2.8648	.005	.2865
6	343.7747	.6	34.3775	.06	3.4377	.006	.3438
7	401.0705	.7	40.1071	.07	4.0107	.007	.4011
8	458.3662	.8	45.8366	.08	4.5837	.008	.4584
9	515.6620	.9	51.5662	.09	5.1566	.009	.5157
10	572.9578	1.0	57.2958	.10	5.7296	.010	.5730

RADIANS—DEGREES

Multiples and Fractions of π Radians

Radians	Radians	Deg.	Radians	Radians	Deg.	Radians	Radians	Deg.
π	3.1416	180	$\pi/2$	1.5708	90	$2\pi/3$	2.0944	120
2π	6.2832	360	$\pi/3$	1.0472	60	$3\pi/4$	2.3562	135
3π	9.4248	540	$\pi/4$	0.7854	45	$5\pi/6$	2.6180	150
4π	12.5664	720	$\pi/5$	0.6283	36	$7\pi/6$	3.6652	210
5π	15.7080	900	$\pi/6$	0.5236	30	$5\pi/4$	3.9270	225
6π	18.8496	1080	$\pi/7$	0.4489	25.714	$4\pi/3$	4.1888	240
7π	21.9911	1260	$\pi/8$	0.3927	22.5	$3\pi/2$	4.7124	270
8π	25.1327	1440	$\pi/9$	0.3491	20	$5\pi/3$	5.2360	300
9π	28.2743	1620	$\pi/10$	0.3142	18	$7\pi/4$	5.4978	315
10π	31.4159	1800	$\pi/12$	0.2618	15	$11\pi/6$	5.7596	330

DECIMAL EQUIVALENTS OF COMMON FRACTIONS

	1/32	2/64 =	0.03125		17/32	34/64 =	0.53125
1/16	2/32	4/64 =	.0625	9/16	18/32	36/64 =	.5625
	3/32	6/64 =	.09375		19/32	38/64 =	.59375
1/8	4/32	8/64 =	.125	5/8	20/32	40/64 =	.625
	5/32	10/64 =	.15625		21/32	42/64 =	.65625
3/16	6/32	12/64 =	.1875	11/16	22/32	44/64 =	.6875
	7/32	14/64 =	.21875		23/32	46/64 =	.71875
1/4	8/32	16/64 =	.25	3/4	24/32	48/64 =	.75
	9/32	18/64 =	.28125		25/32	50/64 =	.78125
5/16	10/32	20/64 =	.3125	13/16	26/32	52/64 =	.8125
	11/32	22/64 =	.34375		27/32	54/64 =	.84375
3/8	12/32	24/64 =	.375	7/8	28/32	56/64 =	.875
	13/32	26/64 =	.40625		29/32	58/64 =	.90625
7/16	14/32	28/64 =	.4375	15/16	30/32	60/64 =	.9375
	15/32	30/64 =	.46875		31/32	62/64 =	.96875
1/2	16/32	32/64 =	.50				

MINUTES AND SECONDS TO DECIMAL PARTS OF A DEGREE

MINUTES AND SECONDS TO DECIMAL PARTS OF A DEG.

Min.	Degrees	Sec.	Degrees
0	0.00000	**0**	0.00000
1	.01667	1	.00028
2	.03333	2	.00056
3	.05	3	.00083
4	.06667	4	.00111
5	.08333	5	.00139
6	.10	6	.00167
7	.11667	7	.00194
8	.13333	8	.00222
9	.15	9	.0025
10	0.16667	**10**	0.00278
11	.18333	11	.00306
12	.20	12	.00333
13	.21667	13	.00361
14	.23333	14	.00389
15	.25	15	.00417
16	.26667	16	.00444
17	.28333	17	.00472
18	.30	18	.005
19	.31667	19	.00528
20	0.33333	**20**	0.00556
21	.35	21	.00583
22	.36667	22	.00611
23	.38333	23	.00639
24	.40	24	.00667
25	.41667	25	.00694
26	.43333	26	.00722
27	.45	27	.0075
28	.46667	28	.00778
29	.48333	29	.00806
30	0.50	**30**	0.00833
31	.51667	31	.00861
32	.53333	32	.00889
33	.55	33	.00917
34	.56667	34	.00944
35	.58333	35	.00972
36	.60	36	.01
37	.61667	37	.01028
38	.63333	38	.01056
39	.65	39	.01083
40	0.66667	**40**	0.01111
41	.68333	41	.01139
42	.70	42	.01167
43	.71667	43	.01194
44	.73333	44	.01222
45	.75	45	.0125
46	.76667	46	.01278
47	.78333	47	.01306
48	.80	48	.01333
49	.81667	49	.01361
50	0.83333	**50**	0.01389
51	.85	51	.01417
52	.86667	52	.01444
53	.88333	53	.01472
54	.90	54	.015
55	.91667	55	.01528
56	.93333	56	.01556
57	.95	57	.01583
58	.96667	58	.01611
59	.98333	59	.01639
60	1.00	**60**	0.01667

DECIMAL PARTS OF A DEGREE TO MINUTES AND SECONDS

Deg.	′	″	Deg.	′	″
0.00	0	00	**0.60**	36	
.01	0	36	.61	36	36
.02	1	12	.62	37	12
.03	1	48	.63	37	48
.04	2	24	.64	38	24
.05	3		.65	39	
.06	3	36	.66	39	36
.07	4	12	.67	40	12
.08	4	48	.68	40	48
.09	5	24	.69	41	24
0.10	6		**0.70**	42	
.11	6	36	.71	42	36
.12	7	12	.72	43	12
.13	7	48	.73	43	48
.14	8	24	.74	44	24
.15	9		.75	45	
.16	9	36	.76	45	36
.17	10	12	.77	46	12
.18	10	48	.78	46	48
.19	11	24	.79	47	24
0.20	12		**0.80**	48	
.21	12	36	.81	48	36
.22	13	12	.82	49	12
.23	13	48	.83	49	48
.24	14	24	.84	50	24
.25	15		.85	51	
.26	15	36	.86	51	36
.27	16	12	.87	52	12
.28	16	48	.88	52	48
.29	17	24	.89	53	24
0.30	18		**0.90**	54	
.31	18	36	.91	54	36
.32	19	12	.92	55	12
.33	19	48	.93	55	48
.34	20	24	.94	56	24
.35	21		.95	57	
.36	21	36	.96	57	36
.37	22	12	.97	58	12
.38	22	48	.98	58	48
.39	23	24	.99	59	24
0.40	24		**1.00**	60	
.41	24	36			
.42	25	12			
.43	25	48			
.44	26	24			
.45	27				
.46	27	36			
.47	28	12			
.48	28	48			
.49	29	24			
0.50	30				
.51	30	36			
.52	31	12			
.53	31	48			
.54	32	24			
.55	33				
.56	33	36			
.57	34	12			
.58	34	48			
.59	35	24			
0.60	36				

Deg.	Sec.
0.000	0.0
.001	3.6
.002	7.2
.003	10.8
.004	14.4
.005	18.
.006	21.6
.007	25.2
.008	28.8
.009	32.4
0.010	36.

NUMERICAL CONSTANTS

Numbers Containing π

$\pi = 3.14159\ 26536$ $\log_{10}\pi = 0.49714\ 98727$ $\log_e \pi = 1.14472\ 98858$

	Number	Logarithm		Number	Logarithm
π	3.1415 927	0.4971 499	π^2	9.8696 044	0.9942 997
2π	6.2831 853	0.7981 799	$2\pi^2$	19.7392 088	1.2953 297
3π	9.4247 780	0.9742 711	$4\pi^2$	39.4784 176	1.5963 597
4π	12.5663 706	1.0992 099	$1/\pi^2$	0.1013 212	9.0057 003 − 10
8π	25.1327 412	1.4002 399	$1/(2\pi^2)$	0.0506 606	8.7046 703 − 10
$\pi/2$	1.5707 963	0.1961 199	$1/(4\pi^2)$	0.0253 303	8.4036 403 − 10
$\pi/3$	1.0471 976	0.0200 286	$\sqrt{\pi}$	1.7724 539	0.2485 749
$\pi/4$	0.7853 982	9.8950 899 − 10	$\sqrt{\pi/4}$ or	0.8862 269	9.9475 449 − 10
$\pi/6$	0.5235 988	9.7189 986 − 10	$\sqrt{\pi}/2$		
$\pi/8$	0.3926 991	9.5940 599 − 10	$\sqrt{\pi/4}$	0.4431 135	9.6465 149 − 10
$2\pi/3$	2.0943 951	0.3210 586	$\sqrt{\pi/2}$	1.2533 141	0.0980 599
$4\pi/3$	4.1887 902	0.6220 886	$\sqrt{2/\pi}$	0.7978 846	9.9019 401 − 10
$1/\pi$	0.3183 099	9.5028 501 − 10	π^3	31.0062 767	1.4914 496
$2/\pi$	0.6366 198	9.8038 801 − 10	$\sqrt[3]{\pi}$	1.4645 919	0.1657 166
$4/\pi$	1.2732 395	0.1049 101	$1/\sqrt[3]{\pi}$	0.6827 841	9.8342 834 − 10
$1/(2\pi)$	0.1591 549	9.2018 201 − 10	$\sqrt[3]{\pi^2}$	2.1450 294	0.3314 332
$1/(4\pi)$	0.0795 775	8.9007 901 − 10	$1/\sqrt{\pi}$	0.5641 896	9.7514 251 − 10
$1/(6\pi)$	0.0530 516	8.7246 989 − 10	$2/\sqrt{\pi}$ or	1.1283 792	0.0524 551
$1/(8\pi)$	0.0397 887	8.5997 601 − 10	$\sqrt{4/\pi}$		

Logarithmic Constants

$e = 2.71828\ 18285$ $M = \log_{10} e = 0.43429\ 44819$

$1/M = \log_e 10 = 2.30258\ 50930$ $\log_{10} M = \log_{10}\log_{10} e = 9.63778\ 43113$

$1/e = 0.36787\ 94412$

$\log_e 2 = 0.69314\ 71806$ $\log_{10} 2 = 0.30102\ 99957$

Change of Base

$$\log_a x = \log_b x / \log_b a$$

$$\log_{10} x = \log_e x / \log_e 10 \qquad \log_e x = \log_{10} x / \log_{10} e$$

$$\log_e x = 1/M \log_{10} x = 2.30258\ 50930 \log_{10} x$$

$$\log_{10} x = M \log_e x = 0.43429\ 44819 \log_e x$$

MISCELLANEOUS CONSTANTS

Mean radius of the earth, 3959 miles = 6371 kilometers.

1 degree of latitude at 40° = 69 miles.

1 nautical mile = 1′ of arc on the earth's surface at the equator.

Mean density of the earth, 5.522 grams per cm³.

Constant of gravitation, $K = 6.664 \times 10^{-8}$ = the attraction in dynes between two gram masses one centimeter apart.

Acceleration due to gravity at sea level, lat. 45° = 980.616 cm. per sec. per sec. = 32.172 feet per sec. per sec.

Length of seconds pendulum at sea level, lat. 45° = 99.356 cm. = 39.116 in.

Density of mercury at 0°C. = 13.59509 g. per cm³.

Density of water, maximum at 3.98° C. = 0.999973 g. per cm³.

Density of dry air at 0° C. and 760 mm. = .001293 g. per cm³.

Velocity of sound in dry air at 0° C., 33,136 cm. per sec. = 1089 feet per sec.

Velocity of light in a vacuum = 2.99796×10^{10} cm. per sec. = 983.571×10^{6} feet per sec. = 186,284 mi./sec.

Heat equivalent of fusion of water 79.24 cal. per gram.

Heat equivalent of vaporization of water, 535.9 cal. per gram.

Coefficient of expansion of gases, .003665.

Specific heat of air, at constant pressure, 0.238.

Electrochemical equivalent of silver, 0.001118 g. per sec. per int. ampere.

Mean wave length of sodium light, .00005893 cm. or 5893. ångström units.

Absolute wave length of red cadmium line in air, 760 mm. pressure, 15° C.; 6438.4696 ångström units.

GREEK ALPHABET

Greek letter	Greek name	English equivalent	Greek letter	Greek name	English equivalent
Α α	Alpha	a	Ν ν	Nu	n
Β β	Beta	b	Ξ ξ	Xi	x
Γ γ	Gamma	g	Ο ο	Omicron	ŏ
Δ δ	Delta	d	Π π	Pi	p
Ε ε	Epsilon	ĕ	Ρ ρ	Rho	r
Ζ ζ	Zeta	z	Σ σ	Sigma	s
Η η	Eta	ē	Τ τ	Tau	t
Θ θ	Theta	th	Υ υ	Upsilon	u
Ι ι	Iota	i	Φ φ	Phi	ph
Κ κ	Kappa	k	Χ χ	Chi	ch
Λ λ	Lambda	l	Ψ ψ	Psi	ps
Μ μ	Mu	m	Ω ω	Omega	ō

NUMERICAL TABLES

Reciprocals, Circumference and Area of Circles

As a matter of convenience, the values of $1000 \times (1/n)$ are given in the table. To obtain the actual value of the reciprocal, shift the decimal point three places to the left.

Circumferences and areas of circles are given for the values of n as the diameter.

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
0	∞	0.000000	.0000000	**50**	20.00000	157.0796	1963.495
1	1000.000	3.141593	.7853982	51	19.60784	160.2212	2042.821
2	500.0000	6.283185	3.141593	52	19.23077	163.3628	2123.717
3	333.3333	9.424778	7.068583	53	18.86792	166.5044	2206.183
4	250.0000	12.56637	12.56637	54	18.51852	169.6460	2290.221
5	200.0000	15.70796	19.63495	55	18.18182	172.7876	2375.829
6	166.6667	18.84956	28.27433	56	17.85714	175.9292	2463.009
7	142.8571	21.99115	38.48451	57	17.54386	179.0708	2551.759
8	125.0000	25.13274	50.26548	58	17.24138	182.2124	2642.079
9	111.1111	28.27433	63.61725	59	16.94915	185.3540	2733.971
10	100.0000	31.41593	78.53982	**60**	16.66667	188.4956	2827.433
11	90.90909	34.55752	95.03318	61	16.39344	191.6372	2922.467
12	83.33333	37.69911	113.0973	62	16.12903	194.7787	3019.071
13	76.92308	40.84070	132.7323	63	15.87302	197.9203	3117.245
14	71.42857	43.98230	153.9380	64	15.62500	201.0619	3216.991
15	66.66667	47.12389	176.7146	65	15.38462	204.2035	3318.307
16	62.50000	50.26548	201.0619	66	15.15152	207.3451	3421.194
17	58.82353	53.40708	226.9801	67	14.92537	210.4867	3525.652
18	55.55556	56.54867	254.4690	68	14.70588	213.6283	3631.681
19	52.63158	59.69026	283.5287	69	14.49275	216.7699	3739.281
20	50.00000	62.83185	314.1593	**70**	14.28571	219.9115	3848.451
21	47.61905	65.97345	346.3606	71	14.08451	223.0531	3959.192
22	45.45455	69.11504	380.1327	72	13.88889	226.1947	4071.504
23	43.47826	72.25663	415.4756	73	13.69863	229.3363	4185.387
24	41.66667	75.39822	452.3893	74	13.51351	232.4779	4300.840
25	40.00000	78.53982	490.8739	75	13.33333	235.6194	4417.865
26	38.46154	81.68141	530.9292	76	13.15789	238.7610	4536.460
27	37.03704	84.82300	572.5553	77	12.98701	241.9026	4656.626
28	35.71429	87.96459	615.7522	78	12.82051	245.0442	4778.362
29	34.48276	91.10619	660.5199	79	12.65823	248.1858	4901.670
30	33.33333	94.24778	706.8583	**80**	12.50000	251.3274	5026.548
31	32.25806	97.38937	754.7676	81	12.34568	254.4690	5152.997
32	31.25000	100.5310	804.2477	82	12.19512	257.6106	5281.017
33	30.30303	103.6726	855.2986	83	12.04819	260.7522	5410.608
34	29.41176	106.8142	907.9203	84	11.90476	263.8938	5541.769
35	28.57143	109.9557	962.1128	85	11.76471	267.0354	5674.502
36	27.77778	113.0973	1017.876	86	11.62791	270.1770	5808.805
37	27.02703	116.2389	1075.210	87	11.49425	273.3186	5944.679
38	26.31579	119.3805	1134.115	88	11.36364	276.4602	6082.123
39	25.64103	122.5221	1194.591	89	11.23596	279.6017	6221.139
40	25.00000	125.6637	1256.637	**90**	11.11111	282.7433	6361.725
41	24.39024	128.8053	1320.254	91	10.98901	285.8849	6503.882
42	23.80952	131.9469	1385.442	92	10.86957	289.0265	6647.610
43	23.25581	135.0885	1452.201	93	10.75269	292.1681	6792.909
44	22.72727	138.2301	1520.531	94	10.63830	295.3097	6939.778
45	22.22222	141.3717	1590.431	95	10.52632	298.4513	7088.218
46	21.73913	144.5133	1661.903	96	10.41667	301.5929	7238.229
47	21.27660	147.6549	1734.945	97	10.30928	304.7345	7389.811
48	20.83333	150.7964	1809.557	98	10.20408	307.8761	7542.964
49	20.40816	153.9380	1885.741	99	10.10101	311.0177	7697.687
50	20.00000	157.0796	1963.495	**100**	10.00000	314.1593	7853.982

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
100	10.00000	314.1593	7853.982	**150**	6.666 667	471.2389	17671.46
101	9.900 990	317.3009	8011.847	151	6.622 517	474.3805	17907.86
102	9.803 922	320.4425	8171.282	152	6.578 947	477.5221	18145.84
103	9.708 738	323.5840	8332.289	153	6.535 948	480.6637	18385.39
104	9.615 385	326.7256	8494.867	154	6.493 506	483.8053	18626.50
105	9.523 810	329.8672	8659.015	155	6.451 613	486.9469	18869.19
106	9.433 962	333.0088	8824.734	156	6.410 256	490.0885	19113.45
107	9.345 794	336.1504	8992.024	157	6.369 427	493.2300	19359.28
108	9.259 259	339.2920	9160.884	158	6.329 114	496.3716	19606.68
109	9.174 312	342.4336	9331.316	159	6.289 308	499.5132	19855.65
110	9.090 909	345.5752	9503.318	**160**	6.250 000	502.6548	20106.19
111	9.009 009	348.7168	9676.891	161	6.211 180	505.7964	20358.31
112	8.928 571	351.8584	9852.035	162	6.172 840	508.9380	20611.99
113	8.849 558	355.0000	10028.75	163	6.134 969	512.0796	20867.24
114	8.771 930	358.1416	10207.03	164	6.097 561	515.2212	21124.07
115	8.695 652	361.2832	10386.89	165	6.060 606	518.3628	21382.46
116	8.620 690	364.4247	10568.32	166	6.024 096	521.5044	21642.43
117	8.547 009	367.5663	10751.32	167	5.988 024	524.6460	21903.97
118	8.474 576	370.7079	10935.88	168	5.952 381	527.7876	22167.08
119	8.403 361	373.8495	11122.02	169	5.917 160	530.9292	22431.76
120	8.333 333	376.9911	11309.73	**170**	5.882 353	534.0708	22698.01
121	8.264 463	380.1327	11499.01	171	5.847 953	537.2123	22965.83
122	8.196 721	383.2743	11689.87	172	5.813 953	540.3539	23235.22
123	8.130 081	386.4159	11882.29	173	5.780 347	543.4955	23506.18
124	8.064 516	389.5575	12076.28	174	5.747 126	546.6371	23778.71
125	8.000 000	392.6991	12271.85	175	5.714 286	549.7787	24052.82
126	7.936 508	395.8407	12468.98	176	5.681 818	552.9203	24328.49
127	7.874 016	398.9823	12667.69	177	5.649 718	556.0619	24605.74
128	7.812 500	402.1239	12867.96	178	5.617 978	559.2035	24884.56
129	7.751 938	405.2655	13069.81	179	5.586 592	562.3451	25164.94
130	7.692 308	408.4070	13273.23	**180**	5.555 556	565.4867	25446.90
131	7.633 588	411.5486	13478.22	181	5.524 862	568.6283	25730.43
132	7.575 758	414.6902	13684.78	182	5.494 505	571.7699	26015.53
133	7.518 797	417.8318	13892.91	183	5.464 481	574.9115	26302.20
134	7.462 687	420.9734	14102.61	184	5.434 783	578.0530	26590.44
135	7.407 407	424.1150	14313.88	185	5.405 405	581.1946	26880.25
136	7.352 941	427.2566	14526.72	186	5.376 344	584.3362	27171.63
137	7.299 270	430.3982	14741.14	187	5.347 594	587.4778	27464.59
138	7.246 377	433.5398	14957.12	188	5.319 149	590.6194	27759.11
139	7.194 245	436.6814	15174.68	189	5.291 005	593.7610	28055.21
140	7.142 857	439.8230	15393.80	**190**	5.263 158	596.9026	28352.87
141	7.092 199	442.9646	15614.50	191	5.235 602	600.0442	28652.11
142	7.042 254	446.1062	15836.77	192	5.208 333	603.1858	28952.92
143	6.993 007	449.2477	16060.61	193	5.181 347	606.3274	29255.30
144	6.944 444	452.3893	16286.02	194	5.154 639	609.4690	29559.25
145	6.896 552	455.5309	16513.00	195	5.128 205	612.6106	29864.77
146	6.849 315	458.6725	16741.55	196	5.102 041	615.7522	30171.86
147	6.802 721	461.8141	16971.67	197	5.076 142	618.8938	30480.52
148	6.756 757	464.9557	17203.36	198	5.050 505	622.0353	30790.75
149	6.711 409	468.0973	17436.62	199	5.025 126	625.1769	31102.55
150	6.666 667	471.2389	17671.46	**200**	5.000 000	628.3185	31415.93

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
200	5.000 000	628.3185	31415.93	**250**	4.000 000	785.3982	49087.39
201	4.975 124	631.4601	31730.87	251	3.984 064	788.5398	49480.87
202	4.950 495	634.6017	32047.39	252	3.968 254	791.6813	49875.92
203	4.926 108	637.7433	32365.47	253	3.952 569	794.8229	50272.55
204	4.901 961	640.8849	32685.13	254	3.937 008	797.9645	50670.75
205	4.878 049	644.0265	33006.36	255	3.921 569	801.1061	51070.52
206	4.854 369	647.1681	33329.16	256	3.906 250	804.2477	51471.85
207	4.830 918	650.3097	33653.53	257	3.891 051	807.3893	51874.76
208	4.807 692	653.4513	33979.47	258	3.875 969	810.5309	52279.24
209	4.784 689	656.5929	34306.98	259	3.861 004	813.6725	52685.29
210	4.761 905	659.7345	34636.06	**260**	3.846 154	816.8141	53092.92
211	4.739 336	662.8760	34966.71	261	3.831 418	819.9557	53502.11
212	4.716 981	666.0176	35298.94	262	3.816 794	823.0973	53912.87
213	4.694 836	669.1592	35632.73	263	3.802 281	826.2389	54325.21
214	4.672 897	672.3008	35968.09	264	3.787 879	829.3805	54739.11
215	4.651 163	675.4424	36305.03	265	3.773 585	832.5221	55154.59
216	4.629 630	678.5840	36643.54	266	3.759 398	835.6636	55571.63
217	4.608 295	681.7256	36983.61	267	3.745 318	838.8052	55990.25
218	4.587 156	684.8672	37325.26	268	3.731 343	841.9468	56416.44
219	4.566 210	688.0088	37668.48	269	3.717 472	845.0884	56832.20
220	4.545 455	691.1504	38013.27	**270**	3.703 704	848.2300	57255.53
221	4.524 887	694.2920	38359.63	271	3.690 037	851.3716	57680.43
222	4.504 505	697.4336	38707.56	272	3.676 471	854.5132	58106.90
223	4.484 305	700.5752	39057.07	273	3.663 004	857.6548	58534.94
224	4.464 286	703.7168	39408.14	274	3.649 635	860.7964	58964.55
225	4.444 444	706.8583	39760.78	275	3.636 364	863.9380	59395.74
226	4.424 779	709.9999	40115.00	276	3.623 188	867.0796	59828.49
227	4.405 286	713.1415	40470.78	277	3.610 108	870.2212	60262.82
228	4.385 965	716.2831	40828.14	278	3.597 122	873.3628	60698.71
229	4.366 812	719.4247	41187.07	279	3.584 229	876.5044	61136.18
230	4.347 826	722.5663	41547.56	**280**	3.571 429	879.6459	61575.22
231	4.329 004	725.7079	41909.63	281	3.558 719	882.7875	62015.82
232	4.310 345	728.8495	42273.27	282	3.546 099	885.9291	62458.00
233	4.291 845	731.9911	42638.48	283	3.533 569	889.0707	62901.75
234	4.273 504	735.1327	43005.26	284	3.521 127	892.2123	63347.07
235	4.255 319	738.2743	43373.61	285	3.508 772	895.3539	63793.97
236	4.237 288	741.4159	43743.54	286	3.496 503	898.4955	64242.43
237	4.219 409	744.5575	44115.03	287	3.484 321	901.6371	64692.46
238	4.201 681	747.6991	44488.09	288	3.472 222	904.7787	65144.07
239	4.184 100	750.8406	44862.73	289	3.460 208	907.9203	65597.24
240	4.166 667	753.9822	45238.93	**290**	3.448 276	911.0619	66051.99
241	4.149 378	757.1238	45616.71	291	3.436 426	914.2035	66508.30
242	4.132 231	760.2654	45996.06	292	3.424 658	917.3451	66966.19
243	4.115 226	763.4070	46376.98	293	3.412 969	920.4866	67425.65
244	4.098 361	766.5486	46759.47	294	3.401 361	923.6282	67886.68
245	4.081 633	769.6902	47143.52	295	3.389 831	926.7698	68349.28
246	4.065 041	772.8318	47529.16	296	3.378 378	929.9114	68813.45
247	4.048 583	775.9734	47916.36	297	3.367 003	933.0530	69279.19
248	4.032 258	779.1150	48305.13	298	3.355 705	936.1946	69746.50
249	4.016 064	782.2566	48695.47	299	3.344 482	939.3362	70215.38
250	4.000 000	785.3982	49087.39	**300**	3.333 333	942.4778	70685.83

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
300	3.333 333	942.4778	70685.83	**350**	2.857 143	1099.557	96211.28
301	3.322 259	945.6194	71157.86	351	2.849 003	1102.699	96761.84
302	3.311 258	948.7610	71631.45	352	2.840 909	1105.841	97313.97
303	3.300 330	951.9026	72106.62	353	2.832 861	1108.982	97867.68
304	3.289 474	955.0442	72583.36	354	2.824 859	1112.124	98422.96
305	3.278 689	958.1858	73061.66	355	2.816 901	1115.265	98979.80
306	3.267 974	961.3274	73541.54	356	2.808 989	1118.407	99538.22
307	3.257 329	964.4689	74022.99	357	2.801 120	1121.549	100 098.2
308	3.246 753	967.6105	74506.01	358	2.793 296	1124.690	100 659.8
309	3.236 246	970.7521	74990.60	359	2.785 515	1127.832	101 222.9
310	3.225 806	973.8937	75476.76	**360**	2.777 778	1130.973	101 787.6
311	3.215 434	977.0353	75964.50	361	2.770 083	1134.115	102 353.9
312	3.205 128	980.1769	76453.80	362	2.762 431	1137.257	102 921.7
313	3.194 888	983.3185	76944.67	363	2.754 821	1140.398	103 491.1
314	3.184 713	986.4601	77437.12	364	2.747 253	1143.540	104 062.1
315	3.174 603	989.6017	77931.13	365	2.739 726	1146.681	104 634.7
316	3.164 557	992.7433	78426.72	366	2.732 240	1149.823	105 208.8
317	3.154 574	995.8849	78923.88	367	2.724 796	1152.965	105 784.5
318	3.144 654	999.0265	79422.60	368	2.717 391	1156.106	106 361.8
319	3.134 796	1002.168	79922.90	369	2.710 027	1159.248	106 940.6
320	3.125 000	1005.310	80424.77	**370**	2.702 703	1162.389	107 521.0
321	3.115 265	1008.451	80928.21	371	2.695 418	1165.531	108 103.0
322	3.105 590	1011.593	81433.22	372	2.688 172	1168.672	108 686.5
323	3.095 975	1014.734	81939.80	373	2.680 965	1171.814	109 271.7
324	3.086 420	1017.876	82447.96	374	2.673 797	1174.956	109 858.4
325	3.076 923	1021.018	82957.68	375	2.666 667	1178.097	110 446.6
326	3.067 485	1024.159	83468.98	376	2.659 574	1181.239	111 036.5
327	3.058 104	1027.301	83981.84	377	2.652 520	1184.380	111 627.9
328	3.048 780	1030.442	84496.28	378	2.645 503	1187.522	112 220.8
329	3.039 514	1033.584	85012.28	379	2.638 522	1190.664	112 815.4
330	3.030 303	1036.726	85529.86	**380**	2.631 579	1193.805	113 411.5
331	3.021 148	1039.867	86049.01	381	2.624 672	1196.947	114 009.2
332	3.012 048	1043.009	86569.73	382	2.617 801	1200.088	114 608.4
333	3.003 003	1046.150	87092.02	383	2.610 966	1203.230	115 209.3
334	2.994 012	1049.292	87615.88	384	2.604 167	1206.372	115 811.7
335	2.985 075	1052.434	88141.31	385	2.597 403	1209.513	116 415.6
336	2.976 190	1055.575	88668.31	386	2.590 674	1212.655	117 021.2
337	2.967 359	1058.717	89196.88	387	2.583 979	1215.796	117 628.3
338	2.958 580	1061.858	89727.03	388	2.577 320	1218.938	118 237.0
339	2.949 853	1065.000	90258.74	389	2.570 694	1222.080	118 847.2
340	2.941 176	1068.142	90792.03	**390**	2.564 103	1225.221	119 459.1
341	2.932 551	1071.283	91326.88	391	2.557 545	1228.363	120 072.5
342	2.923 977	1074.425	91863.31	392	2.551 020	1231.504	120 687.4
343	2.915 452	1077.566	92401.31	393	2.544 529	1234.646	121 304.0
344	2.906 977	1080.708	92940.88	394	2.538 071	1237.788	121 922.1
345	2.898 551	1083.849	93482.02	395	2.531 646	1240.929	122 541.7
346	2.890 173	1086.991	94024.73	396	2.525 253	1244.071	123 163.0
347	2.881 844	1090.133	94569.01	397	2.518 892	1247.212	123 785.8
348	2.873 563	1093.274	95114.86	398	2.512 563	1250.354	124 410.2
349	2.865 330	1096.416	95662.28	399	2.506 266	1253.495	125 036.2
350	2.857 143	1099.557	96211.28	**400**	2.500 000	1256.637	125 663.7

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
400	2.500 000	1256.637	125 663.7	**450**	2.222 222	1413.717	159 043.1
401	2.493 766	1259.779	126 292.8	451	2.217 295	1416.858	159 750.8
402	2.487 562	1262.920	126 923.5	452	2.212 389	1420.000	160 460.0
403	2.481 390	1266.062	127 555.7	453	2.207 506	1423.141	161 170.8
404	2.475 248	1269.203	128 189.5	454	2.202 643	1426.283	161 883.1
405	2.469 136	1272.345	128 824.9	455	2.197 802	1429.425	162 597.1
406	2.463 054	1275.487	129 461.9	456	2.192 982	1432.566	163 312.6
407	2.457 002	1278.628	130 100.4	457	2.188 184	1435.708	164 029.6
408	2.450 980	1281.770	130 740.5	458	2.183 406	1438.849	164 748.3
409	2.444 988	1284.911	131 382.2	459	2.178 649	1441.991	165 468.5
410	2.439 024	1288.053	132 025.4	**460**	2.173 913	1445.133	166 190.3
411	2.433 090	1291.195	132 670.2	461	2.169 197	1448.274	166 913.6
412	2.427 184	1294.336	133 316.6	462	2.164 502	1451.416	167 638.5
413	2.421 308	1297.478	133 964.6	463	2.159 827	1454.557	168 365.0
414	2.415 459	1300.619	134 614.1	464	2.155 172	1457.699	169 093.1
415	2.409 639	1303.761	135 265.2	465	2.150 538	1460.841	169 822.7
416	2.403 846	1306.903	135 917.9	466	2.145 923	1463.982	170 553.9
417	2.398 082	1310.044	136 572.1	467	2.141 328	1467.124	171 286.7
418	2.392 344	1313.186	137 227.9	468	2.136 752	1470.265	172 021.0
419	2.386 635	1316.327	137 885.3	469	2.132 196	1473.407	172 757.0
420	2.380 952	1319.469	138 544.2	**470**	2.127 660	1476.549	173 494.5
421	2.375 297	1322.611	139 204.8	471	2.123 142	1479.690	174 233.5
422	2.369 668	1325.752	139 866.8	472	2.118 644	1482.832	174 974.1
423	2.364 066	1328.894	140 530.5	473	2.114 165	1485.973	175 716.3
424	2.358 491	1332.035	141 195.7	474	2.109 705	1489.115	176 460.1
425	2.352 941	1335.177	141 862.5	475	2.105 263	1492.257	177 205.5
426	2.347 418	1338.318	142 530.9	476	2.100 840	1495.398	177 952.4
427	2.341 920	1341.460	143 200.9	477	2.096 436	1498.540	178 700.9
428	2.336 449	1344.602	143 872.4	478	2.092 050	1501.681	179 450.9
429	2.331 002	1347.743	144 545.5	479	2.087 683	1504.823	180 202.5
430	2.325 581	1350.885	145 220.1	**480**	2.083 333	1507.964	180 955.7
431	2.320 186	1354.026	145 896.3	481	2.079 002	1511.106	181 710.5
432	2.314 815	1357.168	146 574.1	482	2.074 689	1514.248	182 466.8
433	2.309 469	1360.310	147 253.5	483	2.070 393	1517.389	183 224.8
434	2.304 147	1363.451	147 934.5	484	2.066 116	1520.531	183 984.2
435	2.298 851	1366.593	148 617.0	485	2.061 856	1523.672	184 745.3
436	2.293 578	1369.734	149 301.0	486	2.057 613	1526.814	185 507.9
437	2.288 330	1372.876	149 986.7	487	2.053 388	1529.956	186 272.1
438	2.283 105	1376.018	150 673.9	488	2.049 180	1533.097	187 037.9
439	2.277 904	1379.159	151 362.7	489	2.044 990	1536.239	187 805.2
440	2.272 727	1382.301	152 053.1	**490**	2.040 816	1539.380	188 574.1
441	2.267 574	1385.442	152 745.0	491	2.036 660	1542.522	189 344.6
442	2.262 443	1388.584	153 438.5	492	2.032 520	1545.664	190 116.6
443	2.257 336	1391.726	154 133.6	493	2.028 398	1548.805	190 890.2
444	2.252 252	1394.867	154 830.3	494	2.024 291	1551.947	191 665.4
445	2.247 191	1398.009	155 528.5	495	2.020 202	1555.088	192 442.2
446	2.242 152	1401.150	156 228.3	496	2.016 129	1558.230	193 220.5
447	2.237 136	1404.292	156 929.6	497	2.012 072	1561.372	194 000.4
448	2.232 143	1407.434	157 632.6	498	2.008 032	1564.513	194 781.9
449	2.227 171	1410.575	158 337.1	499	2.004 008	1567.655	195 564.9
450	2.222 222	1413.717	159 043.1	**500**	2.000 000	1570.796	196 349.5

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
500	2.000 000	1570.796	196 349.5	**550**	1.818 182	1727.876	237 582.9
501	1.996 008	1573.938	197 135.7	551	1.814 882	1731.018	238 447.7
502	1.992 032	1577.080	197 923.5	552	1.811 594	1734.159	239 314.0
503	1.988 072	1580.221	198 712.8	553	1.808 318	1737.301	240 181.8
504	1.984 127	1583.363	199 503.7	554	1.805 054	1740.442	241 051.3
505	1.980 198	1586.504	200 296.2	555	1.801 802	1743.584	241 922.3
506	1.976 285	1589.646	201 090.2	556	1.798 561	1746.726	242 794.8
507	1.972 387	1592.787	201 885.8	557	1.795 332	1749.867	243 669.0
508	1.968 504	1595.929	202 683.0	558	1.792 115	1753.009	244 544.7
509	1.964 637	1599.071	203 481.7	559	1.788 909	1756.150	245 422.0
510	1.960 784	1602.212	204 282.1	**560**	1.785 714	1759.292	246 300.9
511	1.956 947	1605.354	205 084.0	561	1.782 531	1762.433	247 181.3
512	1.953 125	1608.495	205 887.4	562	1.779 359	1765.575	248 063.3
513	1.949 318	1611.637	206 692.4	563	1.776 199	1768.717	248 946.9
514	1.945 525	1614.779	207 499.1	564	1.773 050	1771.858	249 832.0
515	1.941 748	1617.920	208 307.2	565	1.769 912	1775.000	250 718.7
516	1.937 984	1621.062	209 117.0	566	1.766 784	1778.141	251 607.0
517	1.934 236	1624.203	209 928.3	567	1.763 668	1781.283	252 496.9
518	1.930 502	1627.345	210 741.2	568	1.760 563	1784.425	253 388.3
519	1.926 782	1630.487	211 555.6	569	1.757 469	1787.566	254 281.3
520	1.923 077	1633.628	212 371.7	**570**	1.754 386	1790.708	255 175.9
521	1.919 386	1636.770	213 189.3	571	1.751 313	1793.849	256 072.0
522	1.915 709	1639.911	214 008.4	572	1.748 252	1796.991	256 969.7
523	1.912 046	1643.053	214 829.2	573	1.745 201	1800.133	257 869.0
524	1.908 397	1646.195	215 651.5	574	1.742 160	1803.274	258 769.8
525	1.904 762	1649.336	216 475.4	575	1.739 130	1806.416	259 672.3
526	1.901 141	1652.478	217 300.8	576	1.736 111	1809.557	260 576.3
527	1.897 533	1655.619	218 127.8	577	1.733 102	1812.699	261 481.8
528	1.893 939	1658.761	218 956.4	578	1.730 104	1815.841	262 389.0
529	1.890 359	1661.903	219 786.6	579	1.727 116	1818.982	263 297.7
530	1.886 792	1665.044	220 618.3	**580**	1.724 138	1822.124	264 207.9
531	1.883 239	1668.186	221 451.7	581	1.721 170	1825.265	265 119.8
532	1.879 699	1671.327	222 286.5	582	1.718 213	1828.407	266 033.2
533	1.876 173	1674.469	223 123.0	583	1.715 266	1831.549	266 948.2
534	1.872 659	1677.610	223 961.0	584	1.712 329	1834.690	267 864.8
535	1.869 159	1680.752	224 800.6	585	1.709 402	1837.832	268 782.9
536	1.865 672	1683.894	225 641.8	586	1.706 485	1840.973	269 702.6
537	1.862 197	1687.035	226 484.5	587	1.703 578	1844.115	270 623.9
538	1.858 736	1690.177	227 328.8	588	1.700 680	1847.256	271 546.7
539	1.855 288	1693.318	228 174.7	589	1.697 793	1850.398	272 471.1
540	1.851 852	1696.460	229 022.1	**590**	1.694 915	1853.540	273 397.1
541	1.848 429	1699.602	229 871.1	591	1.692 047	1856.681	274 324.7
542	1.845 018	1702.743	230 721.7	592	1.689 189	1859.823	275 253.8
543	1.841 621	1705.885	231 573.9	593	1.686 341	1862.964	276 184.5
544	1.838 235	1709.026	232 427.6	594	1.683 502	1866.106	277 116.7
545	1.834 862	1712.168	233 282.9	595	1.680 672	1869.248	278 050.6
546	1.831 502	1715.310	234 139.8	596	1.677 852	1872.389	278 986.0
547	1.828 154	1718.451	234 998.2	597	1.675 042	1875.531	279 923.0
548	1.824 818	1721.593	235 858.2	598	1.672 241	1878.672	280 861.5
549	1.821 494	1724.734	236 719.8	599	1.669 449	1881.814	281 801.6
550	1.818 182	1727.876	237 582.9	**600**	1.666 667	1884.956	282 743.3

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
600	1.666 667	1884.956	282 743.3	**650**	1.538 462	2042.035	331 830.7
601	1.663 894	1888.097	283 686.6	651	1.536 098	2045.177	332 852.5
602	1.661 130	1891.239	284 631.4	652	1.533 742	2048.318	333 875.9
603	1.658 375	1894.380	285 577.8	653	1.531 394	2051.460	334 900.8
604	1.655 629	1897.522	286 525.8	654	1.529 052	2054.602	335 927.4
605	1.652 893	1900.664	287 475.4	655	1.526 718	2057.743	336 955.4
606	1.650 165	1903.805	288 426.5	656	1.524 390	2060.885	337 985.1
607	1.647 446	1906.947	289 379.2	657	1.522 070	2064.026	339 016.3
608	1.644 737	1910.088	290 333.4	658	1.519 757	2067.168	340 049.1
609	1.642 036	1913.230	291 289.3	659	1.517 451	2070.310	341 083.5
610	1.639 344	1916.372	292 246.7	**660**	1.515 152	2073.451	342 119.4
611	1.636 661	1919.513	293 205.6	661	1.512 859	2076.593	343 157.0
612	1.633 987	1922.655	294 166.2	662	1.510 574	2079.734	344 196.0
613	1.631 321	1925.796	295 128.3	663	1.508 296	2082.876	345 236.7
614	1.628 664	1928.938	296 092.0	664	1.506 024	2086.018	346 278.9
615	1.626 016	1932.079	297 057.2	665	1.503 759	2089.159	347 322.7
616	1.623 377	1935.221	298 024.0	666	1.501 502	2092.301	348 368.1
617	1.620 746	1938.363	298 992.4	667	1.499 250	2095.442	349 415.0
618	1.618 123	1941.504	299 962.4	668	1.497 006	2098.584	350 463.5
619	1.615 509	1944.646	300 933.9	669	1.494 768	2101.725	351 513.6
620	1.612 903	1947.787	301 907.1	**670**	1.492 537	2104.867	352 565.2
621	1.610 306	1950.929	302 881.7	671	1.490 313	2108.009	353 618.5
622	1.607 717	1954.071	303 858.0	672	1.488 095	2111.150	354 673.2
623	1.605 136	1957.212	304 835.8	673	1.485 884	2114.292	355 729.6
624	1.602 564	1960.354	305 815.2	674	1.483 680	2117.433	356 787.5
625	1.600 000	1963.495	306 796.2	675	1.481 481	2120.575	357 847.0
626	1.597 444	1966.637	307 778.7	676	1.479 290	2123.717	358 908.1
627	1.594 896	1969.779	308 762.8	677	1.477 105	2126.858	359 970.8
628	1.592 357	1972.920	309 748.5	678	1.474 926	2130.000	361 035.0
629	1.589 825	1976.062	310 735.7	679	1.472 754	2133.141	362 100.8
630	1.587 302	1979.203	311 724.5	**680**	1.470 588	2136.283	363 168.1
631	1.584 786	1982.345	312 714.9	681	1.468 429	2139.425	364 237.0
632	1.582 278	1985.487	313 706.9	682	1.466 276	2142.566	365 307.5
633	1.579 779	1988.628	314 700.4	683	1.464 129	2145.708	366 379.6
634	1.577 287	1991.770	315 695.5	684	1.461 988	2148.849	367 453.2
635	1.574 803	1994.911	316 692.2	685	1.459 854	2151.991	368 528.5
636	1.572 327	1998.053	317 690.4	686	1.457 726	2155.133	369 605.2
637	1.569 859	2001.195	318 690.2	687	1.455 604	2158.274	370 683.6
638	1.567 398	2004.336	319 691.6	688	1.453 488	2161.416	371 763.5
639	1.564 945	2007.478	320 694.6	689	1.451 379	2164.557	372 845.0
640	1.562 500	2010.619	321 699.1	**690**	1.449 275	2167.699	373 928.1
641	1.560 062	2013.761	322 705.2	691	1.447 178	2170.841	375 012.7
642	1.557 632	2016.902	323 712.8	692	1.445 087	2173.982	376 098.9
643	1.555 210	2020.044	324 722.1	693	1.443 001	2177.124	377 186.7
644	1.552 795	2023.186	325 732.9	694	1.440 922	2180.265	378 276.0
645	1.550 388	2026.327	326 745.3	695	1.438 849	2183.407	379 366.9
646	1.547 988	2029.469	327 759.2	696	1.436 782	2186.548	380 459.4
647	1.545 595	2032.610	328 774.7	697	1.434 720	2189.690	381 553.5
648	1.543 210	2035.752	329 791.8	698	1.432 665	2192.832	382 649.1
649	1.540 832	2038.894	330 810.5	699	1.430 615	2195.973	383 746.3
650	1.538 462	2042.035	331 830.7	**700**	1.428 571	2199.115	384 845.1

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
700	1.428 571	2199.115	384 845.1	**750**	1.333 333	2356.194	441 786.5
701	1.426 534	2202.256	385 945.4	751	1.331 558	2359.336	442 965.3
702	1.424 501	2205.398	387 047.4	752	1.329 787	2362.478	444 145.8
703	1.422 475	2208.540	388 150.8	753	1.328 021	2365.619	445 327.8
704	1.420 455	2211.681	389 255.9	754	1.326 260	2368.761	446 511.4
705	1.418 440	2214.823	390 362.5	755	1.324 503	2371.902	447 696.6
706	1.416 431	2217.964	391 470.7	756	1.322 751	2375.044	448 883.3
707	1.414 427	2221.106	392 580.5	757	1.321 004	2378.186	450 071.6
708	1.412 429	2224.248	393 691.8	758	1.319 261	2381.327	451 261.5
709	1.410 437	2227.389	394 804.7	759	1.317 523	2384.469	452 453.0
710	1.408 451	2230.531	395 919.2	**760**	1.315 789	2387.610	453 646.0
711	1.406 470	2233.672	397 035.3	761	1.314 060	2390.752	454 840.6
712	1.404 494	2236.814	398 152.9	762	1.312 336	2393.894	456 036.7
713	1.402 525	2239.956	399 272.1	763	1.310 616	2397.035	457 234.5
714	1.400 560	2243.097	400 392.8	764	1.308 901	2400.177	458 433.8
715	1.398 601	2246.239	401 515.2	765	1.307 190	2403.318	459 634.6
716	1.396 648	2249.380	402 639.1	766	1.305 483	2406.460	460 837.1
717	1.394 700	2252.522	403 764.6	767	1.303 781	2409.602	462 041.1
718	1.392 758	2255.664	404 891.6	768	1.302 083	2412.743	463 246.7
719	1.390 821	2258.805	406 020.2	769	1.300 390	2415.885	464 453.8
720	1.388 889	2261.947	407 150.4	**770**	1.298 701	2419.026	465 662.6
721	1.386 963	2265.088	408 282.2	771	1.297 017	2422.168	466 872.9
722	1.385 042	2268.230	409 415.5	772	1.295 337	2425.310	468 084.7
723	1.383 126	2271.371	410 550.4	773	1.293 661	2428.451	469 298.2
724	1.381 215	2274.513	411 686.9	774	1.291 990	2431.593	470 513.2
725	1.379 310	2277.655	412 824.9	775	1.290 323	2434.734	471 729.8
726	1.377 410	2280.796	413 964.5	776	1.288 660	2437.876	472 947.9
727	1.375 516	2283.938	415 105.7	777	1.287 001	2441.017	474 167.6
728	1.373 626	2287.079	416 248.5	778	1.285 347	2444.159	475 388.9
729	1.371 742	2290.221	417 392.8	779	1.283 697	2447.301	476 611.
730	1.369 863	2293.363	418 538.7	**780**	1.282 051	2450.442	477 836.2
731	1.367 989	2296.504	419 686.1	781	1.280 410	2453.584	479 062.2
732	1.366 120	2299.646	420 835.2	782	1.278 772	2456.725	480 289.8
733	1.364 256	2302.787	421 985.8	783	1.277 139	2459.867	481 519.0
734	1.362 398	2305.929	423 138.0	784	1.275 510	2463.009	482 749.7
735	1.360 544	2309.071	424 291.7	785	1.273 885	2466.150	483 982.0
736	1.358 696	2312.212	425 447.0	786	1.272 265	2469.292	485 215.8
737	1.356 852	2315.354	426 603.9	787	1.270 648	2472.433	486 451.3
738	1.355 014	2318.495	427 762.4	788	1.269 036	2475.575	487 688.3
739	1.353 180	2321.637	428 922.4	789	1.267 427	2478.717	488 926.9
740	1.351 351	2324.779	430 084.0	**790**	1.265 823	2481.858	490 167.0
741	1.349 528	2327.920	431 247.2	791	1.264 223	2485.000	491 408.7
742	1.347 709	2331.062	432 412.0	792	1.262 626	2488.141	492 652.0
743	1.345 895	2334.203	433 578.3	793	1.261 034	2491.283	493 896.8
744	1.344 086	2337.345	434 746.2	794	1.259 446	2494.425	495 143.3
745	1.342 282	2340.487	435 915.6	795	1.257 862	2497.566	496 391.3
746	1.340 483	2343.628	437 086.6	796	1.256 281	2500.708	497 640.8
747	1.338 688	2346.770	438 259.2	797	1.254 705	2503.849	498 892.0
748	1.336 898	2349.911	439 433.4	798	1.253 133	2506.991	500 144.7
749	1.335 113	2353.053	440 609.2	799	1.251 564	2510.133	501 399.0
750	1.333 333	2356.194	441 786.5	**800**	1.250 000	2513.274	502 654.8

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
800	1.250 000	2513.274	502 654.8	**850**	1.176 471	2670.354	567 450.2
801	1.248 439	2516.416	503 912.2	851	1.175 088	2673.495	568 786.1
802	1.246 883	2519.557	505 171.2	852	1.173 709	2676.637	570 123.7
803	1.245 330	2522.699	506 431.8	853	1.172 333	2679.779	571 462.8
804	1.243 781	2525.840	507 693.9	854	1.170 960	2682.920	572 803.4
805	1.242 236	2528.982	508 957.6	855	1.169 591	2686.062	574 145.7
806	1.240 695	2532.124	510 222.9	856	1.168 224	2689.203	575 489.5
807	1.239 157	2535.265	511 489.8	857	1.166 861	2692.345	576 834.9
808	1.237 624	2538.407	512 758.2	858	1.165 501	2695.486	578 181.9
809	1.236 094	2541.548	514 028.2	859	1.164 144	2698.628	579 530.4
810	1.234 568	2544.690	515 299.7	**860**	1.162 791	2701.770	580 880.5
811	1.233 046	2547.832	516 572.9	861	1.161 440	2704.911	582 232.2
812	1.231 527	2550.973	517 847.6	862	1.160 093	2708.053	583 585.4
813	1.230 012	2554.115	519 123.8	863	1.158 749	2711.194	584 940.2
814	1.228 501	2557.256	520 401.7	864	1.157 407	2714.336	586 296.6
815	1.226 994	2560.398	521 681.1	865	1.156 069	2717.478	587 654.5
816	1.225 490	2563.540	522 962.1	866	1.154 734	2720.619	589 014.1
817	1.223 990	2566.681	524 244.6	867	1.153 403	2723.761	590 375.2
818	1.222 494	2569.823	525 528.8	868	1.152 074	2726.902	591 737.8
819	1.221 001	2572.964	526 814.5	869	1.150 748	2730.044	593 102.1
820	1.219 512	2576.106	528 101.7	**870**	1.149 425	2733.186	594 467.9
821	1.218 027	2579.248	529 390.6	871	1.148 106	2736.327	595 835.2
822	1.216 545	2582.389	530 681.0	872	1.146 789	2739.469	597 204.2
823	1.215 067	2585.531	531 973.0	873	1.145 475	2742.610	598 574.7
824	1.213 592	2588.672	533 266.5	874	1.144 165	2745.752	599 946.8
825	1.212 121	2591.814	534 561.6	875	1.142 857	2748.894	601 320.5
826	1.210 654	2594.956	535 858.3	876	1.141 553	2752.035	602 695.7
827	1.209 190	2598.097	537 156.6	877	1.140 251	2755.177	604 072.5
828	1.207 729	2601.239	538 456.4	878	1.138 952	2758.318	605 450.9
829	1.206 273	2604.380	539 757.8	879	1.137 656	2761.460	606 830.8
830	1.204 819	2607.522	541 060.8	**880**	1.136 364	2764.602	608 212.3
831	1.203 369	2610.663	542 365.3	881	1.135 074	2767.743	609 595.4
832	1.201 923	2613.805	543 671.5	882	1.133 787	2770.885	610 980.1
833	1.200 480	2616.947	544 979.1	883	1.132 503	2774.026	612 366.3
834	1.199 041	2620.088	546 288.4	884	1.131 222	2777.168	613 754.1
835	1.197 605	2623.230	547 599.2	885	1.129 944	2780.309	615 143.8
836	1.196 172	2626.371	548 911.6	886	1.128 668	2783.451	616 534.4
837	1.194 743	2629.513	550 225.6	887	1.127 396	2786.593	617 926.9
838	1.193 317	2632.655	551 541.1	888	1.126 126	2789.734	619 321.0
839	1.191 895	2635.796	552 858.3	889	1.124 859	2792.876	620 716.7
840	1.190 476	2638.938	554 176.9	**890**	1.123 596	2796.017	622 113.9
841	1.189 061	2642.079	555 497.2	891	1.122 334	2799.159	623 512.7
842	1.187 648	2645.221	556 819.0	892	1.121 076	2802.301	624 913.0
843	1.186 240	2648.363	558 142.4	893	1.119 821	2805.442	626 315.0
844	1.184 834	2651.504	559 467.4	894	1.118 568	2808.584	627 718.5
845	1.183 432	2654.646	560 793.9	895	1.117 318	2811.725	629 123.6
846	1.182 033	2657.787	562 122.0	896	1.116 071	2814.867	630 530.2
847	1.180 638	2660.929	563 451.7	897	1.114 827	2818.009	631 938.4
848	1.179 245	2664.071	564 783.0	898	1.113 586	2821.150	633 348.2
849	1.177 856	2667.212	566 115.8	899	1.112 347	2824.292	634 759.6
850	1.176 471	2670.354	567 450.2	**900**	1.111 111	2827.433	636 172.5

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
900	1.111 111	2827.433	636 172.5	**950**	1.052 632	2984.513	708 821.8
901	1.109 878	2830.575	637 587.0	951	1.051 525	2987.655	710 314.9
902	1.108 647	2833.717	639 003.1	952	1.050 420	2990.796	711 809.5
903	1.107 420	2836.858	640 420.7	953	1.049 318	2993.938	713 305.7
904	1.106 195	2840.000	641 839.9	954	1.048 218	2997.079	714 803.4
905	1.104 972	2843.141	643 260.7	955	1.047 120	3000.221	716 302.8
906	1.103 753	2846.283	644 683.1	956	1.046 025	3003.363	717 803.7
907	1.102 536	2849.425	646 107.0	957	1.044 932	3006.504	719 306.1
908	1.101 322	2852.566	647 532.5	958	1.043 841	3009.646	720 810.2
909	1.100 110	2855.708	648 959.6	959	1.042 753	3012.787	722 315.8
910	1.098 901	2858.849	650 388.2	**960**	1.041 667	3015.929	723 822.9
911	1.097 695	2861.991	651 818.4	961	1.040 583	3019.071	725 331.7
912	1.096 491	2865.133	653 250.2	962	1.039 501	3022.212	726 842.0
913	1.095 290	2868.274	654 683.6	963	1.038 422	3025.354	728 353.9
914	1.094 092	2871.416	656 118.5	964	1.037 344	3028.495	729 867.4
915	1.092 896	2874.557	657 555.0	965	1.036 269	3031.637	731 382.4
916	1.091 703	2877.699	658 993.0	966	1.035 197	3034.779	732 899.0
917	1.090 513	2880.840	660 432.7	967	1.034 126	3037.920	734 417.2
918	1.089 325	2883.982	661 873.9	968	1.033 058	3041.062	735 936.9
919	1.088 139	2887.124	663 316.7	969	1.031 992	3044.203	737 458.2
920	1.086 957	2890.265	664 761.0	**970**	1.030 928	3047.345	738 981.1
921	1.085 776	2893.407	666 206.9	971	1.029 866	3050.486	740 505.6
922	1.084 599	2896.548	667 654.4	972	1.028 807	3053.628	742 031.6
923	1.083 424	2899.690	669 103.5	973	1.027 749	3056.770	743 559.2
924	1.082 251	2902.832	670 554.1	974	1.026 694	3059.911	745 088.4
925	1.081 081	2905.973	672 006.3	975	1.025 641	3063.053	746 619.1
926	1.079 914	2909.115	673 460.1	976	1.024 590	3066.194	748 151.4
927	1.078 749	2912.256	674 915.4	977	1.023 541	3069.336	749 685.3
928	1.077 586	2915.398	676 372.3	978	1.022 495	3072.478	751 220.8
929	1.076 426	2918.540	677 830.8	979	1.021 450	3075.619	752 757.8
930	1.075 269	2921.681	679 290.9	**980**	1.020 408	3078.761	754 296.4
931	1.074 114	2924.823	680 752.5	981	1.019 368	3081.902	755 836.6
932	1.072 961	2927.964	682 215.7	982	1.018 330	3085.044	757 378.3
933	1.071 811	2931.106	683 680.5	983	1.017 294	3088.186	758 921.6
934	1.070 664	2934.248	685 146.8	984	1.016 260	3091.327	760 466.5
935	1.069 519	2937.389	686 614.7	985	1.015 228	3094.469	762 012.9
936	1.068 376	2940.531	688 084.2	986	1.014 199	3097.610	763 561.0
937	1.067 236	2943.672	689 555.2	987	1.013 171	3100.752	765 110.5
938	1.066 098	2946.814	691 027.9	988	1.012 146	3103.894	766 661.7
939	1.064 963	2949.956	692 502.1	989	1.011 122	3107.035	768 214.4
940	1.063 830	2953.097	693 977.8	**990**	1.010 101	3110.177	769 768.7
941	1.062 699	2956.239	695 455.2	991	1.009 082	3113.318	771 324.6
942	1.061 571	2959.380	696 934.1	992	1.008 065	3116.460	772 882.1
943	1.060 445	2962.522	698 414.5	993	1.007 049	3119.602	774 441.1
944	1.059 322	2965.663	699 896.6	994	1.006 036	3122.743	776 001.7
945	1.058 201	2968.805	701 380.2	995	1.005 025	3125.885	777 563.8
946	1.057 082	2971.947	702 865.4	996	1.004 016	3129.026	779 127.5
947	1.055 966	2975.088	704 352.1	997	1.003 009	3132.168	780 692.8
948	1.054 852	2978.230	705 840.5	998	1.002 004	3135.309	782 259.7
949	1.053 741	2981.371	707 330.4	999	1.001 001	3138.451	783 828.2
950	1.052 632	2984.513	708 821.8	**1000**	1.000 000	3141.593	785 398.2

Squares, Cubes and Roots

Roots of numbers other than those given directly may be found by the following relations:

$\sqrt{100n} = 10\sqrt{n}$; $\sqrt{1000n} = 10\sqrt{10n}$; $\sqrt{\frac{1}{10}n} = \frac{1}{10}\sqrt{10n}$; $\sqrt{\frac{1}{100}n} = \frac{1}{10}\sqrt{n}$; $\sqrt{\frac{1}{1000}n} = \frac{1}{100}\sqrt{10n}$; $\sqrt[3]{1000n} = 10\sqrt[3]{n}$; $\sqrt[3]{10{,}000n} = 10\sqrt[3]{10n}$; $\sqrt[3]{100{,}000n} = 10\sqrt[3]{100n}$; $\sqrt[3]{\frac{1}{10}n} = \frac{1}{10}\sqrt[3]{100n}$; $\sqrt[3]{\frac{1}{100}n} = \frac{1}{10}\sqrt[3]{10n}$; $\sqrt[3]{\frac{1}{1000}n} = \frac{1}{10}\sqrt[3]{n}$.

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
1	1	1.000 000	3.162 278	1	1.000 000	2.154 435	4.641 589
2	4	1.414 214	4.472 136	8	1.259 921	2.714 418	5.848 035
3	9	1.732 051	5.477 226	27	1.442 250	3.107 233	6.694 330
4	16	2.000 000	6.324 555	64	1.587 401	3.419 952	7.368 063
5	25	2.236 068	7.071 068	125	1.709 976	3.684 031	7.937 005
6	36	2.449 490	7.745 967	216	1.817 121	3.914 868	8.434 327
7	49	2.645 751	8.366 600	343	1.912 931	4.121 285	8.879 040
8	64	2.828 427	8.944 272	512	2.000 000	4.308 869	9.283 178
9	81	3.000 000	9.486 833	729	2.080 084	4.481 405	9.654 894
10	100	3.162 278	10.00000	1 000	2.154 435	4.641 589	10.00000
11	121	3.316 625	10.48809	1 331	2.223 980	4.791 420	10.32280
12	144	3.464 102	10.95445	1 728	2.289 428	4.932 424	10.62659
13	169	3.605 551	11.40175	2 197	2.351 335	5.065 797	10.91393
14	196	3.741 657	11.83216	2 744	2.410 142	5.192 494	11.18689
15	225	3.872 983	12.24745	3 375	2.466 212	5.313 293	11.44714
16	256	4.000 000	12.64911	4 096	2.519 842	5.428 835	11.69607
17	289	4.123 106	13.03840	4 913	2.571 282	5.539 658	11.93483
18	324	4.242 641	13.41641	5 832	2.620 741	5.646 216	12.16440
19	361	4.358 899	13.78405	6 859	2.668 402	5.748 897	12.38562
20	400	4.472 136	14.14214	8 000	2.714 418	5.848 035	12.59921
21	441	4.582 576	14.49138	9 261	2.758 924	5.943 922	12.80579
22	484	4.690 416	14.83240	10 648	2.802 039	6.036 811	13.00591
23	529	4.795 832	15.16575	12 167	2.843 867	6.126 926	13.20006
24	576	4.898 979	15.49193	13 824	2.884 499	6.214 465	13.38866
25	625	5.000 000	15.81139	15 625	2.924 018	6.299 605	13.57209
26	676	5.099 020	16.12452	17 576	2.962 496	6.382 504	13.75069
27	729	5.196 152	16.43168	19 683	3.000 000	6.463 304	13.92477
28	784	5.291 503	16.73320	21 952	3.036 589	6.542 133	14.09460
29	841	5.385 165	17.02939	24 389	3.072 317	6.619 106	14.26043
30	900	5.477 226	17.32051	27 000	3.107 233	6.694 330	14.42250
31	961	5.567 764	17.60682	29 791	3.141 381	6.767 899	14.58100
32	1 024	5.656 854	17.88854	32 768	3.174 802	6.839 904	14.73613
33	1 089	5.744 563	18.16590	35 937	3.207 534	6.910 423	14.88806
34	1 156	5.830 952	18.43909	39 304	3.239 612	6.979 532	15.03695
35	1 225	5.916 080	18.70829	42 875	3.271 066	7.047 299	15.18294
36	1 296	6.000 000	18.97367	46 656	3.301 927	7.113 787	15.32619
37	1 369	6.082 763	19.23538	50 653	3.332 222	7.179 054	15.46680
38	1 444	6.164 414	19.49359	54 872	3.361 975	7.243 156	15.60491
39	1 521	6.244 998	19.74842	59 319	3.391 211	7.306 144	15.74061
40	1 600	6.324 555	20.00000	64 000	3.419 952	7.368 063	15.87401
41	1 681	6.403 124	20.24846	68 921	3.448 217	7.428 959	16.00521
42	1 764	6.480 741	20.49390	74 088	3.476 027	7.488 872	16.13429
43	1 849	6.557 439	20.73644	79 507	3.503 398	7.547 842	16.26133
44	1 936	6.633 250	20.97618	85 184	3.530 348	7.605 905	16.38643
45	2 025	6.708 204	21.21320	91 125	3.556 893	7.663 094	16.50964
46	2 116	6.782 330	21.44761	97 336	3.583 048	7.719 443	16.63103
47	2 209	6.855 655	21.67948	103 823	3.608 826	7.774 980	16.75069
48	2 304	6.928 203	21.90890	110 592	3.634 241	7.829 735	16.86865
49	2 401	7.000 000	22.13594	117 649	3.659 306	7.883 735	16.98499
50	2 500	7.071 068	22.36068	125 000	3.684 031	7.937 005	17.09976

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
50	2 500	7.071 068	22.36068	125 000	3.684 031	7.937 005	17.09976
51	2 601	7.141 428	22.58318	132 651	3.708 430	7.989 570	17.21301
52	2 704	7.211 103	22.80351	140 608	3.732 511	8.041 452	17.32478
53	2 809	7.280 110	23.02173	148 877	3.756 286	8.092 672	17.43513
54	2 916	7.348 469	23.23790	157 464	3.779 763	8.143 253	17.54411
55	3 025	7.416 198	23.45208	166 375	3.802 952	8.193 213	17.65174
56	3 136	7.483 315	23.66432	175 616	3.825 862	8.242 571	17.75808
57	3 249	7.549 834	23.87467	185 193	3.848 501	8.291 344	17.86316
58	3 364	7.615 773	24.08319	195 112	3.870 877	8.339 551	17.96702
59	3 481	7.681 146	24.28992	205 379	3.892 996	8.387 207	18.06969
60	3 600	7.745 967	24.49490	216 000	3.914 868	8.434 327	18.17121
61	3 721	7.810 250	24.69818	226 981	3.936 497	8.480 926	18.27160
62	3 844	7.874 008	24.89980	238 328	3.957 892	8.527 019	18.37091
63	3 969	7.937 254	25.09980	250 047	3.979 057	8.572 619	18.46915
64	4 096	8.000 000	25.29822	262 144	4.000 000	8.617 739	18.56636
65	4 225	8.062 258	25.49510	274 625	4.020 726	8.662 391	18.66256
66	4 356	8.124 038	25.69047	287 496	4.041 240	8.706 588	18.75777
67	4 489	8.185 353	25.88436	300 763	4.061 548	8.750 340	18.85204
68	4 624	8.246 211	26.07681	314 432	4.081 655	8.793 659	18.94536
69	4 761	8.306 624	26.26785	328 509	4.101 566	8.836 556	19.03778
70	4 900	8.366 600	26.45751	343 000	4.121 285	8.879 040	19.12931
71	5 041	8.426 150	26.64583	357 911	4.140 818	8.921 121	19.21997
72	5 184	8.485 281	26.83282	373 248	4.160 168	8.962 809	19.30979
73	5 329	8.544 004	27.01851	389 017	4.179 339	9.004 113	19.39877
74	5 476	8.602 325	27.20294	405 224	4.198 336	9.045 042	19.48695
75	5 625	8.660 254	27.38613	421 875	4.217 163	9.085 603	19.57434
76	5 776	8.717 798	27.56810	438 976	4.235 824	9.125 805	19.66095
77	5 929	8.774 964	27.74887	456 533	4.254 321	9.165 656	19.74681
78	6 084	8.831 761	27.92848	474 552	4.272 659	9.205 164	19.83192
79	6 241	8.888 194	28.10694	493 039	4.290 840	9.244 335	19.91632
80	6 400	8.944 272	28.28427	512 000	4.308 869	9.283 178	20.00000
81	6 561	9 000 000	28.46050	531 441	4.326 749	9.321 698	20.08299
82	6 724	9.055 385	28.63564	551 368	4.344 481	9.359 902	20.16530
83	6 889	9.110 434	28.80972	571 787	4.362 071	9.397 796	20.24694
84	7 056	9.165 151	28.98275	592 704	4.379 519	9.435 388	20.32793
85	7 225	9.219 544	29.15476	614 125	4.396 830	9.472 682	20.40828
86	7 396	9.273 618	29.32576	636 056	4.414 005	9.509 685	20.48800
87	7 569	9.327 379	29.49576	658 503	4.431 048	9.546 403	20.56710
88	7 744	9.380 832	29.66479	681 472	4.447 960	9.582 840	20.64560
89	7 921	9.433 981	29.83287	704 969	4.464 745	9.619 002	20.72351
90	8 100	9.486 833	30.00000	729 000	4.481 405	9.654 894	20.80084
91	8 281	9.539 392	30.16621	753 571	4.497 941	9.690 521	20.87759
92	8 464	9.591 663	30.33150	778 688	4.514 357	9.725 888	20.95379
93	8 649	9.643 651	30.49590	804 357	4.530 655	9.761 000	21.02944
94	8 836	9.695 360	30.65942	830 584	4.546 836	9.795 861	21.10454
95	9 025	9.746 794	30.82207	857 375	4.562 903	9.830 476	21.17912
96	9 216	9.797 959	30.98387	884 736	4.578 857	9.864 848	21.25317
97	9 409	9.848 858	31.14482	912 673	4.594 701	9.898 983	21.32671
98	9 604	9.899 495	31.30495	941 192	4.610 436	9.932 884	21.39975
99	9 801	9.949 874	31.46427	970 299	4.626 065	9.966 555	21.47229
100	10 000	10.00000	31.62278	1 000 000	4.641 589	10.00000	21.54435

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
100	10 000	10.00000	31.62278	1 000 000	4.641 589	10.00000	21.54435
101	10 201	10.04988	31.78050	1 030 301	4.657 010	10.03322	21.61592
102	10 404	10.09950	31.93744	1 061 208	4.672 329	10.06623	21.68703
103	10 609	10.14889	32.09361	1 092 727	4.687 548	10.09902	21.75767
104	10 816	10.19804	32.24903	1 124 864	4.702 669	10.13159	21.82786
105	11 025	10.24695	32.40370	1 157 625	4.717 694	10.16396	21.89760
106	11 236	10.29563	32.55764	1 191 016	4.732 623	10.19613	21.96689
107	11 449	10.34408	32.71085	1 225 043	4.747 459	10.22809	22.03575
108	11 664	10.39230	32.86335	1 259 712	4.762 203	10.25986	22.10419
109	11 881	10.44031	33.01515	1 295 029	4.776 856	10.29142	22.17220
110	12 100	10.48809	33.16625	1 331 000	4.791 420	10.32280	22.23980
111	12 321	10.53565	33.31666	1 367 631	4.805 896	10.35399	22.30699
112	12 544	10.58301	33.46640	1 404 928	4.820 285	10.38499	22.37378
113	12 769	10.63015	33.61547	1 442 897	4.834 588	10.41580	22.44017
114	12 996	10.67708	33.76389	1 481 544	4.848 808	10.44644	22.50617
115	13 225	10.72381	33.91165	1 520 875	4.862 944	10.47690	22.57179
116	13 456	10.77033	34.05877	1 560 896	4.876 999	10.50718	22.63702
117	13 689	10.81665	34.20526	1 601 613	4.890 973	10.53728	22.70189
118	13 924	10.86278	34.35113	1 643 032	4.904 868	10.56722	22.76638
119	14 161	10.90871	34.49638	1 685 159	4.918 685	10.59699	22.83051
120	14 400	10.95445	34.64102	1 728 000	4.932 424	10.62659	22.89428
121	14 641	11.00000	34.78505	1 771 561	4.946 087	10.65602	22.95770
122	14 884	11.04536	34.92850	1 815 848	4.959 676	10.68530	23.02078
123	15 129	11.09054	35.07136	1 860 867	4.973 190	10.71441	23.08350
124	15 376	11.13553	35.21363	1 906 624	4.986 631	10.74337	23.14589
125	15 625	11.18034	35.35534	1 953 125	5.000 000	10.77217	23.20794
126	15 876	11.22497	35.49648	2 000 376	5.013 298	10.80082	23.26967
127	16 129	11.26943	35.63706	2 048 383	5.026 526	10.82932	23.33107
128	16 384	11.31371	35.77709	2 097 152	5.039 684	10.85767	23.39214
129	16 641	11.35782	35.91657	2 146 689	5.052 774	10.88587	23.45290
130	16 900	11.40175	36.05551	2 197 000	5.065 797	10.91393	23.51335
131	17 161	11.44552	36.19392	2 248 091	5.078 753	10.94184	23.57348
132	17 424	11.48913	36.33180	2 299 968	5.091 643	10.96961	23.63332
133	17 689	11.53256	36.46917	2 352 637	5.104 469	10.99724	23.69285
134	17 956	11.57584	36.60601	2 406 104	5.117 230	11.02474	23.75208
135	18 225	11.61895	36.74235	2 460 375	5.129 928	11.05209	23.81102
136	18 496	11.66190	36.87818	2 515 456	5.142 563	11.07932	23.86966
137	18 769	11.70470	37.01351	2 571 353	5.155 137	11.10641	23.92803
138	19 044	11.74734	37.14835	2 628 072	5.167 649	11.13336	23.98610
139	19 321	11.78983	37.28270	2 685 619	5.180 101	11.16019	24.04390
140	19 600	11.83216	37.41657	2 744 000	5.192 494	11.18689	24.10142
141	19 881	11.87434	37.54997	2 803 221	5.204 828	11.21346	24.15867
142	20 164	11.91638	37.68289	2 863 288	5.217 103	11.23991	24.21565
143	20 449	11.95826	37.81534	2 924 207	5.229 322	11.26623	24.27236
144	20 736	12.00000	37.94733	2 985 984	5.241 483	11.29243	24.32881
145	21 025	12.04159	38.07887	3 048 625	5.253 588	11.31851	24.38499
146	21 316	12.08305	38.20995	3 112 136	5.265 637	11.34447	24.44092
147	21 609	12.12436	38.34058	3 176 523	5.277 632	11.37031	24.49660
148	21 904	12.16553	38.47077	3 241 792	5.289 572	11.39604	24.55202
149	22 201	12.20656	38.60052	3 307 949	5.301 459	11.42165	24.60719
150	22 500	12.24745	38.72983	3 375 000	5.313 293	11.44714	24.66212

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
150	22 500	12.24745	38.72983	3 375 000	5.313 293	11.44714	24.66212
151	22 801	12.28821	38.85872	3 442 951	5.325 074	11.47252	24.71680
152	23 104	12.32883	38.98718	3 511 808	5.336 803	11.49779	24.77125
153	23 409	12.36932	39.11521	3 581 577	5.348 481	11.52295	24.82545
154	23 716	12.40967	39.24283	3 652 264	5.360 108	11.54800	24.87942
155	24 025	12.44990	39.37004	3 723 875	5.371 685	11.57295	24.93315
156	24 336	12.49000	39.49684	3 796 416	5.383 213	11.59778	24.98666
157	24 649	12.52996	39.62323	3 869 893	5.394 691	11.62251	25.03994
158	24 964	12.56981	39.74921	3 944 312	5.406 120	11.64713	25.09299
159	25 281	12.60952	39.87480	4 019 679	5.417 502	11.67165	25.14581
160	25 600	12.64911	40.00000	4 096 000	5.428 835	11.69607	25.19842
161	25 921	12.68858	40.12481	4 173 281	5.440 122	11.72039	25.25081
162	26 244	12.72792	40.24922	4 251 528	5.451 362	11.74460	25.30298
163	26 569	12.76715	40.37326	4 330 747	5.462 556	11.76872	25.35494
164	26 896	12.80625	40.49691	4 410 944	5.473 704	11.79274	25.40668
165	27 225	12.84523	40.62019	4 492 125	5.484 807	11.81666	25.45822
166	27 556	12.88410	40.74310	4 574 296	5.495 865	11.84048	25.50954
167	27 889	12.92285	40.86563	4 657 463	5.506 878	11.86421	25.56067
168	28 224	12.96148	40.98780	4 741 632	5.517 848	11.88784	25.61158
169	28 561	13.00000	41.10961	4 826 809	5.528 775	11.91138	25.66230
170	28 900	13.03840	41.23106	4 913 000	5.539 658	11.93483	25.71282
171	29 241	13.07670	41.35215	5 000 211	5.550 499	11.95819	25.76313
172	29 584	13.11488	41.47288	5 088 448	5.561 298	11.98145	25.81326
173	29 929	13.15295	41.59327	5 177 717	5.572 055	12.00463	25.86319
174	30 276	13.19091	41.71331	5 268 024	5.582 770	12.02771	25.91292
175	30 625	13.22876	41.83300	5 359 375	5.593 445	12.05071	25.96247
176	30 976	13.26650	41.95235	5 451 776	5.604 079	12.07362	26.01183
177	31 329	13.30413	42.07137	5 545 233	5.614 672	12.09645	26.06100
178	31 684	13.34166	42.19005	5 639 752	5.625 226	12.11918	26.10999
179	32 041	13.37909	42.30839	5 735 339	5.635 741	12.14184	26.15879
180	32 400	13.41641	42.42641	5 832 000	5.646 216	12.16440	26.20741
181	32 761	13.45362	42.54409	5 929 741	5.656 653	12.18689	26.25586
182	33 124	13.49074	42.66146	6 028 568	5.667 051	12.20929	26.30412
183	33 489	13.52775	42.77850	6 128 487	5.677 411	12.23161	26.35221
184	33 856	13.56466	42.89522	6 229 504	5.687 734	12.25385	26.40012
185	34 225	13.60147	43.01163	6 331 625	5.698 019	12.27601	26.44786
186	34 596	13.63818	43.12772	6 434 856	5.708 267	12.29809	26.49543
187	34 969	13.67479	43.24350	6 539 203	5.718 479	12.32009	26.54283
188	35 344	13.71131	43.35897	6 644 672	5.728 654	12.34201	26.59006
189	35 721	13.74773	43.47413	6 751 269	5.738 794	12.36386	26.63712
190	36 100	13.78405	43.58899	6 859 000	5.748 897	12.38562	26.68402
191	36 481	13.82027	43.70355	6 967 871	5.758 965	12.40731	26.73075
192	36 864	13.85641	43.81780	7 077 888	5.768 998	12.42893	26.77732
193	37 249	13.89244	43.93177	7 189 057	5.778 997	12.45047	26.82373
194	37 636	13.92839	44.04543	7 301 384	5.788 960	12.47194	26.86997
195	38 025	13.96424	44.15880	7 414 875	5.798 890	12.49333	26.91606
196	38 416	14.00000	44.27189	7 529 536	5.808 786	12.51465	26.96199
197	38 809	14.03567	44.38468	7 645 373	5.818 648	12.53590	27.00777
198	39 204	14.07125	44.49719	7 762 392	5.828 477	12.55707	27.05339
199	39 601	14.10674	44.60942	7 880 599	5.838 272	12.57818	27.09886
200	40 000	14.14214	44.72136	8 000 000	5.848 035	12.59921	27.14418

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
200	40 000	14.14214	44.72136	8 000 000	5.848 035	12.59921	27.14418
201	40 401	14.17745	44.83302	8 120 601	5.857 766	12.62017	27.18934
202	40 804	14.21267	44.94441	8 242 408	5.867 464	12.64107	27.23436
203	41 209	14.24781	45.05552	8 365 427	5.877 131	12.66189	27.27922
204	41 616	14.28286	45.16636	8 489 664	5.886 765	12.68265	27.32394
205	42 025	14.31782	45.27693	8 615 125	5.896 369	12.70334	27.36852
206	42 436	14.35270	45.38722	8 741 816	5.905 941	12.72396	27.41295
207	42 849	14.38749	45.49725	8 869 743	5.915 482	12.74452	27.45723
208	43 264	14.42221	45.60702	8 998 912	5.924 992	12.76501	27.50138
209	43 681	14.45683	45.71652	9 129 329	5.934 472	12.78543	27.54538
210	44 100	14.49138	45.82576	9 261 000	5.943 922	12.80579	27.58924
211	44 521	14.52584	45.93474	9 393 931	5.953 342	12.82609	27.63296
212	44 944	14.56022	46.04346	9 528 128	5.962 732	12.84632	27.67655
213	45 369	14.59452	46.15192	9 663 597	5.972 093	12.86648	27.72000
214	45 796	14.62874	46.26013	9 800 344	5.981 424	12.88659	27.76331
215	46 225	14.66288	46.36809	9 938 375	5.990 726	12.90663	27.80649
216	46 656	14.69694	46.47580	10 077 696	6.000 000	12.92661	27.84953
217	47 089	14.73092	46.58326	10 218 313	6.009 245	12.94653	27.89244
218	47 524	14.76482	46.69047	10 360 232	6.018 462	12.96638	27.93522
219	47 961	14.79865	46.79744	10 503 459	6.027 650	12.98618	27.97787
220	48 400	14.83240	46.90416	10 648 000	6.036 811	13.00591	28.02039
221	48 841	14.86607	47.01064	10 793 861	6.045 944	13.02559	28.06278
222	49 284	14.89966	47.11688	10 941 048	6.055 049	13.04521	28.10505
223	49 729	14.93318	47.22288	11 089 567	6.064 127	13.06477	28.14718
224	50 176	14.96663	47.32864	11 239 424	6.073 178	13.08427	28.18919
225	50 625	15.00000	47.43416	11 390 625	6.082 202	13.10371	28.23108
226	51 076	15.03330	47.53946	11 543 176	6.091 199	13.12309	28.27284
227	51 529	15.06652	47.64452	11 697 083	6.100 170	13.14242	28.31448
228	51 984	15.09967	47.74935	11 852 352	6.109 115	13.16169	28.35600
229	52 441	15.13275	47.85394	12 008 989	6.118 033	13.18090	28.39739
230	52 900	15.16575	47.95832	12 167 000	6.126 926	13.20006	28.43867
231	53 361	15.19868	48.06246	12 326 391	6.135 792	13.21916	28.47983
232	53 824	15.23155	48.16638	12 487 168	6.144 634	13.23821	28.52086
233	54 289	15.26434	48.27007	12 649 337	6.153 449	13.25721	28.56178
234	54 756	15.29706	48.37355	12 812 904	6.162 240	13.27614	28.60259
235	55 225	15.32971	48.47680	12 977 875	6.171 006	13.29503	28.64327
236	55 696	15.36229	48.57983	13 144 256	6.179 747	13.31386	28.68384
237	56 169	15.39480	48.68265	13 312 053	6.188 463	13.33264	28.72430
238	56 644	15.42725	48.78524	13 481 272	6.197 154	13.35136	28.76464
239	57 121	15.45962	48.88763	13 651 919	6.205 822	13.37004	28.80487
240	57 600	15.49193	48.98979	13 824 000	6.214 465	13.38866	28.84499
241	58 081	15.52417	49.09175	13 997 521	6.223 084	13.40723	28.88500
242	58 564	15.55635	49.19350	14 172 488	6.231 680	13.42575	28.92489
243	59 049	15.58846	49.29503	14 348 907	6.240 251	13.44421	28.96468
244	59 536	15.62050	49.39636	14 526 784	6.248 800	13.46263	29.00436
245	60 025	15.65248	49.49747	14 706 125	6.257 325	13.48100	29.04393
246	60 516	15.68439	49.59839	14 886 936	6.265 827	13.49931	29.08339
247	61 009	15.71623	49.69909	15 069 223	6.274 305	13.51758	29.12275
248	61 504	15.74802	49.79960	15 252 992	6.282 761	13.53580	29.16199
249	62 001	15.77973	49.89990	15 438 249	6.291 195	13.55397	29.20114
250	62 500	15.81139	50.00000	15 625 000	6.299 605	13.57209	29.24018

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
250	62 500	15.81139	50.00000	15 625 000	6.299 605	13.57209	29.24018
251	63 001	15.84298	50.09990	15 813 251	6.307 994	13.59016	29.27911
252	63 504	15.87451	50.19960	16 003 008	6.316 360	13.60818	29.31794
253	64 009	15.90597	50.29911	16 194 277	6.324 704	13.62616	29.35667
254	64 516	15.93738	50.39841	16 387 064	6.333 026	13.64409	29.39530
255	65 025	15.96872	50.49752	16 581 375	6.341 326	13.66197	29.43383
256	65 536	16.00000	50.59644	16 777 216	6.349 604	13.67981	29.47225
257	66 049	16.03122	50.69517	16 974 593	6.357 861	13.69760	29.51058
258	66 564	16.06238	50.79370	17 173 512	6.366 097	13.71534	29.54880
259	67 081	16.09348	50.89204	17 373 979	6.374 311	13.73304	29.58693
260	67 600	16.12452	50.99020	17 576 000	6.382 504	13.75069	29.62496
261	68 121	16.15549	51.08816	17 779 581	6.390 677	13.76830	29.66289
262	68 644	16.18641	51.18594	17 984 728	6.398 828	13.78586	29.70073
263	69 169	16.21727	51.28353	18 191 447	6.406 959	13.80337	29.73847
264	69 696	16.24808	51.38093	18 399 744	6.415 069	13.82085	29.77611
265	70 225	16.27882	51.47815	18 609 625	6.423 158	13.83828	29.81366
266	70 756	16.30951	51.57519	18 821 096	6.431 228	13.85566	29.85111
267	71 289	16.34013	51.67204	19 034 163	6.439 277	13.87300	29.88847
268	71 824	16.37071	51.76872	19 248 832	6.447 306	13.89030	29.92574
269	72 361	16.40122	51.86521	19 465 109	6.455 315	13.90755	29.96292
270	72 900	16.43168	51.96152	19 683 000	6.463 304	13.92477	30.00000
271	73 441	16.46208	52.05766	19 902 511	6.471 274	13.94194	30.03699
272	73 984	16.49242	52.15362	20 123 648	6.479 224	13.95906	30.07389
273	74 529	16.52271	52.24940	20 346 417	6.487 154	13.97615	30.11070
274	75 076	16.55295	52.34501	20 570 824	6.495 065	13.99319	30.14742
275	75 625	16.58312	52.44044	20 796 875	6.502 957	14.01020	30.18405
276	76 176	16.61325	52.53570	21 024 576	6.510 830	14.02716	30.22060
277	76 729	16.64332	52.63079	21 253 933	6.518 684	14.04408	30.25705
278	77 284	16.67333	52.72571	21 484 952	6.526 519	14.06096	30.29342
279	77 841	16.70329	52.82045	21 717 639	6.534 335	14.07780	30.32970
280	78 400	16.73320	52.91503	21 952 000	6.542 133	14.09460	30.36589
281	78 961	16.76305	53.00943	22 188 041	6.549 912	14.11136	30.40200
282	79 524	16.79286	53.10367	22 425 768	6.557 672	14.12808	30.43802
283	80 089	16.82260	53.19774	22 665 187	6.565 414	14.14476	30.47395
284	80 656	16.85230	53.29165	22 906 304	6.573 138	14.16140	30.50981
285	81 225	16.88194	53.38539	23 149 125	6.580 844	14.17800	30.54557
286	81 796	16.91153	53.47897	23 393 656	6.588 532	14.19456	30.58126
287	82 369	16.94107	53.57238	23 639 903	6.596 202	14.21109	30.61686
288	82 944	16.97056	53.66563	23 887 872	6.603 854	14.22757	30.65238
289	83 521	17.00000	53.75872	24 137 569	6.611 489	14.24402	30.68781
290	84 100	17.02939	53.85165	24 389 000	6.619 106	14.26043	30.72317
291	84 681	17.05872	53.94442	24 642 171	6.626 705	14.27680	30.75844
292	85 264	17.08801	54.03702	24 897 088	6.634 287	14.29314	30.79363
293	85 849	17.11724	54.12947	25 153 757	6.641 852	14.30944	30.82875
294	86 436	17.14643	54.22177	25 412 184	6.649 400	14.32570	30.86378
295	87 025	17.17556	54.31390	25 672 375	6.656 930	14.34192	30.89873
296	87 616	17.20465	54.40588	25 934 336	6.664 444	14.35811	30.93361
297	88 209	17.23369	54.49771	26 198 073	6.671 940	14.37426	30.96840
298	88 804	17.26268	54.58938	26 463 592	6.679 420	14.39037	31.00312
299	89 401	17.29162	54.68089	26 730 899	6.686 883	14.40645	31.03776
300	90 000	17.32051	54.77226	27 000 000	6.694 330	14.42250	31.07233

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
300	90 000	17.32051	54.77226	27 000 000	6.694 330	14.42250	31.07233
301	90 601	17.34935	54.86347	27 270 901	6.701 759	14.43850	31.10681
302	91 204	17.37815	54.95453	27 543 608	6.709 173	14.45447	31.14122
303	91 809	17.40690	55.04544	27 818 127	6.716 570	14.47041	31.17556
304	92 416	17.43560	55.13620	28 094 464	6.723 951	14.48631	31.20982
305	93 025	17.46425	55.22681	28 372 625	6.731 315	14.50218	31.24400
306	93 636	17.49286	55.31727	28 652 616	6.738 664	14.51801	31.27811
307	94 249	17.52142	55.40758	28 934 443	6.745 997	14.53381	31.31214
308	94 864	17.54993	55.49775	29 218 112	6.753 313	14.54957	31.34610
309	95 481	17.57840	55.58777	29 503 629	6.760 614	14.56530	31.37999
310	96 100	17.60682	55.67764	29 791 000	6.767 899	14.58100	31.41381
311	96 721	17.63519	55.76737	30 080 231	6.775 169	14.59666	31.44755
312	97 344	17.66352	55.85696	30 371 328	6.782 423	14.61229	31.48122
313	97 969	17.69181	55.94640	30 664 297	6.789 661	14.62788	31.51482
314	98 596	17.72005	56.03570	30 959 144	6.796 884	14.64344	31.54834
315	99 225	17.74824	56.12486	31 255 875	6.804 092	14.65897	31.58180
316	99 856	17.77639	56.21388	31 554 496	6.811 285	14.67447	31.61518
317	100 489	17.80449	56.30275	31 855 013	6.818 462	14.68993	31.64850
318	101 124	17.83255	56.39149	32 157 432	6.825 624	14.70536	31.68174
319	101 761	17.86057	56.48008	32 461 759	6.832 771	14.72076	31.71492
320	102 400	17.88854	56.56854	32 768 000	6.839 904	14.73613	31.74802
321	103 041	17.91647	56.65686	33 076 161	6.847 021	14.75146	31.78106
322	103 684	17.94436	56.74504	33 386 248	6.854 124	14.76676	31.81403
323	104 329	17.97220	56.83309	33 698 267	6.861 212	14.78203	31.84693
324	104 976	18.00000	56.92100	34 012 224	6.868 285	14.79727	31.87976
325	105 625	18.02776	57.00877	34 328 125	6.875 344	14.81248	31.91252
326	106 276	18.05547	57.09641	34 645 976	6.882 389	14.82766	31.94522
327	106 929	18.08314	57.18391	34 965 783	6.889 419	14.84280	31.97785
328	107 584	18.11077	57.27128	35 287 552	6.896 434	14.85792	32.01041
329	108 241	18.13836	57.35852	35 611 289	6.903 436	14.87300	32.04291
330	108 900	18.16590	57.44563	35 937 000	6.910 423	14.88806	32.07534
331	109 561	18.19341	57.53260	36 264 691	6.917 396	14.90308	32.10771
332	110 224	18.22087	57.61944	36 594 368	6.924 356	14.91807	32.14001
333	110 889	18.24829	57.70615	36 926 037	6.931 301	14.93303	32.17225
334	111 556	18.27567	57.79273	37 259 704	6.938 232	14.94797	32.20442
335	112 225	18.30301	57.87918	37 595 375	6.945 150	14.96287	32.23653
336	112 896	18.33030	57.96551	37 933 056	6.952 053	14.97774	32.26857
337	113 569	18.35756	58.05170	38 272 753	6.958 943	14.99259	32.30055
338	114 244	18.38478	58.13777	38 614 472	6.965 820	15.00740	32.33247
339	114 921	18.41195	58.22371	38 958 219	6.972 683	15.02219	32.36433
340	115 600	18.43909	58.30952	39 304 000	6.979 532	15.03695	32.39612
341	116 281	18.46619	58.39521	39 651 821	6.986 368	15.05167	32.42785
342	116 964	18.49324	58.48077	40 001 688	6.993 191	15.06637	32.45952
343	117 649	18.52026	58.56620	40 353 607	7.000 000	15.08104	32.49112
344	118 336	18.54724	58.65151	40 707 584	7.006 796	15.09568	32.52267
345	119 025	18.57418	58.73670	41 063 625	7.013 579	15.11030	32.55415
346	119 716	18.60108	58.82176	41 421 736	7.020 349	15.12488	32.58557
347	120 409	18.62794	58.90671	41 781 923	7.027 106	15.13944	32.61694
348	121 104	18.65476	58.99152	42 144 192	7.033 850	15.15397	32.64824
349	121 801	18.68154	59.07622	42 508 549	7.040 581	15.16847	32.67948
350	122 500	18.70829	59.16080	42 875 000	7.047 299	15.18294	32.71066

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
350	122 500	18.70829	59.16080	42 875 000	7.047 299	15.18294	32.71066
351	123 201	18.73499	59.24525	43 243 551	7.054 004	15.19739	32.74179
352	123 904	18.76166	59.32959	43 614 208	7.060 697	15.21181	32.77285
353	124 609	18.78829	59.41380	43 986 977	7.067 377	15.22620	32.80386
354	125 316	18.81489	59.49790	44 361 864	7.074 044	15.24057	32.83480
355	126 025	18.84144	59.58188	44 738 875	7.080 699	15.25490	32.86569
356	126 736	18.86796	59.66574	45 118 016	7.087 341	15.26921	32.89652
357	127 449	18.89444	59.74948	45 499 293	7.093 971	15.28350	32.92730
358	128 164	18.92089	59.83310	45 882 712	7.100 588	15.29775	32.95801
359	128 881	18.94730	59.91661	46 268 279	7.107 194	15.31198	32.98867
360	129 600	18.97367	60.00000	46 656 000	7.113 787	15.32619	33.01927
361	130 321	19.00000	60.08328	47 045 881	7.120 367	15.34037	33.04982
362	131 044	19.02630	60.16644	47 437 928	7.126 936	15.35452	33.08031
363	131 769	19.05256	60.24948	47 832 147	7.133 492	15.36864	33.11074
364	132 496	19.07878	60.33241	48 228 544	7.140 037	15.38274	33.14112
365	133 225	19.10497	60.41523	48 627 125	7.146 569	15.39682	33.17144
366	133 956	19.13113	60.49793	49 027 896	7.153 090	15.41087	33.20170
367	134 689	19.15724	60.58052	49 430 863	7.159 599	15.42489	33.23191
368	135 424	19.18333	60.66300	49 836 032	7.166 096	15.43889	33.26207
369	136 161	19.20937	60.74537	50 243 409	7.172 581	15.45286	33.29217
370	136 900	19.23538	60.82763	50 653 000	7.179 054	15.46680	33.32222
371	137 641	19.26136	60.90977	51 064 811	7.185 516	15.48073	33.35221
372	138 384	19.28730	60.99180	51 478 848	7.191 966	15.49462	33.38215
373	139 129	19.31321	61.07373	51 895 117	7.198 405	15.50849	33.41204
374	139 876	19.33908	61.15554	52 313 624	7.204 832	15.52234	33.44187
375	140 625	19.36492	61.23724	52 734 375	7.211 248	15.53616	33.47165
376	141 376	19.39072	61.31884	53 157 376	7.217 652	15.54996	33.50137
377	142 129	19.41649	61.40033	53 582 633	7.224 045	15.56373	33.53105
378	142 884	19.44222	61.48170	54 010 152	7.230 427	15.57748	33.56067
379	143 641	19.46792	61.56298	54 439 939	7.236 797	15.59121	33.59024
380	144 400	19.49359	61.64414	54 872 000	7.243 156	15.60491	33.61975
381	145 161	19.51922	61.72520	55 306 341	7.249 505	15.61858	33.64922
382	145 924	19.54482	61.80615	55 742 968	7.255 842	15.63224	33.67863
383	146 689	19.57039	61.88699	56 181 887	7.262 167	15.64587	33.70800
384	147 456	19.59592	61.96773	56 623 104	7.268 482	15.65947	33.73731
385	148 225	19.62142	62.04837	57 066 625	7.274 786	15.67305	33.76657
386	148 996	19.64688	62.12890	57 512 456	7.281 079	15.68661	33.79578
387	149 769	19.67232	62.20932	57 960 603	7.287 362	15.70014	33.82494
388	150 544	19.69772	62.28965	58 411 072	7.293 633	15.71366	33.85405
389	151 321	19.72308	62.36986	58 863 869	7.299 894	15.72714	33.88310
390	152 100	19.74842	62.44998	59 319 000	7.306 144	15.74061	33.91211
391	152 881	19.77372	62.52999	59 776 471	7.312 383	15.75405	33.94107
392	153 664	19.79899	62.60990	60 236 288	7.318 611	15.76747	33.96999
393	154 449	19.82423	62.68971	60 698 457	7.324 829	15.78087	33.99885
394	155 236	19.84943	62.76942	61 162 984	7.331 037	15.79424	34.02766
395	156 025	19.87461	62.84903	61 629 875	7.337 234	15.80759	34.05642
396	156 816	19.89975	62.92853	62 099 136	7.343 420	15.82092	34.08514
397	157 609	19.92486	63.00794	62 570 773	7.349 597	15.83423	34.11381
398	158 404	19.94994	63.08724	63 044 792	7.355 762	15.84751	34.14242
399	159 201	19.97498	63.16645	63 521 199	7.361 918	15.86077	34.17100
400	160 000	20.00000	63.24555	64 000 000	7.368 063	15.87401	34.19952

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
400	160 000	20.00000	63.24555	64 000 000	7.368 063	15.87401	34.19952
401	160 801	20.02498	63.32456	64 481 201	7.374 198	15.88723	34.22799
402	161 604	20.04994	63.40347	64 964 808	7.380 323	15.90042	34.25642
403	162 409	20.07486	63.48228	65 450 827	7.386 437	15.91360	34.28480
404	163 216	20.09975	63.56099	65 939 264	7.392 542	15.92675	34.31314
405	164 025	20.12461	63.63961	66 430 125	7.398 636	15.93988	34.34143
406	164 836	20.14944	63.71813	66 923 416	7.404 721	15.95299	34.36967
407	165 649	20.17424	63.79655	67 419 143	7.410 795	15.96607	34.39786
408	166 464	20.19901	63.87488	67 917 312	7.416 860	15.97914	34.42601
409	167 281	20.22375	63.95311	68 417 929	7.422 914	15.99218	34.45412
410	168 100	20.24846	64.03124	68 921 000	7.428 959	16.00521	34.48217
411	168 921	20.27313	64.10928	69 426 531	7.434 994	16.01821	34.51018
412	169 744	20.29778	64.18723	69 934 528	7.441 019	16.03119	34.53815
413	170 569	20.32240	64.26508	70 444 997	7.447 034	16.04415	34.56607
414	171 396	20.34699	64.34283	70 957 944	7.453 040	16.05709	34.59395
415	172 225	20.37155	64.42049	71 473 375	7.459 036	16.07001	34.62178
416	173 056	20.39608	64.49806	71 991 296	7.465 022	16.08290	34.64956
417	173 889	20.42058	64.57554	72 511 713	7.470 999	16.09578	34.67731
418	174 724	20.44505	64.65292	73 034 632	7.476 966	16.10864	34.70500
419	175 561	20.46949	64.73021	73 560 059	7.482 924	16.12147	34.73266
420	176 400	20.49390	64.80741	74 088 000	7.488 872	16.13429	34.76027
421	177 241	20.51828	64.88451	74 618 461	7.494 811	16.14708	34.78783
422	178 084	20.54264	64.96153	75 151 448	7.500 741	16.15986	34.81535
423	178 929	20.56696	65.03845	75 686 967	7.506 661	16.17261	34.84283
424	179 776	20.59126	65.11528	76 225 024	7.512 572	16.18534	34.87027
425	180 625	20.61553	65.19202	76 765 625	7.518 473	16.19806	34.89766
426	181 476	20.63977	65.26868	77 308 776	7.524 365	16.21075	34.92501
427	182 329	20.66398	65.34524	77 854 483	7.530 248	16.22343	34.95232
428	183 184	20.68816	65.42171	78 402 752	7.536 122	16.23608	34.97958
429	184 041	20.71232	65.49809	78 953 589	7.541 987	16.24872	35.00680
430	184 900	20.73644	65.57439	79 507 000	7.547 842	16.26133	35.03398
431	185 761	20.76054	65.65059	80 062 991	7.553 689	16.27393	35.06112
432	186 624	20.78461	65.72671	80 621 568	7.559 526	16.28651	35.08821
433	187 489	20.80865	65.80274	81 182 737	7.565 355	16.29906	35.11527
434	188 356	20.83267	65.87868	81 746 504	7.571 174	16.31160	35.14228
435	189 225	20.85665	65.95453	82 312 875	7.576 985	16.32412	35.16925
436	190 096	20.88061	66.03030	82 881 856	7.582 787	16.33662	35.19618
437	190 969	20.90454	66.10598	83 453 453	7.588 579	16.34910	35.22307
438	191 844	20.92845	66.18157	84 027 672	7.594 363	16.36156	35.24991
439	192 721	20.95233	66.25708	84 604 519	7.600 139	16.37400	35.27672
440	193 600	20.97618	66.33250	85 184 000	7.605 905	16.38643	35.30348
441	194 481	21.00000	66.40783	85 766 121	7.611 663	16.39883	35.33021
442	195 364	21.02380	66.48308	86 350 888	7.617 412	16.41122	35.35689
443	196 249	21.04757	66.55825	86 938 307	7.623 152	16.42358	35.38354
444	197 136	21.07131	66.63332	87 528 384	7.628 884	16.43593	35.41014
445	198 025	21.09502	66.70832	88 121 125	7.634 607	16.44826	35.43671
446	198 916	21.11871	66.78323	88 716 536	7.640 321	16.46057	35.46323
447	199 809	21.14237	66.85806	89 314 623	7.646 027	16.47287	35.48971
448	200 704	21.16601	66.93280	89 915 392	7.651 725	16.48514	35.51616
449	201 601	21.18962	67.00746	90 518 849	7.657 414	16.49740	35.54257
450	202 500	21.21320	67.08204	91 125 000	7.663 094	16.50964	35.56893

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
450	202 500	21.21320	67.08204	91 125 000	7.663 094	16.50964	35.56893
451	203 401	21.23676	67.15653	91 733 851	7.668 766	16.52186	35.59526
452	204 304	21.26029	67.23095	92 345 408	7.674 430	16.53406	35.62155
453	205 209	21.28380	67.30527	92 959 677	7.680 086	16.54624	35.64780
454	206 116	21.30728	67.37952	93 576 664	7.685 733	16.55841	35.67401
455	207 025	21.33073	67.45369	94 196 375	7.691 372	16.57056	35.70018
456	207 936	21.35416	67.52777	94 818 816	7.697 002	16.58269	35.72632
457	208 849	21.37756	67.60178	95 443 993	7.702 625	16.59480	35.75242
458	209 764	21.40093	67.67570	96 071 912	7.708 239	16.60690	35.77848
459	210 681	21.42429	67.74954	96 702 579	7.713 845	16.61897	35.80450
460	211 600	21.44761	67.82330	97 336 000	7.719 443	16.63103	35.83048
461	212 521	21.47091	67.89698	97 972 181	7.725 032	16.64308	35.85642
462	213 444	21.49419	67.97058	98 611 128	7.730 614	16.65510	35.88233
463	214 369	21.51743	68.04410	99 252 847	7.736 188	16.66711	35.90820
464	215 296	21.54066	68.11755	99 897 344	7.741 753	16.67910	35.93404
465	216 225	21.56386	68.19091	100 544 625	7.747 311	16.69108	35.95983
466	217 156	21.58703	68.26419	101 194 696	7.752 861	16.70303	35.98559
467	218 089	21.61018	68.33740	101 847 563	7.758 402	16.71497	36.01131
468	219 024	21.63331	68.41053	102 503 232	7.763 936	16.72689	36.03700
469	219 961	21.65641	68.48357	103 161 709	7.769 462	16.73880	36.06265
470	220 900	21.67948	68.55655	103 823 000	7.774 980	16.75069	36.08826
471	221 841	21.70253	68.62944	104 487 111	7.780 490	16.76256	36.11384
472	222 784	21.72556	68.70226	105 154 048	7.785 993	16.77441	36.13938
473	223 729	21.74856	68.77500	105 823 817	7.791 488	16.78625	36.16488
474	224 676	21.77154	68.84766	106 496 424	7.796 975	16.79807	36.19035
475	225 625	21.79449	68.92024	107 171 875	7.802 454	16.80988	36.21578
476	226 576	21.81742	68.99275	107 850 176	7.807 925	16.82167	36.24118
477	227 529	21.84033	69.06519	108 531 333	7.813 389	16.83344	36.26654
478	228 484	21.86321	69.13754	109 215 352	7.818 846	16.84519	36.29187
479	229 441	21.88607	69.20983	109 902 239	7.824 294	16.85693	36.31716
480	230 400	21.90890	69.28203	110 592 000	7.829 735	16.86865	36.34241
481	231 361	21.93171	69.35416	111 284 641	7.835 169	16.88036	36.36763
482	232 324	21.95450	69.42622	111 980 168	7.840 595	16.89205	36.39282
483	233 289	21.97726	69.49820	112 678 587	7.846 013	16.90372	36.41797
484	234 256	22.00000	69.57011	113 379 904	7.851 424	16.91538	36.44308
485	235 225	22.02272	69.64194	114 084 125	7.856 828	16.92702	36.46817
486	236 196	22.04541	69.71370	114 791 256	7.862 224	16.93865	36.49321
487	237 169	22.06808	69.78539	115 501 303	7.867 613	16.95026	36.51822
488	238 144	22.09072	69.85700	116 214 272	7.872 994	16.96185	36.54320
489	239 121	22.11334	69.92853	116 930 169	7.878 368	16.97343	36.56815
490	240 100	22.13594	70.00000	117 649 000	7.883 735	16.98499	36.59306
491	241 081	22.15852	70.07139	118 370 771	7.889 095	16.99654	36.61793
492	242 064	22.18107	70.14271	119 095 488	7.894 447	17.00807	36.64278
493	243 049	22.20360	70.21396	119 823 157	7.899 792	17.01959	36.66758
494	244 036	22.22611	70.28513	120 553 784	7.905 129	17.03108	36.69236
495	245 025	22.24860	70.35624	121 287 375	7.910 460	17.04257	36.71710
496	246 016	22.27106	70.42727	122 023 936	7.915 783	17.05404	36.74181
497	247 009	22.29350	70.49823	122 763 473	7.921 099	17.06549	36.76649
498	248 004	22.31591	70.56912	123 505 992	7.926 408	17.07693	36.79113
499	249 001	22.33831	70.63993	124 251 499	7.931 710	17.08835	36.81574
500	250 000	22.36068	70.71068	125 000 000	7.937 005	17.09976	36.84031

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
500	250 000	22.36068	70.71068	125 000 000	7.937 005	17.09976	36.84031
501	251 001	22.38303	70.78135	125 751 501	7.942 293	17.11115	36.86486
502	252 004	22.40536	70.85196	126 506 008	7.947 574	17.12253	36.88937
503	253 009	22.42766	70.92249	127 263 527	7.952 848	17.13389	36.91385
504	254 016	22.44994	70.99296	128 024 064	7.958 114	17.14524	36.93830
505	255 025	22.47221	71.06335	128 787 625	7.963 374	17.15657	36.96271
506	256 036	22.49444	71.13368	129 554 216	7.968 627	17.16789	36.98709
507	257 049	22.51666	71.20393	130 323 843	7.973 873	17.17919	37.01144
508	258 064	22.53886	71.27412	131 096 512	7.979 112	17.19048	37.03576
509	259 081	22.56103	71.34424	131 872 229	7.984 344	17.20175	37.06004
510	260 100	22.58318	71.41428	132 651 000	7.989 570	17.21301	37.08430
511	261 121	22.60531	71.48426	133 432 831	7.994 788	17.22425	37.10852
512	262 144	22.62742	71.55418	134 217 728	8.000 000	17.23548	37.13271
513	263 169	22.64950	71.62402	135 005 697	8.005 205	17.24669	37.15687
514	264 196	22.67157	71.69379	135 796 744	8.010 403	17.25789	37.18100
515	265 225	22.69361	71.76350	136 590 875	8.015 595	17.26908	37.20509
516	266 256	22.71563	71.83314	137 388 096	8.020 779	17.28025	37.22916
517	267 289	22.73763	71.90271	138 188 413	8.025 957	17.29140	37.25319
518	268 324	22.75961	71.97222	138 991 832	8.031 129	17.30254	37.27720
519	269 361	22.78157	72.04165	139 798 359	8.036 293	17.31367	37.30117
520	270 400	22.80351	72.11103	140 608 000	8.041 452	17.32478	37.32511
521	271 441	22.82542	72.18033	141 420 761	8.046 603	17.33588	37.34902
522	272 484	22.84732	72.24957	142 236 648	8.051 748	17.34696	37.37290
523	273 529	22.86919	72.31874	143 055 667	8.056 886	17.35804	37.39675
524	274 576	22.89105	72.38784	143 877 824	8.062 018	17.36909	37.42057
525	275 625	22.91288	72.45688	144 703 125	8.067 143	17.38013	37.44436
526	276 676	22.93469	72.52586	145 531 576	8.072 262	17.39116	37.46812
527	277 729	22.95648	72.59477	146 363 183	8.077 374	17.40218	37.49185
528	278 784	22.97825	72.66361	147 197 952	8.082 480	17.41318	37.51555
529	279 841	23.00000	72.73239	148 035 889	8.087 579	17.42416	37.53922
530	280 900	23.02173	72.80110	148 877 000	8.092 672	17.43513	37.56286
531	281 961	23.04344	72.86975	149 721 291	8.097 759	17.44609	37.58647
532	283 024	23.06513	72.93833	150 568 768	8.102 839	17.45704	37.61005
533	284 089	23.08679	73.00685	151 419 437	8.107 913	17.46797	37.63360
534	285 156	23.10844	73.07530	152 273 304	8.112 980	17.47889	37.65712
535	286 225	23.13007	73.14369	153 130 375	8.118 041	17.48979	37.68061
536	287 296	23.15167	73.21202	153 990 656	8.123 096	17.50068	37.70407
537	288 369	23.17326	73.28028	154 854 153	8.128 145	17.51156	37.72751
538	289 444	23.19483	73.34848	155 720 872	8.133 187	17.52242	37.75091
539	290 521	23.21637	73.41662	156 590 819	8.138 223	17.53327	37.77429
540	291 600	23.23790	73.48469	157 464 000	8.143 253	17.54411	37.79763
541	292 681	23.25941	73.55270	158 340 421	8.148 276	17.55493	37.82095
542	293 764	23.28089	73.62065	159 220 088	8.153 294	17.56574	37.84424
543	294 849	23.30236	73.68853	160 103 007	8.158 305	17.57654	37.86750
544	295 936	23.32381	73.75636	160 989 184	8.163 310	17.58732	37.89073
545	297 025	23.34524	73.82412	161 878 625	8.168 309	17.59809	37.91393
546	298 116	23.36664	73.89181	162 771 336	8.173 302	17.60885	37.93711
547	299 209	23.38803	73.95945	163 667 323	8.178 289	17.61959	37.96025
548	300 304	23.40940	74.02702	164 566 592	8.183 269	17.63032	37.98337
549	301 401	23.43075	74.09453	165 469 149	8.188 244	17.64104	38.00646
550	302 500	23.45208	74.16198	166 375 000	8.193 213	17.65174	38.02952

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
550	302 500	23.45208	74.16198	166 375 000	8.193 213	17.65174	38.02952
551	303 601	23.47339	74.22937	167 284 151	8.198 175	17.66243	38.05256
552	304 704	23.49468	74.29670	168 196 608	8.203 132	17.67311	38.07557
553	305 809	23.51595	74.36397	169 112 377	8.208 082	17.68378	38.09854
554	306 916	23.53720	74.43118	170 031 464	8.213 027	17.69443	38.12149
555	308 025	23.55844	74.49832	170 953 875	8.217 966	17.70507	38.14442
556	309 136	23.57965	74.56541	171 879 616	8.222 899	17.71570	38.16731
557	310 249	23.60085	74.63243	172 808 693	8.227 825	17.72631	38.19018
558	311 364	23.62202	74.69940	173 741 112	8.232 746	17.73691	38.21302
559	312 481	23.64318	74.76630	174 676 879	8.237 661	17.74750	38.23584
560	313 600	23.66432	74.83315	175 616 000	8.242 571	17.75808	38.25862
561	314 721	23.68544	74.89993	176 558 481	8.247 474	17.76864	38.28138
562	315 844	23.70654	74.96666	177 504 328	8.252 372	17.77920	38.30412
563	316 969	23.72762	75.03333	178 453 547	8.257 263	17.78973	38.32682
564	318 096	23.74868	75.09993	179 406 144	8.262 149	17.80026	38.34950
565	319 225	23.76973	75.16648	180 362 125	8.267 029	17.81077	38.37215
566	320 356	23.79075	75.23297	181 321 496	8.271 904	17.82128	38.39478
567	321 489	23.81176	75.29940	182 284 263	8.276 773	17.83177	38.41737
568	322 624	23.83275	75.36577	183 250 432	8.281 635	17.84224	38.43995
569	323 761	23.85372	75.43209	184 220 009	8.286 493	17.85271	38.46249
570	324 900	23.87467	75.49834	185 193 000	8.291 344	17.86316	38.48501
571	326 041	23.89561	75.56454	186 169 411	8.296 190	17.87360	38.50759
572	327 184	23.91652	75.63068	187 149 248	8.301 031	17.88403	38.52997
573	328 329	23.93742	75.69676	188 132 517	8.305 865	17.89444	38.55241
574	329 476	23.95830	75.76279	189 119 224	8.310 694	17.90485	38.57482
575	330 625	23.97916	75.82875	190 109 375	8.315 517	17.91524	38.59721
576	331 776	24.00000	75.89466	191 102 976	8.320 335	17.92562	38.61958
577	332 929	24.02082	75.96052	192 100 033	8.325 148	17.93599	38.64191
578	334 084	24.04163	76.02631	193 100 552	8.329 954	17.94634	38.66422
579	335 241	24.06242	76.09205	194 104 539	8.334 755	17.95669	38.68651
580	336 400	24.08319	76.15773	195 112 000	8.339 551	17.96702	38.70877
581	337 561	24.10394	76.22336	196 122 941	8.344 341	17.97734	38.73100
582	338 724	24.12468	76.28892	197 137 368	8.349 126	17.98765	38.75321
583	339 889	24.14539	76.35444	198 155 287	8.353 905	17.99794	38.77539
584	341 056	24.16609	76.41989	199 176 704	8.358 678	18.00823	38.79755
585	342 225	24.18677	76.48529	200 201 625	8.363 447	18.01850	38.81968
586	343 396	24.20744	76.55064	201 230 056	8.368 209	18.02876	38.84179
587	344 569	24.22808	76.61593	202 262 003	8.372 967	18.03901	38.86387
588	345 744	24.24871	76.68116	203 297 472	8.377 719	18.04925	38.88593
589	346 921	24.26932	76.74634	204 336 469	8.382 465	18.05947	38.90796
590	348 100	24.28992	76.81146	205 379 000	8.387 207	18.06969	38.92996
591	349 281	24.31049	76.87652	206 425 071	8.391 942	18.07989	38.95195
592	350 464	24.33105	76.94154	207 474 688	8.396 673	18.09008	38.97390
593	351 649	24.35159	77.00649	208 527 857	8.401 398	18.10026	38.99584
594	352 836	24.37212	77.07140	209 584 584	8.406 118	18.11043	39.01774
595	354 025	24.39262	77.13624	210 644 875	8.410 833	18.12059	39.03963
596	355 216	24.41311	77.20104	211 708 736	8.415 542	18.13074	39.06149
597	356 409	24.43358	77.26578	212 776 173	8.420 246	18.14087	39.08332
598	357 604	24.45404	77.33046	213 847 192	8.424 945	18.15099	39.10513
599	358 801	24.47448	77.39509	214 921 799	8.429 638	18.16111	39.12692
600	360 000	24.49490	77.45967	216 000 000	8.434 327	18.17121	39.14868

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
600	360 000	24.49490	77.45967	216 000 000	8.434 327	18.17121	39.14868
601	361 201	24.51530	77.52419	217 081 801	8.439 010	18.18130	39.17041
602	362 404	24.53569	77.58866	218 167 208	8.443 688	18.19137	39.19213
603	363 609	24.55606	77.65307	219 256 227	8.448 361	18.20144	39.21382
604	364 816	24.57641	77.71744	220 348 864	8.453 028	18.21150	39.23548
605	366 025	24.59675	77.78175	221 445 125	8.457 691	18.22154	39.25712
606	367 236	24.61707	77.84600	222 545 016	8.462 348	18.23158	39.27874
607	368 449	24.63737	77.91020	223 648 543	8.467 000	18.24160	39.30033
608	369 664	24.65766	77.97435	224 755 712	8.471 647	18.25161	39.32190
609	370 881	24.67793	78.03845	225 866 529	8.476 289	18.26161	39.34345
610	372 100	24.69818	78.10250	226 981 000	8.480 926	18.27160	39.36497
611	373 321	24.71841	78.16649	228 099 131	8.485 558	18.28158	39.38647
612	374 544	24.73863	78.23043	229 220 928	8.490 185	18.29155	39.40795
613	375 769	24.75884	78.29432	230 346 397	8.494 807	18.30151	39.42940
614	376 996	24.77902	78.35815	231 475 544	8.499 423	18.31145	39.45083
615	378 225	24.79919	78.42194	232 608 375	8.504 035	18.32139	39.47223
616	379 456	24.81935	78.48567	233 744 896	8.508 642	18.33131	39.49362
617	380 689	24.83948	78.54935	234 885 113	8.513 243	18.34123	39.51498
618	381 924	24.85961	78.61298	236 029 032	8.517 840	18.35113	39.53631
619	383 161	24.87971	78.67655	237 176 659	8.522 432	18.36102	39.55763
620	384 400	24.89980	78.74008	238 328 000	8.527 019	18.37091	39.57892
621	385 641	24.91987	78.80355	239 483 061	8.531 601	18.38078	39.60018
622	386 884	24.93993	78.86698	240 641 848	8.536 178	18.39064	39.62143
623	388 129	24.95997	78.93035	241 804 367	8.540 750	18.40049	39.64265
624	389 376	24.97999	78.99367	242 970 624	8.545 317	18.41033	39.66385
625	390 625	25.00000	79.05694	244 140 625	8.549 880	18.42016	39.68503
626	391 876	25.01999	79.12016	245 314 376	8.554 437	18.42998	39.70618
627	393 129	25.03997	79.18333	246 491 883	8.558 990	18.43978	39.72731
628	394 384	25.05993	79.24645	247 673 152	8.563 538	18.44958	39.74842
629	395 641	25.07987	79.30952	248 858 189	8.568 081	18.45937	39.76951
630	396 900	25.09980	79.37254	250 047 000	8.572 619	18.46915	39.79057
631	398 161	25.11971	79.43551	251 239 591	8.577 152	18.47891	39.81161
632	399 424	25.13961	79.49843	252 435 968	8.581 681	18.48867	39.83263
633	400 689	25.15949	79.56130	253 636 137	8.586 205	18.49842	39.85363
634	401 956	25.17936	79.62412	254 840 104	8.590 724	18.50815	39.87461
635	403 225	25.19921	79.68689	256 047 875	8.595 238	18.51788	39.89556
636	404 496	25.21904	79.74961	257 259 456	8.599 748	18.52759	39.91649
637	405 769	25.23886	79.81228	258 474 853	8.604 252	18.53730	39.93740
638	407 044	25.25866	79.87490	259 694 072	8.608 753	18.54700	39.95829
639	408 321	25.27845	79.93748	260 917 119	8.613 248	18.55668	39.97916
640	409 600	25.29822	80.00000	262 144 000	8.617 739	18.56636	40.00000
641	410 881	25.31798	80.06248	263 374 721	8.622 225	18.57602	40.02082
642	412 164	25.33772	80.12490	264 609 288	8.626 706	18.58568	40.04162
643	413 449	25.35744	80.18728	265 847 707	8.631 183	18.59532	40.06240
644	414 736	25.37716	80.24961	267 089 984	8.635 655	18.60495	40.08316
645	416 025	25.39685	80.31189	268 336 125	8.640 123	18.61458	40.10390
646	417 316	25.41653	80.37413	269 586 136	8.644 585	18.62419	40.12461
647	418 609	25.43619	80.43631	270 840 023	8.649 044	18.63380	40.14530
648	419 904	25.45584	80.49845	272 097 792	8.653 497	18.64340	40.16598
649	421 201	25.47548	80.56054	273 359 449	8.657 947	18.65298	40.18663
650	422 500	25.49510	80.62258	274 625 000	8.662 391	18.66256	40.20726

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
650	422 500	25.49510	80.62258	274 625 000	8.662 391	18.66256	40.20726
651	423 801	25.51470	80.68457	275 894 451	8.666 831	18.67212	40.22787
652	425 104	25.53429	80.74652	277 167 808	8.671 266	18.68168	40.24845
653	426 409	25.55386	80.80842	278 445 077	8.675 697	18.69122	40.26902
654	427 716	25.57342	80.87027	279 726 264	8.680 124	18.70076	40.28957
655	429 025	25.59297	80.93207	281 011 375	8.684 546	18.71029	40.31009
656	430 336	25.61250	80.99383	282 300 416	8.688 963	18.71980	40.33059
657	431 649	25.63201	81.05554	283 593 393	8.693 376	18.72931	40.35108
658	432 964	25.65151	81.11720	284 890 312	8.697 784	18.73881	40.37154
659	434 281	25.67100	81.17881	286 191 179	8.702 188	18.74830	40.39198
660	435 600	25.69047	81.24038	287 496 000	8.706 588	18.75777	40.41240
661	436 921	25.70992	81.30191	288 804 781	8.710 983	18.76724	40.43280
662	438 244	25.72936	81.36338	290 117 528	8.715 373	18.77670	40.45318
663	439 569	25.74879	81.42481	291 434 247	8.719 760	18.78615	40.47354
664	440 896	25.76820	81.48620	292 754 944	8.724 141	18.79559	40.49388
665	442 225	25.78759	81.54753	294 079 625	8.728 519	18.80502	40.51420
666	443 556	25.80698	81.60882	295 408 296	8.732 892	18.81444	40.53449
667	444 889	25.82634	81.67007	296 740 963	8.737 260	18.82386	40.55477
668	446 224	25.84570	81.73127	298 077 632	8.741 625	18.83326	40.57503
669	447 561	25.86503	81.79242	299 418 309	8.745 985	18.84265	40.59526
670	448 900	25.88436	81.85353	300 763 000	8.750 340	18.85204	40.61548
671	450 241	25.90367	81.91459	302 111 711	8.754 691	18.86141	40.63568
672	451 584	25.92296	81.97561	303 464 448	8.759 038	18.87078	40.65585
673	452 929	25.94224	82.03658	304 821 217	8.763 381	18.88013	40.67601
674	454 276	25.96151	82.09750	306 182 024	8.767 719	18.88948	40.69615
675	455 625	25.98076	82.15838	307 546 875	8.772 053	18.89882	40.71626
676	456 976	26.00000	82.21922	308 915 776	8.776 383	18.90814	40.73636
677	458 329	26.01922	82.28001	310 288 733	8.780 708	18.91746	40.75644
678	459 684	26.03843	82.34076	311 665 752	8.785 030	18.92677	40.77650
679	461 041	26.05763	82.40146	313 046 839	8.789 347	18.93607	40.79653
680	462 400	26.07681	82.46211	314 432 000	8.793 659	18.94536	40.81655
681	463 761	26.09598	82.52272	315 821 241	8.797 968	18.95465	40.83655
682	465 124	26.11513	82.58329	317 214 568	8.802 272	18.96392	40.85653
683	466 489	26.13427	82.64381	318 611 987	8.806 572	18.97318	40.87649
684	467 856	26.15339	82.70429	320 013 504	8.810 868	18.98244	40.89643
685	469 225	26.17250	82.76473	321 419 125	8.815 160	18.99169	40.91635
686	470 596	26.19160	82.82512	322 828 856	8.819 447	19.00092	40.93625
687	471 969	26.21068	82.88546	324 242 703	8.823 731	19.01015	40.95613
688	473 344	26.22975	82.94577	325 660 672	8.828 010	19.01937	40.97599
689	474 721	26.24881	83.00602	327 082 769	8.832 285	19.02858	40.99584
690	476 100	26.26785	83.06624	328 509 000	8.836 556	19.03778	41.01566
691	477 481	26.28688	83.12641	329 939 371	8.840 823	19.04698	41.03546
692	478 864	26.30589	83.18654	331 373 888	8.845 085	19.05616	41.05525
693	480 249	26.32489	83.24662	332 812 557	8.849 344	19.06533	41.07502
694	481 636	26.34388	83.30666	334 255 384	8.853 599	19.07450	41.09476
695	483 025	26.36285	83.36666	335 702 375	8.857 849	19.08366	41.11449
696	484 416	26.38181	83.42661	337 153 536	8.862 095	19.09281	41.13420
697	485 809	26.40076	83.48653	338 608 873	8.866 338	19.10195	41.15389
698	487 204	26.41969	83.54639	340 068 392	8.870 576	19.11108	41.17357
699	488 601	26.43861	83.60622	341 532 099	8.874 810	19.12020	41.19322
700	490 000	26.45751	83.66600	343 000 000	8.879 040	19.12931	41.21285

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
700	490 000	26.45751	83.66600	343 000 000	8.879 040	19.12931	41.21285
701	491 401	26.47640	83.72574	344 472 101	8.883 266	19.13842	41.23247
702	492 804	26.49528	83.78544	345 948 408	8.887 488	19.14751	41.25207
703	494 209	26.51415	83.84510	347 428 927	8.891 706	19.15660	41.27164
704	495 616	26.53300	83.90471	348 913 664	8.895 920	19.16568	41.29120
705	497 025	26.55184	83.96428	350 402 625	8.900 130	19.17475	41.31075
706	498 436	26.57066	84.02381	351 895 816	8.904 337	19.18381	41.33027
707	499 849	26.58947	84.08329	353 393 243	8.908 539	19.19286	41.34977
708	501 264	26.60827	84.14274	354 894 912	8.912 737	19.20191	41.36926
709	502 681	26.62705	84.20214	356 400 829	8.916 931	19.21095	41.38873
710	504 100	26.64583	84.26150	357 911 000	8.921 121	19.21997	41.40818
711	505 521	26.66458	84.32082	359 425 431	8.925 308	19.22899	41.42761
712	506 944	26.68333	84.38009	360 944 128	8.929 490	19.23800	41.44702
713	508 369	26.70206	84.43933	362 467 097	8.933 669	19.24701	41.46642
714	509 796	26.72078	84.49852	363 994 344	8.937 843	19.25600	41.48579
715	511 225	26.73948	84.55767	365 525 875	8.942 014	19.26499	41.50515
716	512 656	26.75818	84.61678	367 061 696	8.946 181	19.27396	41.52449
717	514 089	26.77686	84.67585	368 601 813	8.950 344	19.28293	41.54382
718	515 524	26.79552	84.73488	370 146 232	8.954 503	19.29189	41.56312
719	516 961	26.81418	84.79387	371 694 959	8.958 658	19.30084	41.58241
720	518 400	26.83282	84.85281	373 248 000	8.962 809	19.30979	41.60168
721	519 841	26.85144	84.91172	374 805 361	8.966 957	19.31872	41.62093
722	521 284	26.87006	84.97058	376 367 048	8.971 101	19.32765	41.64016
723	522 729	26.88866	85.02941	377 933 067	8.975 241	19.33657	41.65938
724	524 176	26.90725	85.08819	379 503 424	8.979 377	19.34548	41.67857
725	525 625	26.92582	85.14693	381 078 125	8.983 509	19.35438	41.69775
726	527 076	26.94439	85.20563	382 657 176	8.987 637	19.36328	41.71692
727	528 529	26.96294	85.26429	384 240 583	8.991 762	19.37216	41.73606
728	529 984	26.98148	85.32292	385 828 352	8.995 883	19.38104	41.75519
729	531 441	27.00000	85.38150	387 420 489	9.000 000	19.38991	41.77430
730	532 900	27.01851	85.44004	389 017 000	9.004 113	19.39877	41.79339
731	534 361	27.03701	85.49854	390 617 891	9.008 223	19.40763	41.81247
732	535 824	27.05550	85.55700	392 223 168	9.012 329	19.41647	41.83152
733	537 289	27.07397	85.61542	393 832 837	9.016 431	19.42531	41.85056
734	538 756	27.09243	85.67380	395 446 904	9.020 529	19.43414	41.86959
735	540 225	27.11088	85.73214	397 065 375	9.024 624	19.44296	41.88859
736	541 696	27.12932	85.79044	398 688 256	9.028 715	19.45178	41.90758
737	543 169	27.14774	85.84870	400 315 553	9.032 802	19.46058	41.92655
738	544 644	27.16616	85.90693	401 947 272	9.036 886	19.46938	41.94551
739	546 121	27.18455	85.96511	403 583 419	9.040 966	19.47817	41.96444
740	547 600	27.20294	86.02325	405 224 000	9.045 042	19.48695	41.98336
741	549 081	27.22132	86.08136	406 869 021	9.049 114	19.49573	42.00227
742	550 564	27.23968	86.13942	408 518 488	9.053 183	19.50449	42.02115
743	552 049	27.25803	86.19745	410 172 407	9.057 248	19.51325	42.04002
744	553 536	27.27636	86.25543	411 830 784	9.061 310	19.52200	42.05887
745	555 025	27.29469	86.31338	413 493 625	9.065 368	19.53074	42.07771
746	556 516	27.31300	86.37129	415 160 936	9.069 422	19.53948	42.09653
747	558 009	27.33130	86.42916	416 832 723	9.073 473	19.54820	42.11533
748	559 504	27.34959	86.48699	418 508 992	9.077 520	19.55692	42.13411
749	561 001	27.36786	86.54479	420 189 749	9.081 563	19.56563	42.15288
750	562 500	27.38613	86.60254	421 875 000	9.085 603	19.57434	42.17163

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
750	562 500	27.38613	86.60254	421 875 000	9.085 603	19.57434	42.17163
751	564 001	27.40438	86.66026	423 564 751	9.089 639	19.58303	42.19037
752	565 504	27.42262	86.71793	425 259 008	9.093 672	19.59172	42.20909
753	567 009	27.44085	86.77557	426 957 777	9.097 701	19.60040	42.22779
754	568 516	27.45906	86.83317	428 661 064	9.101 727	19.60908	42.24647
755	570 025	27.47726	86.89074	430 368 875	9.105 748	19.61774	42.26514
756	571 536	27.49545	86.94826	432 081 216	9.109 767	19.62640	42.28379
757	573 049	27.51363	87.00575	433 798 093	9.113 782	19.63505	42.30243
758	574 564	27.53180	87.06320	435 519 512	9.117 793	19.64369	42.32105
759	576 081	27.54995	87.12061	437 245 479	9.121 801	19.65232	42.33965
760	577 600	27.56810	87.17798	438 976 000	9.125 805	19.66095	42.35824
761	579 121	27.58623	87.23531	440 711 081	9.129 806	19.66957	42.37681
762	580 644	27.60435	87.29261	442 450 728	9.133 803	19.67818	42.39536
763	582 169	27.62245	87.34987	444 194 947	9.137 797	19.68679	42.41390
764	583 696	27.64055	87.40709	445 943 744	9.141 787	19.69538	42.43242
765	585 225	27.65863	87.46428	447 697 125	9.145 774	19.70397	42.45092
766	586 756	27.67671	87.52143	449 455 096	9.149 758	19.71256	42.46941
767	588 289	27.69476	87.57854	451 217 663	9.153 738	19.72113	42.48789
768	589 824	27.71281	87.63561	452 984 832	9.157 714	19.72970	42.50634
769	591 361	27.73085	87.69265	454 756 609	9.161 687	19.73826	42.52478
770	592 900	27.74887	87.74964	456 533 000	9.165 656	19.74681	42.54321
771	594 441	27.76689	87.80661	458 314 011	9.169 623	19.75535	42.56162
772	595 984	27.78489	87.86353	460 099 648	9.173 585	19.76389	42.58001
773	597 529	27.80288	87.92042	461 889 917	9.177 544	19.77242	42.59839
774	599 076	27.82086	87.97727	463 684 824	9.181 500	19.78094	42.61675
775	600 625	27.83882	88.03408	465 484 375	9.185 453	19.78946	42.63509
776	602 176	27.85678	88.09086	467 288 576	9.189 402	19.79797	42.65342
777	603 729	27.87472	88.14760	469 097 433	9.193 347	19.80647	42.67174
778	605 284	27.89265	88.20431	470 910 952	9.197 290	19.81496	42.69004
779	606 841	27.91057	88.26098	472 729 139	9.201 229	19.82345	42.70832
780	608 400	27.92848	88.31761	474 552 000	9.205 164	19.83192	42.72659
781	609 961	27.94638	88.37420	476 379 541	9.209 096	19.84040	42.74484
782	611 524	27.96426	88.43076	478 211 768	9.213 025	19.84886	42.76307
783	613 089	27.98214	88.48729	480 048 687	9.216 950	19.85732	42.78129
784	614 656	28.00000	88.54377	481 890 304	9.220 873	19.86577	42.79950
785	616 225	28.01785	88.60023	483 736 625	9.224 791	19.87421	42.81769
786	617 796	28.03569	88.65664	485 587 656	9.228 707	19.88265	42.83586
787	619 369	28.05352	88.71302	487 443 403	9.232 619	19.89107	42.85402
788	620 944	28.07134	88.76936	489 303 872	9.236 528	19.89950	42.87216
780	622 521	28.08914	88.82567	491 169 069	9.240 433	19.90791	42.89029
790	624 100	28.10694	88.88194	493 039 000	9.244 335	19.91632	42.90840
791	625 681	28.12472	88.93818	494 913 671	9.248 234	19.92472	42.92650
792	627 264	28.14249	88.99438	496 793 088	9.252 130	19.93311	42.94458
793	628 849	28.16026	89.05055	498 677 257	9.256 022	19.94150	42.96265
794	630 436	28.17801	89.10668	500 566 184	9.259 911	19.94987	42.98070
795	632 025	28.19574	89.16277	502 459 875	9.263 797	19.95825	42.99874
796	633 616	28.21347	89.21883	504 358 336	9.267 680	19.96661	43.01676
797	635 209	28.23119	89.27486	506 261 573	9.271 559	19.97497	43.03477
798	636 804	28.24889	89.33085	508 169 592	9.275 435	19.98332	43.05276
799	638 401	28.26659	89.38680	510 082 399	9.279 308	19.99166	43.07073
800	640 000	28.28427	89.44272	512 000 000	9.283 178	20.00000	43.08869

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
800	640 000	28.28427	89.44272	512 000 000	9.283 178	20.00000	43.08869
801	641 601	28.30194	89.49860	513 922 401	9.287 044	20.00833	43.10664
802	643 204	28.31960	89.55445	515 849 608	9.290 907	20.01665	43.12457
803	644 809	28.33725	89.61027	517 781 627	9.294 767	20.02497	43.14249
804	646 416	28.35489	89.66605	519 718 464	9.298 624	20.03328	43.16039
805	648 025	28.37252	89.72179	521 660 125	9.302 477	20.04158	43.17828
806	649 636	28.39014	89.77750	523 606 616	9.306 328	20.04988	43.19615
807	651 249	28.40775	89.83318	525 557 943	9.310 175	20.05816	43.21400
808	652 864	28.42534	89.88882	527 514 112	9.314 019	20.06645	43.23185
809	654 481	28.44293	89.94443	529 475 129	9.317 860	20.07472	43.24967
810	656 100	28.46050	90.00000	531 441 000	9.321 698	20.08299	43.26749
811	657 721	28.47806	90.05554	533 411 731	9.325 532	20.09125	43.28529
812	659 344	28.49561	90.11104	535 387 328	9.329 363	20.09950	43.30307
813	660 969	28.51315	90.16651	537 367 797	9.333 192	20.10775	43.32084
814	662 596	28.53069	90.22195	539 353 144	9.337 017	20.11599	43.33859
815	664 225	28.54820	90.27735	541 343 375	9.340 839	20.12423	43.35633
816	665 856	28.56571	90.33272	543 338 496	9.344 657	20.13245	43.37406
817	667 489	28.58321	90.38805	545 338 513	9.348 473	20.14067	43.39177
818	669 124	28.60070	90.44335	547 343 432	9.352 286	20.14889	43.40947
819	670 761	28.61818	90.49862	549 353 259	9.356 095	20.15710	43.42715
820	672 400	28.63564	90.55385	551 368 000	9.359 902	20.16530	43.44481
821	674 041	28.65310	90.60905	553 387 661	9.363 705	20.17349	43.46247
822	675 684	28.67054	90.66422	555 412 248	9.367 505	20.18168	43.48011
823	677 329	28.68798	90.71935	557 441 767	9.371 302	20.18986	43.49773
824	678 976	28.70540	90.77445	559 476 224	9.375 096	20.19803	43.51534
825	680 625	28.72281	90.82951	561 515 625	9.378 887	20.20620	43.53294
826	682 276	28.74022	90.88454	563 559 976	9.382 675	20.21436	43.55052
827	683 929	28.75761	90.93954	565 609 283	9.386 460	20.22252	43.56809
828	685 584	28.77499	90.99451	567 663 552	9.390 242	20.23066	43.58564
829	687 241	28.79236	91.04944	569 722 789	9.394 021	20.23880	43.60318
830	688 900	28.80972	91.10434	571 787 000	9.397 796	20.24694	43.62071
831	690 561	28.82707	91.15920	573 856 191	9.401 569	20.25507	43.63822
832	692 224	28.84441	91.21403	575 930 368	9.405 339	20.26319	43.65572
833	693 889	28.86174	91.26883	578 009 537	9.409 105	20.27130	43.67320
834	695 556	28.87906	91.32360	580 093 704	9.412 869	20.27941	43.69067
835	697 225	28.89637	91.37833	582 182 875	9.416 630	20.28751	43.70812
836	698 896	28.91366	91.43304	584 277 056	9.420 387	20.29561	43.72556
837	700 569	28.93095	91.48770	586 376 253	9.424 142	20.30370	43.74299
838	702 244	28.94823	91.54234	588 480 472	9.427 894	20.31178	43.76041
839	703 921	28.96550	91.59694	590 589 719	9.431 642	20.31986	43.77781
840	705 600	28.98275	91.65151	592 704 000	9.435 388	20.32793	43.79519
841	707 281	29.00000	91.70605	594 823 321	9.439 131	20.33599	43.81256
842	708 964	29.01724	91.76056	596 947 688	9.442 870	20.34405	43.82992
843	710 649	29.03446	91.81503	599 077 107	9.446 607	20.35210	43.84727
844	712 336	29.05168	91.86947	601 211 584	9.450 341	20.36014	43.86460
845	714 025	29.06888	91.92388	603 351 125	9.454 072	20.36818	43.88191
846	715 716	29.08608	91.97826	605 495 736	9.457 800	20.37621	43.89922
847	717 409	29.10326	92.03260	607 645 423	9.461 525	20.38424	43.91651
848	719 104	29.12044	92.08692	609 800 192	9.465 247	20.39226	43.93378
849	720 801	29.13760	92.14120	611 960 049	9.468 966	20.40027	43.95105
850	722 500	29.15476	92.19544	614 125 000	9.472 682	20.40828	43.96830

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
850	722 500	29.15476	92.19544	614 125 000	9.472 682	20.40828	43.96830
851	724 201	29.17190	92.24966	616 295 051	9.476 396	20.41628	43.98553
852	725 904	29.18904	92.30385	618 470 208	9.480 106	20.42427	44.00275
853	727 609	29.20616	92.35800	620 650 477	9.483 814	20.43226	44.01996
854	729 316	29.22328	92.41212	622 835 864	9.487 518	20.44024	44.03716
855	731 025	29.24038	92.46621	625 026 375	9.491 220	20.44821	44.05434
856	732 736	29.25748	92.52027	627 222 016	9.494 919	20.45618	44.07151
857	734 449	29.27456	92.57429	629 422 793	9.498 615	20.46415	44.08866
858	736 164	29.29164	92.62829	631 628 712	9.502 308	20.47210	44.10581
859	737 881	29.30870	92.68225	633 839 779	9.505 998	20.48005	44.12293
860	739 600	29.32576	92.73618	636 056 000	9.509 685	20.48800	44.14005
861	741 321	29.34280	92.79009	638 277 381	9.513 370	20.49593	44.15715
862	743 044	29.35984	92.84396	640 503 928	9.517 052	20.50387	44.17424
863	744 769	29.37686	92.89779	642 735 647	9.520 730	20.51179	44.19132
864	746 496	29.39388	92.95160	644 972 544	9.524 406	20.51971	44.20838
865	748 225	29.41088	93.00538	647 214 625	9.528 079	20.52762	44.22543
866	749 956	29.42788	93.05912	649 461 896	9.531 750	20.53553	44.24246
867	751 689	29.44486	93.11283	651 714 363	9.535 417	20.54343	44.25949
868	753 424	29.46184	93.16652	653 972 032	9.539 082	20.55133	44.27650
869	755 161	29.47881	93.22017	656 234 909	9.542 744	20.55922	44.29349
870	756 900	29.49576	93.27379	658 503 000	9.546 403	20.56710	44.31048
871	758 641	29.51271	93.32738	660 776 311	9.550 059	20.57498	44.32745
872	760 384	29.52965	93.38094	663 054 848	9.553 712	20.58285	44.34440
873	762 129	29.54657	93.43447	665 338 617	9.557 363	20.59071	44.36135
874	763 876	29.56349	93.48797	667 627 624	9.561 011	20.59857	44.37828
875	765 625	29.58040	93.54143	669 921 875	9.564 656	20.60643	44.39520
876	767 376	29.59730	93.59487	672 221 376	9.568 298	20.61427	44.41211
877	769 129	29.61419	93.64828	674 526 133	9.571 938	20.62211	44.42900
878	770 884	29.63106	93.70165	676 836 152	9.575 574	20.62995	44.44588
879	772 641	29.64793	93.75500	679 151 439	9.579 208	20.63778	44.46275
880	774 400	29.66479	93.80832	681 472 000	9.582 840	20.64560	44.47960
881	776 161	29.68164	93.86160	683 797 841	9.586 468	20.65342	44.49644
882	777 924	29.69848	93.91486	686 128 968	9.590 094	20.66123	44.51327
883	779 689	29.71532	93.96808	688 465 387	9.593 717	20.66904	44.53009
884	781 456	29.73214	94.02127	690 807 104	9.597 337	20.67684	44.54689
885	783 225	29.74895	94.07444	693 154 125	9.600 955	20.68463	44.56368
886	784 996	29.76575	94.12757	695 506 456	9.604 570	20.69242	44.58046
887	786 769	29.78255	94.18068	697 864 103	9.608 182	20.70020	44.59723
888	788 544	29.79933	94.23375	700 227 072	9.611 791	20.70798	44.61398
889	790 321	29.81610	94.28680	702 595 369	9.615 398	20.71575	44.63072
890	792 100	29.83287	94.33981	704 969 000	9.619 002	20.72351	44.64745
891	793 881	29.84962	94.39280	707 347 971	9.622 603	20.73127	44.66417
892	795 664	29.86637	94.44575	709 732 288	9.626 202	20.73902	44.68087
893	797 449	29.88311	94.49868	712 121 957	9.629 797	20.74677	44.69756
894	799 236	29.89983	94.55157	714 516 984	9.633 391	20.75451	44.71424
805	801 025	29.91655	94.60444	716 917 375	9.636 981	20.76225	44.73090
896	802 816	29.93326	94.65728	719 323 136	9.640 569	20.76998	44.74756
897	804 609	29.94996	94.71008	721 734 273	9.644 154	20.77770	44.76420
898	806 404	29.96665	94.76286	724 150 792	9.647 737	20.78542	44.78083
899	808 201	29.98333	94.81561	726 572 699	9.651 317	20.79313	44.79744
900	810 000	30.00000	94.86833	729 000 000	9.654 894	20.80084	44.81405

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
900	810 000	30.00000	94.86833	729 000 000	9.654 894	20.80084	44.81405
901	811 801	30.01666	94.92102	731 432 701	9.658 468	20.80854	44.83064
902	813 604	30.03331	94.97368	733 870 808	9.662 040	20.81623	44.84722
903	815 409	30.04996	95.02631	736 314 327	9.665 610	20.82392	44.86379
904	817 216	30.06659	95.07891	738 763 264	9.669 176	20.83161	44.88034
905	819 025	30.08322	95.13149	741 217 625	9.672 740	20.83929	44.89688
906	820 836	30.09983	95.18403	743 677 416	9.676 302	20.84696	44.91341
907	822 649	30.11644	95.23655	746 142 643	9.679 860	20.85463	44.92993
908	824 464	30.13304	95.28903	748 613 312	9.683 417	20.86229	44.94644
909	826 281	30.14963	95.34149	751 089 429	9.686 970	20.86994	44.96293
910	828 100	30.16621	95.39392	753 571 000	9.690 521	20.87759	44.97941
911	829 921	30.18278	95.44632	756 058 031	9.694 069	20.88524	44.99588
912	831 744	30.19934	95.49869	758 550 528	9.697 615	20.89288	45.01234
913	833 569	30.21589	95.55103	761 048 497	9.701 158	20.90051	45.02879
914	835 396	30.23243	95.60335	763 551 944	9.704 699	20.90814	45.04522
915	837 225	30.24897	95.65563	766 060 875	9.708 237	20.91576	45.06164
916	839 056	30.26549	95.70789	768 575 296	9.711 772	20.92338	45.07805
917	840 889	30.28201	95.76012	771 095 213	9.715 305	20.93099	45.09445
918	842 724	30.29851	95.81232	773 620 632	9.718 835	20.93860	45 11084
919	844 561	30.31501	95.86449	776 151 559	9.722 363	20.94620	45.12721
920	846 400	30.33150	95.91663	778 688 000	9.725 888	20.95379	45.14357
921	848 241	30.34798	95.96874	781 229 961	9.729 411	20.96138	45.15992
922	850 084	30.36445	96.02083	783 777 448	9.732 931	20.96896	45.17626
923	851 929	30.38092	96.07289	786 330 467	9.736 448	20.97654	45.19259
924	853 776	30.39737	96.12492	788 889 024	9.739 963	20.98411	45.20891
925	855 625	30.41381	96.17692	791 453 125	9.743 476	20.99168	45.22521
926	857 476	30.43025	96.22889	794 022 776	9.746 986	20.99924	45.24150
927	859 329	30.44667	96.28084	796 597 983	9.750 493	21.00680	45.25778
928	861 184	30.46309	96.33276	799 178 752	9.753 998	21.01435	45.27405
929	863 041	30.47950	96.38465	801 765 089	9.757 500	21.02190	45.29030
930	864 900	30.49590	96.43651	804 357 000	9.761 000	21.02944	45.30655
931	866 761	30.51229	96.48834	806 954 491	9.764 497	21.03697	45.32278
932	868 624	30.52868	96.54015	809 557 568	9.767 992	21.04450	45.33900
933	870 489	30.54505	96.59193	812 166 237	9.771 485	21.05203	45.35521
934	872 356	30.56141	96.64368	814 780 504	9.774 974	21.05954	45.37141
935	874 225	30.57777	96.69540	817 400 375	9.778 462	21.06706	45.38760
936	876 096	30.59412	96.74709	820 025 856	9.781 946	21.07456	45.40377
937	877 969	30.61046	96.79876	822 656 953	9.785 429	21.08207	45.41994
938	879 844	30.62679	96.85040	825 293 672	9.788 909	21.08956	45.43609
939	881 721	30.64311	96.90201	827 936 019	9.792 386	21.09706	45.45223
940	883 600	30.65942	96.95360	830 584 000	9.795 861	21.10454	45.46836
941	885 481	30.67572	97.00515	833 237 621	9.799 334	21.11202	45.48448
942	887 364	30.69202	97.05668	835 896 888	9.802 804	21.11950	45.50058
943	889 249	30.70831	97.10819	838 561 807	9.806 271	21.12697	45.51668
944	891 136	30.72458	97.15966	841 232 384	9.809 736	21.13444	45.53276
945	893 025	30.74085	97.21111	843 908 625	9.813 199	21.14190	45.54883
946	894 916	30.75711	97.26253	846 590 536	9.816 659	21.14935	45.56490
947	896 809	30.77337	97.31393	849 278 123	9.820 117	21.15680	45.58095
948	898 704	30.78961	97.36529	851 971 392	9.823 572	21.16424	45.59698
949	900 601	30.80584	97.41663	854 670 349	9.827 025	21.17168	45.61301
950	902 500	30.82207	97.46794	857 375 000	9.830 476	21.17912	45.62903

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
950	902 500	30.82207	97.46794	857 375 000	9.830 476	21.17912	45.62903
951	904 401	30.83829	97.51923	860 085 351	9.833 924	21.18655	45.64503
952	906 304	30.85450	97.57049	862 801 408	9.837 369	21.19397	45.66102
953	908 209	30.87070	97.62172	865 523 177	9.840 813	21.20139	45.67701
954	910 116	30.88689	97.67292	868 250 664	9.844 254	21.20880	45.69298
955	912 025	30.90307	97.72410	870 983 875	9.847 692	21.21621	45.70894
956	913 936	30.91925	97.77525	873 722 816	9.851 128	21.22361	45.72489
957	915 849	30.93542	97.82638	876 467 493	9.854 562	21.23101	45.74082
958	917 764	30.95158	97.87747	879 217 912	9.857 993	21.23840	45.75675
959	919 681	30.96773	97.92855	881 974 079	9.861 422	21.24579	45.77267
960	921 600	30.98387	97.97959	884 736 000	9.864 848	21.25317	45.78857
961	923 521	31.00000	98.03061	887 503 681	9.868 272	21.26055	45.80446
962	925 444	31.01612	98.08160	890 277 128	9.871 694	21.26792	45.82035
963	927 369	31.03224	98.13256	893 056 347	9.875 113	21.27529	45.83622
964	929 296	31.04835	98.18350	895 841 344	9.878 530	21.28265	45.85208
965	931 225	31.06445	98.23441	898 632 125	9.881 945	21.29001	45.86793
966	933 156	31.08054	98.28530	901 428 696	9.885 357	21.29736	45.88376
967	935 089	31.09662	98.33616	904 231 063	9.888 767	21.30470	45.89959
968	937 024	31.11270	98.38699	907 039 232	9.892 175	21.31204	45.91541
969	938 961	31.12876	98.43780	909 853 209	9.895 580	21.31938	45.93121
970	940 900	31.14482	98.48858	912 673 000	9.898 983	21.32671	45.94701
971	942 841	31.16087	98.53933	915 498 611	9.902 384	21.33404	45.96279
972	944 784	31.17691	98.59006	918 330 048	9.905 782	21.34136	45.97857
973	946 729	31.19295	98.64076	921 167 317	9.909 178	21.34868	45.99433
974	948 676	31.20897	98.69144	924 010 424	9.912 571	21.35599	46.01008
975	950 625	31.22499	98.74209	926 859 375	9.915 962	21.36329	46.02582
976	952 576	31.24100	98.79271	929 714 176	9.919 351	21.37059	46.04155
977	954 529	31.25700	98.84331	932 574 833	9.922 738	21.37789	46.05727
978	956 484	31.27299	98.89388	935 441 352	9.926 122	21.38518	46.07298
979	958 441	31.28898	98.94443	938 313 739	9.929 504	21.39247	46.08868
980	960 400	31.30495	98.99495	941 192 000	9.932 884	21.39975	46.10436
981	962 361	31.32092	99.04544	944 076 141	9.936 261	21.40703	46.12004
982	964 324	31.33688	99.09591	946 966 168	9.939 636	21.41430	46.13571
983	966 289	31.35283	99.14636	949 862 087	9.943 009	21.42156	46.15136
984	968 256	31.36877	99.19677	952 763 904	9.946 380	21.42883	46.16700
985	970 225	31.38471	99.24717	955 671 625	9.949 748	21.43608	46.18264
986	972 196	31.40064	99.29753	958 585 256	9.953 114	21.44333	46.19826
987	974 169	31.41656	99.34787	961 504 803	9.956 478	21.45058	46.21387
988	976 144	31.43247	99.39819	964 430 272	9.959 839	21.45782	46.22948
989	978 121	31.44837	99.44848	967 361 669	9.963 198	21.46506	46.24507
990	980 100	31.46427	99.49874	970 299 000	9.966 555	21.47229	46.26065
991	982 081	31.48015	99.54898	973 242 271	9.969 910	21.47952	46.27622
992	984 064	31.49603	99.59920	976 191 488	9.973 262	21.48674	46.29178
993	986 049	31.51190	99.64939	979 146 657	9.976 612	21.49396	46.30733
994	988 036	31.52777	99.69955	982 107 784	9.979 960	21.50117	46.32287
995	990 025	31.54362	99.74969	985 074 875	9.983 305	21.50838	46.33840
996	992 016	31.55947	99.79980	988 047 936	9.986 649	21.51558	46.35392
997	994 009	31.57531	99.84989	991 026 973	9.989 990	21.52278	46.36943
998	996 004	31.59114	99.89995	994 011 992	9.993 329	21.52997	46.38492
999	998 001	31.60696	99.94999	997 002 999	9.996 666	21.53716	46.40041
1000	1 000 000	31.62278	100.00000	1 000 000 000	10.000 000	21.54435	46.41589

POWERS OF NUMBERS

n	n^4	n^5	n^6	n^7	n^8
1	1	1	1	1	1
2	16	32	64	128	256
3	81	243	729	2187	6561
4	256	1024	4096	16384	65536
5	625	3125	15625	78125	390625
6	1296	7776	46656	279936	1679616
7	2401	16807	117649	823543	5764801
8	4096	32768	262144	2097152	16777216
9	6561	59049	531441	4782969	43046721
					$\times 10^8$
10	10000	100000	1000000	10000000	1.000000
11	14641	161051	1771561	19487171	2.143589
12	20736	248832	2985984	35831808	4.299817
13	28561	371293	4826809	62748517	8.157307
14	38416	537824	7529536	105413504	14.757891
15	50625	759375	11390625	170859375	25.628906
16	65536	1048576	16777216	268435456	42.949673
17	83521	1419857	24137569	410338673	69.757574
18	104976	1889568	34012224	612220032	110.199606
19	130321	2476099	47045881	893871739	169.835630
				$\times 10^9$	$\times 10^{10}$
20	160000	3200000	64000000	1.280000	2.560000
21	194481	4084101	85766121	1.801089	3.782286
22	234256	5153632	113379904	2.494358	5.487587
23	279841	6436343	148035889	3.404825	7.831099
24	331776	7962624	191102976	4.586471	11.007531
25	390625	9765625	244140625	6.103516	15.258789
26	456976	11881376	308915776	8.031810	20.882706
27	531441	14348907	387420489	10.460353	28.242954
28	614656	17210368	481890304	13.492929	37.780200
29	707281	20511149	594823321	17.249876	50.024641
			$\times 10^8$	$\times 10^{10}$	$\times 10^{11}$
30	810000	24300000	7.290000	2.187000	6.561000
31	923521	28629151	8.875037	2.751261	8.528910
32	1048576	33554432	10.737418	3.435974	10.995116
33	1185921	39135393	12.914680	4.261844	14.064086
34	1336336	45435424	15.448044	5.252335	17.857939
35	1500625	52521875	18.382656	6.433930	22.518754
36	1679616	60466176	21.767823	7.836416	28.211099
37	1874161	69343957	25.657264	9.493188	35.124795
38	2085136	79235168	30.109364	11.441558	43.477921
39	2313441	90224199	35.187438	13.723101	53.520093
			$\times 10^9$	$\times 10^{10}$	$\times 10^{12}$
40	2560000	102400000	4.096000	16.384000	6.553600
41	2825761	115856201	4.750104	19.475427	7.984925
42	3111696	130691232	5.489032	23.053933	9.682652
43	3418801	147008443	6.321363	27.181861	11.688200
44	3748096	164916224	7.256314	31.927781	14.048224
45	4100625	184528125	8.303766	37.366945	16.815125
46	4477456	205962976	9.474297	43.581766	20.047612
47	4879681	229345007	10.779215	50.662312	23.811287
48	5308416	254803968	12.230590	58.706834	28.179280
49	5764801	282475249	13.841287	67.822307	33.232931
50	6250000	312500000	15.625000	78.125000	39.062500

POWERS OF NUMBERS (Continued)

n	n^4	n^5	n^6	n^7	n^8
			$\times 10^9$	$\times 10^{11}$	$\times 10^{13}$
50	6250000	312500000	15.625000	7.812500	3.906250
51	6765201	345025251	17.596288	8.974107	4.576794
52	7311616	380204032	19.770610	10.280717	5.345973
53	7890481	418195493	22.164361	11.747111	6.225969
54	8503056	459165024	24.794911	13.389252	7.230196
55	9150625	503284375	27.680641	15.224352	8.373394
56	9834496	550731776	30.840979	17.270948	9.671731
57	10556001	601692057	34.296447	19.548975	11.142916
58	11316496	656356768	38.068693	22.079842	12.806308
59	12117361	714924299	42.180534	24.886515	14.683044
		$\times 10^8$	$\times 10^{10}$	$\times 10^{11}$	$\times 10^{13}$
60	12960000	7.776000	4.665600	27.993600	16.796160
61	13845841	8.445963	5.152037	31.427428	19.170731
62	14776336	9.161328	5.680024	35.216146	21.834011
63	15752961	9.924365	6.252350	39.389806	24.815578
64	16777216	10.737418	6.871948	43.980465	28.147498
65	17850625	11.602906	7.541889	49.022279	31.864481
66	18974736	12.523326	8.265395	54.551607	36.004061
67	20151121	13.501251	9.045838	60.607116	40.606768
68	21381376	14.539336	9.886748	67.229888	45.716324
69	22667121	15.640313	10.791816	74.463533	51.379837
		$\times 10^8$	$\times 10^{10}$	$\times 10^{12}$	$\times 10^{14}$
70	24010000	16.807000	11.764900	8.235430	5.764801
71	25411681	18.042294	12.810028	9.095120	6.457535
72	26873856	19.349176	13.931407	10.030613	7.222041
73	28398241	20.730716	15.133423	11.047399	8.064601
74	29986576	22.190066	16.420649	12.151280	8.991947
75	31640625	23.730469	17.797852	13.348389	10.011292
76	33362176	25.355254	19.269993	14.645195	11.130348
77	35153041	27.067842	20.842238	16.048523	12.357363
78	37015056	28.871744	22.519960	17.565569	13.701144
79	38950081	30.770564	24.308746	19.203909	15.171088
		$\times 10^8$	$\times 10^{10}$	$\times 10^{12}$	$\times 10^{14}$
80	40960000	32.768000	26.214400	20.971520	16.777216
81	43046721	34.867844	28.242954	22.876792	18.530202
82	45212176	37.073984	30.400667	24.928547	20.441409
83	47458321	39.390406	32.694037	27.136051	22.522922
84	49787136	41.821194	35.129803	29.509035	24.787589
85	52200625	44.370531	37.714952	32.057709	27.249053
86	54700816	47.042702	40.456724	34.792782	29.921793
87	57289761	49.842092	43.362620	37.725479	32.821167
88	59969536	52.773192	46.440409	40.867560	35.963452
89	62742241	55.840594	49.698129	44.231335	39.365888
		$\times 10^9$	$\times 10^{11}$	$\times 10^{13}$	$\times 10^{15}$
90	65610000	5.904900	5.314410	4.782969	4.304672
91	68574961	6.240321	5.678693	5.167610	4.702525
92	71639296	6.590815	6.063550	5.578466	5.132189
93	74805201	6.956884	6.469902	6.017009	5.595818
94	78074896	7.339040	6.898698	6.484776	6.095689
95	81450625	7.737809	7.350919	6.983373	6.634204
96	84934656	8.153727	7.827578	7.514475	7.213896
97	88529281	8.587340	8.329720	8.079828	7.837434
98	92236816	9.039208	8.858424	8.681255	8.507630
99	96059601	9.509900	9.414801	9.320653	9.227447
100	100000000	10.000000	10.000000	10.000000	10.000000

FACTORIALS AND THEIR LOGARITHMS

n	$n!$	$\log n!$	n	$n!$	$\log n!$
			50	3.0414×10^{64}	64.48307
1	1.0000	0.00000	51	1.5511×10^{66}	66.19065
2	2.0000	0.30103	52	8.0658×10^{67}	67.90665
3	6.0000	0.77815	53	4.2749×10^{69}	69.63092
4	2.4000×10	1.38021	54	2.3084×10^{71}	71.36332
5	1.2000×10^{2}	2.07918	**55**	1.2696×10^{73}	73.10368
6	7.2000×10^{2}	2.85733	56	7.1100×10^{74}	74.85187
7	5.0400×10^{3}	3.70243	57	4.0527×10^{76}	76.60774
8	4.0320×10^{4}	4.60552	58	2.3506×10^{78}	78.37117
9	3.6288×10^{5}	5.55976	59	1.3868×10^{80}	80.14202
10	3.6288×10^{6}	6.55976	**60**	8.3210×10^{81}	81.92017
11	3.9917×10^{7}	7.60116	61	5.0758×10^{83}	83.70550
12	4.7900×10^{8}	8.68034	62	3.1470×10^{85}	85.49790
13	6.2270×10^{9}	9.79428	63	1.9826×10^{87}	87.29724
14	8.7178×10^{10}	10.94041	64	1.2689×10^{89}	89.10342
15	1.3077×10^{12}	12.11650	**65**	8.2477×10^{90}	90.91633
16	2.0923×10^{13}	13.32062	66	5.4435×10^{92}	92.73587
17	3.5569×10^{14}	14.55107	67	3.6471×10^{94}	94.56195
18	6.4024×10^{15}	15.80634	68	2.4800×10^{96}	96.39446
19	1.2165×10^{17}	17.08509	69	1.7112×10^{98}	98.23331
20	2.4329×10^{18}	18.38612	**70**	1.1979×10^{100}	100.07841
21	5.1091×10^{19}	19.70834	71	8.5048×10^{101}	101.92966
22	1.1240×10^{21}	21.05077	72	6.1234×10^{103}	103.78700
23	2.5852×10^{22}	22.41249	73	4.4701×10^{105}	105.65032
24	6.2045×10^{23}	23.79271	74	3.3079×10^{107}	107.51955
25	1.5511×10^{25}	25.19065	**75**	2.4809×10^{109}	109.39461
26	4.0329×10^{26}	26.60562	76	1.8855×10^{111}	111.27543
27	1.0889×10^{28}	28.03698	77	1.4518×10^{113}	113.16192
28	3.0489×10^{29}	29.48414	78	1.1324×10^{115}	115.05401
29	8.8418×10^{30}	30.94654	79	8.9462×10^{116}	116.95164
30	2.6525×10^{32}	32.42366	**80**	7.1569×10^{118}	118.85473
31	8.2228×10^{33}	33.91502	81	5.7971×10^{120}	120.76321
32	2.6313×10^{35}	35.42017	82	4.7536×10^{122}	122.67703
33	8.6833×10^{36}	36.93869	83	3.9455×10^{124}	124.59610
34	2.9523×10^{38}	38.47016	84	3.3142×10^{126}	126.52038
35	1.0333×10^{40}	40.01423	**85**	2.8171×10^{128}	128.44980
36	3.7199×10^{41}	41.57054	86	2.4227×10^{130}	130.38430
37	1.3764×10^{43}	43.13874	87	2.1078×10^{132}	132.32382
38	5.2302×10^{44}	44.71852	88	1.8548×10^{134}	134.26830
39	2.0398×10^{46}	46.30959	89	1.6508×10^{136}	136.21769
40	8.1592×10^{47}	47.91165	**90**	1.4857×10^{138}	138.17194
41	3.3453×10^{49}	49.52443	91	1.3520×10^{140}	140.13098
42	1.4050×10^{51}	51.14768	92	1.2438×10^{142}	142.09477
43	6.0415×10^{52}	52.78115	93	1.1568×10^{144}	144.06325
44	2.6583×10^{54}	54.42460	94	1.0874×10^{146}	146.03638
45	1.1962×10^{56}	56.07781	**95**	1.0330×10^{148}	148.01410
46	5.5026×10^{57}	57.74057	96	9.9168×10^{149}	149.99637
47	2.5862×10^{59}	59.41267	97	9.6193×10^{151}	151.98314
48	1.2414×10^{61}	61.09391	98	9.4269×10^{153}	153.97437
49	6.0828×10^{62}	62.78410	99	9.3326×10^{155}	155.97000
50	3.0414×10^{64}	64.48307	**100**	9.3326×10^{157}	157.97000

FACTORS FOR COMPUTING PROBABLE ERRORS

n	$\frac{1}{\sqrt{n}}$	$\frac{1}{\sqrt{n(n-1)}}$	$\frac{.6745}{\sqrt{n-1}}$	$\frac{.6745}{\sqrt{n(n-1)}}$	$\frac{.8453}{n\sqrt{n-1}}$	$\frac{.8453}{\sqrt{n(n-1)}}$
2	.707107	.707107	.6745	.4769	.4227	.5978
3	.577350	.408248	.4769	.2754	.1993	.3451
4	.500000	.288675	.3894	.1947	.1220	.2440
5	.447214	.223607	.3372	.1508	.0845	.1890
6	.408248	.182574	.3016	.1231	.0630	.1543
7	.377964	.154303	.2754	.1041	.0493	.1304
8	.353553	.133631	.2549	.0901	.0399	.1130
9	.333333	.117851	.2385	.0795	.0332	.0996
10	.316228	.105409	.2248	.0711	.0282	.0891
11	.301511	.095346	.2133	.0643	.0243	.0806
12	.288675	.087039	.2034	.0587	.0212	.0736
13	.277350	.080064	.1947	.0540	.0188	.0677
14	.267261	.074125	.1871	.0500	.0167	.0627
15	.258199	.069007	.1803	.0465	.0151	.0583
16	.250000	.064550	.1742	.0435	.0136	.0546
17	.242536	.060634	.1686	.0409	.0124	.0513
18	.235702	.057166	.1636	.0386	.0114	.0483
19	.229416	.054074	.1590	.0365	.0105	.0457
20	.223607	.051299	.1547	.0346	.0097	.0434
21	.218218	.048795	.1508	.0329	.0090	.0412
22	.213201	.046524	.1472	.0314	.0084	.0393
23	.208514	.044455	.1438	.0300	.0078	.0376
24	.204124	.042563	.1406	.0287	.0073	.0360
25	.200000	.040825	.1377	.0275	.0069	.0345
26	.196116	.039223	.1349	.0265	.0065	.0332
27	.192450	.037743	.1323	.0255	.0061	.0319
28	.188982	.036370	.1298	.0245	.0058	.0307
29	.185695	.035093	.1275	.0237	.0055	.0297
30	.182574	.033903	.1252	.0229	.0052	.0287
31	.179605	.032791	.1231	.0221	.0050	.0277
32	.176777	.031750	.1211	.0214	0047	.0268
33	.174078	.030773	.1192	.0208	.0045	.0260
34	.171499	.029854	.1174	.0201	.0043	.0252
35	.169031	.028989	.1157	.0196	.0041	.0245
36	.166667	.028172	.1140	.0190	.0040	.0238
37	.164399	.027400	.1124	.0185	.0038	.0232
38	.162221	.026669	.1109	.0180	.0037	.0225
39	.160128	.025976	.1094	.0175	.0035	.0220
40	.158114	.025318	.1080	.0171	.0034	.0214
41	.156174	.024693	.1066	.0167	.0033	.0209
42	.154303	.024098	.1053	.0163	.0031	.0204
43	.152499	.023531	.1041	.0159	.0030	.0199
44	.150756	.022990	.1029	.0155	.0029	.0194
45	.149071	.022473	.1017	.0152	.0028	.0190
46	.147442	.021979	.1005	.0148	.0027	.0186
47	.145865	.021507	.0994	.0145	.0027	.0182
48	.144338	.021054	.0984	.0142	.0026	.0178
49	.142857	.020620	.0974	.0139	.0025	.0174
50	.141421	.020203	.0964	.0136	.0024	.0171

FACTORS FOR COMPUTING PROBABLE ERRORS
(Continued)

n	$\frac{1}{\sqrt{n}}$	$\frac{1}{\sqrt{n(n-1)}}$	$\frac{.6745}{\sqrt{n-1}}$	$\frac{.6745}{\sqrt{n(n-1)}}$	$\frac{.8453}{n\sqrt{n-1}}$	$\frac{.8453}{\sqrt{n(n-1)}}$
50	.141421	.020203	.0964	.0136	.0024	.0171
51	.140028	.019803	.0954	.0134	.0023	.0167
52	.138675	.019418	.0945	.0131	.0023	.0164
53	.137361	.019048	.0935	.0129	.0022	.0161
54	.136083	.018692	.0927	.0126	.0022	.0158
55	.134840	.018349	.0918	.0124	.0021	.0155
56	.133631	.018019	.0910	.0122	.0020	.0152
57	.132453	.017700	.0901	.0119	.0020	.0150
58	.131306	.017392	.0893	.0117	.0019	.0147
59	.130189	.017095	.0886	.0115	.0019	.0145
60	.129099	.016807	.0878	.0113	.0018	.0142
61	.128037	.016529	.0871	.0112	.0018	.0140
62	.127000	.016261	.0864	.0110	.0018	.0138
63	.125988	.016001	.0857	.0108	.0017	.0135
64	.125000	.015749	.0850	.0106	.0017	.0133
65	.124035	.015504	.0843	.0105	.0016	.0131
66	.123091	.015268	.0837	.0103	.0016	.0129
67	.122169	.015038	.0830	.0101	.0016	.0127
68	.121268	.014815	.0824	.0100	.0015	.0125
69	.120386	.014599	.0818	.0099	.0015	.0123
70	.119523	.014389	.0812	.0097	.0015	.0122
71	.118678	.014185	.0806	.0096	.0014	.0120
72	.117851	.013986	.0801	.0094	.0014	.0118
73	.117041	.013793	.0795	.0093	.0014	.0117
74	.116248	.013606	.0789	.0092	.0013	.0115
75	.115470	.013423	.0784	.0091	.0013	.0113
76	.114708	.013245	.0779	.0089	.0013	.0112
77	.113961	.013072	.0773	.0088	.0013	.0111
78	.113228	.012904	.0769	.0087	.0012	.0109
79	.112509	.012739	.0764	.0086	.0012	.0108
80	.111803	.012579	.0759	.0085	.0012	.0106
81	.111111	.012423	.0754	.0084	.0012	.0105
82	.110432	.012270	.0749	.0083	.0012	.0104
83	.109764	.012121	.0745	.0082	.0011	.0103
84	.109109	.011976	.0740	.0081	.0011	.0101
85	.108465	.011835	.0736	.0080	.0011	.0100
86	.107833	.011696	.0732	.0079	.0011	.0099
87	.107211	.011561	.0727	.0078	.0011	.0098
88	.106600	.011429	.0723	.0077	.0010	.0097
89	.106000	.011300	.0719	.0076	.0010	.0096
90	.105409	.011173	.0715	.0075	.0010	.0094
91	.104828	.011050	.0711	.0075	.0010	.0093
92	.104257	.010929	.0707	.0074	.0010	.0092
93	.103695	.010811	.0703	.0073	.0010	.0091
94	.103142	.010695	.0699	.0072	.0009	.0090
95	.102598	.010582	.0696	.0071	.0009	.0089
96	.102062	.010471	.0692	.0071	.0009	.0089
97	.101535	.010363	.0688	.0070	.0009	.0088
98	.101015	.010257	.0685	.0069	.0009	.0087
99	.100504	.010152	.0681	.0069	.0009	.0086
100	.100000	.010050	.0678	.0068	.0008	.0085

PROBABILITY OF OCCURRENCE OF DEVIATIONS

Valid for thirty or more samples.

Probability of occurrence, expressed as per cent, and odds against a deviation as great or greater than that designated is given for various ratios of the deviation to the probable error and to the standard deviation.

(From Pearl, Medical Biometry and Statistics, W. B. Saunders Company, publishers, by permission.)

Ratio dev. to P.E.	Probable occurrence %	Odds against, to 1	Ratio dev. to std. dev.	Probable occurrence %	Odds against, to 1
1.0	50.00	1.00	0.67449	50.00	1.00
1.1	45.81	1.18	0.7	48.39	1.07
1.2	41.83	1.39	0.8	42.37	1.36
1.3	38.06	1.63	0.9	36.81	1.72
1.4	34.50	1.90	1.0	31.73	2.15
1.5	31.17	2.21	1.1	27.13	2.69
1.6	28.05	2.57	1.2	23.01	3.35
1.7	25.15	2.98	1.3	19.36	4.17
1.8	22.47	3.45	1.4	16.15	5.19
1.9	20.00	4.00	1.5	13.36	6.48
2.0	17.73	4.64	1.6	10.96	8.12
2.1	15.67	5.38	1.7	8.91	10.22
2.2	13.78	6.25	1.8	7.19	12.92
2.3	12.08	7.28	1.9	5.74	16.41
2.4	10.55	8.48	2.0	4.55	20.98
2.5	9.18	9.90	2.1	3.57	26.99
2.6	7.95	11.58	2.2	2.78	34.96
2.7	6.86	13.58	2.3	2.14	45.62
2.8	5.89	15.96	2.4	1.64	60.00
2.9	5.05	18.82	2.5	1.24	79.52
3.0	4.30	22.24	2.6	.932	106.3
3.1	3.65	26.37	2.7	.693	143.2
3.2	3.09	31.36	2.8	.511	194.7
3.3	2.60	37.42	2.9	.373	267.0
3.4	2.18	44.80	3.0	.270	369.4
3.5	1.82	53.82	3.1	.194	515.7
3.6	1.52	64.89	3.2	.137	726.7
3.7	1.26	78.53	3.3	.0967	1,033.
3.8	1.04	95.38	3.4	.0674	1,483.
3.9	.853	116.3	3.5	.0465	2,149.
4.0	.698	142.3	3.6	.0318	3,142.
4.1	.569	174.9	3.7	.0216	4,637.
4.2	.461	215.8	3.8	.0145	6,915.
4.3	.373	267.2	3.9	.00962	10,390.
4.4	.300	332.4	4.0	.00634	15,770.
4.5	.240	415.0	5.0	5.73×10^{-5}	1.744×10^{6}
4.6	.192	520.4	6.0	2.0×10^{-7}	5.0×10^{8}
4.7	.152	655.3	7.0	2.6×10^{-10}	3.9×10^{11}
4.8	.121	828.3			
4.9	.0950	1,052.			
5.0	.0745	1,341.			
6.0	.0052	19,300.			
7.0	.00023	4.27×10^{5}			
8.0	6.8×10^{-6}	1.47×10^{7}			
9.0	1.3×10^{-7}	7.30×10^{8}			
10.0	1.5×10^{-9}	6.5×10^{10}			

AREAS, ORDINATES AND DERIVATIVES OF THE NORMAL CURVE OF ERROR

The following table gives values of the area under the curve from the ordinate at $t = 0$ to the ordinate for the values of t given in the column at the left. Values of the ordinate and of the second, third and fourth derivatives are also given.

t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative	t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative
.00	.0000	.3989	−.3989	.0000	1.1968	**.50**	.1915	.3521	−.2641	.4841	.5501
.01	.0040	.3989	−.3989	.0120	1.1965	.51	.1950	.3503	−.2592	.4895	.5279
.02	.0080	.3989	−.3987	.0239	1.1956	.52	.1985	.3485	−.2543	.4947	.5056
.03	.0120	.3988	−.3984	.0359	1.1941	.53	.2019	.3467	−.2493	.4996	.4831
.04	.0160	.3986	−.3980	.0478	1.1920	.54	.2054	.3448	−.2443	.5043	.4605
.05	.0199	.3984	−.3975	.0597	1.1894	**.55**	.2088	.3429	−.2392	.5088	.4378
.06	.0239	.3982	−.3968	.0716	1.1861	.56	.2123	.3411	−.2341	.5131	.4150
.07	.0279	.3980	−.3960	.0834	1.1822	.57	.2157	.3391	−.2289	.5171	.3921
.08	.0319	.3977	−.3951	.0952	1.1778	.58	.2190	.3372	−.2238	.5209	.3691
.09	.0359	.3973	−.3941	.1070	1.1727	.59	.2224	.3352	−.2185	.5245	.3461
.10	.0398	.3970	−.3930	.1187	1.1671	**.60**	.2258	.3332	−.2133	.5278	.3231
.11	.0438	.3965	−.3917	.1303	1.1609	.61	.2291	.3312	−.2080	.5309	.3000
.12	.0478	.3961	−.3904	.1419	1.1541	.62	.2324	.3292	−.2027	.5338	.2770
.13	.0517	.3956	−.3889	.1534	1.1468	.63	.2357	.3271	−.1973	.5365	.2539
.14	.0557	.3951	−.3873	.1648	1.1389	.64	.2389	.3251	−.1919	.5389	.2309
.15	.0596	.3945	−.3856	.1762	1.1304	**.65**	.2422	.3230	−.1865	.5411	.2078
.16	.0636	.3939	−.3838	.1874	1.1214	.66	.2454	.3209	−.1811	.5431	.1849
.17	.0675	.3932	−.3819	.1986	1.1118	.67	.2486	.3187	−.1757	.5448	.1620
.18	.0714	.3925	−.3798	.2097	1.1017	.68	.2518	.3166	−.1702	.5463	.1391
.19	.0754	.3918	−.3777	.2206	1.0911	.69	.2549	.3144	−.1647	.5476	.1164
.20	.0793	.3910	−.3754	.2315	1.0799	**.70**	.2580	.3123	−.1593	.5486	.0937
.21	.0832	.3902	−.3730	.2422	1.0682	.71	.2612	.3101	−.1538	.5495	.0712
.22	.0871	.3894	−.3706	.2529	1.0560	.72	.2642	.3079	−.1483	.5501	.0487
.23	.0910	.3885	−.3680	.2634	1.0434	.73	.2673	.3056	−.1428	.5504	.0265
.24	.0948	.3876	−.3653	.2737	1.0302	.74	.2704	.3034	−.1373	.5506	.0043
.25	.0987	.3867	−.3625	.2840	1.0165	**.75**	.2734	.3011	−.1318	.5505	−.0176
.26	.1026	.3857	−.3596	.2941	1.0024	.76	.2764	.2989	−.1262	.5502	−.0394
.27	.1064	.3847	−.3566	.3040	0.9878	.77	.2794	.2966	−.1207	.5497	−.0611
.28	.1103	.3836	−.3535	.3138	0.9727	.78	.2823	.2943	−.1153	.5490	−.0825
.29	.1141	.3825	−.3504	.3235	0.9572	.79	.2852	.2920	−.1098	.5481	−.1037
.30	.1179	.3814	−.3471	.3330	0.9413	**.80**	.2881	.2897	−.1043	.5469	−.1247
.31	.1217	.3802	−.3437	.3423	0.9250	.81	.2910	.2874	−.0988	.5456	−.1455
.32	.1255	.3790	−.3402	.3515	0.9082	.82	.2939	.2850	−.0934	.5440	−.1660
.33	.1293	.3778	−.3367	.3605	0.8910	.83	.2967	.2827	−.0880	.5423	−.1862
.34	.1331	.3765	−.3330	.3693	0.8735	.84	.2996	.2803	−.0825	.5403	−.2063
.35	.1368	.3752	−.3293	.3779	0.8556	**.85**	.3023	.2780	−.0771	.5381	−.2260
.36	.1406	.3739	−.3255	.3864	0.8373	.86	.3051	.2756	−.0718	.5358	−.2455
.37	.1443	.3726	−.3216	.3947	0.8186	.87	.3079	.2732	−.0664	.5332	−.2646
.38	.1480	.3712	−.3176	.4028	0.7996	.88	.3106	.2709	−.0611	.5305	−.2835
.39	.1517	.3697	−.3135	.4107	0.7803	.89	.3133	.2685	−.0558	.5276	−.3021
.40	.1554	.3683	−.3094	.4184	0.7607	**.90**	.3159	.2661	−.0506	.5245	−.3203
.41	.1591	.3668	−.3059	.4259	0.7408	.91	.3186	.2637	−.0453	.5212	−.3383
.42	.1628	.3653	−.3008	.4332	0.7206	.92	.3212	.2613	−.0401	.5177	−.3559
.43	.1664	.3637	−.2965	.4403	0.7001	.93	.3238	.2589	−.0350	.5140	−.3731
.44	.1700	.3621	−.2920	.4472	0.6793	.94	.3264	.2565	−.0299	.5102	−.3901
.45	.1736	.3605	−.2875	.4539	0.6583	**.95**	.3289	.2541	−.0248	.5062	−.4066
.46	.1772	.3589	−.2830	.4603	0.6371	.96	.3315	.2516	−.0197	.5021	−.4228
.47	.1808	.3572	−.2783	.4666	0.6156	.97	.3340	.2492	−.0147	.4978	−.4387
.48	.1844	.3555	−.2736	.4727	0.5940	.98	.3365	.2468	−.0098	.4933	−.4541
.49	.1879	.3538	−.2689	.4785	0.5721	.99	.3389	.2444	−.0049	.4887	−.4692
.50	.1915	.3521	−.2641	.4841	0.5501	**1.00**	.3413	.2420	.0000	.4839	−.4839

AREAS, ORDINATES AND DERIVATIVES OF THE NORMAL CURVE OF ERROR (Continued)

t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative	t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative
1.00	.3413	.2420	.0000	.4839	−.4839	**1.50**	.4332	.1295	.1619	.1457	−.7043
1.01	.3438	.2396	.0048	.4790	−.4983	1.51	.4345	.1276	.1633	.1387	−.6994
1.02	.3461	.2371	.0096	.4740	−.5122	1.52	.4357	.1257	.1647	.1317	−.6942
1.03	.3485	.2347	.0143	.4688	−.5257	1.53	.4370	.1238	.1660	.1248	−.6888
1.04	.3508	.2323	.0190	.4635	−.5389	1.54	.4382	.1219	.1672	.1180	−.6831
1.05	.3531	.2299	.0236	.4580	−.5516	**1.55**	.4394	.1200	.1683	.1111	−.6772
1.06	.3554	.2275	.0281	.4524	−.5639	1.56	.4406	.1182	.1694	.1044	−.6710
1.07	.3577	.2251	.0326	.4467	−.5758	1.57	.4418	.1163	.1704	.0977	−.6646
1.08	.3599	.2227	.0371	.4409	−.5873	1.58	.4430	.1145	.1714	.0911	−.6580
1.09	.3621	.2203	.0414	.4350	−.5984	1.59	.4441	.1127	.1722	.0846	−.6511
1.10	.3643	.2179	.0458	.4290	−.6091	**1.60**	.4452	.1109	.1730	.0781	−.6441
1.11	.3665	.2155	.0500	.4228	−.6193	1.61	.4463	.1092	.1738	.0717	−.6368
1.12	.3686	.2131	.0542	.4166	−.6292	1.62	.4474	.1074	.1745	.0654	−.6293
1.13	.3708	.2107	.0583	.4102	−.6386	1.63	.4485	.1057	.1751	.0591	−.6216
1.14	.3729	.2083	.0624	.4038	−.6476	1.64	.4495	.1040	.1757	.0529	−.6138
1.15	.3749	.2059	.0664	.3973	−.6561	**1.65**	.4505	.1023	.1762	.0468	−.6057
1.16	.3770	.2036	.0704	.3907	−.6643	1.66	.4515	.1006	.1766	.0408	−.5975
1.17	.3790	.2012	.0742	.3840	−.6720	1.67	.4525	.0989	.1770	.0349	−.5891
1.18	.3810	.1989	.0780	.3772	−.6792	1.68	.4535	.0973	.1773	.0290	−.5806
1.19	.3830	.1965	.0818	.3704	−.6861	1.69	.4545	.0957	.1776	.0233	−.5720
1.20	.3849	.1942	.0854	.3635	−.6926	**1.70**	.4554	.0941	.1778	.0176	−.5633
1.21	.3869	.1919	.0890	.3566	−.6986	1.71	.4564	.0925	.1779	.0120	−.5542
1.22	.3888	.1895	.0926	.3496	−.7042	1.72	.4573	.0909	.1780	.0065	−.5452
1.23	.3907	.1872	.0960	.3425	−.7094	1.73	.4582	.0893	.1780	.0011	−.5360
1.24	.3925	.1849	.0994	.3354	−.7141	1.74	.4591	.0878	.1780	−.0042	−.5267
1.25	.3944	.1827	.1027	.3282	−.7185	**1.75**	.4599	.0863	.1780	−.0094	−.5173
1.26	.3962	.1804	.1060	.3210	−.7224	1.76	.4608	.0848	.1778	−.0146	−.5079
1.27	.3980	.1781	.1092	.3138	−.7259	1.77	.4616	.0833	.1777	−.0196	−.4983
1.28	.3997	.1759	.1123	.3065	−.7291	1.78	.4625	.0818	.1774	−.0245	−.4887
1.29	.4015	.1736	.1153	.2992	−.7318	1.79	.4633	.0804	.1772	−.0294	−.4789
1.30	.4032	.1714	.1182	.2918	−.7341	**1.80**	.4641	.0790	.1769	−.0341	−.4692
1.31	.4049	.1692	.1211	.2845	−.7361	1.81	.4649	.0775	.1765	−.0388	−.4593
1.32	.4066	.1669	.1239	.2771	−.7376	1.82	.4656	.0761	.1761	−.0433	−.4494
1.33	.4082	.1647	.1267	.2697	−.7388	1.83	.4664	.0748	.1756	−.0477	−.4395
1.34	.4099	.1626	.1293	.2624	−.7395	1.84	.4671	.0734	.1751	−.0521	−.4295
1.35	.4115	.1604	.1319	.2550	−.7399	**1.85**	.4678	.0721	.1746	−.0563	−.4195
1.36	.4131	.1582	.1344	.2476	−.7400	1.86	.4686	.0707	.1740	−.0605	−.4095
1.37	.4147	.1561	.1369	.2402	−.7396	1.87	.4693	.0694	.1734	−.0645	−.3995
1.38	.4162	.1540	.1392	.2328	−.7389	1.88	.4700	.0681	.1727	−.0685	−.3894
1.39	.4177	.1518	.1415	.2254	−.7378	1.89	.4706	.0669	.1720	−.0723	−.3793
1.40	.4192	.1497	.1437	.2180	−.7364	**1.90**	.4713	.0656	.1713	−.0761	−.3693
1.41	.4207	.1476	.1459	.2107	−.7347	1.91	.4719	.0644	.1705	−.0797	−.3592
1.42	.4222	.1456	.1480	.2033	−.7326	1.92	.4726	.0632	.1697	−.0832	−.3492
1.43	.4236	.1435	.1500	.1960	−.7301	1.93	.4732	.0620	.1688	−.0867	−.3392
1.44	.4251	.1415	.1519	.1887	−.7274	1.94	.4738	.0608	.1679	−.0900	−.3292
1.45	.4265	.1394	.1537	.1815	−.7243	**1.95**	.4744	.0596	.1670	−.0933	−.3192
1.46	.4279	.1374	.1555	.1742	−.7209	1.96	.4750	.0584	.1661	−.0964	−.3093
1.47	.4292	.1354	.1572	.1670	−.7172	1.97	.4756	.0573	.1651	−.0994	−.2994
1.48	.4306	.1334	.1588	.1599	−.7132	1.98	.4762	.0562	.1641	−.1024	−.2895
1.49	.4319	.1315	.1604	.1528	−.7089	1.99	.4767	.0551	.1630	−.1052	−.2797
1.50	.4332	.1295	.1619	.1457	−.7043	**2.00**	.4773	.0540	.1620	−.1080	−.2700

AREAS, ORDINATES AND DERIVATIVES OF THE NORMAL CURVE OF ERROR (Continued)

t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative	t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative
2.00	.4773	.0540	.1620	−.1080	−.2700	**2.50**	.4938	.0175	.0920	−.1424	.0800
2.01	.4778	.0529	.1609	−.1106	−.2603	2.51	.4940	.0171	.0906	−.1416	.0836
2.02	.4783	.0519	.1598	−.1132	−.2506	2.52	.4941	.0167	.0892	−.1408	.0871
2.03	.4788	.0508	.1586	−.1157	−.2411	2.53	.4943	.0163	.0878	−.1399	.0905
2.04	.4793	.0498	.1575	−.1180	−.2316	2.54	.4945	.0159	.0864	−.1389	.0937
2.05	.4798	.0488	.1563	−.1203	−.2222	**2.55**	.4946	.0155	.0850	−.1380	.0968
2.06	.4803	.0478	.1550	−.1225	−.2129	2.56	.4948	.0151	.0836	−.1370	.0998
2.07	.4808	.0468	.1538	−.1245	−.2036	2.57	.4949	.0147	.0823	−.1360	.1027
2.08	.4812	.0459	.1526	−.1265	−.1945	2.58	.4951	.0143	.0809	−.1350	.1054
2.09	.4817	.0449	.1513	−.1284	−.1854	2.59	.4952	.0139	.0796	−.1339	.1080
2.10	.4821	.0440	.1500	−.1302	−.1765	**2.60**	.4953	.0136	.0782	−.1328	.1105
2.11	.4826	.0431	.1487	−.1320	−.1676	2.61	.4955	.0132	.0769	−.1317	.1129
2.12	.4830	.0422	.1474	−.1336	−.1588	2.62	.4956	.0129	.0756	−.1305	.1152
2.13	.4834	.0413	.1460	−.1351	−.1502	2.63	.4957	.0126	.0743	−.1294	.1173
2.14	.4838	.0404	.1446	−.1366	−.1416	2.64	.4959	.0122	.0730	−.1282	.1194
2.15	.4842	.0396	.1433	−.1380	−.1332	**2.65**	.4960	.0119	.0717	−.1270	.1213
2.16	.4846	.0387	.1419	−.1393	−.1249	2.66	.4961	.0116	.0705	−.1258	.1231
2.17	.4850	.0379	.1405	−.1405	−.1167	2.67	.4962	.0113	.0692	−.1245	.1248
2.18	.4854	.0371	.1391	−.1416	−.1086	2.68	.4963	.0110	.0680	−.1233	.1264
2.19	.4857	.0363	.1377	−.1426	−.1006	2.69	.4964	.0107	.0668	−.1220	.1279
2.20	.4861	.0355	.1362	−.1436	−.0927	**2.70**	.4965	.0104	.0656	−.1207	.1293
2.21	.4865	.0347	.1348	−.1445	−.0850	2.71	.4966	.0101	.0644	−.1194	.1306
2.22	.4868	.0339	.1333	−.1453	−.0774	2.72	.4967	.0099	.0632	−.1181	.1317
2.23	.4871	.0332	.1319	−.1460	−.0700	2.73	.4968	.0096	.0620	−.1168	.1328
2.24	.4875	.0325	.1304	−.1467	−.0626	2.74	.4969	.0094	.0608	−.1154	.1338
2.25	.4878	.0317	.1289	−.1473	−.0554	**2.75**	.4970	.0091	.0597	−.1141	.1347
2.26	.4881	.0310	.1275	−.1478	−.0484	2.76	.4971	.0089	.0585	−.1127	.1356
2.27	.4884	.0303	.1260	−.1483	−.0414	2.77	.4972	.0086	.0574	−.1114	.1363
2.28	.4887	.0297	.1245	−.1486	−.0346	2.78	.4973	.0084	.0563	−.1100	.1369
2.29	.4890	.0290	.1230	−.1490	−.0279	2.79	.4974	.0081	.0552	−.1087	.1375
2.30	.4893	.0283	.1215	−.1492	−.0214	**2.80**	.4974	.0079	.0541	−.1073	.1379
2.31	.4896	.0277	.1200	−.1494	−.0150	2.81	.4975	.0077	.0531	−.1059	.1383
2.32	.4898	.0271	.1185	−.1495	−.0088	2.82	.4976	.0075	.0520	−.1045	.1386
2.33	.4901	.0264	.1170	−.1496	−.0027	2.83	.4977	.0073	.0510	−.1031	.1389
2.34	.4904	.0258	.1155	−.1496	.0033	2.84	.4977	.0071	.0500	−.1017	.1390
2.35	.4906	.0252	.1141	−.1495	.0092	**2.85**	.4978	.0069	.0490	−.1003	.1391
2.36	.4909	.0246	.1126	−.1494	.0149	2.86	.4979	.0067	.0480	−.0990	.1391
2.37	.4911	.0241	.1111	−.1492	.0204	2.87	.4980	.0065	.0470	−.0976	.1391
2.38	.4913	.0235	.1096	−.1490	.0258	2.88	.4980	.0063	.0460	−.0962	.1389
2.39	.4916	.0229	.1081	−.1487	.0311	2.89	.4981	.0061	.0451	−.0948	.1388
2.40	.4918	.0224	.1066	−.1483	.0362	**2.90**	.4981	.0060	.0441	−.0934	.1385
2.41	.4920	.0219	.1051	−.1480	.0412	2.91	.4982	.0058	.0432	−.0920	.1382
2.42	.4922	.0213	.1036	−.1475	.0461	2.92	.4983	.0056	.0423	−.0906	.1378
2.43	.4925	.0208	.1022	−.1470	.0508	2.93	.4983	.0055	.0414	−.0893	.1374
2.44	.4927	.0203	.1007	−.1465	.0554	2.94	.4984	.0053	.0405	−.0879	.1369
2.45	.4929	.0198	.0992	−.1459	.0598	**2.95**	.4984	.0051	.0396	−.0865	.1364
2.46	.4931	.0194	.0978	−.1453	.0641	2.96	.4985	.0050	.0388	−.0852	.1358
2.47	.4932	.0189	.0963	−.1446	.0683	2.97	.4985	.0049	.0379	−.0838	.1352
2.48	.4934	.0184	.0949	−.1439	.0723	2.98	.4986	.0047	.0371	−.0825	.1345
2.49	.4936	.0180	.0935	−.1432	.0762	2.99	.4986	.0046	.0363	−.0811	.1337
2.50	.4938	.0175	.0920	−.1424	.0800	**3.00**	.4987	.0044	.0355	−.0798	.1330

AREAS, ORDINATES AND DERIVATIVES OF THE NORMAL CURVE OF ERROR (Continued)

t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative	t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative
3.00	.4987	.0044	.0355	−.0798	.1330	**3.50**	.4998	.0009	.0098	−.0283	.0694
3.01	.4987	.0043	.0347	−.0785	.1321	3.51	.4998	.0008	.0095	−.0276	.0681
3.02	.4987	.0042	.0339	−.0771	.1313	3.52	.4998	.0008	.0093	−.0269	.0669
3.03	.4988	.0041	.0331	−.0758	.1304	3.53	.4998	.0008	.0090	−.0262	.0656
3.04	.4988	.0039	.0324	−.0745	.1294	3.54	.4998	.0008	.0087	−.0256	.0643
3.05	.4989	.0038	.0316	−.0732	.1285	**3.55**	.4998	.0007	.0085	−.0249	.0631
3.06	.4989	.0037	.0309	−.0720	.1275	3.56	.4998	.0007	.0082	−.0243	.0618
3.07	.4989	.0036	.0302	−.0707	.1264	3.57	.4998	.0007	.0080	−.0237	.0606
3.08	.4990	.0035	.0295	−.0694	.1254	3.58	.4998	.0007	.0078	−.0231	.0594
3.09	.4990	.0034	.0288	−.0682	.1243	3.59	.4998	.0006	.0075	−.0225	.0582
3.10	.4990	.0033	.0281	−.0669	.1231	**3.60**	.4998	.0006	.0073	−.0219	.0570
3.11	.4991	.0032	.0275	−.0657	.1220	3.61	.4999	.0006	.0071	−.0214	.0559
3.12	.4991	.0031	.0268	−.0645	.1208	3.62	.4999	.0006	.0069	−.0208	.0547
3.13	.4991	.0030	.0262	−.0633	.1196	3.63	.4999	.0006	.0067	−.0203	.0536
3.14	.4992	.0029	.0256	−.0621	.1184	3.64	.4999	.0005	.0065	−.0198	.0524
3.15	.4992	.0028	.0249	−.0609	.1171	**3.65**	.4999	.0005	.0063	−.0192	.0513
3.16	.4992	.0027	.0243	−.0598	.1159	3.66	.4999	.0005	.0061	−.0187	.0502
3.17	.4992	.0026	.0237	−.0586	.1146	3.67	.4999	.0005	.0059	−.0182	.0492
3.18	.4993	.0025	.0232	−.0575	.1133	3.68	.4999	.0005	.0057	−.0177	.0481
3.19	.4993	.0025	.0226	−.0564	.1120	3.69	.4999	.0004	.0056	−.0173	.0470
3.20	.4993	.0024	.0220	−.0552	.1107	**3.70**	.4999	.0004	.0054	−.0168	.0460
3.21	.4993	.0023	.0215	−.0541	.1093	3.71	.4999	.0004	.0052	−.0164	.0450
3.22	.4994	.0022	.0210	−.0531	.1080	3.72	.4999	.0004	.0051	−.0159	.0440
3.23	.4994	.0022	.0204	−.0520	.1066	3.73	.4999	.0004	.0049	−.0155	.0430
3.24	.4994	.0021	.0199	−.0509	.1053	3.74	.4999	.0004	.0048	−.0150	.0420
3.25	.4994	.0020	.0194	−.0499	.1039	**3.75**	.4999	.0004	.0046	−.0146	.0410
3.26	.4994	.0020	.0189	−.0488	.1025	3.76	.4999	.0003	.0045	−.0142	.0401
3.27	.4995	.0019	.0184	−.0478	.1011	3.77	.4999	.0003	.0043	−.0138	.0392
3.28	.4995	.0018	.0180	−.0468	.0997	3.78	.4999	.0003	.0042	−.0134	.0382
3.29	.4995	.0018	.0175	−.0458	.0983	3.79	.4999	.0003	.0041	−.0131	.0373
3.30	.4995	.0017	.0170	−.0449	.0969	**3.80**	.4999	.0003	.0039	−.0127	.0365
3.31	.4995	.0017	.0166	−.0439	.0955	3.81	.4999	.0003	.0038	−.0123	.0356
3.32	.4996	.0016	.0162	−.0429	.0941	3.82	.4999	.0003	.0037	−.0120	.0347
3.33	.4996	.0016	.0157	−.0420	.0927	3.83	.4999	.0003	.0036	−.0116	.0339
3.34	.4996	.0015	.0153	−.0411	.0913	3.84	.4999	.0003	.0034	−.0113	.0331
3.35	.4996	.0015	.0149	−.0402	.0899	**3.85**	.4999	.0002	.0033	−.0110	.0323
3.36	.4996	.0014	.0145	−.0393	.0885	3.86	.4999	.0002	.0032	−.0107	.0315
3.37	.4996	.0014	.0141	−.0384	.0871	3.87	.5000	.0002	.0031	−.0104	.0307
3.38	.4996	.0013	.0138	−.0376	.0857	3.88	.5000	.0002	.0030	−.0100	.0299
3.39	.4997	.0013	.0134	−.0367	.0843	3.89	.5000	.0002	.0029	−.0098	.0292
3.40	.4997	.0012	.0130	−.0359	.0829	**3.90**	.5000	.0002	.0028	−.0095	.0284
3.41	.4997	.0012	.0127	−.0350	.0815	3.91	.5000	.0002	.0027	−.0092	.0277
3.42	.4997	.0012	.0123	−.0342	.0801	3.92	.5000	.0002	.0026	−.0089	.0270
3.43	.4997	.0011	.0120	−.0334	.0788	3.93	.5000	.0002	.0026	−.0086	.0263
3.44	.4997	.0011	.0116	−.0327	.0774	3.94	.5000	.0002	.0025	−.0084	.0256
3.45	.4997	.0010	.0113	−.0319	.0761	**3.95**	.5000	.0002	.0024	−.0081	.0250
3.46	.4997	.0010	.0110	−.0311	.0747	3.96	.5000	.0002	.0023	−.0079	.0243
3.47	.4997	.0010	.0107	−.0304	.0734	3.97	.5000	.0002	.0022	−.0076	.0237
3.48	.4998	.0009	.0104	−.0297	.0721	3.98	.5000	.0001	.0022	−.0074	.0230
3.49	.4998	.0009	.0101	−.0290	.0707	3.99	.5000	.0001	.0021	−.0072	.0224
3.50	.4998	.0009	.0098	−.0283	.0694	**4.00**	.5000	.0001	.0020	−.0070	.0218

AREAS, ORDINATES AND DERIVATIVES OF THE NORMAL CURVE OF ERROR (Continued)

t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative	t	Area	Ordinate	Second derivative	Third derivative	Fourth derivative
4.00	.5000	.0001	.0020	−.0070	.0218	**4.50**	.5000	.0000	.0003	−.0012	.0047
4.01	.5000	.0001	.0019	−.0067	.0212	4.51	.5000	.0000	.0003	−.0012	.0045
4.02	.5000	.0001	.0019	−.0065	.0207	4.52	.5000	.0000	.0003	−.0012	.0044
4.03	.5000	.0001	.0018	−.0063	.0201	4.53	.5000	.0000	.0003	−.0011	.0042
4.04	.5000	.0001	.0018	−.0061	.0195	4.54	.5000	.0000	.0003	−.0011	.0041
4.05	.5000	.0001	.0017	−.0059	.0190	**4.55**	.5000	.0000	.0003	−.0010	.0039
4.06	.5000	.0001	.0016	−.0058	.0185	4.56	.5000	.0000	.0002	−.0010	.0038
4.07	.5000	.0001	.0016	−.0056	.0180	4.57	.5000	.0000	.0002	−.0010	.0037
4.08	.5000	.0001	.0015	−.0054	.0175	4.58	.5000	.0000	.0002	−.0009	.0035
4.09	.5000	.0001	.0015	−.0052	.0170	4.59	.5000	.0000	.0002	−.0009	.0034
4.10	.5000	.0001	.0014	−.0051	.0165	**4.60**	.5000	.0000	.0002	−.0009	.0033
4.11	.5000	.0001	.0014	−.0049	.0160	4.61	.5000	.0000	.0002	−.0008	.0032
4.12	.5000	.0001	.0013	−.0047	.0156	4.62	.5000	.0000	.0002	−.0008	.0031
4.13	.5000	.0001	.0013	−.0046	.0151	4.63	.5000	.0000	.0002	−.0008	.0030
4.14	.5000	.0001	.0012	−.0044	.0147	4.64	.5000	.0000	.0002	−.0007	.0028
4.15	.5000	.0001	.0012	−.0043	.0143	**4.65**	.5000	.0000	.0002	−.0007	.0027
4.16	.5000	.0001	.0011	−.0042	.0138	4.66	.5000	.0000	.0002	−.0007	.0026
4.17	.5000	.0001	.0011	−.0040	.0134	4.67	.5000	.0000	.0002	−.0006	.0026
4.18	.5000	.0001	.0011	−.0039	.0130	4.68	.5000	.0000	.0002	−.0006	.0025
4.19	.5000	.0001	.0010	−.0038	.0127	4.69	.5000	.0000	.0001	−.0006	.0024
4.20	.5000	.0001	.0010	−.0036	.0123	**4.70**	.5000	.0000	.0001	−.0006	.0023
4.21	.5000	.0001	.0009	−.0035	.0119	4.71	.5000	.0000	.0001	−.0006	.0022
4.22	.5000	.0001	.0009	−.0034	.0116	4.72	.5000	.0000	.0001	−.0005	.0021
4.23	.5000	.0001	.0009	−.0033	.0112	4.73	.5000	.0000	.0001	−.0005	.0020
4.24	.5000	.0001	.0009	−.0032	.0109	4.74	.5000	.0000	.0001	−.0005	.0020
4.25	.5000	.0001	.0008	−.0031	.0105	**4.75**	.5000	.0000	.0001	−.0005	.0019
4.26	.5000	.0001	.0008	−.0030	.0102	4.76	.5000	.0000	.0001	−.0005	.0018
4.27	.5000	.0000	.0008	−.0029	.0099	4.77	.5000	.0000	.0001	−.0004	.0018
4.28	.5000	.0000	.0007	−.0028	.0096	4.78	.5000	.0000	.0001	−.0004	.0017
4.29	.5000	.0000	.0007	−.0027	.0093	4.79	.5000	.0000	.0001	−.0004	.0016
4.30	.5000	.0000	.0007	−.0026	.0090	**4.80**	.5000	.0000	.0001	−.0004	.0016
4.31	.5000	.0000	.0007	−.0025	.0087	4.81	.5000	.0000	.0001	−.0004	.0015
4.32	.5000	.0000	.0006	−.0024	.0085	4.82	.5000	.0000	.0001	−.0004	.0015
4.33	.5000	.0000	.0006	−.0023	.0082	4.83	.5000	.0000	.0001	−.0003	.0014
4.34	.5000	.0000	.0006	−.0022	.0079	4.84	.5000	.0000	.0001	−.0003	.0013
4.35	.5000	.0000	.0006	−.0022	.0077	**4.85**	.5000	.0000	.0001	−.0003	.0013
4.36	.5000	.0000	.0005	−.0021	.0074	4.86	.5000	.0000	.0001	−.0003	.0012
4.37	.5000	.0000	.0005	−.0020	.0072	4.87	.5000	.0000	.0001	−.0003	.0012
4.38	.5000	.0000	.0005	−.0019	.0070	4.88	.5000	.0000	.0001	−.0003	.0012
4.39	.5000	.0000	.0005	−.0019	.0067	4.89	.5000	.0000	.0001	−.0003	.0011
4.40	.5000	.0000	.0005	−.0018	.0065	**4.90**	.5000	.0000	.0001	−.0003	.0011
4.41	.5000	.0000	.0004	−.0017	.0063	4.91	.5000	.0000	.0001	−.0002	.0010
4.42	.5000	.0000	.0004	−.0017	.0061	4.92	.5000	.0000	.0001	−.0002	.0010
4.43	.5000	.0000	.0004	−.0016	.0059	4.93	.5000	.0000	.0001	−.0002	.0009
4.44	.5000	.0000	.0004	−.0016	.0057	4.94	.5000	.0000	.0001	−.0002	.0009
4.45	.5000	.0000	.0004	−.0015	.0055	**4.95**	.5000	.0000	.0000	−.0002	.0009
4.46	.5000	.0000	.0004	−.0014	.0053	4.96	.5000	.0000	.0000	−.0002	.0008
4.47	.5000	.0000	.0004	−.0014	.0052	4.97	.5000	.0000	.0000	−.0002	.0008
4.48	.5000	.0000	.0003	−.0013	.0050	4.98	.5000	.0000	.0000	−.0002	.0008
4.49	.5000	.0000	.0003	−.0013	.0048	4.99	.5000	.0000	.0000	−.0002	.0007
4.50	.5000	.0000	.0003	−.0012	.0047						

FACTORS AND PRIMES

FACTORS AND PRIMES

If n is prime the mantissa of its logarithm is given.

n	0	1	2	3	4
0	....	**0000000**	**3010300**	**4771213**	2^2
1	$2 \cdot 5$	**0413927**	$2^2 \cdot 3$	**1139434**	$2 \cdot 7$
2	$2^2 \cdot 5$	$3 \cdot 7$	$2 \cdot 11$	**3617278**	$2^3 \cdot 3$
3	$2 \cdot 3 \cdot 5$	**4913617**	2^5	$3 \cdot 11$	$2 \cdot 17$
4	$2^3 \cdot 5$	**6127839**	$2 \cdot 3 \cdot 7$	**6334685**	$2^2 \cdot 11$
5	$2 \cdot 5^2$	$3 \cdot 17$	$2^2 \cdot 13$	**7242759**	$2 \cdot 3^3$
6	$2^2 \cdot 3 \cdot 5$	**7853298**	$2 \cdot 31$	$3^2 \cdot 7$	2^6
7	$2 \cdot 5 \cdot 7$	**8512583**	$2^3 \cdot 3^2$	**8633229**	$2 \cdot 37$
8	$2^4 \cdot 5$	3^4	$2 \cdot 41$	**9190781**	$2^2 \cdot 3 \cdot 7$
9	$2 \cdot 3^2 \cdot 5$	$7 \cdot 13$	$2^2 \cdot 23$	$3 \cdot 31$	$2 \cdot 47$
10	$2^2 \cdot 5^2$	**0043214**	$2 \cdot 3 \cdot 17$	**0128372**	$2^3 \cdot 13$
11	$2 \cdot 5 \cdot 11$	$3 \cdot 37$	$2^4 \cdot 7$	**0530784**	$2 \cdot 3 \cdot 19$
12	$2^3 \cdot 3 \cdot 5$	11^2	$2 \cdot 61$	$3 \cdot 41$	$2^2 \cdot 31$
13	$2 \cdot 5 \cdot 13$	**1172713**	$2^2 \cdot 3 \cdot 11$	$7 \cdot 19$	$2 \cdot 67$
14	$2^2 \cdot 5 \cdot 7$	$3 \cdot 47$	$2 \cdot 71$	$11 \cdot 13$	$2^4 \cdot 3^2$
15	$2 \cdot 3 \cdot 5^2$	**1789769**	$2^3 \cdot 19$	$3^2 \cdot 17$	$2 \cdot 7 \cdot 11$
16	$2^5 \cdot 5$	$7 \cdot 23$	$2 \cdot 3^4$	**2121876**	$2^2 \cdot 41$
17	$2 \cdot 5 \cdot 17$	$3^2 \cdot 19$	$2^2 \cdot 43$	**2380461**	$2 \cdot 3 \cdot 29$
18	$2^2 \cdot 3^2 \cdot 5$	**2576786**	$2 \cdot 7 \cdot 13$	$3 \cdot 61$	$2^3 \cdot 23$
19	$2 \cdot 5 \cdot 19$	**2810334**	$2^6 \cdot 3$	**2855573**	$2 \cdot 97$
20	$2^3 \cdot 5^2$	$3 \cdot 67$	$2 \cdot 101$	$7 \cdot 29$	$2^2 \cdot 3 \cdot 17$
21	$2 \cdot 3 \cdot 5 \cdot 7$	**3242825**	$2^2 \cdot 53$	$3 \cdot 71$	$2 \cdot 107$
22	$2^2 \cdot 5 \cdot 11$	$13 \cdot 17$	$2 \cdot 3 \cdot 37$	**3483049**	$2^5 \cdot 7$
23	$2 \cdot 5 \cdot 23$	$3 \cdot 7 \cdot 11$	$2^3 \cdot 29$	**3673559**	$2 \cdot 3^2 \cdot 13$
24	$2^4 \cdot 3 \cdot 5$	**3820170**	$2 \cdot 11^2$	3^5	$2^2 \cdot 61$
25	$2 \cdot 5^3$	**3996737**	$2^2 \cdot 3^2 \cdot 7$	$11 \cdot 23$	$2 \cdot 127$
26	$2^2 \cdot 5 \cdot 13$	$3^2 \cdot 29$	$2 \cdot 131$	**4199557**	$2^3 \cdot 3 \cdot 11$
27	$2 \cdot 3^3 \cdot 5$	**4329693**	$2^4 \cdot 17$	$3 \cdot 7 \cdot 13$	$2 \cdot 137$
28	$2^3 \cdot 5 \cdot 7$	**4487063**	$2 \cdot 3 \cdot 47$	**4517864**	$2^2 \cdot 71$
29	$2 \cdot 5 \cdot 29$	$3 \cdot 97$	$2^2 \cdot 73$	**4668676**	$2 \cdot 3 \cdot 7^2$
30	$2^2 \cdot 3 \cdot 5^2$	$7 \cdot 43$	$2 \cdot 151$	$3 \cdot 101$	$2^4 \cdot 19$
31	$2 \cdot 5 \cdot 31$	**4927604**	$2^3 \cdot 3 \cdot 13$	**4955443**	$2 \cdot 157$
32	$2^6 \cdot 5$	$3 \cdot 107$	$2 \cdot 7 \cdot 23$	$17 \cdot 19$	$2^2 \cdot 3^4$
33	$2 \cdot 3 \cdot 5 \cdot 11$	**5198280**	$2^2 \cdot 83$	$3^2 \cdot 37$	$2 \cdot 167$
34	$2^2 \cdot 5 \cdot 17$	$11 \cdot 31$	$2 \cdot 3^2 \cdot 19$	7^3	$2^3 \cdot 43$
35	$2 \cdot 5^2 \cdot 7$	$3^3 \cdot 13$	$2^5 \cdot 11$	**5477747**	$2 \cdot 3 \cdot 59$
36	$2^3 \cdot 3^2 \cdot 5$	19^2	$2 \cdot 181$	$3 \cdot 11^2$	$2^2 \cdot 7 \cdot 13$
37	$2 \cdot 5 \cdot 37$	$7 \cdot 53$	$2^2 \cdot 3 \cdot 31$	**5717088**	$2 \cdot 11 \cdot 17$
38	$2^2 \cdot 5 \cdot 19$	$3 \cdot 127$	$2 \cdot 191$	**5831988**	$2^7 \cdot 3$
39	$2 \cdot 3 \cdot 5 \cdot 13$	$17 \cdot 23$	$2^3 \cdot 7^2$	$3 \cdot 131$	$2 \cdot 197$
40	$2^4 \cdot 5^2$	**6031444**	$2 \cdot 3 \cdot 67$	$13 \cdot 31$	$2^2 \cdot 101$
41	$2 \cdot 5 \cdot 41$	$3 \cdot 137$	$2^2 \cdot 103$	$7 \cdot 59$	$2 \cdot 3^2 \cdot 23$
42	$2^2 \cdot 3 \cdot 5 \cdot 7$	**6242821**	$2 \cdot 211$	$3^2 \cdot 47$	$2^3 \cdot 53$
43	$2 \cdot 5 \cdot 43$	**6344773**	$2^4 \cdot 3^3$	**6364879**	$2 \cdot 7 \cdot 31$
44	$2^3 \cdot 5 \cdot 11$	$3^2 \cdot 7^2$	$2 \cdot 13 \cdot 17$	**6464037**	$2^2 \cdot 3 \cdot 37$
45	$2 \cdot 3^2 \cdot 5^2$	$11 \cdot 41$	$2^2 \cdot 113$	$3 \cdot 151$	$2 \cdot 227$
46	$2^2 \cdot 5 \cdot 23$	**6637009**	$2 \cdot 3 \cdot 7 \cdot 11$	**6655810**	$2^4 \cdot 29$
47	$2 \cdot 5 \cdot 47$	$3 \cdot 157$	$2^3 \cdot 59$	$11 \cdot 43$	$2 \cdot 3 \cdot 79$
48	$2^5 \cdot 3 \cdot 5$	$13 \cdot 37$	$2 \cdot 241$	$3 \cdot 7 \cdot 23$	$2^2 \cdot 11^2$
49	$2 \cdot 5 \cdot 7^2$	**6910815**	$2^2 \cdot 3 \cdot 41$	$17 \cdot 29$	$2 \cdot 13 \cdot 19$
50	$2^2 \cdot 5^3$	$3 \cdot 167$	$2 \cdot 251$	**7015680**	$2^3 \cdot 3^2 \cdot 7$

FACTORS AND PRIMES (Continued)

If n is not prime its prime factors are given.

n	5	6	7	8	9
0	**6989700**	$2 \cdot 3$	**8450980**	2^3	3^2
1	$3 \cdot 5$	2^4	**2304489**	$2 \cdot 3^2$	**2787536**
2	5^2	$2 \cdot 13$	3^3	$2^2 \cdot 7$	**4623980**
3	$5 \cdot 7$	$2^2 \cdot 3^2$	**5682017**	$2 \cdot 19$	$3 \cdot 13$
4	$3^2 \cdot 5$	$2 \cdot 23$	**6720979**	$2^4 \cdot 3$	7^2
5	$5 \cdot 11$	$2^3 \cdot 7$	$3 \cdot 19$	$2 \cdot 29$	**7708520**
6	$5 \cdot 13$	$2 \cdot 3 \cdot 11$	**8260748**	$2^2 \cdot 17$	$3 \cdot 23$
7	$3 \cdot 5^2$	$2^2 \cdot 19$	$7 \cdot 11$	$2 \cdot 3 \cdot 13$	**8976271**
8	$5 \cdot 17$	$2 \cdot 43$	$3 \cdot 29$	$2^3 \cdot 11$	**9493900**
9	$5 \cdot 19$	$2^5 \cdot 3$	**9867717**	$2 \cdot 7^2$	$3^2 \cdot 11$
10	$3 \cdot 5 \cdot 7$	$2 \cdot 53$	**0293838**	$2^2 \cdot 3^3$	**0374265**
11	$5 \cdot 23$	$2^2 \cdot 29$	$3^2 \cdot 13$	$2 \cdot 59$	$7 \cdot 17$
12	5^3	$2 \cdot 3^2 \cdot 7$	**1038037**	2^7	$3 \cdot 43$
13	$3^3 \cdot 5$	$2^3 \cdot 17$	**1367206**	$2 \cdot 3 \cdot 23$	**1430148**
14	$5 \cdot 29$	$2 \cdot 73$	$3 \cdot 7^2$	$2^2 \cdot 37$	**1731863**
15	$5 \cdot 31$	$2^2 \cdot 3 \cdot 13$	**1958997**	$2 \cdot 79$	$3 \cdot 53$
16	$3 \cdot 5 \cdot 11$	$2 \cdot 83$	**2227165**	$2^3 \cdot 3 \cdot 7$	13^2
17	$5^2 \cdot 7$	$2^4 \cdot 11$	$3 \cdot 59$	$2 \cdot 89$	**2528530**
18	$5 \cdot 37$	$2 \cdot 3 \cdot 31$	$11 \cdot 17$	$2^2 \cdot 47$	$3^3 \cdot 7$
19	$3 \cdot 5 \cdot 13$	$2^2 \cdot 7^2$	**2944662**	$2 \cdot 3^2 \cdot 11$	**2988531**
20	$5 \cdot 41$	$2 \cdot 103$	$3^2 \cdot 23$	$2^4 \cdot 13$	$11 \cdot 19$
21	$5 \cdot 43$	$2^3 \cdot 3^3$	$7 \cdot 31$	$2 \cdot 109$	$3 \cdot 73$
22	$3^2 \cdot 5^2$	$2 \cdot 113$	**3560259**	$2^2 \cdot 3 \cdot 19$	**3598355**
23	$5 \cdot 47$	$2^2 \cdot 59$	$3 \cdot 79$	$2 \cdot 7 \cdot 17$	**3783979**
24	$5 \cdot 7^2$	$2 \cdot 3 \cdot 41$	$13 \cdot 19$	$2^3 \cdot 31$	$3 \cdot 83$
25	$3 \cdot 5 \cdot 17$	2^8	**4099331**	$2 \cdot 3 \cdot 43$	$7 \cdot 37$
26	$5 \cdot 53$	$2 \cdot 7 \cdot 19$	$3 \cdot 89$	$2^2 \cdot 67$	**4297523**
27	$5^2 \cdot 11$	$2^2 \cdot 3 \cdot 23$	**4424798**	$2 \cdot 139$	$3^2 \cdot 31$
28	$3 \cdot 5 \cdot 19$	$2 \cdot 11 \cdot 13$	$7 \cdot 41$	$2^5 \cdot 3^2$	17^2
29	$5 \cdot 59$	$2^3 \cdot 37$	$3^3 \cdot 11$	$2 \cdot 149$	$13 \cdot 23$
30	$5 \cdot 61$	$2 \cdot 3^2 \cdot 17$	**4871384**	$2^2 \cdot 7 \cdot 11$	$3 \cdot 103$
31	$3^2 \cdot 5 \cdot 7$	$2^2 \cdot 79$	**5010593**	$2 \cdot 3 \cdot 53$	$11 \cdot 29$
32	$5^2 \cdot 13$	$2 \cdot 163$	$3 \cdot 109$	$2^3 \cdot 41$	$7 \cdot 47$
33	$5 \cdot 67$	$2^4 \cdot 3 \cdot 7$	**5276299**	$2 \cdot 13^2$	$3 \cdot 113$
34	$3 \cdot 5 \cdot 23$	$2 \cdot 173$	**5403295**	$2^2 \cdot 3 \cdot 29$	**5428254**
35	$5 \cdot 71$	$2^2 \cdot 89$	$3 \cdot 7 \cdot 17$	$2 \cdot 179$	**5550944**
36	$5 \cdot 73$	$2 \cdot 3 \cdot 61$	**5646661**	$2^4 \cdot 23$	$3^2 \cdot 41$
37	$3 \cdot 5^3$	$2^3 \cdot 47$	$13 \cdot 29$	$2 \cdot 3^3 \cdot 7$	**5786392**
38	$5 \cdot 7 \cdot 11$	$2 \cdot 193$	$3^2 \cdot 43$	$2^2 \cdot 97$	**5899496**
39	$5 \cdot 79$	$2^2 \cdot 3^2 \cdot 11$	**5987905**	$2 \cdot 199$	$3 \cdot 7 \cdot 19$
40	$3^4 \cdot 5$	$2 \cdot 7 \cdot 29$	$11 \cdot 37$	$2^3 \cdot 3 \cdot 17$	**6117233**
41	$5 \cdot 83$	$2^5 \cdot 13$	$3 \cdot 139$	$2 \cdot 11 \cdot 19$	**6222140**
42	$5^2 \cdot 17$	$2 \cdot 3 \cdot 71$	$7 \cdot 61$	$2^2 \cdot 107$	$3 \cdot 11 \cdot 13$
43	$3 \cdot 5 \cdot 29$	$2^2 \cdot 109$	$19 \cdot 23$	$2 \cdot 3 \cdot 73$	**6424645**
44	$5 \cdot 89$	$2 \cdot 223$	$3 \cdot 149$	$2^6 \cdot 7$	**6522463**
45	$5 \cdot 7 \cdot 13$	$2^3 \cdot 3 \cdot 19$	**6599162**	$2 \cdot 229$	$3^3 \cdot 17$
46	$3 \cdot 5 \cdot 31$	$2 \cdot 233$	**6693169**	$2^2 \cdot 3^2 \cdot 13$	$7 \cdot 67$
47	$5^2 \cdot 19$	$2^2 \cdot 7 \cdot 17$	$3^2 \cdot 53$	$2 \cdot 239$	**6803355**
48	$5 \cdot 97$	$2 \cdot 3^5$	**6875290**	$2^3 \cdot 61$	$3 \cdot 163$
49	$3^2 \cdot 5 \cdot 11$	$2^4 \cdot 31$	$7 \cdot 71$	$2 \cdot 3 \cdot 83$	**6981005**
50	$5 \cdot 101$	$2 \cdot 11 \cdot 23$	$3 \cdot 13^2$	$2^2 \cdot 127$	**7067178**

FACTORS AND PRIMES (Continued)

n	0	1	2	3	4
50	$2^2 \cdot 5^3$	$3 \cdot 167$	$2 \cdot 251$	**7015680**	$2^3 \cdot 3^2 \cdot 7$
51	$2 \cdot 3 \cdot 5 \cdot 17$	$7 \cdot 73$	2^9	$3^3 \cdot 19$	$2 \cdot 257$
52	$2^3 \cdot 5 \cdot 13$	**7168377**	$2 \cdot 3^2 \cdot 29$	**7185017**	$2^2 \cdot 131$
53	$2 \cdot 5 \cdot 53$	$3^2 \cdot 59$	$2^2 \cdot 7 \cdot 19$	$13 \cdot 41$	$2 \cdot 3 \cdot 89$
54	$2^2 \cdot 3^3 \cdot 5$	**7331973**	$2 \cdot 271$	$3 \cdot 181$	$2^5 \cdot 17$
55	$2 \cdot 5^2 \cdot 11$	$19 \cdot 29$	$2^3 \cdot 3 \cdot 23$	$7 \cdot 79$	$2 \cdot 277$
56	$2^4 \cdot 5 \cdot 7$	$3 \cdot 11 \cdot 17$	$2 \cdot 281$	**7505084**	$2^2 \cdot 3 \cdot 47$
57	$2 \cdot 3 \cdot 5 \cdot 19$	**7566361**	$2^2 \cdot 11 \cdot 13$	$3 \cdot 191$	$2 \cdot 7 \cdot 41$
58	$2^2 \cdot 5 \cdot 29$	$7 \cdot 83$	$2 \cdot 3 \cdot 97$	$11 \cdot 53$	$2^3 \cdot 73$
59	$2 \cdot 5 \cdot 59$	$3 \cdot 197$	$2^4 \cdot 37$	**7730547**	$2 \cdot 3^3 \cdot 11$
60	$2^3 \cdot 3 \cdot 5^2$	**7788745**	$2 \cdot 7 \cdot 43$	$3^2 \cdot 67$	$2^2 \cdot 151$
61	$2 \cdot 5 \cdot 61$	$13 \cdot 47$	$2^2 \cdot 3^2 \cdot 17$	**7874605**	$2 \cdot 307$
62	$2^2 \cdot 5 \cdot 31$	$3^3 \cdot 23$	$2 \cdot 311$	$7 \cdot 89$	$2^4 \cdot 3 \cdot 13$
63	$2 \cdot 3^2 \cdot 5 \cdot 7$	**8000294**	$2^3 \cdot 79$	$3 \cdot 211$	$2 \cdot 317$
64	$2^7 \cdot 5$	**8068580**	$2 \cdot 3 \cdot 107$	**8082110**	$2^2 \cdot 7 \cdot 23$
65	$2 \cdot 5^2 \cdot 13$	$3 \cdot 7 \cdot 31$	$2^2 \cdot 163$	**8149132**	$2 \cdot 3 \cdot 109$
66	$2^2 \cdot 3 \cdot 5 \cdot 11$	**8202015**	$2 \cdot 331$	$3 \cdot 13 \cdot 17$	$2^3 \cdot 83$
67	$2 \cdot 5 \cdot 67$	$11 \cdot 61$	$2^5 \cdot 3 \cdot 7$	**8280151**	$2 \cdot 337$
68	$2^3 \cdot 5 \cdot 17$	$3 \cdot 227$	$2 \cdot 11 \cdot 31$	**8344207**	$2^2 \cdot 3^2 \cdot 19$
69	$2 \cdot 3 \cdot 5 \cdot 23$	**8394780**	$2^2 \cdot 173$	$3^2 \cdot 7 \cdot 11$	$2 \cdot 347$
70	$2^2 \cdot 5^2 \cdot 7$	**8457180**	$2 \cdot 3^3 \cdot 13$	$19 \cdot 37$	$2^6 \cdot 11$
71	$2 \cdot 5 \cdot 71$	$3^2 \cdot 79$	$2^3 \cdot 89$	$23 \cdot 31$	$2 \cdot 3 \cdot 7 \cdot 17$
72	$2^4 \cdot 3^2 \cdot 5$	$7 \cdot 103$	$2 \cdot 19^2$	$3 \cdot 241$	$2^2 \cdot 181$
73	$2 \cdot 5 \cdot 73$	$17 \cdot 43$	$2^2 \cdot 3 \cdot 61$	**8651040**	$2 \cdot 367$
74	$2^2 \cdot 5 \cdot 37$	$3 \cdot 13 \cdot 19$	$2 \cdot 7 \cdot 53$	**8709888**	$2^3 \cdot 3 \cdot 31$
75	$2 \cdot 3 \cdot 5^3$	**8756399**	$2^4 \cdot 47$	$3 \cdot 251$	$2 \cdot 13 \cdot 29$
76	$2^3 \cdot 5 \cdot 19$	**8813847**	$2 \cdot 3 \cdot 127$	$7 \cdot 109$	$2^2 \cdot 191$
77	$2 \cdot 5 \cdot 7 \cdot 11$	$3 \cdot 257$	$2^2 \cdot 193$	**8881795**	$2 \cdot 3^2 \cdot 43$
78	$2^2 \cdot 3 \cdot 5 \cdot 13$	$11 \cdot 71$	$2 \cdot 17 \cdot 23$	$3^3 \cdot 29$	$2^4 \cdot 7^2$
79	$2 \cdot 5 \cdot 79$	$7 \cdot 113$	$2^3 \cdot 3^2 \cdot 11$	$13 \cdot 61$	$2 \cdot 397$
80	$2^5 \cdot 5^2$	$3^2 \cdot 89$	$2 \cdot 401$	$11 \cdot 73$	$2^2 \cdot 3 \cdot 67$
81	$2 \cdot 3^4 \cdot 5$	**9090209**	$2^2 \cdot 7 \cdot 29$	$3 \cdot 271$	$2 \cdot 11 \cdot 37$
82	$2^2 \cdot 5 \cdot 41$	**9143432**	$2 \cdot 3 \cdot 137$	**9153998**	$2^3 \cdot 103$
83	$2 \cdot 5 \cdot 83$	$3 \cdot 277$	$2^6 \cdot 13$	$7^2 \cdot 17$	$2 \cdot 3 \cdot 139$
84	$2^3 \cdot 3 \cdot 5 \cdot 7$	29^2	$2 \cdot 421$	$3 \cdot 281$	$2^2 \cdot 211$
85	$2 \cdot 5^2 \cdot 17$	$23 \cdot 37$	$2^2 \cdot 3 \cdot 71$	**9309490**	$2 \cdot 7 \cdot 61$
86	$2^2 \cdot 5 \cdot 43$	$3 \cdot 7 \cdot 41$	$2 \cdot 431$	**9360108**	$2^5 \cdot 3^3$
87	$2 \cdot 3 \cdot 5 \cdot 29$	$13 \cdot 67$	$2^3 \cdot 109$	$3^2 \cdot 97$	$2 \cdot 19 \cdot 23$
88	$2^4 \cdot 5 \cdot 11$	**9449759**	$2 \cdot 3^2 \cdot 7^2$	**9459607**	$2^2 \cdot 13 \cdot 17$
89	$2 \cdot 5 \cdot 89$	$3^4 \cdot 11$	$2^2 \cdot 223$	$19 \cdot 47$	$2 \cdot 3 \cdot 149$
90	$2^2 \cdot 3^2 \cdot 5^2$	$17 \cdot 53$	$2 \cdot 11 \cdot 41$	$3 \cdot 7 \cdot 43$	$2^3 \cdot 113$
91	$2 \cdot 5 \cdot 7 \cdot 13$	**9595184**	$2^4 \cdot 3 \cdot 19$	$11 \cdot 83$	$2 \cdot 457$
92	$2^3 \cdot 5 \cdot 23$	$3 \cdot 307$	$2 \cdot 461$	$13 \cdot 71$	$2^2 \cdot 3 \cdot 7 \cdot 11$
93	$2 \cdot 3 \cdot 5 \cdot 31$	$7^2 \cdot 19$	$2^2 \cdot 233$	$3 \cdot 311$	$2 \cdot 467$
94	$2^2 \cdot 5 \cdot 47$	**9735896**	$2 \cdot 3 \cdot 157$	$23 \cdot 41$	$2^4 \cdot 59$
95	$2 \cdot 5^2 \cdot 19$	$3 \cdot 317$	$2^3 \cdot 7 \cdot 17$	**9790929**	$2 \cdot 3^2 \cdot 53$
96	$2^6 \cdot 3 \cdot 5$	31^2	$2 \cdot 13 \cdot 37$	$3^2 \cdot 107$	$2^2 \cdot 241$
97	$2 \cdot 5 \cdot 97$	**9872192**	$2^2 \cdot 3^5$	$7 \cdot 139$	$2 \cdot 487$
98	$2^2 \cdot 5 \cdot 7^2$	$3^2 \cdot 109$	$2 \cdot 491$	**9925535**	$2^3 \cdot 3 \cdot 41$
99	$2 \cdot 3^2 \cdot 5 \cdot 11$	**9960737**	$2^5 \cdot 31$	$3 \cdot 331$	$2 \cdot 7 \cdot 71$
100	$2^3 \cdot 5^3$	$7 \cdot 11 \cdot 13$	$2 \cdot 3 \cdot 167$	$17 \cdot 59$	$2^2 \cdot 251$

FACTORS AND PRIMES (Continued)

n	5	6	7	8	9
50	$5 \cdot 101$	$2 \cdot 11 \cdot 23$	$3 \cdot 13^2$	$2^2 \cdot 127$	**7067178**
51	$5 \cdot 103$	$2^2 \cdot 3 \cdot 43$	$11 \cdot 47$	$2 \cdot 7 \cdot 37$	$3 \cdot 173$
52	$3 \cdot 5^2 \cdot 7$	$2 \cdot 263$	$17 \cdot 31$	$2^4 \cdot 3 \cdot 11$	23^2
53	$5 \cdot 107$	$2^3 \cdot 67$	$3 \cdot 179$	$2 \cdot 269$	$7^2 \cdot 11$
54	$5 \cdot 109$	$2 \cdot 3 \cdot 7 \cdot 13$	**7379873**	$2^3 \cdot 137$	$3^2 \cdot 61$
55	$3 \cdot 5 \cdot 37$	$2^2 \cdot 139$	**7458552**	$2 \cdot 3^2 \cdot 31$	$13 \cdot 43$
56	$5 \cdot 113$	$2 \cdot 283$	$3^4 \cdot 7$	$2^3 \cdot 71$	**7551123**
57	$5^2 \cdot 23$	$2^6 \cdot 3^2$	**7611758**	$2 \cdot 17^2$	$3 \cdot 193$
58	$3^2 \cdot 5 \cdot 13$	$2 \cdot 293$	**7686381**	$2^2 \cdot 3 \cdot 7^2$	$19 \cdot 31$
59	$5 \cdot 7 \cdot 17$	$2^2 \cdot 149$	$3 \cdot 199$	$2 \cdot 13 \cdot 23$	**7774268**
60	$5 \cdot 11^2$	$2 \cdot 3 \cdot 101$	**7831887**	$2^5 \cdot 19$	$3 \cdot 7 \cdot 29$
61	$3 \cdot 5 \cdot 41$	$2^3 \cdot 7 \cdot 11$	**7902852**	$2 \cdot 3 \cdot 103$	**7916906**
62	5^4	$2 \cdot 313$	$3 \cdot 11 \cdot 19$	$2^2 \cdot 157$	$17 \cdot 37$
63	$5 \cdot 127$	$2^2 \cdot 3 \cdot 53$	$7^2 \cdot 13$	$2 \cdot 11 \cdot 29$	$3^2 \cdot 71$
64	$3 \cdot 5 \cdot 43$	$2 \cdot 17 \cdot 19$	**8109043**	$2^3 \cdot 3^4$	$11 \cdot 59$
65	$5 \cdot 131$	$2^4 \cdot 41$	$3^2 \cdot 73$	$2 \cdot 7 \cdot 47$	**8188854**
66	$5 \cdot 7 \cdot 19$	$2 \cdot 3^2 \cdot 37$	$23 \cdot 29$	$2^2 \cdot 167$	$3 \cdot 223$
67	$3^3 \cdot 5^2$	$2^2 \cdot 13^2$	**8305887**	$2 \cdot 3 \cdot 113$	$7 \cdot 97$
68	$5 \cdot 137$	$2 \cdot 7^3$	$3 \cdot 229$	$2^4 \cdot 43$	$13 \cdot 53$
69	$5 \cdot 139$	$2^3 \cdot 3 \cdot 29$	$17 \cdot 41$	$2 \cdot 349$	$3 \cdot 233$
70	$3 \cdot 5 \cdot 47$	$2 \cdot 353$	$7 \cdot 101$	$2^2 \cdot 3 \cdot 59$	**8506462**
71	$5 \cdot 11 \cdot 13$	$2^2 \cdot 179$	$3 \cdot 239$	$2 \cdot 359$	**8567280**
72	$5^2 \cdot 29$	$2 \cdot 3 \cdot 11^2$	**8615344**	$2^3 \cdot 7 \cdot 13$	3^6
73	$3 \cdot 5 \cdot 7^2$	$2^5 \cdot 23$	$11 \cdot 67$	$2 \cdot 3^2 \cdot 41$	**8686444**
74	$5 \cdot 149$	$2 \cdot 373$	$3^2 \cdot 83$	$2^2 \cdot 11 \cdot 17$	$7 \cdot 107$
75	$5 \cdot 151$	$2^2 \cdot 3^3 \cdot 7$	**8790959**	$2 \cdot 379$	$3 \cdot 11 \cdot 23$
76	$3^2 \cdot 5 \cdot 17$	$2 \cdot 383$	$13 \cdot 59$	$2^8 \cdot 3$	**8859263**
77	$5^2 \cdot 31$	$2^3 \cdot 97$	$3 \cdot 7 \cdot 37$	$2 \cdot 389$	$19 \cdot 41$
78	$5 \cdot 157$	$2 \cdot 3 \cdot 131$	**8959747**	$2^2 \cdot 197$	$3 \cdot 263$
79	$3 \cdot 5 \cdot 53$	$2^2 \cdot 199$	**9014583**	$2 \cdot 3 \cdot 7 \cdot 19$	$17 \cdot 47$
80	$5 \cdot 7 \cdot 23$	$2 \cdot 13 \cdot 31$	$3 \cdot 269$	$2^3 \cdot 101$	**9079485**
81	$5 \cdot 163$	$2^4 \cdot 3 \cdot 17$	$19 \cdot 43$	$2 \cdot 409$	$3^2 \cdot 7 \cdot 13$
82	$3 \cdot 5^2 \cdot 11$	$2 \cdot 7 \cdot 59$	**9175055**	$2^2 \cdot 3^2 \cdot 23$	**9185545**
83	$5 \cdot 167$	$2^2 \cdot 11 \cdot 19$	$3^3 \cdot 31$	$2 \cdot 419$	**9237620**
84	$5 \cdot 13^2$	$2 \cdot 3^2 \cdot 47$	$7 \cdot 11^2$	$2^4 \cdot 53$	$3 \cdot 283$
85	$3^2 \cdot 5 \cdot 19$	$2^3 \cdot 107$	**9329808**	$2 \cdot 3 \cdot 11 \cdot 13$	**9339932**
86	$5 \cdot 173$	$2 \cdot 433$	$3 \cdot 17^2$	$2^2 \cdot 7 \cdot 31$	$11 \cdot 79$
87	$5^3 \cdot 7$	$2^2 \cdot 3 \cdot 73$	**9429996**	$2 \cdot 439$	$3 \cdot 293$
88	$3 \cdot 5 \cdot 59$	$2 \cdot 443$	**9479236**	$2^3 \cdot 3 \cdot 37$	$7 \cdot 127$
89	$5 \cdot 179$	$2^7 \cdot 7$	$3 \cdot 13 \cdot 23$	$2 \cdot 449$	$29 \cdot 31$
90	$5 \cdot 181$	$2 \cdot 3 \cdot 151$	**9576073**	$2^2 \cdot 227$	$3^2 \cdot 101$
91	$3 \cdot 5 \cdot 61$	$2^2 \cdot 229$	$7 \cdot 131$	$2 \cdot 3^3 \cdot 17$	**9633155**
92	$5^2 \cdot 37$	$2 \cdot 463$	$3^2 \cdot 103$	$2^5 \cdot 29$	**9680157**
93	$5 \cdot 11 \cdot 17$	$2^3 \cdot 3^2 \cdot 13$	**9717396**	$2 \cdot 7 \cdot 67$	$3 \cdot 313$
94	$3^3 \cdot 5 \cdot 7$	$2 \cdot 11 \cdot 43$	**9763500**	$2^2 \cdot 3 \cdot 79$	$13 \cdot 73$
95	$5 \cdot 191$	$2^2 \cdot 239$	$3 \cdot 11 \cdot 29$	$2 \cdot 479$	$7 \cdot 137$
96	$5 \cdot 193$	$2 \cdot 3 \cdot 7 \cdot 23$	**9854265**	$2^3 \cdot 11^2$	$3 \cdot 17 \cdot 19$
97	$3 \cdot 5^2 \cdot 13$	$2^4 \cdot 61$	**9898946**	$2 \cdot 3 \cdot 163$	$11 \cdot 89$
98	$5 \cdot 197$	$2 \cdot 17 \cdot 29$	$3 \cdot 7 \cdot 47$	$2^2 \cdot 13 \cdot 19$	$23 \cdot 43$
99	$5 \cdot 199$	$2^2 \cdot 3 \cdot 83$	**9986952**	$2 \cdot 499$	$3^3 \cdot 37$
100	$3 \cdot 5 \cdot 67$	$2 \cdot 503$	$19 \cdot 53$	$2^4 \cdot 3^2 \cdot 7$	**0038912**

FACTORS AND PRIMES (Continued)

n	0	1	2	3	4
100	$2^3 \cdot 5^3$	$7 \cdot 11 \cdot 13$	$2 \cdot 3 \cdot 167$	$17 \cdot 59$	$2^2 \cdot 251$
101	$2 \cdot 5 \cdot 101$	$3 \cdot 337$	$2^2 \cdot 11 \cdot 23$	**0056094**	$2 \cdot 3 \cdot 13^2$
102	$2^2 \cdot 3 \cdot 5 \cdot 17$	**0090257**	$2 \cdot 7 \cdot 73$	$3 \cdot 11 \cdot 31$	2^{10}
103	$2 \cdot 5 \cdot 103$	**0132587**	$2^3 \cdot 3 \cdot 43$	**0141003**	$2 \cdot 11 \cdot 47$
104	$2^4 \cdot 5 \cdot 13$	$3 \cdot 347$	$2 \cdot 521$	$7 \cdot 149$	$2^2 \cdot 3^2 \cdot 29$
105	$2 \cdot 3 \cdot 5^2 \cdot 7$	**0216027**	$2^2 \cdot 263$	$3^4 \cdot 13$	$2 \cdot 17 \cdot 31$
106	$2^2 \cdot 5 \cdot 53$	**0257154**	$2 \cdot 3^2 \cdot 59$	**0265333**	$2^3 \cdot 7 \cdot 19$
107	$2 \cdot 5 \cdot 107$	$3^2 \cdot 7 \cdot 17$	$2^4 \cdot 67$	$29 \cdot 37$	$2 \cdot 3 \cdot 179$
108	$2^3 \cdot 3^3 \cdot 5$	$23 \cdot 47$	$2 \cdot 541$	$3 \cdot 19^2$	$2^2 \cdot 271$
109	$2 \cdot 5 \cdot 109$	**0378248**	$2^2 \cdot 3 \cdot 7 \cdot 13$	**0386202**	$2 \cdot 547$
110	$2^2 \cdot 5^2 \cdot 11$	$3 \cdot 367$	$2 \cdot 19 \cdot 29$	**0425755**	$2^4 \cdot 3 \cdot 23$
111	$2 \cdot 3 \cdot 5 \cdot 37$	$11 \cdot 101$	$2^3 \cdot 139$	$3 \cdot 7 \cdot 53$	$2 \cdot 557$
112	$2^5 \cdot 5 \cdot 7$	$19 \cdot 59$	$2 \cdot 3 \cdot 11 \cdot 17$	**0503798**	$2^2 \cdot 281$
113	$2 \cdot 5 \cdot 113$	$3 \cdot 13 \cdot 29$	$2^2 \cdot 283$	$11 \cdot 103$	$2 \cdot 3^4 \cdot 7$
114	$2^2 \cdot 3 \cdot 5 \cdot 19$	$7 \cdot 163$	$2 \cdot 571$	$3^2 \cdot 127$	$2^3 \cdot 11 \cdot 13$
115	$2 \cdot 5^2 \cdot 23$	**0610753**	$2^7 \cdot 3^2$	**0618293**	$2 \cdot 577$
116	$2^3 \cdot 5 \cdot 29$	$3^3 \cdot 43$	$2 \cdot 7 \cdot 83$	**0655797**	$2^2 \cdot 3 \cdot 97$
117	$2 \cdot 3^2 \cdot 5 \cdot 13$	**0685569**	$2^2 \cdot 293$	$3 \cdot 17 \cdot 23$	$2 \cdot 587$
118	$2^2 \cdot 5 \cdot 59$	**0722499**	$2 \cdot 3 \cdot 197$	$7 \cdot 13^2$	$2^5 \cdot 37$
119	$2 \cdot 5 \cdot 7 \cdot 17$	$3 \cdot 397$	$2^3 \cdot 149$	**0766404**	$2 \cdot 3 \cdot 199$
120	$2^4 \cdot 3 \cdot 5^2$	**0795430**	$2 \cdot 601$	$3 \cdot 401$	$2^2 \cdot 7 \cdot 43$
121	$2 \cdot 5 \cdot 11^2$	$7 \cdot 173$	$2^2 \cdot 3 \cdot 101$	**0838608**	$2 \cdot 607$
122	$2^2 \cdot 5 \cdot 61$	$3 \cdot 11 \cdot 37$	$2 \cdot 13 \cdot 47$	**0874265**	$2^3 \cdot 3^2 \cdot 17$
123	$2 \cdot 3 \cdot 5 \cdot 41$	**0902581**	$2^4 \cdot 7 \cdot 11$	$3^2 \cdot 137$	$2 \cdot 617$
124	$2^3 \cdot 5 \cdot 31$	$17 \cdot 73$	$2 \cdot 3^3 \cdot 23$	$11 \cdot 113$	$2^2 \cdot 311$
125	$2 \cdot 5^4$	$3^2 \cdot 139$	$2^2 \cdot 313$	$7 \cdot 179$	$2 \cdot 3 \cdot 11 \cdot 19$
126	$2^2 \cdot 3^2 \cdot 5 \cdot 7$	$13 \cdot 97$	$2 \cdot 631$	$3 \cdot 421$	$2^4 \cdot 79$
127	$2 \cdot 5 \cdot 127$	$31 \cdot 41$	$2^3 \cdot 3 \cdot 53$	$19 \cdot 67$	$2 \cdot 7^2 \cdot 13$
128	$2^8 \cdot 5$	$3 \cdot 7 \cdot 61$	$2 \cdot 641$	**1082267**	$2^2 \cdot 3 \cdot 107$
129	$2 \cdot 3 \cdot 5 \cdot 43$	**1109262**	$2^2 \cdot 17 \cdot 19$	$3 \cdot 431$	$2 \cdot 647$
130	$2^2 \cdot 5^2 \cdot 13$	**1142773**	$2 \cdot 3 \cdot 7 \cdot 31$	**1149444**	$2^3 \cdot 163$
131	$2 \cdot 5 \cdot 131$	$3 \cdot 19 \cdot 23$	$2^5 \cdot 41$	$13 \cdot 101$	$2 \cdot 3^2 \cdot 73$
132	$2^3 \cdot 3 \cdot 5 \cdot 11$	**1209028**	$2 \cdot 661$	$3^3 \cdot 7^2$	$2^2 \cdot 331$
133	$2 \cdot 5 \cdot 7 \cdot 19$	11^3	$2^2 \cdot 3^2 \cdot 37$	$31 \cdot 43$	$2 \cdot 23 \cdot 29$
134	$2^2 \cdot 5 \cdot 67$	$3^2 \cdot 149$	$2 \cdot 11 \cdot 61$	$17 \cdot 79$	$2^6 \cdot 3 \cdot 7$
135	$2 \cdot 3^3 \cdot 5^2$	$7 \cdot 193$	$2^3 \cdot 13^2$	$3 \cdot 11 \cdot 41$	$2 \cdot 677$
136	$2^4 \cdot 5 \cdot 17$	**1338581**	$2 \cdot 3 \cdot 227$	$29 \cdot 47$	$2^2 \cdot 11 \cdot 31$
137	$2 \cdot 5 \cdot 137$	$3 \cdot 457$	$2^2 \cdot 7^3$	**1376705**	$2 \cdot 3 \cdot 229$
138	$2^2 \cdot 3 \cdot 5 \cdot 23$	**1401937**	$2 \cdot 691$	$3 \cdot 461$	$2^3 \cdot 173$
139	$2 \cdot 5 \cdot 139$	$13 \cdot 107$	$2^4 \cdot 3 \cdot 29$	$7 \cdot 199$	$2 \cdot 17 \cdot 41$
140	$2^3 \cdot 5^2 \cdot 7$	$3 \cdot 467$	$2 \cdot 701$	$23 \cdot 61$	$2^2 \cdot 3^3 \cdot 13$
141	$2 \cdot 3 \cdot 5 \cdot 47$	$17 \cdot 83$	$2^2 \cdot 353$	$3^2 \cdot 157$	$2 \cdot 7 \cdot 101$
142	$2^2 \cdot 5 \cdot 71$	$7^2 \cdot 29$	$2 \cdot 3^2 \cdot 79$	**1532049**	$2^4 \cdot 89$
143	$2 \cdot 5 \cdot 11 \cdot 13$	$3^3 \cdot 53$	$2^3 \cdot 179$	**1562462**	$2 \cdot 3 \cdot 239$
144	$2^5 \cdot 3^2 \cdot 5$	$11 \cdot 131$	$2 \cdot 7 \cdot 103$	$3 \cdot 13 \cdot 37$	$2^2 \cdot 19^2$
145	$2 \cdot 5^2 \cdot 29$	**1616674**	$2^2 \cdot 3 \cdot 11^2$	**1622656**	$2 \cdot 727$
146	$2^2 \cdot 5 \cdot 73$	$3 \cdot 487$	$2 \cdot 17 \cdot 43$	$7 \cdot 11 \cdot 19$	$2^3 \cdot 3 \cdot 61$
147	$2 \cdot 3 \cdot 5 \cdot 7^2$	**1676127**	$2^6 \cdot 23$	$3 \cdot 491$	$2 \cdot 11 \cdot 67$
148	$2^3 \cdot 5 \cdot 37$	**1705551**	$2 \cdot 3 \cdot 13 \cdot 19$	**1711412**	$2^2 \cdot 7 \cdot 53$
149	$2 \cdot 5 \cdot 149$	$3 \cdot 7 \cdot 71$	$2^2 \cdot 373$	**1740598**	$2 \cdot 3^2 \cdot 83$
150	$2^2 \cdot 3 \cdot 5^3$	$19 \cdot 79$	$2 \cdot 751$	$3^2 \cdot 167$	$2^5 \cdot 47$

FACTORS AND PRIMES (Continued)

n	5	6	7	8	9
100	$3 \cdot 5 \cdot 67$	$2 \cdot 503$	$19 \cdot 53$	$2^4 \cdot 3^2 \cdot 7$	**0038912**
101	$5 \cdot 7 \cdot 29$	$2^3 \cdot 127$	$3^2 \cdot 113$	$2 \cdot 509$	**0081742**
102	$5^2 \cdot 41$	$2 \cdot 3^3 \cdot 19$	$13 \cdot 79$	$2^2 \cdot 257$	$3 \cdot 7^3$
103	$3^2 \cdot 5 \cdot 23$	$2^2 \cdot 7 \cdot 37$	$17 \cdot 61$	$2 \cdot 3 \cdot 173$	**0166155**
104	$5 \cdot 11 \cdot 19$	$2 \cdot 523$	$3 \cdot 349$	$2^3 \cdot 131$	**0207755**
105	$5 \cdot 211$	$2^5 \cdot 3 \cdot 11$	$7 \cdot 151$	$2 \cdot 23^2$	$3 \cdot 353$
106	$3 \cdot 5 \cdot 71$	$2 \cdot 13 \cdot 41$	$11 \cdot 97$	$2^2 \cdot 3 \cdot 89$	**0289777**
107	$5^2 \cdot 43$	$2^2 \cdot 269$	$3 \cdot 359$	$2 \cdot 7^2 \cdot 11$	$13 \cdot 83$
108	$5 \cdot 7 \cdot 31$	$2 \cdot 3 \cdot 181$	**0362295**	$2^6 \cdot 17$	$3^2 \cdot 11^2$
109	$3 \cdot 5 \cdot 73$	$2^3 \cdot 137$	**0402066**	$2 \cdot 3^2 \cdot 61$	$7 \cdot 157$
110	$5 \cdot 13 \cdot 17$	$2 \cdot 7 \cdot 79$	$3^3 \cdot 41$	$2^2 \cdot 277$	**0449315**
111	$5 \cdot 223$	$2^2 \cdot 3^2 \cdot 31$	**0480532**	$2 \cdot 13 \cdot 43$	$3 \cdot 373$
112	$3^2 \cdot 5^3$	$2 \cdot 563$	$7^2 \cdot 23$	$2^3 \cdot 3 \cdot 47$	**0526939**
113	$5 \cdot 227$	$2^4 \cdot 71$	$3 \cdot 379$	$2 \cdot 569$	$17 \cdot 67$
114	$5 \cdot 229$	$2 \cdot 3 \cdot 191$	$31 \cdot 37$	$2^2 \cdot 7 \cdot 41$	$3 \cdot 383$
115	$3 \cdot 5 \cdot 7 \cdot 11$	$2^2 \cdot 17^2$	$13 \cdot 89$	$2 \cdot 3 \cdot 193$	$19 \cdot 61$
116	$5 \cdot 233$	$2 \cdot 11 \cdot 53$	$3 \cdot 389$	$2^4 \cdot 73$	$7 \cdot 167$
117	$5^2 \cdot 47$	$2^3 \cdot 3 \cdot 7^2$	$11 \cdot 107$	$2 \cdot 19 \cdot 31$	$3^2 \cdot 131$
118	$3 \cdot 5 \cdot 79$	$2 \cdot 593$	**0744507**	$2^2 \cdot 3^3 \cdot 11$	$29 \cdot 41$
119	$5 \cdot 239$	$2^2 \cdot 13 \cdot 23$	$3^2 \cdot 7 \cdot 19$	$2 \cdot 599$	$11 \cdot 109$
120	$5 \cdot 241$	$2 \cdot 3^2 \cdot 67$	$17 \cdot 71$	$2^3 \cdot 151$	$3 \cdot 13 \cdot 31$
121	$3^5 \cdot 5$	$2^6 \cdot 19$	**0852906**	$2 \cdot 3 \cdot 7 \cdot 29$	$23 \cdot 53$
122	$5^2 \cdot 7^2$	$2 \cdot 613$	$3 \cdot 409$	$2^2 \cdot 307$	**0895519**
123	$5 \cdot 13 \cdot 19$	$2^2 \cdot 3 \cdot 103$	**0923697**	$2 \cdot 619$	$3 \cdot 7 \cdot 59$
124	$3 \cdot 5 \cdot 83$	$2 \cdot 7 \cdot 89$	$29 \cdot 43$	$2^5 \cdot 3 \cdot 13$	**0965624**
125	$5 \cdot 251$	$2^3 \cdot 157$	$3 \cdot 419$	$2 \cdot 17 \cdot 37$	**1000257**
126	$5 \cdot 11 \cdot 23$	$2 \cdot 3 \cdot 211$	$7 \cdot 181$	$2^2 \cdot 317$	$3^3 \cdot 47$
127	$3 \cdot 5^2 \cdot 17$	$2^2 \cdot 11 \cdot 29$	**1061909**	$2 \cdot 3^2 \cdot 71$	**1068705**
128	$5 \cdot 257$	$2 \cdot 643$	$3^2 \cdot 11 \cdot 13$	$2^3 \cdot 7 \cdot 23$	**1102529**
129	$5 \cdot 7 \cdot 37$	$2^4 \cdot 3^4$	**1129400**	$2 \cdot 11 \cdot 59$	$3 \cdot 433$
130	$3^2 \cdot 5 \cdot 29$	$2 \cdot 653$	**1162756**	$2^2 \cdot 3 \cdot 109$	$7 \cdot 11 \cdot 17$
131	$5 \cdot 263$	$2^2 \cdot 7 \cdot 47$	$3 \cdot 439$	$2 \cdot 659$	**1202448**
132	$5^2 \cdot 53$	$2 \cdot 3 \cdot 13 \cdot 17$	**1228709**	$2^4 \cdot 83$	$3 \cdot 443$
133	$3 \cdot 5 \cdot 89$	$2^3 \cdot 167$	$7 \cdot 191$	$2 \cdot 3 \cdot 223$	$13 \cdot 103$
134	$5 \cdot 269$	$2 \cdot 673$	$3 \cdot 449$	$2^2 \cdot 337$	$19 \cdot 71$
135	$5 \cdot 271$	$2^2 \cdot 3 \cdot 113$	$23 \cdot 59$	$2 \cdot 7 \cdot 97$	$3^2 \cdot 151$
136	$3 \cdot 5 \cdot 7 \cdot 13$	$2 \cdot 683$	**1357685**	$2^3 \cdot 3^2 \cdot 19$	37^2
137	$5^3 \cdot 11$	$2^5 \cdot 43$	$3^4 \cdot 17$	$2 \cdot 13 \cdot 53$	$7 \cdot 197$
138	$5 \cdot 277$	$2 \cdot 3^2 \cdot 7 \cdot 11$	$19 \cdot 73$	$2^2 \cdot 347$	$3 \cdot 463$
139	$3^2 \cdot 5 \cdot 31$	$2^2 \cdot 349$	$11 \cdot 127$	$2 \cdot 3 \cdot 233$	**1458177**
140	$5 \cdot 281$	$2 \cdot 19 \cdot 37$	$3 \cdot 7 \cdot 67$	$2^7 \cdot 11$	**1489110**
141	$5 \cdot 283$	$2^3 \cdot 3 \cdot 59$	$13 \cdot 109$	$2 \cdot 709$	$3 \cdot 11 \cdot 43$
142	$3 \cdot 5^2 \cdot 19$	$2 \cdot 23 \cdot 31$	**1544240**	$2^2 \cdot 3 \cdot 7 \cdot 17$	**1550322**
143	$5 \cdot 7 \cdot 41$	$2^2 \cdot 359$	$3 \cdot 479$	$2 \cdot 719$	**1580608**
144	$5 \cdot 17^2$	$2 \cdot 3 \cdot 241$	**1604685**	$2^3 \cdot 181$	$3^2 \cdot 7 \cdot 23$
145	$3 \cdot 5 \cdot 97$	$2^4 \cdot 7 \cdot 13$	$31 \cdot 47$	$2 \cdot 3^6$	**1640553**
146	$5 \cdot 293$	$2 \cdot 733$	$3^2 \cdot 163$	$2^2 \cdot 367$	$13 \cdot 113$
147	$5^2 \cdot 59$	$2^2 \cdot 3^2 \cdot 41$	$7 \cdot 211$	$2 \cdot 739$	$3 \cdot 17 \cdot 29$
148	$3^3 \cdot 5 \cdot 11$	$2 \cdot 743$	**1723110**	$2^4 \cdot 3 \cdot 31$	**1728947**
149	$5 \cdot 13 \cdot 23$	$2^3 \cdot 11 \cdot 17$	$3 \cdot 499$	$2 \cdot 7 \cdot 107$	**1758016**
150	$5 \cdot 7 \cdot 43$	$2 \cdot 3 \cdot 251$	$11 \cdot 137$	$2^2 \cdot 13 \cdot 29$	$3 \cdot 503$

FACTORS AND PRIMES (Continued)

n	0	1	2	3	4
150	$2^2 \cdot 3 \cdot 5^3$	$19 \cdot 79$	$2 \cdot 751$	$3^2 \cdot 167$	$2^5 \cdot 47$
151	$2 \cdot 5 \cdot 151$	**1792645**	$2^3 \cdot 3^3 \cdot 7$	$17 \cdot 89$	$2 \cdot 757$
152	$2^4 \cdot 5 \cdot 19$	$3^2 \cdot 13^2$	$2 \cdot 761$	**1826999**	$2^2 \cdot 3 \cdot 127$
153	$2 \cdot 3^2 \cdot 5 \cdot 17$	**1849752**	$2^2 \cdot 383$	$3 \cdot 7 \cdot 73$	$2 \cdot 13 \cdot 59$
154	$2^2 \cdot 5 \cdot 7 \cdot 11$	$23 \cdot 67$	$2 \cdot 3 \cdot 257$	**1883659**	$2^3 \cdot 193$
155	$2 \cdot 5^2 \cdot 31$	$3 \cdot 11 \cdot 47$	$2^4 \cdot 97$	**1911715**	$2 \cdot 3 \cdot 7 \cdot 37$
156	$2^3 \cdot 3 \cdot 5 \cdot 13$	$7 \cdot 223$	$2 \cdot 11 \cdot 71$	$3 \cdot 521$	$2^2 \cdot 17 \cdot 23$
157	$2 \cdot 5 \cdot 157$	**1961762**	$2^2 \cdot 3 \cdot 131$	$11^2 \cdot 13$	$2 \cdot 787$
158	$2^2 \cdot 5 \cdot 79$	$3 \cdot 17 \cdot 31$	$2 \cdot 7 \cdot 113$	**1994809**	$2^4 \cdot 3^2 \cdot 11$
159	$2 \cdot 3 \cdot 5 \cdot 53$	$37 \cdot 43$	$2^3 \cdot 199$	$3^3 \cdot 59$	$2 \cdot 797$
160	$2^6 \cdot 5^2$	**2043913**	$2 \cdot 3^2 \cdot 89$	$7 \cdot 229$	$2^2 \cdot 401$
161	$2 \cdot 5 \cdot 7 \cdot 23$	$3^2 \cdot 179$	$2^2 \cdot 13 \cdot 31$	**2076344**	$2 \cdot 3 \cdot 269$
162	$2^2 \cdot 3^4 \cdot 5$	**2097830**	$2 \cdot 811$	$3 \cdot 541$	$2^3 \cdot 7 \cdot 29$
163	$2 \cdot 5 \cdot 163$	$7 \cdot 233$	$2^5 \cdot 3 \cdot 17$	$23 \cdot 71$	$2 \cdot 19 \cdot 43$
164	$2^3 \cdot 5 \cdot 41$	$3 \cdot 547$	$2 \cdot 821$	$31 \cdot 53$	$2^2 \cdot 3 \cdot 137$
165	$2 \cdot 3 \cdot 5^2 \cdot 11$	$13 \cdot 127$	$2^2 \cdot 7 \cdot 59$	$3 \cdot 19 \cdot 29$	$2 \cdot 827$
166	$2^2 \cdot 5 \cdot 83$	$11 \cdot 151$	$2 \cdot 3 \cdot 277$	**2208922**	$2^7 \cdot 13$
167	$2 \cdot 5 \cdot 167$	$3 \cdot 557$	$2^3 \cdot 11 \cdot 19$	$7 \cdot 239$	$2 \cdot 3^3 \cdot 31$
168	$2^4 \cdot 3 \cdot 5 \cdot 7$	41^2	$2 \cdot 29^2$	$3^2 \cdot 11 \cdot 17$	$2^2 \cdot 421$
169	$2 \cdot 5 \cdot 13^2$	$19 \cdot 89$	$2^2 \cdot 3^2 \cdot 47$	**2286570**	$2 \cdot 7 \cdot 11^2$
170	$2^2 \cdot 5^2 \cdot 17$	$3^5 \cdot 7$	$2 \cdot 23 \cdot 37$	$13 \cdot 131$	$2^3 \cdot 3 \cdot 71$
171	$2 \cdot 3^2 \cdot 5 \cdot 19$	$29 \cdot 59$	$2^4 \cdot 107$	$3 \cdot 571$	$2 \cdot 857$
172	$2^3 \cdot 5 \cdot 43$	**2357809**	$2 \cdot 3 \cdot 7 \cdot 41$	**2362853**	$2^2 \cdot 431$
173	$2 \cdot 5 \cdot 173$	$3 \cdot 577$	$2^2 \cdot 433$	**2387986**	$2 \cdot 3 \cdot 17^2$
174	$2^2 \cdot 3 \cdot 5 \cdot 29$	**2407988**	$2 \cdot 13 \cdot 67$	$3 \cdot 7 \cdot 83$	$2^4 \cdot 109$
175	$2 \cdot 5^3 \cdot 7$	$17 \cdot 103$	$2^3 \cdot 3 \cdot 73$	**2437819**	$2 \cdot 877$
176	$2^5 \cdot 5 \cdot 11$	$3 \cdot 587$	$2 \cdot 881$	$41 \cdot 43$	$2^2 \cdot 3^2 \cdot 7^2$
177	$2 \cdot 3 \cdot 5 \cdot 59$	$7 \cdot 11 \cdot 23$	$2^2 \cdot 443$	$3^2 \cdot 197$	$2 \cdot 887$
178	$2^2 \cdot 5 \cdot 89$	$13 \cdot 137$	$2 \cdot 3^4 \cdot 11$	**2511513**	$2^3 \cdot 223$
179	$2 \cdot 5 \cdot 179$	$3^2 \cdot 199$	$2^8 \cdot 7$	$11 \cdot 163$	$2 \cdot 3 \cdot 13 \cdot 23$
180	$2^3 \cdot 3^2 \cdot 5^2$	**2555137**	$2 \cdot 17 \cdot 53$	$3 \cdot 601$	$2^2 \cdot 11 \cdot 41$
181	$2 \cdot 5 \cdot 181$	**2579185**	$2^2 \cdot 3 \cdot 151$	$7^2 \cdot 37$	$2 \cdot 907$
182	$2^2 \cdot 5 \cdot 7 \cdot 13$	$3 \cdot 607$	$2 \cdot 911$	**2607867**	$2^5 \cdot 3 \cdot 19$
183	$2 \cdot 3 \cdot 5 \cdot 61$	**2626883**	$2^3 \cdot 229$	$3 \cdot 13 \cdot 47$	$2 \cdot 7 \cdot 131$
184	$2^4 \cdot 5 \cdot 23$	$7 \cdot 263$	$2 \cdot 3 \cdot 307$	$19 \cdot 97$	$2^2 \cdot 461$
185	$2 \cdot 5^2 \cdot 37$	$3 \cdot 617$	$2^2 \cdot 463$	$17 \cdot 109$	$2 \cdot 3^2 \cdot 103$
186	$2^2 \cdot 3 \cdot 5 \cdot 31$	**2697464**	$2 \cdot 7^2 \cdot 19$	$3^4 \cdot 23$	$2^3 \cdot 233$
187	$2 \cdot 5 \cdot 11 \cdot 17$	**2720738**	$2^4 \cdot 3^2 \cdot 13$	**2725378**	$2 \cdot 937$
188	$2^3 \cdot 5 \cdot 47$	$3^2 \cdot 11 \cdot 19$	$2 \cdot 941$	$7 \cdot 269$	$2^2 \cdot 3 \cdot 157$
189	$2 \cdot 3^3 \cdot 5 \cdot 7$	$31 \cdot 61$	$2^2 \cdot 11 \cdot 43$	$3 \cdot 631$	$2 \cdot 947$
190	$2^2 \cdot 5^2 \cdot 19$	**2789821**	$2 \cdot 3 \cdot 317$	$11 \cdot 173$	$2^4 \cdot 7 \cdot 17$
191	$2 \cdot 5 \cdot 191$	$3 \cdot 7^2 \cdot 13$	$2^3 \cdot 239$	**2817150**	$2 \cdot 3 \cdot 11 \cdot 29$
192	$2^7 \cdot 3 \cdot 5$	$17 \cdot 113$	$2 \cdot 31^2$	$3 \cdot 641$	$2^2 \cdot 13 \cdot 37$
193	$2 \cdot 5 \cdot 193$	**2857823**	$2^2 \cdot 3 \cdot 7 \cdot 23$	**2862319**	$2 \cdot 967$
194	$2^2 \cdot 5 \cdot 97$	$3 \cdot 647$	$2 \cdot 971$	$29 \cdot 67$	$2^3 \cdot 3^5$
195	$2 \cdot 3 \cdot 5^2 \cdot 13$	**2902573**	$2^5 \cdot 61$	$3^2 \cdot 7 \cdot 31$	$2 \cdot 977$
196	$2^3 \cdot 5 \cdot 7^2$	$37 \cdot 53$	$2 \cdot 3^2 \cdot 109$	$13 \cdot 151$	$2^2 \cdot 491$
197	$2 \cdot 5 \cdot 197$	$3^3 \cdot 73$	$2^2 \cdot 17 \cdot 29$	**2951271**	$2 \cdot 3 \cdot 7 \cdot 47$
198	$2^2 \cdot 3^2 \cdot 5 \cdot 11$	$7 \cdot 283$	$2 \cdot 991$	$3 \cdot 661$	$2^6 \cdot 31$
199	$2 \cdot 5 \cdot 199$	$11 \cdot 181$	$2^3 \cdot 3 \cdot 83$	**2995073**	$2 \cdot 997$
200	$2^4 \cdot 5^3$	$3 \cdot 23 \cdot 29$	$2 \cdot 7 \cdot 11 \cdot 13$	**3016809**	$2^2 \cdot 3 \cdot 167$

FACTORS AND PRIMES (Continued)

n	5	6	7	8	9
150	$5 \cdot 7 \cdot 43$	$2 \cdot 3 \cdot 251$	$11 \cdot 137$	$2^2 \cdot 13 \cdot 29$	$3 \cdot 503$
151	$3 \cdot 5 \cdot 101$	$2^2 \cdot 379$	$37 \cdot 41$	$2 \cdot 3 \cdot 11 \cdot 23$	$7^2 \cdot 31$
152	$5^2 \cdot 61$	$2 \cdot 7 \cdot 109$	$3 \cdot 509$	$2^3 \cdot 191$	$11 \cdot 139$
153	$5 \cdot 307$	$2^9 \cdot 3$	$29 \cdot 53$	$2 \cdot 769$	$3^4 \cdot 19$
154	$3 \cdot 5 \cdot 103$	$2 \cdot 773$	$7 \cdot 13 \cdot 17$	$2^2 \cdot 3^2 \cdot 43$	**1900514**
155	$5 \cdot 311$	$2^2 \cdot 389$	$3^2 \cdot 173$	$2 \cdot 19 \cdot 41$	**1928461**
156	$5 \cdot 313$	$2 \cdot 3^3 \cdot 29$	**1950690**	$2^5 \cdot 7^2$	$3 \cdot 523$
157	$3^2 \cdot 5^2 \cdot 7$	$2^3 \cdot 197$	$19 \cdot 83$	$2 \cdot 3 \cdot 263$	**1983821**
158	$5 \cdot 317$	$2 \cdot 13 \cdot 61$	$3 \cdot 23^2$	$2^2 \cdot 397$	$7 \cdot 227$
159	$5 \cdot 11 \cdot 29$	$2^2 \cdot 3 \cdot 7 \cdot 19$	**2033049**	$2 \cdot 17 \cdot 47$	$3 \cdot 13 \cdot 41$
160	$3 \cdot 5 \cdot 107$	$2 \cdot 11 \cdot 73$	**2060159**	$2^3 \cdot 3 \cdot 67$	**2065560**
161	$5 \cdot 17 \cdot 19$	$2^4 \cdot 101$	$3 \cdot 7^2 \cdot 11$	$2 \cdot 809$	**2092468**
162	$5^3 \cdot 13$	$2 \cdot 3 \cdot 271$	**2113876**	$2^2 \cdot 11 \cdot 37$	$3^2 \cdot 181$
163	$3 \cdot 5 \cdot 109$	$2^2 \cdot 409$	**2140487**	$2 \cdot 3^2 \cdot 7 \cdot 13$	$11 \cdot 149$
164	$5 \cdot 7 \cdot 47$	$2 \cdot 823$	$3^3 \cdot 61$	$2^4 \cdot 103$	$17 \cdot 97$
165	$5 \cdot 331$	$2^3 \cdot 3^2 \cdot 23$	**2193225**	$2 \cdot 829$	$3 \cdot 7 \cdot 79$
166	$3^2 \cdot 5 \cdot 37$	$2 \cdot 7^2 \cdot 17$	**2219356**	$2^2 \cdot 3 \cdot 139$	**2224563**
167	$5^2 \cdot 67$	$2^2 \cdot 419$	$3 \cdot 13 \cdot 43$	$2 \cdot 839$	$23 \cdot 73$
168	$5 \cdot 337$	$2 \cdot 3 \cdot 281$	$7 \cdot 241$	$2^3 \cdot 211$	$3 \cdot 563$
169	$3 \cdot 5 \cdot 113$	$2^5 \cdot 53$	**2296818**	$2 \cdot 3 \cdot 283$	**2301934**
170	$5 \cdot 11 \cdot 31$	$2 \cdot 853$	$3 \cdot 569$	$2^2 \cdot 7 \cdot 61$	**2327421**
171	$5 \cdot 7^3$	$2^2 \cdot 3 \cdot 11 \cdot 13$	$17 \cdot 101$	$2 \cdot 859$	$3^2 \cdot 191$
172	$3 \cdot 5^2 \cdot 23$	$2 \cdot 863$	$11 \cdot 157$	$2^6 \cdot 3^3$	$7 \cdot 13 \cdot 19$
173	$5 \cdot 347$	$2^3 \cdot 7 \cdot 31$	$3^2 \cdot 193$	$2 \cdot 11 \cdot 79$	$37 \cdot 47$
174	$5 \cdot 349$	$2 \cdot 3^2 \cdot 97$	**2422929**	$2^2 \cdot 19 \cdot 23$	$3 \cdot 11 \cdot 53$
175	$3^3 \cdot 5 \cdot 13$	$2^2 \cdot 439$	$7 \cdot 251$	$2 \cdot 3 \cdot 293$	**2452658**
176	$5 \cdot 353$	$2 \cdot 883$	$3 \cdot 19 \cdot 31$	$2^3 \cdot 13 \cdot 17$	$29 \cdot 61$
177	$5^2 \cdot 71$	$2^4 \cdot 3 \cdot 37$	**2496874**	$2 \cdot 7 \cdot 127$	$3 \cdot 593$
178	$3 \cdot 5 \cdot 7 \cdot 17$	$2 \cdot 19 \cdot 47$	**2521246**	$2^2 \cdot 3 \cdot 149$	**2526103**
179	$5 \cdot 359$	$2^2 \cdot 449$	$3 \cdot 599$	$2 \cdot 29 \cdot 31$	$7 \cdot 257$
180	$5 \cdot 19^2$	$2 \cdot 3 \cdot 7 \cdot 43$	$13 \cdot 139$	$2^4 \cdot 113$	$3^3 \cdot 67$
181	$3 \cdot 5 \cdot 11^2$	$2^3 \cdot 227$	$23 \cdot 79$	$2 \cdot 3^2 \cdot 101$	$17 \cdot 107$
182	$5^2 \cdot 73$	$2 \cdot 11 \cdot 83$	$3^2 \cdot 7 \cdot 29$	$2^2 \cdot 457$	$31 \cdot 59$
183	$5 \cdot 367$	$2^2 \cdot 3^3 \cdot 17$	$11 \cdot 167$	$2 \cdot 919$	$3 \cdot 613$
184	$3^2 \cdot 5 \cdot 41$	$2 \cdot 13 \cdot 71$	**2664669**	$2^3 \cdot 3 \cdot 7 \cdot 11$	43^2
185	$5 \cdot 7 \cdot 53$	$2^6 \cdot 29$	$3 \cdot 619$	$2 \cdot 929$	$11 \cdot 13^2$
186	$5 \cdot 373$	$2 \cdot 3 \cdot 311$	**2711443**	$2^2 \cdot 467$	$3 \cdot 7 \cdot 89$
187	$3 \cdot 5^4$	$2^2 \cdot 7 \cdot 67$	**2734643**	$2 \cdot 939$	**2739268**
188	$5 \cdot 13 \cdot 29$	$2 \cdot 23 \cdot 41$	$3 \cdot 17 \cdot 37$	$2^5 \cdot 59$	**2762320**
189	$5 \cdot 379$	$2^3 \cdot 3 \cdot 79$	$7 \cdot 271$	$2 \cdot 13 \cdot 73$	$3^2 \cdot 211$
190	$3 \cdot 5 \cdot 127$	$2 \cdot 953$	**2803507**	$2^2 \cdot 3^2 \cdot 53$	$23 \cdot 83$
191	$5 \cdot 383$	$2^2 \cdot 479$	$3^3 \cdot 71$	$2 \cdot 7 \cdot 137$	$19 \cdot 101$
192	$5^2 \cdot 7 \cdot 11$	$2 \cdot 3^2 \cdot 107$	$41 \cdot 47$	$2^3 \cdot 241$	$3 \cdot 643$
193	$3^2 \cdot 5 \cdot 43$	$2^4 \cdot 11^2$	$13 \cdot 149$	$2 \cdot 3 \cdot 17 \cdot 19$	$7 \cdot 277$
194	$5 \cdot 389$	$2 \cdot 7 \cdot 139$	$3 \cdot 11 \cdot 59$	$2^2 \cdot 487$	**2898118**
195	$5 \cdot 17 \cdot 23$	$2^2 \cdot 3 \cdot 163$	$19 \cdot 103$	$2 \cdot 11 \cdot 89$	$3 \cdot 653$
196	$3 \cdot 5 \cdot 131$	$2 \cdot 983$	$7 \cdot 281$	$2^4 \cdot 3 \cdot 41$	$11 \cdot 179$
197	$5^2 \cdot 79$	$2^3 \cdot 13 \cdot 19$	$3 \cdot 659$	$2 \cdot 23 \cdot 43$	**2964458**
198	$5 \cdot 397$	$2 \cdot 3 \cdot 331$	**2981979**	$2^2 \cdot 7 \cdot 71$	$3^2 \cdot 13 \cdot 17$
199	$3 \cdot 5 \cdot 7 \cdot 19$	$2^2 \cdot 499$	**3003781**	$2 \cdot 3^3 \cdot 37$	**3008128**
200	$5 \cdot 401$	$2 \cdot 17 \cdot 59$	$3^2 \cdot 223$	$2^3 \cdot 251$	$7^2 \cdot 41$

INTEREST TABLES

Simple Interest

If P is the principal placed at interest at a rate i (expressed as a decimal), for a period of n years

The amount,

$$A = P(1 + ni)$$

Present value,

$$P = \frac{A}{1 + ni}$$

Compound Interest

At interest compounded annually the **amount,**—

$$A = P(1 + i)^n$$

At interest compounded q times per year,—

$$A = P\left(1 + \frac{i}{q}\right)^{nq}$$

At interest compounded annually the **present value,**—

$$P = \frac{A}{(1 + i)^n} = A(1 + i)^{-n} = Av^n. \qquad v = \frac{1}{1 + i}$$

At interest compounded q times per year,—

$$P = A\left(1 + \frac{i}{q}\right)^{-nq}$$

The **amount of an annuity of 1 per annum,**—

$$s_{\overline{n}|} \text{ at } i = \frac{(1 + i)^n - 1}{i}$$

The **present value of an annuity,**—

$$a_{\overline{n}|} \text{ at } i = \frac{1 - (1 + i)^{-n}}{i}$$

The **annuity whose present value is 1,**—

$$\frac{1}{a_{\overline{n}|} \text{ at } i} = \frac{1}{s_{\overline{n}|}} + i = \frac{i}{(1 - v^n)}$$

Compound amount of 1 for fractional periods,—$(1 + i)^{1/p}$

Nominal rate convertible p times per year **equivalent** to effective rate i,—

$$j_p = p[(1 + i)^{1/p} - 1]$$

Amount for year of p deposits of $1/p$, p times **per year,**—i/j_p

THE NUMBER OF EACH DAY OF THE YEAR

Day of Mo.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Day of Mo.
1	1	32	60	91	121	152	182	213	244	274	305	335	1
2	2	33	61	92	122	153	183	214	245	275	306	336	2
3	3	34	62	93	123	154	184	215	246	276	307	337	3
4	4	35	63	94	124	155	185	216	247	277	308	338	4
5	5	36	64	95	125	156	186	217	248	278	309	339	5
6	6	37	65	96	126	157	187	218	249	279	310	340	6
7	7	38	66	97	127	158	188	219	250	280	311	341	7
8	8	39	67	98	128	159	189	220	251	281	312	342	8
9	9	40	68	99	129	160	190	221	252	282	313	343	9
10	10	41	69	100	130	161	191	222	253	283	314	344	10
11	11	42	70	101	131	162	192	223	254	284	315	345	11
12	12	43	71	102	132	163	193	224	255	285	316	346	12
13	13	44	72	103	133	164	194	225	256	286	317	347	13
14	14	45	73	104	134	165	195	226	257	287	318	348	14
15	15	46	74	105	135	166	196	227	258	288	319	349	15
16	16	47	75	106	136	167	197	228	259	289	320	350	16
17	17	48	76	107	137	168	198	229	260	290	321	351	17
18	18	49	77	108	138	169	199	230	261	291	322	352	18
19	19	50	78	109	139	170	200	231	262	292	323	353	19
20	20	51	79	110	140	171	201	232	263	293	324	354	20
21	21	52	80	111	141	172	202	233	264	294	325	355	21
22	22	53	81	112	142	173	203	234	265	295	326	356	22
23	23	54	82	113	143	174	204	235	266	296	327	357	23
24	24	55	83	114	144	175	205	236	267	297	328	358	24
25	25	56	84	115	145	176	206	237	268	298	329	359	25
26	26	57	85	116	146	177	207	238	269	299	330	360	26
27	27	58	86	117	147	178	208	239	270	300	331	361	27
28	28	59	87	118	148	179	209	240	271	301	332	362	28
29	29	*	88	119	149	180	210	241	272	302	333	363	29
30	30		89	120	150	181	211	242	273	303	334	364	30
31	31		90		151		212	243		304		365	31

* In leap years, after February 28, add 1 to the tabulated number.

AMOUNT AT COMPOUND INTEREST $(1 + i)^n$

The following table gives the amount after a term of n years on unit original principal at rate of interest i.

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
1	1.00250000	1.00416667	1.00500000	1.00583333	1.00750000
2	1.00500625	1.00835069	1.01002500	1.01170069	1.01505625
3	1.00751877	1.01255216	1.01507513	1.01760228	1.02266917
4	1.01003756	1.01677112	1.02015050	1.02353830	1.03033919
5	1.01256266	1.02100767	1.02525125	1.02950894	1.03806673
6	1.01509406	1.02526187	1.03037751	1.03551440	1.04585224
7	1.01763180	1.02953379	1.03552940	1.04155490	1.05369613
8	1.02017588	1.03382352	1.04070704	1.04763064	1.06159885
9	1.02272632	1.03813111	1.04591058	1.05374182	1.06956084
10	1.02528313	1.04245666	1.05114013	1.05988865	1.07758255
11	1.02784634	1.04680023	1.05639583	1.06607133	1.08566441
12	1.03041596	1.05116190	1.06167781	1.07229008	1.09380690
13	1.03299200	1.05554174	1.06698620	1.07854511	1.10201045
14	1.03557448	1.05993983	1.07232113	1.08483662	1.11027553
15	1.03816341	1.06435625	1.07768274	1.09116483	1.11860259
16	1.04075882	1.06879106	1.08307115	1.09752996	1.12699211
17	1.04336072	1.07324436	1.08848651	1.10393222	1.13544455
18	1.04596912	1.07771621	1.09392894	1.11037182	1.14396039
19	1.04858404	1.08220670	1.09939858	1.11684899	1.15254009
20	1.05120550	1.08671589	1.10489558	1.12336395	1.16118414
21	1.05383352	1.09124387	1.11042006	1.12991690	1.16989302
22	1.05646810	1.09579072	1.11597216	1.13650808	1.17866722
23	1.05910927	1.10035652	1.12155202	1.14313771	1.18750723
24	1.06175704	1.10494134	1.12715978	1.14980602	1.19641353
25	1.06441144	1.10954526	1.13279558	1.15651322	1.20538663
26	1.06707247	1.11416836	1.13845955	1.16325955	1.21442703
27	1.06974015	1.11881073	1.14415185	1.17004523	1.22353523
28	1.07241450	1.12347244	1.14987261	1.17687049	1.23271175
29	1.07509553	1.12815358	1.15562197	1.18373557	1.24195709
30	1.07778327	1.13285422	1.16140008	1.19064069	1.25127176
31	1.08047773	1.13757444	1.16720708	1.19758610	1.26065630
32	1.08317892	1.14231434	1.17304312	1.20457202	1.27011122
33	1.08588687	1.14707398	1.17890833	1.21159869	1.27963706
34	1.08860159	1.15185346	1.18480288	1.21866634	1.28923434
35	1.09132309	1.15665284	1.19072689	1.22577523	1.29890359
36	1.09405140	1.16147223	1.19668052	1.23292559	1.30864537
37	1.09678653	1.16631170	1.20266393	1.24011765	1.31846021
38	1.09952850	1.17117133	1.20867725	1.24735167	1.32834866
39	1.10227732	1.17605121	1.21472063	1.25462789	1.33831128
40	1.10503301	1.18095142	1.22079424	1.26194655	1.34834861
41	1.10779559	1.18587206	1.22689821	1.26930791	1.35846123
42	1.11056508	1.19081319	1.23303270	1.27671220	1.36864969
43	1.11334149	1.19577491	1.23919786	1.28415969	1.37891456
44	1.11612485	1.20075731	1.24539385	1.29165062	1.38925642
45	1.11891516	1.20576046	1.25162082	1.29918525	1.39967584
46	1.12171245	1.21078446	1.25787892	1.30676383	1.41017341
47	1.12451673	1.21582940	1.26416832	1.31438662	1.42074971
48	1.12732802	1.22089536	1.27048916	1.32205388	1.43140533
49	1.13014634	1.22598242	1.27684161	1.32976586	1.44214087
50	1.13297171	1.23109068	1.28322581	1.33752283	1.452956[illegible]

AMOUNT AT COMPOUND INTEREST $(1 + i)^n$
(Continued)

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
50	1.13297171	1.23109068	1.28322581	1.33752283	1.45295693
51	1.13580414	1.23622022	1.28964194	1.34532504	1.46385411
52	1.13864365	1.24137114	1.29609015	1.35317277	1.47483301
53	1.14149026	1.24654352	1.30257060	1.36106628	1.48589426
54	1.14434398	1.25173745	1.30908346	1.36900583	1.49703847
55	1.14720484	1.25695302	1.31562887	1.37699170	1.50826626
56	1.15007285	1.26219033	1.32220702	1.38502415	1.51957825
57	1.15294804	1.26744946	1.32881805	1.39310346	1.53097509
58	1.15583041	1.27273050	1.33546214	1.40122990	1.54245740
59	1.15871998	1.27803354	1.34213946	1.40940374	1.55402583
60	1.16161678	1.28335868	1.34885015	1.41762526	1.56568103
61	1.16452082	1.28870601	1.35559440	1.42589474	1.57742363
62	1.16743213	1.29407561	1.36237238	1.43421246	1.58925431
63	1.17035071	1.29946760	1.36918424	1.44257870	1.60117372
64	1.17327658	1.30488204	1.37603016	1.45099374	1.61318252
65	1.17620977	1.31031905	1.38291031	1.45945787	1.62528139
66	1.17915030	1.31577872	1.38982486	1.46797138	1.63747100
67	1.18209817	1.32126113	1.39677399	1.47653454	1.64975203
68	1.18505342	1.32676638	1.40375785	1.48514766	1.66212517
69	1.18801605	1.33229458	1.41077664	1.49381102	1.67459111
70	1.19098609	1.33784580	1.41783053	1.50252492	1.68715055
71	1.19396356	1.34342016	1.42491968	1.51128965	1.69980418
72	1.19694847	1.34901774	1.43204428	1.52010550	1.71255271
73	1.19994084	1.35463865	1.43920450	1.52897279	1.72539685
74	1.20294069	1.36028298	1.44640052	1.53789179	1.73833733
75	1.20594804	1.36595082	1.45363252	1.54686283	1.75137486
76	1.20896291	1.37164229	1.46090069	1.55588620	1.76451017
77	1.21198532	1.37735746	1.46820519	1.56496220	1.77774400
78	1.21501528	1.38309645	1.47554622	1.57409115	1.79107708
79	1.21805282	1.38885935	1.48292395	1.58327334	1.80451015
80	1.22109795	1.39464627	1.49033857	1.59250910	1.81804398
81	1.22415070	1.40045729	1.49779026	1.60179874	1.83167931
82	1.22721108	1.40629253	1.50527921	1.61114257	1.84541691
83	1.23027910	1.41215209	1.51280561	1.62054090	1.85925753
84	1.23335480	1.41803605	1.52036964	1.62999405	1.87320196
85	1.23643819	1.42394454	1.52797148	1.63950235	1.88725098
86	1.23952928	1.42987764	1.53561134	1.64906612	1.90140536
87	1.24262811	1.43583546	1.54328940	1.65868567	1.91566590
88	1.24573468	1.44181811	1.55100585	1.66836134	1.93003339
89	1.24884901	1.44782568	1.55876087	1.67809344	1.94450865
90	1.25197114	1.45385829	1.56655468	1.68788232	1.95909246
91	1.25510106	1.45991603	1.57438745	1.69772830	1.97378565
92	1.25823882	1.46599902	1.58225939	1.70763172	1.98858905
93	1.26138441	1.47210735	1.59017069	1.71759290	2.00350346
94	1.26453787	1.47824113	1.59812154	1.72761219	2.01852974
95	1.26769922	1.48440047	1.60611215	1.73768993	2.03366871
96	1.27086847	1.49058547	1.61414271	1.74782646	2.04892123
97	1.27404564	1.49679624	1.62221342	1.75802211	2.06428814
98	1.27723075	1.50303289	1.63032449	1.76827724	2.07977030
99	1.28042383	1.50929553	1.63847611	1.77859219	2.09536858
100	1.28362489	1.51558426	1.64666849	1.78896731	2.11108384

AMOUNT AT COMPOUND INTEREST $(1 + i)^n$
(Continued)

Years	Rate i				
n	.01(1 %)	.01125($1\frac{1}{8}$ %)	.0125($1\frac{1}{4}$ %)	.015($1\frac{1}{2}$ %)	.0175($1\frac{3}{4}$ %)
1	1.01000000	1.01125000	1.01250000	1.01500000	1.01750000
2	1.02010000	1.02262656	1.02515625	1.03022500	1.03530625
3	1.03030100	1.03413111	1.03797070	1.04567838	1.05342411
4	1.04060401	1.04576509	1.05094534	1.06136355	1.07185903
5	1.05101005	1.05752994	1.06408215	1.07728400	1.09061656
6	1.06152015	1.06942716	1.07738318	1.09344326	1.10970235
7	1.07213535	1.08145821	1.09085047	1.10984491	1.12912215
8	1.08285671	1.09362462	1.10448610	1.12649259	1.14888178
9	1.09368527	1.10592789	1.11829218	1.14338998	1.16898721
10	1.10462213	1.11836958	1.13227083	1.16054083	1.18944449
11	1.11566835	1.13095124	1.14642422	1.17794894	1.21025977
12	1.12682503	1.14367444	1.16075452	1.19561817	1.23143931
13	1.13809328	1.15654078	1.17526395	1.21355244	1.25298950
14	1.14947421	1.16955186	1.18995475	1.23175573	1.27491682
15	1.16096896	1.18270932	1.20482918	1.25023207	1.29722786
16	1.17257864	1.19601480	1.21988955	1.26898555	1.31992935
17	1.18430443	1.20946997	1.23513817	1.28802033	1.34302811
18	1.19614748	1.22307650	1.25057739	1.30734064	1.36653111
19	1.20810895	1.23683611	1.26620961	1.32695075	1.39044540
20	1.22019004	1.25075052	1.28203723	1.34685501	1.41477820
21	1.23239194	1.26482146	1.29806270	1.36705783	1.43953681
22	1.24471586	1.27905071	1.31428848	1.38756370	1.46472871
23	1.25716302	1.29344003	1.33071709	1.40837715	1.49036146
24	1.26973465	1.30799123	1.34735105	1.42950281	1.51644279
25	1.28243200	1.32270613	1.36419294	1.45094535	1.54298054
26	1.29525631	1.33758657	1.38124535	1.47270953	1.56998269
27	1.30820888	1.35263442	1.39851092	1.49480018	1.59745739
28	1.32129097	1.36785156	1.41599230	1.51722218	1.62541290
29	1.33450388	1.38323989	1.43369221	1.53998051	1.65385762
30	1.34784892	1.39880134	1.45161336	1.56308022	1.68280013
31	1.36132740	1.41453785	1.46975853	1.58652642	1.71224913
32	1.37494068	1.43045140	1.48813051	1.61032432	1.74221349
33	1.38869009	1.44654398	1.50673214	1.63447918	1.77270223
34	1.40257699	1.46281760	1.52556629	1.65899637	1.80372452
35	1.41660276	1.47927430	1.54463587	1.68388132	1.83528970
36	1.43076878	1.49591613	1.56394382	1.70913954	1.86740727
37	1.44507647	1.51274519	1.58349312	1.73477663	1.90008689
38	1.45952724	1.52976357	1.60328678	1.76079828	1.93333841
39	1.47412251	1.54697341	1.62332787	1.78721025	1.96717184
40	1.48886373	1.56437687	1.64361946	1.81401841	2.00159734
41	1.50375237	1.58197611	1.66416471	1.84122868	2.03662530
42	1.51878989	1.59977334	1.68496677	1.86884712	2.07226624
43	1.53397779	1.61777079	1.70602885	1.89687982	2.10853090
44	1.54931757	1.63597071	1.72735421	1.92533302	2.14543019
45	1.56481075	1.65437538	1.74894614	1.95421301	2.18297522
46	1.58045885	1.67298710	1.77080797	1.98352621	2.22117728
47	1.59626344	1.69180821	1.79294306	2.01327910	2.26004789
48	1.61222608	1.71084105	1.81535485	2.04347829	2.29959872
49	1.62834834	1.73008801	1.83804679	2.07413046	2.33984170
50	1.64463182	1.74955150	1.86102237	2.10524242	2.38078893

AMOUNT AT COMPOUND INTEREST $(1 + i)^n$
(Continued)

Years	Rate i				
n	.01(1 %)	.01125(1⅛ %)	.0125(1¼ %)	.015(1½ %)	.0175(1¾ %)
50	1.64463182	1.74955150	1.86102237	2.10524242	2.38078893
51	1.66107814	1.76923395	1.88428515	2.13682106	2.42245274
52	1.67768892	1.78913784	1.90783872	2.16887337	2.46484566
53	1.69446581	1.80926564	1.93168670	2.20140647	2.50798046
54	1.71141047	1.82961988	1.95583279	2.23442757	2.55187012
55	1.72852457	1.85020310	1.98028070	2.26794398	2.59652785
56	1.74580982	1.87101788	2.00503420	2.30196314	2.64196708
57	1.76326792	1.89206684	2.03009713	2.33649259	2.68820151
58	1.78090060	1.91335259	2.05547335	2.37153998	2.73524503
59	1.79870960	1.93487780	2.08116676	2.40711308	2.78311182
60	1.81669670	1.95664518	2.10718135	2.44321978	2.83181628
61	1.83486367	1.97865744	2.13352111	2.47986807	2.88137306
62	1.85321230	2.00091733	2.16019013	2.51706609	2.93179709
63	1.87174443	2.02342765	2.18719250	2.55482208	2.98310354
64	1.89046187	2.04619121	2.21453241	2.59314442	3.03530785
65	1.90936649	2.06921087	2.24221407	2.63204158	3.08842574
66	1.92846015	2.09248949	2.27024174	2.67152221	3.14247319
67	1.94774475	2.11602999	2.29861976	2.71159504	3.19746647
68	1.96722220	2.13983533	2.32735251	2.75226896	3.25342213
69	1.98689442	2.16390848	2.35644442	2.79355300	3.31035702
70	2.00676337	2.18825245	2.38589997	2.83545629	3.36828827
71	2.02683100	2.21287029	2.41572372	2.87798814	3.42723331
72	2.04709931	2.23776508	2.44592027	2.92115796	3.48720990
73	2.06757031	2.26293994	2.47649427	2.96497533	3.54823607
74	2.08824601	2.28839801	2.50745045	3.00944996	3.61033020
75	2.10912847	2.31414249	2.53879358	3.05459171	3.67351098
76	2.13021975	2.34017659	2.57052850	3.10041059	3.73779742
77	2.15152195	2.36650358	2.60266011	3.14691674	3.80320888
78	2.17303717	2.39312675	2.63519336	3.19412050	3.86976503
79	2.19476754	2.42004942	2.66813327	3.24203230	3.93748592
80	2.21671522	2.44727498	2.70148494	3.29066279	4.00639192
81	2.23888237	2.47480682	2.73525350	3.34002273	4.07650378
82	2.26127119	2.50264840	2.76944417	3.39012307	4.14784260
83	2.28388390	2.53080319	2.80406222	3.44097492	4.22042984
84	2.30672274	2.55927473	2.83911300	3.49258954	4.29428737
85	2.32978997	2.58806657	2.87460191	3.54497838	4.36943740
86	2.35308787	2.61718232	2.91053444	3.59815306	4.44590255
87	2.37661875	2.64662562	2.94691612	3.65212535	4.52370584
88	2.40038494	2.67640016	2.98375257	3.70690723	4.60287070
89	2.42438879	2.70650966	3.02104948	3.76251084	4.68342093
90	2.44863267	2.73695789	3.05881260	3.81894851	4.76538080
91	2.47311900	2.76774867	3.09704775	3.87623273	4.84877496
92	2.49785019	2.79888584	3.13576085	3.93437622	4.93362853
93	2.52282869	2.83037331	3.17495786	3.99339187	5.01996703
94	2.54805698	2.86221501	3.21464483	4.05329275	5.10781645
95	2.57353755	2.89441492	3.25482789	4.11409214	5.19720324
96	2.59927293	2.92697709	3.29551324	4.17580352	5.28815429
97	2.62526565	2.95990559	3.33670716	4.23844057	5.38069699
98	2.65151831	2.99320452	3.37841600	4.30201718	5.47485919
99	2.67803349	3.02687807	3.42064620	4.36654744	5.57066923
100	2.70481383	3.06093045	3.46340427	4.43204565	5.66815594

AMOUNT AT COMPOUND INTEREST $(1 + i)^n$
(Continued)

Years	Rate i				
n	.02(2 %)	.0225(2¼ %)	.025(2½ %)	.0275(2¾ %)	.03(3 %)
1	1.02000000	1.02250000	1.02500000	1.02750000	1.03000000
2	1.04040000	1.04550625	1.05062500	1.05575625	1.06090000
3	1.06120800	1.06903014	1.07689063	1.08478955	1.09272700
4	1.08243216	1.09308332	1.10381289	1.11462126	1.12550881
5	1.10408080	1.11767769	1.13140821	1.14527334	1.15927407
6	1.12616242	1.14282544	1.15969342	1.17676836	1.19405230
7	1.14868567	1.16853901	1.18868575	1.20912949	1.22987387
8	1.17165938	1.19483114	1.21840290	1.24238055	1.26677008
9	1.19509257	1.22171484	1.24886297	1.27654602	1.30477318
10	1.21899442	1.24920343	1.28008454	1.31165103	1.34391638
11	1.24337431	1.27731050	1.31208666	1.34772144	1.38423387
12	1.26824179	1.30604999	1.34488882	1.38478378	1.42576089
13	1.29360663	1.33543611	1.37851104	1.42286533	1.46853371
14	1.31947876	1.36548343	1.41297382	1.46199413	1.51258972
15	1.34586834	1.39620680	1.44829817	1.50219896	1.55796742
16	1.37278571	1.42762146	1.48450562	1.54350944	1.60470644
17	1.40024142	1.45974294	1.52161826	1.58595595	1.65284763
18	1.42824625	1.49258716	1.55965872	1.62956973	1.70243306
19	1.45681117	1.52617037	1.59865019	1.67438290	1.75350605
20	1.48594740	1.56050920	1.63861644	1.72042843	1.80611123
21	1.51566634	1.59562066	1.67958185	1.76774021	1.86029457
22	1.54597967	1.63152212	1.72157140	1.81635307	1.91610341
23	1.57689926	1.66823137	1.76461068	1.86630278	1.97358651
24	1.60843725	1.70576658	1.80872595	1.91762610	2.03279411
25	1.64060599	1.74414632	1.85394410	1.97036082	2.09377793
26	1.67341811	1.78338962	1.90029270	2.02454575	2.15659127
27	1.70688648	1.82351588	1.94780002	2.08022075	2.22128901
28	1.74102421	1.86454499	1.99649502	2.13742682	2.28792768
29	1.77584469	1.90649725	2.04640739	2.19620606	2.35656551
30	1.81136158	1.94939344	2.09756758	2.25660173	2.42726247
31	1.84758882	1.99325479	2.15000677	2.31865828	2.50008035
32	1.88454059	2.03810303	2.20375694	2.38242138	2.57508276
33	1.92223140	2.08396034	2.25885086	2.44793797	2.65233524
34	1.96067603	2.13084945	2.31532213	2.51525626	2.73190530
35	1.99988955	2.17879356	2.37320519	2.58442581	2.81386245
36	2.03988734	2.22781642	2.43253532	2.65549752	2.89827833
37	2.08068509	2.27794229	2.49334870	2.72852370	2.98522668
38	2.12229879	2.32919599	2.55568242	2.80355810	3.07478348
39	2.16474477	2.38160290	2.61957448	2.88065595	3.16702698
40	2.20803966	2.43518897	2.68506384	2.95987399	3.26203779
41	2.25220046	2.48998072	2.75219043	3.04127052	3.35989893
42	2.29724447	2.54600528	2.82099520	3.12490546	3.46069589
43	2.34318936	2.60329040	2.89152008	3.21084036	3.56451677
44	2.39005314	2.66186444	2.96380808	3.29913847	3.67145227
45	2.43785421	2.72175639	3.03790328	3.38986478	3.78159584
46	2.48661129	2.78299590	3.11385086	3.48308606	3.89504372
47	2.53634351	2.84561331	3.19169713	3.57887093	4.01189503
48	2.58707039	2.90963961	3.27148956	3.67728988	4.13225188
49	2.63881179	2.97510650	3.35327680	3.77841535	4.25621944
50	2.69158803	3.04204640	3.43710872	3.88232177	4.38390602

AMOUNT AT COMPOUND INTEREST $(1 + i)^n$
(Continued)

Years n	Rate i .02 (2 %)	.0225 ($2\frac{1}{4}$ %)	.025 ($2\frac{1}{2}$ %)	.0275 ($2\frac{3}{4}$ %)	.03 (3 %)
50	2.69158803	3.04204640	3.43710872	3.88232177	4.38390602
51	2.74541979	3.11049244	3.52303644	3.98908562	4.51542320
52	2.80032819	3.18047852	3.61111235	4.09878547	4.65088590
53	2.85633475	3.25203929	3.70139016	4.21150208	4.79041247
54	2.91346144	3.32521017	3.79392491	4.32731838	4.93412485
55	2.97173067	3.40002740	3.88877303	4.44631964	5.08214859
56	3.03116529	3.47652802	3.98599236	4.56859343	5.23461305
57	3.09178859	3.55474990	4.08564217	4.69422975	5.39165144
58	3.15362436	3.63473177	4.18778322	4.82332107	5.55340098
59	3.21669685	3.71651324	4.29247780	4.95596239	5.72000301
60	3.28103079	3.80013479	4.39978975	5.09225136	5.89160310
61	3.34665140	3.88563782	4.50978449	5.23228827	6.06835120
62	3.41358443	3.97306467	4.62252910	5.37617620	6.25040173
63	3.48185612	4.06245862	4.73809233	5.52402105	6.43791379
64	3.55149324	4.15386394	4.85654464	5.67593162	6.63105120
65	3.62252311	4.24732588	[illegible]	5.83201974	6.82998273
66	[illegible]	[illegible]	5.10240721	5.99240029	7.03488222
67	[illegible]	[illegible]	[illegible]	6.15719130	[illegible]
68	[illegible]	[illegible]	[illegible]	6.32651406	[illegible]
69	[illegible]	[illegible]	[illegible]	6.50049319	7.68720574
70	[illegible]	4.74714140	[illegible]	6.67925676	7.91782191
71	[illegible]	[illegible]	[illegible]	[illegible]	8.15535657
72	[illegible]	[illegible]	[illegible]	[illegible]	8.40001727
73	[illegible]	[illegible]	[illegible]	[illegible]	8.65201778
74	[illegible]	5.18902107	[illegible]	[illegible]	8.91157832
75	[illegible]	5.30577405	6.37220743	7.64957472	9.17892567
76	[illegible]	5.42515396	6.53151261	7.85993802	9.45429344
77	[illegible]	5.54721993	6.69480043	8.07608632	9.73792224
78	[illegible]	5.67203237	6.86217044	8.29817869	10.0300599
79	[illegible]	5.79965310	7.03372470	8.52637861	10.3309617
80	[illegible]	5.93014530	7.20956782	8.76085402	10.6408906
81	[illegible]	6.06357357	[illegible]	9.00177751	10.9601173
82	[illegible]	6.20000397	7.57455219	[illegible]	11.2889208
83	[illegible]	[illegible]	[illegible]	9.50368286	11.6275884
84	[illegible]	[illegible]	[illegible]	9.76503414	11.9764161
85	[illegible]	6.62799112	8.15696424	10.0335726	12.3357086
86	[illegible]	6.77712092	8.36088834	10.3094958	12.7057798
87	[illegible]	[illegible]	8.56991055	10.5930070	13.0869532
88	[illegible]	7.08552228	8.78415832	10.8843147	13.4795618
89	[illegible]	[illegible]	9.00376228	11.1836333	13.8839487
90	[illegible]	[illegible]	9.22885633	[illegible]	14.3004671
91	[illegible]	[illegible]	9.45957774	[illegible]	14.7294811
92	[illegible]	[illegible]	[illegible]	12.1318885	15.1713658
93	[illegible]	[illegible]	[illegible]	12.4655154	15.6265065
94	[illegible]	[illegible]	[illegible]	12.8083171	16.0953017
95	[illegible]	[illegible]	10.4407390	13.1605458	16.5781608
96	[illegible]	[illegible]	10.7017646	13.5224608	17.0755058
97	[illegible]	[illegible]	[illegible]	13.8943285	17.5877798
98	[illegible]	[illegible]	[illegible]	14.2764226	18.1154089
99	[illegible]	[illegible]	[illegible]	14.6690242	18.6588660
100	[illegible]	[illegible]	[illegible]	15.0724223	19.2186320

AMOUNT AT COMPOUND INTEREST $(1 + i)^n$
(Continued)

Years	Rate i				
n	.035(3½ %)	.04(4 %)	.045(4½ %)	.05(5 %)	.055(5½ %)
1	1.03500000	1.04000000	1.04500000	1.05000000	1.05500000
2	1.07122500	1.08160000	1.09202500	1.10250000	1.11302500
3	1.10871788	1.12486400	1.14116613	1.15762500	1.17424138
4	1.14752300	1.16985856	1.19251860	1.21550625	1.23882465
5	1.18768631	1.21665290	1.24618194	1.27628156	1.30696001
6	1.22925533	1.26531902	1.30226012	1.34009564	1.37884281
7	1.27227926	1.31593178	1.36086183	1.40710042	1.45467916
8	1.31680904	1.36856905	1.42210061	1.47745544	1.53468651
9	1.36289735	1.42331181	1.48609514	1.55132822	1.61909427
10	1.41059876	1.48024428	1.55296942	1.62889463	1.70814446
11	1.45996972	1.53945406	1.62285305	1.71033936	1.80209240
12	1.51106866	1.60103222	1.69588143	1.79585633	1.90120749
13	1.56395606	1.66507351	1.77219610	1.88564914	2.00577390
14	1.61869452	1.73167645	1.85194492	1.97993160	2.11609146
15	1.67534883	1.80094351	1.93528244	2.07892818	2.23247649
16	1.73398604	1.87298125	2.02237015	2.18287459	2.35526270
17	1.79467555	1.94790050	2.11337681	2.29201832	2.48480215
18	1.85748920	2.02581652	2.20847877	2.40661923	2.62146627
19	1.92250132	2.10684918	2.30786031	2.52695020	2.76564691
20	1.98978886	2.19112314	2.41171402	2.65329771	2.91775749
21	2.05943147	2.27876807	2.52024116	2.78596259	3.07823415
22	2.13151158	2.36991879	2.63365201	2.92526072	3.24753703
23	2.20611448	2.46471554	2.75216635	3.07152376	3.42615157
24	2.28332849	2.56330416	2.87601383	3.22509994	3.61458990
25	2.36324498	2.66583633	3.00543446	3.38635494	3.81339235
26	2.44595856	2.77246978	3.14067901	3.55567269	4.02312893
27	2.53156711	2.88336858	3.28200956	3.73345632	4.24440102
28	2.62017196	2.99870332	3.42969999	3.92012914	4.47784307
29	2.71187798	3.11865145	3.58403649	4.11613560	4.72412444
30	2.80679370	3.24339751	3.74531813	4.32194238	4.98395129
31	2.90503148	3.37313341	3.91385745	4.53803949	5.25806861
32	3.00670759	3.50805875	4.08998104	4.76494147	5.54726238
33	3.11194235	3.64838110	4.27403018	5.00318854	5.85236181
34	3.22086033	3.79431634	4.46636154	5.25334797	6.17424171
35	3.33359045	3.94608899	4.66734781	5.51601537	6.51382501
36	3.45026611	4.10393255	4.87737846	5.79181614	6.87208538
37	3.57102543	4.26808986	5.09686049	6.08140694	7.25005008
38	3.69601132	4.43881345	5.32621921	6.38547729	7.64880283
39	3.82537171	4.61636599	5.56589908	6.70475115	8.06948699
40	3.95925972	4.80102063	5.81636454	7.03998871	8.51330877
41	4.09783381	4.99306145	6.07810094	7.39198815	8.98154076
42	4.24125799	5.19278391	6.35161548	7.76158756	9.47552550
43	4.38970202	5.40049527	6.63743818	8.14966693	9.99667940
44	4.54334160	5.61651508	6.93612290	8.55715028	10.5464968
45	4.70235855	5.84117568	7.24824843	8.98500779	11.1265541
46	4.86694110	6.07482271	7.57441961	9.43425818	11.7385146
47	5.03728404	6.31781562	7.91526849	9.90597109	12.3841329
48	5.21358898	6.57052824	8.27145557	10.4012697	13.0652602
49	5.39606459	6.83334937	8.64367107	10.9213331	13.7838495
50	5.58492686	7.10668335	9.03263627	11.4673998	14.5419612

AMOUNT AT COMPOUND INTEREST $(1+i)^n$
(Continued)

Years	Rate i				
n	.06(6 %)	.065($6\frac{1}{2}$ %)	.07(7 %)	.075($7\frac{1}{2}$) %	.08(8 %)
1	1.06000000	1.06500000	1.07000000	1.07500000	1.08000000
2	1.12360000	1.13422500	1.14490000	1.15562500	1.16640000
3	1.19101600	1.20794963	1.22504300	1.24229688	1.25971200
4	1.26247696	1.28646635	1.31079601	1.33546914	1.36048896
5	1.33822558	1.37008666	1.40255173	1.43562933	1.46932808
6	1.41851911	1.45914230	1.50073035	1.54330153	1.58687432
7	1.50363026	1.55398655	1.60578148	1.65904914	1.71382427
8	1.59384807	1.65499567	1.71818618	1.78347783	1.85093021
9	1.68947896	1.76257039	1.83845921	1.91723866	1.99900463
10	1.79084770	1.87713747	1.96715136	2.06103156	2.15892500
11	1.89829856	1.99915140	2.10485195	2.21560893	2.33163900
12	2.01219647	2.12909624	2.25219159	2.38177960	2.51817012
13	2.13292826	2.26748750	2.40984500	2.56041307	2.71962373
14	2.26090396	2.41487418	2.57853415	2.75244405	2.93719362
15	2.39655819	2.57184101	2.75903154	2.95887735	3.17216911
16	2.54035168	2.73901067	2.95216375	3.18079315	3.42594264
17	2.69277279	2.91704637	3.15881521	3.41935264	3.70001805
18	2.85433915	3.10665438	3.37993228	3.67580409	3.99601950
19	3.02559950	3.30858691	3.61652754	3.95148940	4.31570106
20	3.20713547	3.52364506	3.86968446	4.24785110	4.66095714
21	3.39956360	3.75268199	4.14056237	4.56643993	5.03383372
22	3.60353742	3.99660632	4.43040174	4.90892293	5.43654041
23	3.81974966	4.25638573	4.74052986	5.27709215	5.87146365
24	4.04893464	4.53305081	5.07236695	5.67287406	6.34118074
25	4.29187072	4.82769911	5.42743264	6.09833961	6.84847520
26	4.54938296	5.14149955	5.80735292	6.55571508	7.39635321
27	4.82234594	5.47569702	6.21386763	7.04739371	7.98806147
28	5.11168670	5.83161733	6.64883836	7.57594824	8.62710639
29	5.41838790	6.21067245	7.11425705	8.14414436	9.31727490
30	5.74349117	6.61436616	7.61225504	8.75495519	10.0626569
31	6.08810064	7.04429996	8.14511290	9.41157683	10.8676694
32	6.45338668	7.50217946	8.71527080	10.1174451	11.7370830
33	6.84058988	7.98982113	9.32533975	10.8762535	12.6760496
34	7.25102528	8.50915950	9.97811354	11.6919725	13.6901336
35	7.68608679	9.06225487	10.6765815	12.5688704	14.7853443
36	8.14725200	9.65130143	11.4239422	13.5115357	15.9681718
37	8.63608712	10.2786360	12.2236181	14.5249009	17.2456256
38	9.15425235	10.9467474	13.0792714	15.6142684	18.6252756
39	9.70350749	11.6582860	13.9948204	16.7853386	20.1152977
40	10.2857179	12.4160745	14.9744578	18.0442390	21.7245215
41	10.9028610	13.2231194	16.0226699	19.3975569	23.4624832
42	11.5570327	14.0826221	17.1442568	20.8523737	25.3394819
43	12.2504546	14.9979926	18.3443548	22.4163017	27.3666404
44	12.9854819	15.9728621	19.6284596	24.0975243	29.5559717
45	13.7646108	17.0110981	21.0024518	25.9048386	31.9204494
46	14.5904875	18.1168195	22.4726234	27.8477015	34.4740853
47	15.4659167	19.2944128	24.0457070	29.9362792	37.2320122
48	16.3938717	20.5485496	25.7289065	32.1815001	40.2105731
49	17.3775040	21.8842053	27.5299300	34.5951126	43.4274190
50	18.4201543	23.3066787	29.4570251	37.1897460	46.9016125

PRESENT VALUE $1/(1 + i)^n$

The following table gives the value of unit amount due in n years at rate of interest i, compounded annually, $1/(1 + i)^n = v^n$.

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
1	.99750623	.99585062	.99502488	.99420050	.99255583
2	.99501869	.99171846	.99007450	.98843463	.98516708
3	.99253734	.98760345	.98514876	.98270220	.97783333
4	.99006219	.98350551	.98024752	.97700302	.97055417
5	.98759321	.97942457	.97537067	.97133688	.96332920
6	.98513038	.97536057	.97051808	.96570361	.95615802
7	.98267370	.97131343	.96568963	.96010301	.94904022
8	.98022314	.96728308	.96088520	.95453189	.94197540
9	.97777869	.96326946	.95610468	.94899907	.93496318
10	.97534034	.95927249	.95134794	.94349534	.92800315
11	.97290807	.95529211	.94661489	.93802354	.92109494
12	.97048187	.95132824	.94190534	.93258347	.91423815
13	.96806171	.94738082	.93721924	.92717495	.90743241
14	.96564759	.94344978	.93255646	.92179780	.90067733
15	.96323949	.93953505	.92791688	.91645183	.89397254
16	.96083740	.93563656	.92330037	.91113686	.88731766
17	.95844130	.93175425	.91870684	.90585272	.88071231
18	.95605117	.92788805	.91413616	.90059923	.87415614
19	.95366700	.92403789	.90958822	.89537620	.86764878
20	.95128878	.92020371	.90506290	.89018346	.86118985
21	.94891649	.91638544	.90056010	.88502084	.85477901
22	.94655011	.91258301	.89607971	.87988816	.84841589
23	.94418964	.90879636	.89162160	.87478525	.84210014
24	.94183505	.90502542	.88718567	.86971193	.83583140
25	.93948634	.90127012	.88277181	.86466803	.82960933
26	.93714348	.89753041	.87837991	.85965339	.82343358
27	.93480646	.89380622	.87400986	.85466782	.81730380
28	.93247527	.89009748	.86966155	.84971118	.81121966
29	.93014990	.88640413	.86533488	.84478327	.80518080
30	.92783032	.88272610	.86102973	.83988395	.79918690
31	.92551653	.87906334	.85674600	.83501304	.79323762
32	.92320851	.87541577	.85248358	.83017038	.78733262
33	.92090624	.87178334	.84824237	.82535581	.78147158
34	.91860972	.86816599	.84402226	.82056915	.77565418
35	.91631892	.86456364	.83982314	.81581026	.76988008
36	.91403384	.86097624	.83564492	.81107897	.76414896
37	.91175445	.85740372	.83148748	.80637511	.75846051
38	.90948075	.85384603	.82735073	.80169854	.75281440
39	.90721272	.85030310	.82323455	.79704908	.74721032
40	.90495034	.84677487	.81913886	.79242660	.74164796
41	.90269361	.84326128	.81506354	.78783092	.73612701
42	.90044250	.83976227	.81100850	.78326189	.73064716
43	.89819701	.83627778	.80697363	.77871936	.72520809
44	.89595712	.83280775	.80295884	.77420317	.71980952
45	.89372281	.82935211	.79896402	.76971318	.71445114
46	.89149407	.82591082	.79498907	.76524923	.70913264
47	.88927090	.82248380	.79103390	.76081116	.70385374
48	.88705326	.81907100	.78709841	.75639884	.69861414
49	.88484116	.81567237	.78318250	.75201210	.69341353
50	.88263457	.81228784	.77928607	.74765080	.68825165

PRESENT VALUE $1/(1 + i)^n$ (Continued)

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
50	.88263457	.81228784	.77928607	.74765080	.68825165
51	.88043349	.80891735	.77540902	.74331480	.68312819
52	.87823790	.80556084	.77155127	.73900394	.67804286
53	.87604778	.80221827	.76771270	.73471809	.67299540
54	.87386312	.79888956	.76389324	.73045709	.66798551
55	.87168391	.79557467	.76009277	.72622080	.66301291
56	.86951013	.79227353	.75631122	.72200908	.65807733
57	.86734178	.78898608	.75254847	.71782179	.65317849
58	.86517883	.78571228	.74880445	.71365878	.64831612
59	.86302128	.78245207	.74507906	.70951991	.64348995
60	.86086911	.77920538	.74137220	.70540505	.63869970
61	.85872230	.77597216	.73768378	.70131405	.63394511
62	.85658085	.77275236	.73401371	.69724678	.62922592
63	.85444474	.76954591	.73036190	.69320310	.62454185
64	.85231395	.76635278	.72672826	.68918286	.61989266
65	.85018848	.76317289	.72311269	.68518594	.61527807
66	.84806831	.76000620	.71951512	.68121221	.61069784
67	.84595343	.75685265	.71593544	.67726151	.60615170
68	.84384382	.75371218	.71237357	.67333373	.60163940
69	.84173947	.75058474	.70882943	.66942873	.59716070
70	.83964037	.74747028	.70530291	.66554638	.59271533
71	.83754650	.74436874	.70179394	.66168654	.58830306
72	.83545786	.74128008	.69830243	.65784909	.58392363
73	.83337442	.73820423	.69482829	.65403389	.57957681
74	.83129618	.73514114	.69137143	.65024082	.57526234
75	.82922312	.73209076	.68793177	.64646975	.57097999
76	.82715523	.72905304	.68450923	.64272054	.56672952
77	.82509250	.72602792	.68110371	.63899308	.56251069
78	.82303491	.72301536	.67771513	.63528724	.55832326
79	.82098246	.72001529	.67434342	.63160289	.55416701
80	.81893512	.71702768	.67098847	.62793991	.55004170
81	.81689289	.71405246	.66765022	.62429817	.54594710
82	.81485575	.71108959	.66432858	.62067755	.54188297
83	.81282369	.70813901	.66102346	.61707793	.53784911
84	.81079670	.70520067	.65773479	.61349919	.53384527
85	.80877476	.70227453	.65446248	.60994120	.52987123
86	.80675787	.69936052	.65120644	.60640384	.52592678
87	.80474600	.69645861	.64796661	.60288700	.52201169
88	.80273915	.69356874	.64474290	.59939056	.51812575
89	.80073731	.69069086	.64153522	.59591439	.51426873
90	.79874046	.68782493	.63834350	.59245838	.51044042
91	.79674859	.68497088	.63516766	.58902242	.50664063
92	.79476168	.68212868	.63200763	.58560638	.50286911
93	.79277973	.67929827	.62886331	.58221015	.49912567
94	.79080273	.67647960	.62573464	.57883363	.49541009
95	.78883065	.67367263	.62262153	.57547668	.49172217
96	.78686349	.67087731	.61952391	.57213920	.48806171
97	.78490124	.66809359	.61644170	.56882108	.48442850
98	.78294388	.66532141	.61337483	.56552220	.48082233
99	.78099140	.66256074	.61032321	.56224245	.47724301
100	.77904379	.65981153	.60728678	.55898172	.47369033

PRESENT VALUE $1/(1+i)^n$ (Continued)

Years	Rate i				
n	.01(1 %)	.01125(1⅛ %)	.0125(1¼ %)	.015(1½ %)	.0175(1¾ %)
1	.99009901	.98887515	.98765432	.98522167	.98280098
2	.98029605	.97787407	.97546106	.97066175	.96589777
3	.97059015	.96699537	.96341833	.95631699	.94928528
4	.96098034	.95623770	.95152428	.94218423	.93295851
5	.95146569	.94559970	.93977706	.92826033	.91691254
6	.94204524	.93508005	.92817488	.91454219	.90114254
7	.93271805	.92467743	.91671593	.90102679	.88564378
8	.92348322	.91439054	.90539845	.88771112	.87041157
9	.91433982	.90421808	.89422069	.87459224	.85544135
10	.90528695	.89415881	.88318093	.86166723	.84072860
11	.89632372	.88421142	.87227746	.84893323	.82626889
12	.88744923	.87437470	.86150860	.83638742	.81205788
13	.87866260	.86464742	.85087269	.82402702	.79809128
14	.86996297	.85502835	.84036809	.81184928	.78436490
15	.86134947	.84551629	.82999318	.79985150	.77087459
16	.85282126	.83611005	.81974635	.78803104	.75761631
17	.84437749	.82680846	.80962602	.77638526	.74458605
18	.83601731	.81761034	.79963064	.76491159	.73177990
19	.82773992	.80851455	.78975866	.75360747	.71919401
20	.81954447	.79951995	.78000855	.74247042	.70682458
21	.81143017	.79062542	.77037881	.73149795	.69466789
22	.80339621	.78182983	.76086796	.72068763	.68272028
23	.79544179	.77313210	.75147453	.71003708	.67097817
24	.78756613	.76453112	.74219707	.69954392	.65943800
25	.77976844	.75602583	.73303414	.68920583	.64809632
26	.77204796	.74761516	.72398434	.67902052	.63694970
27	.76440392	.73929806	.71504626	.66898574	.62599479
28	.75683557	.73107348	.70621853	.65909925	.61522829
29	.74934215	.72294040	.69749978	.64935887	.60464697
30	.74192292	.71489780	.68888867	.63976243	.59424764
31	.73457715	.70694467	.68038387	.63030781	.58402716
32	.72730411	.69908002	.67198407	.62099292	.57398247
33	.72010307	.69130287	.66368797	.61181568	.56411053
34	.71297334	.68361223	.65549429	.60277407	.55440839
35	.70591420	.67600715	.64740177	.59386608	.54487311
36	.69892495	.66848667	.63940916	.58508974	.53550183
37	.69200490	.66104986	.63151522	.57644309	.52629172
38	.68515337	.65369578	.62371873	.56792423	.51724002
39	.67836967	.64642352	.61601850	.55953126	.50834400
40	.67165314	.63923216	.60841334	.55126232	.49960098
41	.66500311	.63212080	.60090206	.54311559	.49100834
42	.65841892	.62508855	.59348352	.53508925	.48256348
43	.65189992	.61813454	.58615656	.52718153	.47426386
44	.64544546	.61125789	.57892006	.51939067	.46610699
45	.63905492	.60445774	.57177290	.51171494	.45809040
46	.63272764	.59773324	.56471397	.50415265	.45021170
47	.62646301	.59108355	.55774219	.49670212	.44246850
48	.62026041	.58450784	.55085649	.48936170	.43485848
49	.61411921	.57800528	.54405579	.48212975	.42737934
50	.60803882	.57157506	.53733905	.47500468	.42002883

PRESENT VALUE $1/(1 + i)^n$ (Continued)

Years	Rate i				
n	.01(1 %)	.01125(1⅛ %)	.0125(1¼ %)	.015(1½ %)	.0175(1¾ %)
50	.60803882	.57157506	.53733905	.47500468	.42002883
51	.60201864	.56521637	.53070524	.46798491	.41280475
52	.59605806	.55892843	.52415332	.46106887	.40570492
53	.59015649	.55271044	.51768229	.45425505	.39872719
54	.58431336	.54656162	.51129115	.44754192	.39186947
55	.57852808	.54048120	.50497892	.44092800	.38512970
56	.57280008	.53446843	.49874461	.43441182	.37850585
57	.56712879	.52852256	.49258727	.42799194	.37199592
58	.56151365	.52264282	.48650594	.42166694	.36559796
59	.55595411	.51682850	.48049970	.41543541	.35931003
60	.55044962	.51107887	.47456760	.40929597	.35313025
61	.54499962	.50539319	.46870874	.40324726	.34705676
62	.53960358	.49977077	.46292222	.39728794	.34108772
63	.53426097	.49421090	.45720713	.39141669	.33522135
64	.52897126	.48871288	.45156259	.38563221	.32945587
65	.52373392	.48327602	.44598775	.37993321	.32378956
66	.51854844	.47789965	.44048173	.37431843	.31822069
67	.51341429	.47258309	.43504368	.36878663	.31274761
68	.50833099	.46732568	.42967277	.36333658	.30736866
69	.50329801	.46212675	.42436817	.35796708	.30208222
70	.49831486	.45698566	.41912905	.35267692	.29688670
71	.49338105	.45190177	.41395462	.34746495	.29178054
72	.48849609	.44687443	.40884407	.34233000	.28676221
73	.48365949	.44190302	.40379661	.33727093	.28183018
74	.47887078	.43698692	.39881147	.33228663	.27698298
75	.47412949	.43212551	.39388787	.32737599	.27221914
76	.46943514	.42731818	.38902506	.32253793	.26753724
77	.46478726	.42256433	.38422228	.31777136	.26293586
78	.46018541	.41786337	.37947879	.31307523	.25841362
79	.45562912	.41321470	.37479387	.30844850	.25396916
80	.45111794	.40861775	.37016679	.30389015	.24960114
81	.44665142	.40407194	.36559683	.29939916	.24530825
82	.44222913	.39957670	.36108329	.29497454	.24108919
83	.43785063	.39513148	.35662547	.29061531	.23694269
84	.43351547	.39073570	.35222268	.28632050	.23286751
85	.42922324	.38638882	.34787426	.28208917	.22886242
86	.42497350	.38209031	.34357951	.27792036	.22492621
87	.42076585	.37783961	.33933779	.27381316	.22105770
88	.41659985	.37363621	.33514843	.26976666	.21725572
89	.41247510	.36947956	.33101080	.26577997	.21351914
90	.40839119	.36536916	.32692425	.26185218	.20984682
91	.40434771	.36130448	.32288814	.25798245	.20623766
92	.40034427	.35728503	.31890187	.25416990	.20269057
93	.39638046	.35331029	.31496481	.25041369	.19920450
94	.39245590	.34937976	.31107636	.24671300	.19577837
95	.38857020	.34549297	.30723591	.24306699	.19241118
96	.38472297	.34164941	.30344287	.23947487	.18910190
97	.38091383	.33784861	.29969666	.23593583	.18584953
98	.37714241	.33409010	.29599670	.23244909	.18265310
99	.37340832	.33037340	.29234242	.22901389	.17951165
100	.36971121	.32669805	.28873326	.22562944	.17642422

PRESENT VALUE $1/(1 + i)^n$ (Continued)

Years	Rate i				
n	.02(2 %)	.0225(2¼ %)	.025(2½ %)	.0275(2¾ %)	.03(3 %)
1	.98039216	.97799511	.97560976	.97323601	.97087379
2	.96116878	.95647444	.95181440	.94718833	.94259591
3	.94232233	.93542732	.92859941	.92183779	.91514166
4	.92384543	.91484335	.90595064	.89716573	.88848705
5	.90573081	.89471232	.88385429	.87315400	.86260878
6	.88797138	.87502427	.86229687	.84978491	.83748426
7	.87056018	.85576946	.84126524	.82704128	.81309151
8	.85349037	.83693835	.82074657	.80490635	.78940923
9	.83675527	.81852161	.80072836	.78336385	.76641673
10	.82034830	.80051013	.78119840	.76239791	.74409391
11	.80426304	.78289499	.76214478	.74199310	.72242128
12	.78849318	.76566748	.74355589	.72213440	.70137988
13	.77303253	.74881905	.72542038	.70280720	.68095134
14	.75787502	.73234137	.70772720	.68399728	.66111781
15	.74301473	.71622628	.69046556	.66569078	.64186195
16	.72844581	.70046580	.67362493	.64787424	.62316694
17	.71416256	.68505212	.65719506	.63053454	.60501645
18	.70015937	.66997763	.64116591	.61365892	.58739461
19	.68643076	.65523484	.62552772	.59723496	.57028603
20	.67297133	.64081647	.61027094	.58125057	.55367575
21	.65977582	.62671538	.59538629	.56569398	.53754928
22	.64683904	.61292457	.58086467	.55055375	.52189250
23	.63415592	.59943724	.56669724	.53581874	.50669175
24	.62172149	.58624668	.55287535	.52147809	.49193374
25	.60953087	.57334639	.53939059	.50752126	.47760557
26	.59757928	.56072997	.52623472	.49393796	.46369473
27	.58586204	.54839117	.51339973	.48071821	.45018906
28	.57437455	.53632388	.50087778	.46785227	.43707675
29	.56311231	.52452213	.48866125	.45533068	.42434636
30	.55207089	.51298008	.47674269	.44314421	.41198676
31	.54124597	.50169201	.46511481	.43128391	.39998715
32	.53063330	.49065233	.45377055	.41974103	.38833703
33	.52022873	.47985558	.44270298	.40850708	.37702625
34	.51002817	.46929641	.43190534	.39757380	.36604490
35	.50002761	.45896960	.42137107	.38693314	.35538340
36	.49022315	.44887002	.41109372	.37657727	.34503243
37	.48061093	.43899268	.40106705	.36649856	.33498294
38	.47118719	.42933270	.39128492	.35668959	.32522615
39	.46194822	.41988528	.38174139	.34714316	.31575355
40	.45289042	.41064575	.37243062	.33785222	.30655684
41	.44401021	.40160954	.36334695	.32880995	.29762800
42	.43530413	.39277216	.35448483	.32000968	.28895922
43	.42676875	.38412925	.34583886	.31144495	.28054294
44	.41840074	.37567653	.33740376	.30310944	.27237178
45	.41019680	.36740981	.32917440	.29499702	.26443862
46	.40215373	.35932500	.32114576	.28710172	.25673653
47	.39426836	.35141809	.31331294	.27941773	.24925876
48	.38653761	.34368518	.30567116	.27193940	.24199880
49	.37895844	.33612242	.29821576	.26466122	.23495029
50	.37152788	.32872608	.29094221	.25757783	.22810708

PRESENT VALUE $1/(1+i)^n$ (Continued)

Years	Rate i				
n	.02(2 %)	.0225(2¼ %)	.025(2½ %)	.0275(2¾ %)	.03(3 %)
50	.37152788	.32872608	.29094221	.25757783	.22810708
51	.36424302	.32149250	.28384606	.25068402	.22146318
52	.35710100	.31441810	.27692298	.24397471	.21501280
53	.35009902	.30749936	.27016876	.23744497	.20875029
54	.34323433	.30073287	.26357928	.23109000	.20267019
55	.33650425	.29411528	.25715052	.22490511	.19676717
56	.32990613	.28764330	.25087855	.21888575	.19103609
57	.32343738	.28131374	.24475956	.21302749	.18547193
58	.31709547	.27512347	.23878982	.20732603	.18006984
59	.31087791	.26906940	.23296568	.20177716	.17482508
60	.30478227	.26314856	.22728359	.19637679	.16973309
61	.29880614	.25735801	.22174009	.19112097	.16478941
62	.29294720	.25169487	.21633179	.18600581	.15998972
63	.28720314	.24615635	.21105541	.18102755	.15532982
64	.28157170	.24073971	.20590771	.17618253	.15080565
65	.27605069	.23544226	.20088557	.17146718	.14641325
66	.27063793	.23026138	.19598593	.16687804	.14214879
67	.26533130	.22519450	.19120578	.16241172	.13800853
68	.26012873	.22023912	.18654223	.15806493	.13398887
69	.25502817	.21539278	.18199241	.15383448	.13008628
70	.25002761	.21065309	.17755358	.14971726	.12629736
71	.24512511	.20601769	.17322300	.14571023	.12261880
72	.24031874	.20148429	.16899805	.14181044	.11904737
73	.23560661	.19705065	.16487615	.13801503	.11557998
74	.23098687	.19271458	.16085478	.13432119	.11221357
75	.22645771	.18847391	.15693149	.13072622	.10894521
76	.22201737	.18432657	.15310389	.12722747	.10577205
77	.21766408	.18027048	.14936965	.12382235	.10269131
78	.21339616	.17630365	.14572649	.12050837	.09970030
79	.20921192	.17242411	.14217218	.11728309	.09679641
80	.20510973	.16862993	.13870457	.11414412	.09397710
81	.20108797	.16491925	.13532153	.11108917	.09123990
82	.19714507	.16129022	.13202101	.10811598	.08858243
83	.19327948	.15774105	.12880098	.10522237	.08600236
84	.18948968	.15426997	.12565949	.10240620	.08349743
85	.18577420	.15087528	.12259463	.09966540	.08106547
86	.18213157	.14755528	.11960452	.09699795	.07870434
87	.17856036	.14430835	.11668733	.09440190	.07641198
88	.17505918	.14113286	.11384130	.09187533	.07418639
89	.17162665	.13802724	.11106468	.08941638	.07202562
90	.16826142	.13498997	.10835579	.08702324	.06992779
91	.16496217	.13201953	.10571296	.08469415	.06789105
92	.16172762	.12911445	.10313460	.08242740	.06591364
93	.15855649	.12627331	.10061912	.08022131	.06399383
94	.15544754	.12349468	.09816500	.07807427	.06212993
95	.15239955	.12077719	.09577073	.07598469	.06032032
96	.14941132	.11811950	.09343486	.07395104	.05856342
97	.14648169	.11552029	.09115596	.07197181	.05685769
98	.14360950	.11297828	.08893264	.07004556	.05520164
99	.14079363	.11049221	.08676355	.06817086	.05359383
100	.13803297	.10806084	.08464737	.06634634	.05203284

PRESENT VALUE $1/(1+i)^n$ (Continued)

Years	Rate i				
n	.035(3½ %)	.04(4 %)	.045(4½ %)	.05(5 %)	.055(5½ %)
1	.96618357	.96153846	.95693780	.95238095	.94786730
2	.93351070	.92455621	.91572995	.90702948	.89845242
3	.90194271	.88899636	.87629660	.86383760	.85161366
4	.87144223	.85480419	.83856134	.82270247	.80721674
5	.84197317	.82192711	.80245105	.78352617	.76513435
6	.81350064	.79031453	.76789574	.74621540	.72524583
7	.78599096	.75991781	.73482846	.71068133	.68743681
8	.75941156	.73069021	.70318513	.67683936	.65159887
9	.73373097	.70258674	.67290443	.64460892	.61762926
10	.70891881	.67556417	.64392768	.61391325	.58543058
11	.68494571	.64958093	.61619874	.58467929	.55491050
12	.66178330	.62459705	.58966386	.55683742	.52598152
13	.63940415	.60057409	.56427164	.53032135	.49856068
14	.61778179	.57747508	.53997286	.50506795	.47256937
15	.59689062	.55526450	.51672044	.48101710	.44793305
16	.57670591	.53390818	.49446932	.45811152	.42458109
17	.55720378	.51337325	.47317639	.43629669	.40244653
18	.53836114	.49362812	.45280037	.41552065	.38146590
19	.52015569	.47464242	.43330179	.39573396	.36157906
20	.50256588	.45638695	.41464286	.37688948	.34272896
21	.48557090	.43883360	.39678743	.35894236	.32486158
22	.46915063	.42195539	.37970089	.34184987	.30792567
23	.45328563	.40572633	.36335013	.32557131	.29187267
24	.43795713	.39012147	.34770347	.31006791	.27665656
25	.42314699	.37511680	.33273060	.29530277	.26223370
26	.40883767	.36068923	.31840248	.28124073	.24856275
27	.39501224	.34681657	.30469137	.26784832	.23560450
28	.38165434	.33347747	.29157069	.25509364	.22332181
29	.36874815	.32065141	.27901502	.24294632	.21167944
30	.35627841	.30831867	.26700002	.23137745	.20064402
31	.34423035	.29646026	.25550241	.22035947	.19018390
32	.33258971	.28505794	.24449991	.20986617	.18026910
33	.32134271	.27409417	.23397121	.19987254	.17087119
34	.31047605	.26355209	.22389589	.19035480	.16196321
35	.29997686	.25341547	.21425444	.18129029	.15351963
36	.28983272	.24366872	.20502817	.17265741	.14551624
37	.28003161	.23429685	.19619921	.16443563	.13793008
38	.27056194	.22528543	.18775044	.15660536	.13073941
39	.26141250	.21662061	.17966549	.14914797	.12392362
40	.25257247	.20828904	.17192870	.14204568	.11746314
41	.24403137	.20027793	.16452507	.13528160	.11133947
42	.23577910	.19257493	.15744026	.12883962	.10553504
43	.22780590	.18516820	.15066054	.12270440	.10003322
44	.22010231	.17804635	.14417276	.11686133	.09481822
45	.21265924	.17119841	.13796437	.11129651	.08987509
46	.20546787	.16461386	.13202332	.10599668	.08518965
47	.19851968	.15828256	.12633810	.10094921	.08074849
48	.19180645	.15219476	.12089771	.09614211	.07653885
49	.18532024	.14634112	.11569158	.09156391	.07254867
50	.17905337	.14071262	.11070965	.08720373	.06876652

PRESENT VALUE $1/(1 + i)^n$ (Continued)

Years	Rate i				
n	.06(6 %)	.065(6½ %)	.07(7 %)	.075(7½ %)	.08(8 %)
1	.94339623	.93896714	.93457944	.93023256	.92592593
2	.88999644	.88165928	.87343873	.86533261	.85733882
3	.83961928	.82784909	.81629788	.80496057	.79383224
4	.79209366	.77732309	.76289521	.74880053	.73502985
5	.74725817	.72988084	.71298618	.69655863	.68058320
6	.70496054	.68533412	.66634222	.64796152	.63016963
7	.66505711	.64350621	.62274974	.60275490	.58349040
8	.62741237	.60423119	.58200910	.56070223	.54026888
9	.59189846	.56735323	.54393374	.52158347	.50024897
10	.55839478	.53272604	.50834929	.48519393	.46319349
11	.52678753	.50021224	.47509280	.45134319	.42888286
12	.49696936	.46968285	.44401196	.41985413	.39711376
13	.46883902	.44101676	.41496445	.39056198	.36769792
14	.44230096	.41410025	.38781724	.36331347	.34046104
15	.41726506	.38882652	.36244602	.33796602	.31524170
16	.39364628	.36509533	.33873460	.31438699	.29189047
17	.37136442	.34281251	.31657439	.29245302	.27026895
18	.35034379	.32188969	.29586392	.27204932	.25024903
19	.33051301	.30224384	.27650832	.25306913	.23171206
20	.31180473	.28379703	.25841900	.23541315	.21454821
21	.29415540	.26647608	.24151309	.21898897	.19865575
22	.27750510	.25021228	.22571317	.20371067	.18394051
23	.26179726	.23494111	.21094688	.18949830	.17031528
24	.24697855	.22060198	.19714662	.17627749	.15769934
25	.23299863	.20713801	.18424918	.16397906	.14601790
26	.21981003	.19449579	.17219549	.15253866	.13520176
27	.20736795	.18262515	.16093037	.14189643	.12518682
28	.19563014	.17147902	.15040221	.13199668	.11591372
29	.18455674	.16101316	.14056282	.12278761	.10732752
30	.17411013	.15118607	.13136712	.11422103	.09937733
31	.16425484	.14195875	.12277301	.10625212	.09201605
32	.15495740	.13329460	.11474113	.09883918	.08520005
33	.14618622	.12515925	.10723470	.09194343	.07888893
34	.13791153	.11752042	.10021934	.08552877	.07304531
35	.13010522	.11034781	.09366294	.07956164	.06763454
36	.12274077	.10361297	.08753546	.07401083	.06262458
37	.11579318	.09728917	.08180884	.06884729	.05798572
38	.10923885	.09135134	.07645686	.06404399	.05369048
39	.10305552	.08577590	.07145501	.05957580	.04971341
40	.09722219	.08054075	.06678038	.05541935	.04603093
41	.09171905	.07562512	.06241157	.05155288	.04262123
42	.08652740	.07100950	.05832857	.04795617	.03946411
43	.08162962	.06667559	.05451268	.04461039	.03654084
44	.07700908	.06260619	.05094643	.04149804	.03383411
45	.07265007	.05878515	.04761349	.03860283	.03132788
46	.06853781	.05519733	.04449859	.03590961	.02900730
47	.06465831	.05182848	.04158747	.03340428	.02685861
48	.06099840	.04866524	.03886679	.03107375	.02486908
49	.05754566	.04569506	.03632410	.02890582	.02302693
50	.05428836	.04290616	.03394776	.02688913	.02132123

AMOUNT OF ANNUITY $[(1 + i)^n - 1]/i$

The following table gives the amount of an annuity of unit value per period after a term of n periods at rate of interest of i per period; usually indicated as ($s_{\overline{n|}}$ at i).

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
1	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
2	2.00250000	2.00416667	2.00500000	2.00583333	2.00750000
3	3.00750625	3.01251736	3.01502500	3.01753403	3.02255625
4	4.01502502	4.02506952	4.03010013	4.03513631	4.04522542
5	5.02506258	5.04184064	5.05025063	5.05867460	5.07556461
6	6.03762523	6.06284831	6.07550188	6.08818354	6.11363135
7	7.05271930	7.08811018	7.10587939	7.12369794	7.15948358
8	8.07035110	8.11764397	8.14140879	8.16525284	8.21317971
9	9.09052697	9.15146749	9.18211583	9.21288349	9.27477856
10	10.1132533	10.1895986	10.2280264	10.2666253	10.3443394
11	11.1385364	11.2320553	11.2791665	11.3265140	11.4219219
12	12.1663828	12.2788555	12.3355624	12.3925853	12.5075864
13	13.1967987	13.3300174	13.3972402	13.4648754	13.6013933
14	14.2297907	14.3855591	14.4642264	14.5434205	14.7034037
15	15.2653652	15.4454990	15.5365475	15.6282571	15.8136792
16	16.3035286	16.5098552	16.6142303	16.7194219	16.9322818
17	17.3442874	17.5786463	17.6973014	17.8169519	18.0592739
18	18.3876482	18.6518906	18.7857879	18.9208841	19.1947185
19	19.4336173	19.7296068	19.8797169	20.0312559	20.3386789
20	20.4822013	20.8118135	20.9791154	21.1481049	21.4912190
21	21.5334068	21.8985294	22.0840110	22.2714689	22.6524031
22	22.5872403	22.9897733	23.1944311	23.4013858	23.8222961
23	23.6437084	24.0855640	24.3104032	24.5378939	25.0009634
24	24.7028177	25.1859205	25.4319552	25.6810316	26.1884706
25	25.7645748	26.2908619	26.5591150	26.8308376	27.3848841
26	26.8289862	27.4004071	27.6919106	27.9873508	28.5902708
27	27.8960587	28.5145755	28.8303702	29.1506104	29.8046978
28	28.9657988	29.6333862	29.9745220	30.3206556	31.0282330
29	30.0382133	30.7568587	31.1243946	31.4975261	32.2609448
30	31.1133088	31.8850122	32.2800166	32.6812616	33.5029018
31	32.1910921	33.0178665	33.4414167	33.8719023	34.7541736
32	33.2715698	34.1554409	34.6086238	35.0694884	36.0148299
33	34.3547488	35.2977552	35.7816669	36.2740605	37.2849411
34	35.4406356	36.4448292	36.9605752	37.4856591	38.5645782
35	36.5292372	37.5966827	38.1453781	38.7043255	39.8538125
36	37.6205603	38.7533355	39.3361050	39.9301007	41.1527161
37	38.7146117	39.9148078	40.5327855	41.1630263	42.4613615
38	39.8113982	41.0811195	41.7354494	42.4031440	43.7798217
39	40.9109267	42.2522908	42.9441267	43.6504956	45.1081704
40	42.0132041	43.4283420	44.1588473	44.9051235	46.4464816
41	43.1182371	44.6092934	45.3796415	46.1670701	47.7048303
42	44.2260327	45.7951655	46.6065397	47.4363780	49.1532915
43	45.3365977	46.9859787	47.8395724	48.7130902	50.5219412
44	46.4499392	48.1817536	49.0787703	49.9972499	51.9008557
45	47.5660641	49.3825109	50.3241642	51.2889005	53.2901122
46	48.6849792	50.5882713	51.5757850	52.5880858	54.6897880
47	49.8066917	51.7990558	52.8336639	53.8948496	56.0999614
48	50.9312084	53.0148852	54.0978322	55.2092362	57.5207111
49	52.0585364	54.2357806	55.3683214	56.5312901	58.9521164
50	53.1886828	55.4617630	56.6451630	57.8610560	60.3942573

AMOUNT OF ANNUITY $[(1+i)^n - 1]/i$ (Continued)

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
50	53.1886828	55.4617630	56.6451630	57.8610560	60.3942573
51	54.3216545	56.6928537	57.9283888	59.1985788	61.8472142
52	55.4574586	57.9290739	59.2180308	60.5439038	63.3110684
53	56.5961023	59.1704450	60.5141209	61.8970766	64.7859014
54	57.7375925	60.4169886	61.8166915	63.2581429	66.2717956
55	58.8819365	61.6687260	63.1257750	64.6271487	67.7688341
56	60.0291414	62.9256790	64.4414038	66.0041404	69.2771004
57	61.1792142	64.1878694	65.7636109	67.3891646	70.7966786
58	62.3321622	65.4553188	67.0924289	68.7822680	72.3276537
59	63.4879926	66.7280493	68.4278911	70.1834979	73.8701111
60	64.6467126	68.0060828	69.7700305	71.5929017	75.4241369
61	65.8083294	69.2894415	71.1188807	73.0105269	76.9898180
62	66.9728502	70.5781475	72.4744751	74.4364217	78.5672416
63	68.1402824	71.8722231	73.8368474	75.8706341	80.1564959
64	69.3106331	73.1716907	75.2060317	77.3132128	81.7576696
65	70.4839096	74.4765728	76.5820618	78.7642066	83.3708521
66	71.6601194	75.7868918	77.9649722	80.2236644	84.9961335
67	72.8392697	77.1026706	79.3547970	81.6916358	86.6336045
68	74.0213679	78.4239317	80.7515710	83.1681703	88.2833566
69	75.2064213	79.7506981	82.1553289	84.6533180	89.9454817
70	76.3944374	81.0829926	83.5661055	86.1471290	91.6200729
71	77.5854235	82.4208384	84.9839360	87.6496539	93.3072234
72	78.7793870	83.7642586	86.4088557	89.1609436	95.0070276
73	79.9763355	85.1132763	87.8409000	90.6810491	96.7195803
74	81.1762763	86.4679150	89.2801045	92.2100219	98.4449771
75	82.3792170	87.8281980	90.7265050	93.7479137	100.183314
76	83.5851651	89.1941488	92.1801375	95.2947765	101.934689
77	84.7941280	90.5657911	93.6410382	96.8506627	103.699199
78	86.0061133	91.9431486	95.1092434	98.4156249	105.476943
79	87.2211286	93.3262450	96.5847896	99.9897160	107.268021
80	88.4391814	94.7151044	98.0677136	101.572989	109.072531
81	89.6602793	96.1097506	99.5580521	103.165498	110.890575
82	90.8844300	97.5102079	101.055842	104.767297	112.722254
83	92.1116411	98.9165005	102.561122	106.378440	114.567671
84	93.3419202	100.328653	104.073927	107.998981	116.426928
85	94.5752750	101.746689	105.594297	109.628975	118.300130
86	95.8117132	103.170633	107.122268	111.268477	120.187381
87	97.0512425	104.600511	108.657880	112.917543	122.088787
88	98.2938706	106.036346	110.201169	114.576229	124.004453
89	99.5396053	107.478164	111.752175	116.244590	125.934486
90	100.788454	108.925990	113.310936	117.922684	127.878995
91	102.040425	110.379848	114.877490	119.610566	129.838087
92	103.295526	111.839764	116.451878	121.308294	131.811873
93	104.553765	113.305763	118.034137	123.015926	133.800462
94	105.815150	114.777871	119.624308	124.733519	135.803965
95	107.079688	116.256112	121.222430	126.461131	137.822495
96	108.347387	117.740512	122.828542	128.198821	139.856164
97	109.618255	119.231098	124.442684	129.946647	141.905085
98	110.892301	120.727894	126.064898	131.704670	143.969373
99	112.169532	122.230927	127.695222	133.472947	146.049143
100	113.449956	123.740222	129.333698	135.251539	148.144512

AMOUNT OF ANNUITY $[(1 + i)^n - 1]/i$ (Continued)

Years	Rate i				
n	.01(1 %)	.01125($1\frac{1}{8}$ %)	.0125($1\frac{1}{4}$ %)	.015($1\frac{1}{2}$ %)	.0175($1\frac{3}{4}$ %)
1	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
2	2.01000000	2.01125000	2.01250000	2.01500000	2.01750000
3	3.03010000	3.03387656	3.03765625	3.04522500	3.05280625
4	4.06040100	4.06800767	4.07562695	4.09090338	4.10623036
5	5.10100501	5.11377276	5.12657229	5.15226693	5.17808938
6	6.15201506	6.17130270	6.19065444	6.22955093	6.26870596
7	7.21353521	7.24072986	7.26803762	7.32299419	7.37840831
8	8.28567056	8.32218807	8.35888809	8.43283911	8.50753045
9	9.36852727	9.41581269	9.46337420	9.55933169	9.65641224
10	10.4622125	10.5217406	10.5816664	10.7027217	10.8253995
11	11.5668347	11.6401102	11.7139372	11.8632625	12.0148439
12	12.6825030	12.7710614	12.8603614	13.0412114	13.2251037
13	13.8093280	13.9147358	14.0211159	14.2368296	14.4565430
14	14.9474213	15.0712766	15.1963799	15.4503821	15.7095325
15	16.0968955	16.2408285	16.3863346	16.6821378	16.9844494
16	17.2578645	17.4235378	17.5911638	17.9323698	18.2816772
17	18.4304431	18.6195526	18.8110534	19.2013554	19.6016066
18	19.6147476	19.8290226	20.0461915	20.4893757	20.9446347
19	20.8108950	21.0520991	21.2967689	21.7967164	22.3111658
20	22.0190040	22.2889352	22.5629785	23.1236671	23.7016112
21	23.2391940	23.5396857	23.8450158	24.4705221	25.1163894
22	24.4715860	24.8045072	25.1430785	25.8375799	26.5559262
23	25.7163018	26.0835579	26.4573670	27.2251436	28.0206549
24	26.9734649	27.3769979	27.7880840	28.6335208	29.5110164
25	28.2431995	28.6849891	29.1354351	30.0630236	31.0274592
26	29.5256315	30.0076953	30.4996280	31.5139690	32.5704397
27	30.8208878	31.3452818	31.8808734	32.9866785	34.1404224
28	32.1290967	32.6979163	33.2793843	34.4814787	35.7378798
29	33.4503877	34.0657678	34.6953766	35.9987009	37.3632927
30	34.7848915	35.4490077	36.1290688	37.5386814	39.0171503
31	36.1327405	36.8478090	37.5806822	39.1017616	40.6999504
32	37.4940679	38.2623469	39.0504407	40.6882880	42.4121996
33	38.8690085	39.6927983	40.5385712	42.2986123	44.1544131
34	40.2576986	41.1393423	42.0453033	43.9330915	45.9271153
35	41.6602756	42.6021599	43.5708696	45.5920879	47.7308398
36	43.0768784	44.0814342	45.1155055	47.2759692	49.5661295
37	44.5076471	45.5773503	46.6794493	48.9851087	51.4335368
38	45.9527236	47.0900955	48.2629424	50.7198854	53.3336237
39	47.4122509	48.6198591	49.8662292	52.4806837	55.2669621
40	48.8863734	50.1668325	51.4895571	54.2678939	57.2341339
41	50.3752371	51.7312093	53.1331765	56.0819123	59.2357312
42	51.8789895	53.3131855	54.7973413	57.9231410	61.2723565
43	53.3977794	54.9129588	56.4823080	59.7919881	63.3446228
44	54.9317572	56.5307296	58.1883369	61.6888679	65.4531537
45	56.4810747	58.1667003	59.9156911	63.6142010	67.5985839
46	58.0458855	59.8210757	61.6646372	65.5684140	69.7815591
47	59.6263443	61.4940628	63.4354452	67.5519402	72.0027364
48	61.2226078	63.1858710	65.2283882	69.5652193	74.2627843
49	62.8348339	64.8967120	67.0437431	71.6086976	76.5623830
50	64.4631822	66.6268000	68.8817899	73.6828280	78.9022247

AMOUNT OF ANNUITY $[(1 + i)^n - 1]/i$ (Continued)

Years	Rate i				
n	.01(1 %)	.01125($1\frac{1}{8}$ %)	.0125($1\frac{1}{4}$ %)	.015($1\frac{1}{2}$ %)	.0175($1\frac{3}{4}$ %)
50	64.4631822	66.6268000	68.8817899	73.6828280	78.9022247
51	66.1078140	68.3763515	70.7428123	75.7880705	81.2830136
52	67.7688922	70.1455855	72.6270974	77.9248915	83.7054664
53	69.4465811	71.9347233	74.5349361	80.0937649	86.1703120
54	71.1410469	73.7439890	76.4666228	82.2951714	88.6782925
55	72.8524574	75.5736088	78.4224556	84.5295989	91.2301626
56	74.5809819	77.4238119	80.4027363	86.7975429	93.8266904
57	76.3267917	79.2948298	82.4077705	89.0995061	96.4686575
58	78.0900597	81.1868967	84.4378677	91.4359987	99.1568590
59	79.8709603	83.1002492	86.4933410	93.8075386	101.892104
60	81.6696699	85.0351270	88.5745078	96.2146517	104.675216
61	83.4863666	86.9917722	90.6816891	98.6578715	107.507032
62	85.3212302	88.9704297	92.8152102	101.137740	110.388405
63	87.1744425	90.9713470	94.9754003	103.654806	113.320202
64	89.0461870	92.9947746	97.1625929	106.209628	116.303306
65	90.9366488	95.0409659	99.3771253	108.802772	119.338614
66	92.8460153	97.1101767	101.619339	111.434814	122.427039
67	94.7744755	99.2026662	103.889581	114.106336	125.569513
68	96.7222202	101.318696	106.188201	116.817931	128.766979
69	98.6894424	103.458532	108.515553	119.570200	132.020401
70	100.676337	105.622440	110.871998	122.363753	135.330758
71	102.683100	107.810692	113.257898	125.199209	138.699047
72	104.709931	110.023563	115.673621	128.077197	142.126280
73	106.757031	112.261328	118.119542	130.998355	145.613490
74	108.824601	114.524268	120.596036	133.963331	149.161726
75	110.912847	116.812666	123.103486	136.972781	152.772056
76	113.021975	119.126808	125.642280	140.027372	156.445567
77	115.152195	121.466985	128.212809	143.127783	160.183364
78	117.303717	123.833488	130.815469	146.274700	163.986573
79	119.476754	126.226615	133.450662	149.468820	167.856338
80	121.671522	128.646665	136.118795	152.710852	171.793824
81	123.888237	131.093940	138.820280	156.001515	175.800216
82	126.127119	133.568746	141.555534	159.341538	179.876720
83	128.388391	136.071395	144.324978	162.731661	184.024563
84	130.672274	138.602198	147.129040	166.172636	188.244992
85	132.978997	141.161473	149.968153	169.665226	192.539280
86	135.308787	143.749539	152.842755	173.210204	196.908717
87	137.661875	146.366722	155.753289	176.808357	201.354620
88	140.038494	149.013347	158.700206	180.460482	205.878326
89	142.438879	151.689747	161.683958	184.167390	210.481196
90	144.863267	154.396257	164.705008	187.929900	215.164617
91	147.311900	157.133215	167.763820	191.748849	219.929998
92	149.785019	159.900964	170.860868	195.625082	224.778773
93	152.282869	162.699849	173.996629	199.559458	229.712401
94	154.805698	165.530223	177.171587	203.552850	234.732369
95	157.353755	168.392438	180.386232	207.606142	239.840185
96	159.927293	171.286853	183.641059	211.720235	245.037388
97	162.526565	174.213830	186.936573	215.896038	250.325542
98	165.151831	177.173735	190.273280	220.134479	255.706239
99	167.803349	180.166940	193.651696	224.436496	261.181099
100	170.481383	183.193818	197.072342	228.803043	266.751768

AMOUNT OF ANNUITY $[(1 + i)^n - 1]/i$ (Continued)

Years	Rate i				
n	.02(2 %)	.0225(2¼ %)	.025(2½ %)	.0275(2¾ %)	.03(3 %)
1	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
2	2.02000000	2.02250000	2.02500000	2.02750000	2.03000000
3	3.06040000	3.06800625	3.07562500	3.08325625	3.09090000
4	4.12160800	4.13703639	4.15251563	4.16804580	4.18362700
5	5.20404016	5.23011971	5.25632852	5.28266706	5.30913581
6	6.30812096	6.34779740	6.38773673	6.42794040	6.46840988
7	7.43428338	7.49062284	7.54743015	7.60470876	7.66246218
8	8.58296905	8.65916186	8.73611590	8.81383825	8.89233605
9	9.75462843	9.85399300	9.95451880	10.0562188	10.1591061
10	10.9497210	11.0757078	11.2033818	11.3327648	11.4638793
11	12.1687154	12.3249113	12.4834663	12.6444159	12.8077957
12	13.4120897	13.6022218	13.7955530	13.9921373	14.1920296
13	14.6803315	14.9082718	15.1404418	15.3769211	15.6177905
14	15.9739382	16.2437079	16.5189528	16.7997864	17.0863242
15	17.2934169	17.6091913	17.9319267	18.2617805	18.5989139
16	18.6392853	19.0053981	19.3802248	19.7639795	20.1568813
17	20.0120710	20.4330196	20.8647305	21.3074889	21.7615877
18	21.4123124	21.8927625	22.3863487	22.8934449	23.4144354
19	22.8405586	23.3853497	23.9460074	24.5230146	25.1168684
20	24.2973698	24.9115200	25.5446576	26.1973975	26.8703745
21	25.7833172	26.4720292	27.1832741	27.9178259	28.6764857
22	27.2989835	28.0676499	28.8628559	29.6855662	30.5367803
23	28.8449632	29.6991720	30.5844273	31.5019192	32.4528837
24	30.4218625	31.3674034	32.3490380	33.3682220	34.4264702
25	32.0302997	33.0731700	34.1577639	35.2858481	36.4592643
26	33.6709057	34.8173163	36.0117080	37.2562089	38.5530423
27	35.3443238	36.6007059	37.9120007	39.2807547	40.7096335
28	37.0512103	38.4242218	39.8598008	41.3609754	42.9309225
29	38.7922345	40.2887668	41.8562958	43.4984022	45.2188502
30	40.5680792	42.1952640	43.9027032	45.6946083	47.5754157
31	42.3794408	44.1446575	46.0002707	47.9512100	50.0026782
32	44.2270296	46.1379123	48.1502775	50.2698683	52.5027585
33	46.1115702	48.1760153	50.3540345	52.6522897	55.0778413
34	48.0338016	50.2599756	52.6128853	55.1002277	57.7301765
35	49.9944776	52.3908251	54.9282074	57.6154839	60.4620818
36	51.9943672	54.5696186	57.3014126	60.1999097	63.2759443
37	54.0342545	56.7974351	59.7339479	62.8554072	66.1742226
38	56.1149396	59.0753774	62.2272966	65.5839309	69.1594493
39	58.2372384	61.4045733	64.7829791	68.3874890	72.2342328
40	60.4019832	63.7861762	67.4025535	71.2681450	75.4012597
41	62.6100228	66.2213652	70.0876174	74.2280190	78.6632975
42	64.8622233	68.7113459	72.8398078	77.2692895	82.0231965
43	67.1594678	71.2573512	75.6608030	80.3941950	85.4838923
44	69.5026571	73.8606416	78.5523231	83.6050353	89.0484091
45	71.8927103	76.5225061	81.5161312	86.9041738	92.7198614
46	74.3305645	79.2442624	84.5540344	90.2940386	96.5014572
47	76.8171758	82.0272583	87.6678853	93.7771246	100.396501
48	79.3535193	84.8728717	90.8595824	97.3559956	104.408396
49	81.9405897	87.7825113	94.1310720	101.033285	108.540648
50	84.5794015	90.7576178	97.4843488	104.811701	112.796867

AMOUNT OF ANNUITY $[(1+i)^n - 1]/i$ (Continued)

Years n	Rate i .02(2 %)	.0225($2\frac{1}{4}$ %)	.025($2\frac{1}{2}$ %)	.0275($2\frac{3}{4}$ %)	.03(3 %)
50	84.5794015	90.7576178	97.4843488	104.811701	112.796867
51	87.2709895	93.7996642	100.921458	108.694023	117.180773
52	90.0164093	96.9101566	104.444494	112.683108	121.696197
53	92.8167375	100.090635	108.055606	116.781894	126.347082
54	95.6730722	103.342674	111.756996	120.993396	131.137495
55	98.5865337	106.667885	115.550921	125.320714	136.071620
56	101.558264	110.067912	119.439694	129.767034	141.153768
57	104.589430	113.544440	123.425687	134.335627	146.388381
58	107.681218	117.099190	127.511329	139.029857	151.780033
59	110.834843	120.733922	131.699112	143.853178	157.333434
60	114.051539	124.450435	135.991590	148.809140	163.053437
61	117.332570	128.250570	140.391380	153.901392	168.945040
62	120.679222	132.136208	144.901164	159.133680	175.013391
63	124.092806	136.109272	149.523693	164.509856	181.263793
64	127.574662	140.171731	154.261786	170.033877	187.701707
65	131.126155	144.325595	159.118330	175.709809	194.332758
66	134.748679	148.572921	164.096289	181.541829	201.162741
67	138.443652	152.915811	169.198696	187.534229	208.197623
68	142.212525	157.356417	174.428663	193.691420	215.443551
69	146.056776	161.896937	179.789380	200.017934	222.906858
70	149.977911	166.539618	185.284114	206.518427	230.594064
71	153.977469	171.286759	190.916217	213.197684	238.511886
72	158.057019	176.140711	196.689122	220.060621	246.667242
73	162.218159	181.103877	202.606351	227.112288	255.067259
74	166.462522	186.178714	208.671509	234.357876	263.719277
75	170.791773	191.367735	214.888297	241.802717	272.630856
76	175.207608	196.673509	221.260504	249.452292	281.809781
77	179.711760	202.098663	227.792017	257.312230	291.264075
78	184.305996	207.645883	234.486818	265.388316	301.001997
79	188.992115	213.317916	241.348988	273.686495	311.032057
80	193.771958	219.117569	248.382713	282.212873	321.363019
81	198.647397	225.047714	255.592280	290.973727	332.003909
82	203.620345	231.111288	262.982087	299.975505	342.964026
83	208.692752	237.311292	270.556640	309.224831	354.252947
84	213.866607	243.650796	278.320556	318.728514	365.880536
85	219.143939	250.132939	286.278570	328.493548	377.856952
86	224.526818	256.760930	294.435534	338.527121	390.192660
87	230.017354	263.538051	302.796422	348.836617	402.898440
88	235.617701	270.467657	311.366333	359.429624	415.985393
89	241.330055	277.553179	320.150491	370.313938	429.464955
90	247.156656	284.798126	329.154253	381.497572	443.348904
91	253.099789	292.206083	338.383110	392.988755	457.649371
92	259.161785	299.780720	347.842687	404.795946	472.378852
93	265.345021	307.525786	357.538755	416.927834	487.550217
94	271.651921	315.445117	367.477223	429.393350	503.176724
95	278.084960	323.542632	377.664154	442.201667	519.272026
96	284.646659	331.822341	388.105758	455.362213	535.850186
97	291.339592	340.288344	398.808402	468.884673	552.925692
98	298.166384	348.944831	409.778612	482.779002	570.513463
99	305.129712	357.796090	421.023077	497.055424	588.628867
100	312.232306	366.846502	432.548654	511.724449	607.287733

AMOUNT OF ANNUITY $[(1 + i)^n - 1]/i$ (Continued)

Years	Rate i				
n	.035(3½ %)	.04(4 %)	.045(4½ %)	05(5 %)	.055(5½ %)
1	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
2	2.03500000	2.04000000	2.04500000	2.05000000	2.05500000
3	3.10622500	3.12160000	3.13702500	3.15250000	3.16802500
4	4.21494288	4.24646400	4.27819113	4.31012500	4.34226638
5	5.36246588	5.41632256	5.47070973	5.52563125	5.58109103
6	6.55015218	6.63297546	6.71689166	6.80191281	6.88805103
7	7.77940751	7.89829448	8.01915179	8.14200845	8.26689384
8	9.05168677	9.21422626	9.38001362	9.54910888	9.72157300
9	10.3684958	10.5827953	10.8021142	11.0265643	11.2562595
10	11.7313932	12.0061071	12.2882094	12.5778925	12.8753538
11	13.1419919	13.4863514	13.8411788	14.2067872	14.5834983
12	14.6019616	15.0258055	15.4640318	15.9171265	16.3855907
13	16.1130303	16.6268377	17.1599133	17.7129829	18.2867981
14	17.6769864	18.2919112	18.9321094	19.5986320	20.2925720
15	19.2956809	20.0235876	20.7840543	21.5785636	22.4086635
16	20.9710297	21.8245311	22.7193367	23.6574918	24.6411400
17	22.7050158	23.6975124	24.7417069	25.8403664	26.9964027
18	24.4996913	25.6454129	26.8550837	28.1323847	29.4812048
19	26.3571805	27.6712294	29.0635625	30.5390039	32.1026711
20	28.2796818	29.7780786	31.3714228	33.0659541	34.8683180
21	30.2694707	31.9692017	33.7831368	35.7192518	37.7860755
22	32.3289022	34.2479698	36.3033780	38.5052144	40.8643097
23	34.4604137	36.6178886	38.9370300	41.4304751	44.1118467
24	36.6665282	39.0826041	41.6891963	44.5019989	47.5379983
25	38.9498567	41.6459083	44.5652102	47.7270988	51.1525882
26	41.3131017	44.3117446	47.5706446	51.1134538	54.9659805
27	43.7590602	47.0842144	50.7113236	54.6691265	58.9891094
28	46.2906273	49.9675830	53.9933332	58.4025828	63.2335105
29	48.9107993	52.9662863	57.4230332	62.3227119	67.7113535
30	51.6226773	56.0849378	61.0070697	66.4388475	72.4354780
31	54.4294710	59.3283353	64.7523878	70.7607899	77.4194293
32	57.3345025	62.7014687	68.6662452	75.2988294	82.6774979
33	60.3412101	66.2095274	72.7562263	80.0637708	88.2247603
34	63.4531524	69.8579085	77.0302565	85.0669594	94.0771221
35	66.6740127	73.6522249	81.4966180	90.3203074	100.251364
36	70.0076032	77.5983139	86.1639658	95.8363227	106.765189
37	73.4578693	81.7022464	91.0413443	101.628139	113.637274
38	77.0288947	85.9703363	96.1382048	107.709546	120.887324
39	80.7249060	90.4091497	101.464424	114.095023	128.536127
40	84.5502778	95.0255157	107.030323	120.799774	136.605614
41	88.5095375	99.8265363	112.846688	127.839763	145.118923
42	92.6073713	104.819598	118.924789	135.231751	154.100464
43	96.8486293	110.012382	125.276404	142.993339	163.575989
44	101.238331	115.412877	131.913842	151.143006	173.572669
45	105.781673	121.029392	138.849965	159.700156	184.119165
46	110.484031	126.870568	146.098214	168.685164	195.245719
47	115.350973	132.945390	153.672633	178.119422	206.984234
48	120.388257	139.263206	161.587902	188.025393	219.368367
49	125.601846	145.833734	169.859357	198.426663	232.433627
50	130.997910	152.667084	178.503028	209.347996	246.217476

AMOUNT OF ANNUITY $[(1 + i)^n - 1]/i$ (Continued)

Years	Rate i				
n	.06(6 %)	.065($6\frac{1}{2}$ %)	.07(7 %)	.075($7\frac{1}{2}$ %)	.08(8 %)
1	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
2	2.06000000	2.06500000	2.07000000	2.07500000	2.08000000
3	3.18360000	3.19922500	3.21490000	3.23062500	3.24640000
4	4.37461600	4.40717463	4.43994300	4.47292188	4.50611200
5	5.63709296	5.69364098	5.75073901	5.80839102	5.86660096
6	6.97531854	7.06372764	7.15329074	7.24402034	7.33592904
7	8.39383765	8.52286994	8.65402109	8.78732187	8.92280336
8	9.89746791	10.0768565	10.2598026	10.4463710	10.6366276
9	11.4913160	11.7318522	11.9779888	12.2298488	12.4875578
10	13.1807949	13.4944225	13.8164480	14.1470875	14.4865625
11	14.9716426	15.3715600	15.7835993	16.2081191	16.6454875
12	16.8699412	17.3707114	17.8884513	18.4237280	18.9771265
13	18.8821377	19.4998077	20.1406429	20.8055076	21.4952966
14	21.0150659	21.7672952	22.5504879	23.3659207	24.2149203
15	23.2759699	24.1821693	25.1290220	26.1183647	27.1521139
16	25.6725281	26.7540103	27.8880536	29.0772421	30.3242830
17	28.2128798	29.4930210	30.8402173	32.2580352	33.7502257
18	30.9056526	32.4100674	33.9990325	35.6773879	37.4502437
19	33.7599917	35.5167218	37.3789648	39.3531919	41.4462632
20	36.7855912	38.8253087	40.9954923	43.3046813	45.7619643
21	39.9927267	42.3489537	44.8651768	47.5525324	50.4229214
22	43.3922903	46.1016357	49.0057392	52.1189724	55.4567552
23	46.9958277	50.0982421	53.4361409	57.0278953	60.8932956
24	50.8155774	54.3546278	58.1766708	62.3049874	66.7647592
25	54.8645120	58.8876786	63.2490377	67.9778615	73.1059400
26	59.1563827	63.7153777	68.6764704	74.0762011	79.9544152
27	63.7057657	68.8568773	74.4838233	80.6319162	87.3507684
28	68.5281116	74.3325743	80.6976909	87.6793099	95.3388298
29	73.6397983	80.1641916	87.3465293	95.2552582	103.965936
30	79.0581862	86.3748641	94.4607863	103.399403	113.283211
31	84.8016774	92.9892302	102.073041	112.154358	123.345868
32	90.8897780	100.033530	110.218154	121.565935	134.213537
33	97.3431647	107.535710	118.933425	131.683380	145.950620
34	104.183755	115.525531	128.258765	142.559633	158.626670
35	111.434780	124.034690	138.236878	154.251606	172.316804
36	119.120867	133.096945	148.913460	166.820476	187.102148
37	127.268119	142.748247	160.337402	180.332012	203.070320
38	135.904206	153.026883	172.561020	194.856913	220.315945
39	145.058458	163.973630	185.640292	210.471181	238.941221
40	154.761966	175.631916	199.635112	227.256520	259.056519
41	165.047684	188.047990	214.609570	245.300759	280.781040
42	175.950545	201.271110	230.632240	264.698315	304.243523
43	187.507577	215.353732	247.776497	285.550689	329.583005
44	199.758032	230.351725	266.120851	307.966991	356.949646
45	212.743514	246.324587	285.749311	332.064515	386.505617
46	226.508125	263.335685	306.751763	357.969354	418.426067
47	241.098612	281.452504	329.224386	385.817055	452.900152
48	256.564529	300.746917	353.270093	415.753334	490.132164
49	272.958401	321.295467	378.999000	447.934835	530.342737
50	290.335905	343.179672	406.528929	482.529947	573.770156

PRESENT VALUE OF ANNUITY $[1 - (1 + i)^{-n}]/i$

The following table gives the present value of an annuity of unit value per period for a term of n periods at rate of interest i per period; usually indicated as $a_{\overline{n|}}$ at i.

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
1	0.99750623	0.99585062	0.99502488	0.99420050	0.99255583
2	1.99252492	1.98756908	1.98509938	1.98263513	1.97772291
3	2.98506227	2.97517253	2.97024814	2.96533733	2.95555624
4	3.97512446	3.95867804	3.95049566	3.94234034	3.92611041
5	4.96271766	4.93810261	4.92586633	4.91367723	4.88943961
6	5.94784804	5.91346318	5.89638441	5.87938084	5.84559763
7	6.93052174	6.88477661	6.86207404	6.83948385	6.79463785
8	7.91074487	7.85205969	7.82295924	7.79401875	7.73661325
9	8.88852357	8.81532915	8.77906392	8.74301781	8.67157642
10	9.86386391	9.77460164	9.73041186	9.68651315	9.59957958
11	10.8367720	10.7298937	10.6770267	10.6245367	10.5206745
12	11.8072538	11.6812220	11.6189321	11.5571202	11.4349127
13	12.7753156	12.6286028	12.5561513	12.4842951	12.3423451
14	13.7409631	13.5720526	13.4887078	13.4060929	13.2430224
15	14.7042026	14.5115876	14.4166247	14.3225447	14.1369950
16	15.6650400	15.4472242	15.3399250	15.2336816	15.0243126
17	16.6234813	16.3789784	16.2586319	16.1395343	15.9050249
18	17.5795325	17.3068665	17.1727680	17.0401335	16.7791811
19	18.5331995	18.2309044	18.0823562	17.9355097	17.6468298
20	19.4844883	19.1511081	18.9874192	18.8256932	18.5080197
21	20.4324048	20.0674935	19.8879793	19.7107140	19.3627987
22	21.3799549	20.9800765	20.7840590	20.5906022	20.2112146
23	22.3241445	21.8888729	21.6756806	21.4653875	21.0533147
24	23.2659796	22.7938983	22.5628662	22.3350994	21.8891461
25	24.2054659	23.6951684	23.4456380	23.1997674	22.7187555
26	25.1426094	24.5926988	24.3240179	24.0594208	23.5421891
27	26.0774159	25.4865051	25.1980278	24.9140886	24.3594929
28	27.0098911	26.3766025	26.0676894	25.7637998	25.1707125
29	27.9400410	27.2630067	26.9330242	26.6085831	25.9758933
30	28.8678713	28.1457328	27.7940540	27.4484670	26.7750802
31	29.7933879	29.0247961	28.6508000	28.2834801	27.5683178
32	30.7165964	29.9002119	29.5032836	29.1136504	28.3556505
33	31.6375026	30.7719952	30.3515259	29.9390063	29.1371220
34	32.5561123	31.6401612	31.1955482	30.7595754	29.9127762
35	33.4724313	32.5047249	32.0353713	31.5753857	30.6826563
36	34.3864651	33.3657011	32.8710162	32.3864646	31.4468053
37	35.2982196	34.2231048	33.7025037	33.1928397	32.2052658
38	36.2077003	35.0769508	34.5298545	33.9945383	32.9580802
39	37.1149130	35.9272539	35.3530890	34.7915874	33.7052905
40	38.0198634	36.7740288	36.1722279	35.5840140	34.4469384
41	38.9225570	37.6172901	36.9872914	36.3718449	35.1830655
42	39.8229995	38.4570524	37.7982999	37.1551068	35.9137126
43	40.7211965	39.2933301	38.6052735	37.9338261	36.6389207
44	41.6171536	40.1261379	39.4082324	38.7080293	37.3587302
45	42.5108764	40.9554900	40.2071964	39.4777425	38.0731814
46	43.4023705	41.7814008	41.0021855	40.2429917	38.7823140
47	44.2916414	42.6038846	41.7932194	41.0038029	39.4861677
48	45.1786946	43.4229556	42.5803178	41.7602017	40.1847819
49	46.0635358	44.2386280	43.3635003	42.5122138	40.8781954
50	46.9461704	45.0509158	44.1427864	43.2598646	41.5664471

PRESENT VALUE OF ANNUITY $[1 - (1 + i)^{-n}]/i$
(Continued)

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
50	46.9461704	45.0509158	44.1427864	43.2598646	41.5664471
51	47.8266039	45.8598332	44.9181954	44.0031794	42.2495753
52	48.7048418	46.6653940	45.6897466	44.7421834	42.9276181
53	49.5808895	47.4676123	46.4574593	45.4769014	43.6006135
54	50.4547527	48.2665018	47.2213526	46.2073585	44.2685990
55	51.3264366	49.0620765	47.9814454	46.9335793	44.9316119
56	52.1959467	49.8543500	48.7377566	47.6555884	45.5896893
57	53.0632885	50.6433361	49.4903051	48.3734102	46.2428678
58	53.9284673	51.4290484	50.2391095	49.0870690	46.8911839
59	54.7914886	52.2115005	50.9841886	49.7965889	47.5346738
60	55.6523577	52.9907058	51.7255608	50.5019939	48.1733735
61	56.5110800	53.7666780	52.4632445	51.2033080	48.8073186
62	57.3676608	54.5394304	53.1972582	51.9005548	49.4365446
63	58.2221056	55.3089763	53.9276201	52.5937579	50.0610864
64	59.0744195	56.0753291	54.6543484	53.2829407	50.6809791
65	59.9246080	56.8385019	55.3774611	53.9681267	51.2962571
66	60.7726763	57.5985081	56.0969762	54.6493389	51.9069550
67	61.6186297	58.3553608	56.8129117	55.3266004	52.5131067
68	62.4624736	59.1090730	57.5252852	55.9999341	53.1147461
69	63.3042130	59.8596577	58.2341147	56.6693629	53.7119068
70	64.1438534	60.6071280	58.9394176	57.3349093	54.3046221
71	64.9813999	61.3514967	59.6412115	57.9965958	54.8929252
72	65.8168577	62.0927768	60.3395139	58.6544449	55.4768488
73	66.6502322	62.8309810	61.0343422	59.3084788	56.0564256
74	67.4815283	63.5661222	61.7257137	59.9587196	56.6316880
75	68.3107515	64.2982129	62.4136454	60.6051893	57.2026679
76	69.1379067	65.0272660	63.0981547	61.2479099	57.7693975
77	69.9629992	65.7532939	63.7792584	61.8869030	58.3319082
78	70.7860341	66.4763092	64.4569735	62.5221902	58.8902314
79	71.6070166	67.1963245	65.1313169	63.1537931	59.4443984
80	72.4259517	67.9133522	65.8023054	63.7817330	59.9944401
81	73.2428446	68.6274047	66.4699556	64.4060312	60.5403872
82	74.0577003	69.3384943	67.1342842	65.0267087	61.0822702
83	74.8705240	70.0466333	67.7953077	65.6437867	61.6201193
84	75.6813207	70.7518339	68.4530424	66.2572859	62.1539646
85	76.4900955	71.4541085	69.1075040	66.8672271	62.6838358
86	77.2968534	72.1534690	69.7587114	67.4736309	63.2097626
87	78.1015994	72.8499276	70.4066780	68.0765179	63.7317743
88	78.9043385	73.5434963	71.0514209	68.6759085	64.2499000
89	79.7050758	74.2341872	71.6929561	69.2718228	64.7641688
90	80.5038163	74.9220121	72.3312996	69.8642812	65.2746092
91	81.3005649	75.6069830	72.9664673	70.4533036	65.7812498
92	82.0953265	76.2891117	73.5984749	71.0389100	66.2841189
93	82.8881063	76.9684100	74.2273382	71.6211202	66.7832446
94	83.6789090	77.6448896	74.8530728	72.1999538	67.2786547
95	84.4677397	78.3185622	75.4756943	72.7754305	67.7703769
96	85.2546032	78.9894395	76.0952183	73.3475697	68.2584386
97	86.0395044	79.6575331	76.7116600	73.9163908	68.7428671
98	86.8224483	80.3228545	77.3250348	74.4819129	69.2236894
99	87.6034397	80.9854152	77.9353580	75.0441554	69.7009324
100	88.3824835	81.6452268	78.5426448	75.6031371	70.1746227

PRESENT VALUE OF ANNUITY $[1 - (1 + i)^{-n}]/i$ (Continued)

Years	Rate i				
n	.01(1 %)	.01125($1\frac{1}{8}$ %)	.0125($1\frac{1}{4}$ %)	.015($1\frac{1}{2}$ %)	.0175($1\frac{3}{4}$ %)
1	0.99009901	0.98887515	0.98765432	0.98522167	0.98280098
2	1.97039506	1.96674923	1.96311538	1.95588342	1.94869875
3	2.94098521	2.93374460	2.92653371	2.91220042	2.89798403
4	3.90196555	3.88998230	3.87805798	3.85438465	3.83094254
5	4.85343124	4.83558200	4.81783504	4.78264497	4.74785508
6	5.79547647	5.77066205	5.74600992	5.69718717	5.64899762
7	6.72819453	6.69533948	6.66272585	6.59821396	6.53464139
8	7.65167775	7.60973002	7.56812429	7.48592508	7.40505297
9	8.56601758	8.51394810	8.46234498	8.36051732	8.26049432
10	9.47130453	9.40810690	9.34552591	9.22218455	9.10122291
11	10.3676283	10.2923183	10.2178034	10.0711178	9.92749181
12	11.2550775	11.1666930	11.0793120	10.9075052	10.7395497
13	12.1337401	12.0313404	11.9301847	11.7315322	11.5376410
14	13.0037030	12.8863688	12.7705528	12.5433815	12.3220059
15	13.8650525	13.7318851	13.6005459	13.3432330	13.0928805
16	14.7178738	14.5679951	14.4202923	14.1312641	13.8504968
17	15.5622513	15.3948036	15.2299183	14.9076493	14.5950828
18	16.3982686	16.2124140	16.0295489	15.6725609	15.3268627
19	17.2260085	17.0209285	16.8193076	16.4261684	16.0460567
20	18.0455530	17.8204485	17.5993161	17.1686388	16.7528813
21	18.8569831	18.6110739	18.3696950	17.9001367	17.4475492
22	19.6603793	19.3929037	19.1305629	18.6208244	18.1302695
23	20.4558211	20.1660358	19.8820374	19.3308615	18.8012476
24	21.2433873	20.9305669	20.6242345	20.0304054	19.4606857
25	22.0231557	21.6865928	21.3572687	20.7196112	20.1087820
26	22.7952037	22.4342079	22.0812530	21.3986317	20.7457317
27	23.5596076	23.1735060	22.7962993	22.0676175	21.3717264
28	24.3164432	23.9045795	23.5025178	22.7267167	21.9869547
29	25.0657853	24.6275199	24.2000176	23.3760756	22.5916017
30	25.8077082	25.3424177	24.8889062	24.0158380	23.1858493
31	26.5422854	26.0493623	25.5692901	24.6461458	23.7698765
32	27.2695895	26.7484424	26.2412742	25.2671387	24.3438590
33	27.9896926	27.4397452	26.9049622	25.8789544	24.9079695
34	28.7026659	28.1233575	27.5604564	26.4817285	25.4623779
35	29.4085801	28.7993646	28.2078582	27.0755946	26.0072510
36	30.1075050	29.4678513	28.8472674	27.6606843	26.5427528
37	30.7995099	30.1289011	29.4787826	28.2371274	27.0690446
38	31.4846633	30.7825969	30.1025013	28.8050516	27.5862846
39	32.1630330	31.4290204	30.7185198	29.3645829	28.0946286
40	32.8346861	32.0682526	31.3269332	29.9158452	28.5942296
41	33.4996892	32.7903734	31.9278352	30.4589608	29.0852379
42	34.1581081	33.3254620	32.5213187	30.9940500	29.5678014
43	34.8100081	33.9435965	33.1074753	31.5212316	30.0420652
44	35.4554535	34.5548544	33.6863954	32.0406222	30.5081722
45	36.0945084	35.1593121	34.2581683	32.5523372	30.9662626
46	36.7272361	35.7570454	34.8228822	33.0564898	31.4164743
47	37.3536991	36.3481289	35.3806244	33.5531920	31.8589428
48	37.9739595	36.9326367	35.9314809	34.0425537	32.2938013
49	38.5880787	37.5106420	36.4755367	34.5246834	32.7211806
50	39.1961175	38.0822171	37.0128757	34.9996881	33.1412095

PRESENT VALUE OF ANNUITY $[1 - (1 + i)^{-n}]/i$
(Continued)

Years n	Rate i: .01(1 %)	.01125(1⅛ %)	.0125(1¼ %)	.015(1½ %)	.0175(1¾ %)
50	39.1961175	38.0822171	37.0128757	34.9996881	33.1412095
51	39.7981362	38.6474335	37.5435810	35.4676730	33.5540142
52	40.3941942	39.2063619	38.0677343	35.9287419	33.9597191
53	40.9843507	39.7590723	38.5854166	36.3829969	34.3584463
54	41.5686641	40.3056339	39.0967078	36.8305388	34.7503158
55	42.1471922	40.8461151	39.6016867	37.2714668	35.1354455
56	42.7199922	41.3805836	40.1004313	37.7058786	35.5139514
57	43.2871210	41.9091061	40.5930186	38.1338706	35.8859473
58	43.8486347	42.4317490	41.0795245	38.5555375	36.2515452
59	44.4045888	42.9485775	41.5600242	38.9709729	36.6108553
60	44.9550384	43.4596563	42.0345918	39.3802689	36.9639855
61	45.5000380	43.9650495	42.5033005	39.7835161	37.3110423
62	46.0396416	44.4648203	42.9662228	40.1808041	37.6521300
63	46.5739026	44.9590312	43.4234299	40.5722208	37.9873514
64	47.1028739	45.4477441	43.8749925	40.9578530	38.3168072
65	47.6266078	45.9310201	44.3209802	41.3377862	38.6405968
66	48.1451562	46.4089198	44.7614620	41.7121046	38.9588175
67	48.6585705	46.8815028	45.1965056	42.0808913	39.2715651
68	49.1669015	47.3488285	45.6261784	42.4442278	39.5789338
69	49.6701995	47.8109553	46.0505466	42.8021949	39.8810160
70	50.1685144	48.2679409	46.4696756	43.1548718	40.1779027
71	50.6618954	48.7198427	46.8836302	43.5023368	40.4696832
72	51.1503915	49.1667171	47.2924743	43.8446668	40.7564454
73	51.6340510	49.6086202	47.6962709	44.1819377	41.0382756
74	52.1129218	50.0456071	48.0950824	44.5142243	41.3152586
75	52.5870512	50.4777326	48.4889703	44.8416003	41.5874777
76	53.0564864	50.9050508	48.8779953	45.1641383	41.8550150
77	53.5212736	51.3276151	49.2622176	45.4819096	42.1179508
78	53.9814591	51.7454785	49.6416964	45.7949849	42.3763644
79	54.4370882	52.1586932	50.0164903	46.1034334	42.6303336
80	54.8882061	52.5673109	50.3866571	46.4073235	42.8799347
81	55.3348575	52.9713829	50.7522539	46.7067227	43.1252430
82	55.7770867	53.3709596	51.1133372	47.0016972	43.3663322
83	56.2149373	53.7660910	51.4699626	47.2923125	43.6032749
84	56.6484528	54.1568267	51.8221853	47.5786330	43.8361424
85	57.0776760	54.5432156	52.1700596	47.8607222	44.0650048
86	57.5026495	54.9253059	52.5136391	48.1386425	44.2899310
87	57.9234154	55.3031455	52.8529769	48.4124557	44.5109887
88	58.3400152	55.6767817	53.1881253	48.6822224	44.7282444
89	58.7524903	56.0462613	53.5191361	48.9480023	44.9417636
90	59.1608815	56.4116304	53.8460604	49.2098545	45.1516104
91	59.5652292	56.7729349	54.1689485	49.4678370	45.3578480
92	59.9655735	57.1302199	54.4878504	49.7220069	45.5605386
93	60.3619539	57.4835302	54.8028152	49.9724206	45.7597431
94	60.7544098	57.8329100	55.1138915	50.2191336	45.9555215
95	61.1429800	58.1784029	55.4211274	50.4622005	46.1479327
96	61.5277030	58.5200524	55.7245703	50.7016754	46.3370346
97	61.9086168	58.8579010	56.0242670	50.9376112	46.5228841
98	62.2857592	59.1919911	56.3202637	51.1700603	46.7055372
99	62.6591676	59.5223645	56.6126061	51.3990742	46.8850488
100	63.0288788	59.8490625	56.9013394	51.6247037	47.0614730

PRESENT VALUE OF ANNUITY $[1 - (1 + i)^{-n}]/i$
(Continued)

Years	Rate i				
n	.02(2 %)	.0225($2\frac{1}{4}$ %)	.025($2\frac{1}{2}$ %)	.0275($2\frac{3}{4}$ %)	.03(3 %)
1	0.98039216	0.97799511	0.97560976	0.97323601	0.97087379
2	1.94156094	1.93446955	1.92742415	1.92042434	1.91346970
3	2.88388327	2.86989687	2.85602356	2.84226213	2.82861135
4	3.80772870	3.78474021	3.76197421	3.73942787	3.71709840
5	4.71345951	4.67945253	4.64582850	4.61258186	4.57970719
6	5.60143089	5.55447680	5.50812536	5.46236678	5.41719144
7	6.47199107	6.41024626	6.34939060	6.28940806	6.23028296
8	7.32548144	7.24718461	7.17013717	7.09431441	7.01969219
9	8.16223671	8.06570622	7.97086553	7.87767826	7.78610892
10	8.98258501	8.86621635	8.75206393	8.64007616	8.53020284
11	9.78684805	9.64911134	9.51420871	9.38206926	9.25262411
12	10.5753412	10.4147788	10.2577646	10.1042037	9.95400399
13	11.3483738	11.1635979	10.9831850	10.8070109	10.6349553
14	12.1062488	11.8959392	11.6909122	11.4910081	11.2960731
15	12.8492635	12.6121655	12.3813777	12.1566989	11.9379351
16	13.5777093	13.3126313	13.0550027	12.8045732	12.5611020
17	14.2918719	13.9976834	13.7121977	13.4351077	13.1661185
18	14.9920313	14.6676611	14.3533636	14.0487666	13.7535131
19	15.6784620	15.3228959	14.9788913	14.6460016	14.3237991
20	16.3514333	15.9637124	15.5891623	15.2272521	14.8774749
21	17.0112092	16.5904278	16.1845486	15.7929461	15.4150241
22	17.6580482	17.2033523	16.7654132	16.3434999	15.9369166
23	18.2922041	17.8027896	17.3321105	16.8793186	16.4436084
24	18.9139256	18.3890362	17.8849858	17.4007967	16.9355421
25	19.5234565	18.9623826	18.4243764	17.9083180	17.4131477
26	20.1210358	19.5231126	18.9506111	18.4022559	17.8768424
27	20.7068978	20.0715038	19.4640109	18.8829741	18.3270315
28	21.2812724	20.6078276	19.9648887	19.3508264	18.7641082
29	21.8443847	21.1323498	20.4535499	19.8061571	19.1884546
30	22.3964556	21.6453299	20.9302926	20.2493013	19.6004414
31	22.9377015	22.1470219	21.3954074	20.6805852	20.0004285
32	23.4683348	22.6376742	21.8491780	21.1003262	20.3887655
33	23.9885636	23.1175298	22.2918809	21.5088333	20.7657918
34	24.4985917	23.5868262	22.7237863	21.9064071	21.1318367
35	24.9986193	24.0457958	23.1451573	22.2933403	21.4872201
36	25.4888425	24.4946658	23.5562511	22.6699175	21.8322525
37	25.9694534	24.9336585	23.9573181	23.0364161	22.1672354
38	26.4406406	25.3629912	24.3486030	23.3931057	22.4924616
39	26.9025888	25.7828765	24.7303444	23.7402488	22.8082151
40	27.3554792	26.1935222	25.1027751	24.0781011	23.1147720
41	27.7994895	26.5951317	25.4661220	24.4069110	23.4124000
42	28.2347936	26.9879039	25.8206068	24.7269207	23.7013592
43	28.6615623	27.3720332	26.1664457	25.0383656	23.9819021
44	29.0799631	27.7477097	26.5038495	25.3414751	24.2542739
45	29.4901599	28.1151195	26.8330239	25.6364721	24.5187125
46	29.8923136	28.4744445	27.1541696	25.9235738	24.7754491
47	30.2865820	28.8258626	27.4674826	26.2029915	25.0247078
48	30.6731196	29.1695478	27.7731537	26.4749309	25.2667066
49	31.0520780	29.5056702	28.0713695	26.7395922	25.5016569
50	31.4236059	29.8343963	28.3623117	26.9971700	25.7297640

PRESENT VALUE OF ANNUITY $[1 - (1 + i)^{-n}]/i$
(Continued)

Years	Rate i				
n	.02(2 %)	.0225(2¼ %)	.025(2½ %)	.0275(2¾ %)	.03(3 %)
50	31.4236059	29.8343963	28.3623117	26.9971700	25.7297640
51	31.7878489	30.1558888	28.6461577	27.2478540	25.9512272
52	32.1449499	30.4703069	28.9230807	27.4918287	26.1662400
53	32.4950489	30.7778062	29.1932495	27.7292737	26.3749903
54	32.8382833	31.0785391	29.4568288	27.9603637	26.5776605
55	33.1747875	31.3726544	29.7139793	28.1852688	26.7744276
56	33.5046937	31.6602977	29.9648578	28.4041545	26.9654637
57	33.8281310	31.9416114	30.2096174	28.6171820	27.1509357
58	34.1452265	32.2167349	30.4484072	28.8245081	27.3310055
59	34.4561044	32.4858043	30.6813729	29.0262852	27.5058306
60	34.7608867	32.7489529	30.9086565	29.2226620	27.6755637
61	35.0596928	33.0063109	31.1303966	29.4137830	27.8403531
62	35.3526400	33.2580057	31.3467284	29.5997888	28.0003428
63	35.6398432	33.5041621	31.5577838	29.7808163	28.1556726
64	35.9214149	33.7449018	31.7636915	29.9569989	28.3064783
65	36.1974656	33.9803441	31.9645771	30.1284661	28.4528915
66	36.4681035	34.2106054	32.1605630	30.2953441	28.5950403
67	36.7334348	34.4357999	32.3517688	30.4577558	28.7330488
68	36.9935635	34.6560391	32.5383110	30.6158207	28.8670377
69	37.2485917	34.8714318	32.7203034	30.7696552	28.9971240
70	37.4986193	35.0820849	32.8978570	30.9193725	29.1234214
71	37.7437444	35.2881026	33.0710800	31.0650827	29.2460402
72	37.9840631	35.4895869	33.2400780	31.2068931	29.3650875
73	38.2196698	35.6866376	33.4049542	31.3449082	29.4806675
74	38.4506566	35.8793521	33.5658090	31.4792294	29.5928811
75	38.6771143	36.0678261	33.7227404	31.6099556	29.7018263
76	38.8991317	36.2521526	33.8758443	31.7371830	29.8075983
77	39.1167958	36.4324231	34.0252140	31.8610054	29.9102896
78	39.3301919	36.6087268	34.1709405	31.9815138	30.0099899
79	39.5394039	36.7811509	34.3131127	32.0987969	30.1067864
80	39.7445136	36.9497808	34.4518172	32.2129410	30.2007635
81	39.9456016	37.1147000	34.5871388	32.3240302	30.2920034
82	40.1427466	37.2759903	34.7191598	32.4321461	30.3805858
83	40.3360261	37.4337313	34.8479607	32.5373685	30.4665881
84	40.5255158	37.5880013	34.9736202	32.6397747	30.5500856
85	40.7112900	37.7388766	35.0962149	32.7394401	30.6311510
86	40.8934216	37.8864318	35.2158194	32.8364380	30.7098554
87	41.0719819	38.0307402	35.3325067	32.9308399	30.7862674
88	41.2470411	38.1718730	35.4463480	33.0227153	30.8604537
89	41.4186677	38.3099003	35.5574127	33.1121317	30.9324794
90	41.5869292	38.4448903	35.6657685	33.1991549	31.0024071
91	41.7518913	38.5769098	35.7714814	33.2838491	31.0702982
92	41.9136190	38.7060242	35.8746160	33.3662764	31.1362118
93	42.0721755	38.8322975	35.9752352	33.4464978	31.2002057
94	42.2276230	38.9557922	36.0734002	33.5245720	31.2623356
95	42.3800225	39.0765694	36.1691709	33.6005567	31.3226559
96	42.5294339	39.1946889	36.2626057	33.6745078	31.3812193
97	42.6759156	39.3102092	36.3537617	33.7464796	31.4380770
98	42.8195251	39.4231875	36.4426943	33.8165251	31.4932787
99	42.9603187	39.5336797	36.5294579	33.8846960	31.5468725
100	43.0983516	39.6417405	36.6141053	33.9510423	31.5989053

PRESENT VALUE OF ANNUITY $[1 - (1 + i)^{-n}]/i$
(Continued)

Years	Rate i				
n	.035(3½ %)	.04(4 %)	.045(4½ %)	.05(5 %)	.055(5½ %)
1	0.96618357	0.96153846	0.95693780	0.95238095	0.94786730
2	1.89969428	1.88609467	1.87266775	1.85941043	1.84631971
3	2.80163698	2.77509103	2.74896435	2.72324803	2.69793338
4	3.67307921	3.62989522	3.58752570	3.54595050	3.50515012
5	4.51505238	4.45182233	4.38997674	4.32947667	4.27028448
6	5.32855302	5.24213686	5.15787248	5.07569206	4.99553031
7	6.11454398	6.00205467	5.89270094	5.78637340	5.68296712
8	6.87395554	6.73274487	6.59588607	6.46321276	6.33456599
9	7.60768651	7.43533161	7.26879050	7.10782168	6.95219525
10	8.31660532	8.11089578	7.91271818	7.72173493	7.53762583
11	9.00155104	8.76047671	8.52891692	8.30641422	8.09253633
12	9.66333433	9.38507376	9.11858078	8.86325164	8.61851785
13	10.3027385	9.98564785	9.68285242	9.39357299	9.11707853
14	10.9205203	10.5631229	10.2228253	9.89864094	9.58964790
15	11.5174109	11.1183874	10.7395457	10.3796580	10.0375809
16	12.0941168	11.6522956	11.2340151	10.8377696	10.4621620
17	12.6513206	12.1656689	11.7071914	11.2740663	10.8646086
18	13.1896817	12.6592970	12.1599918	11.6895869	11.2460745
19	13.7098374	13.1339394	12.5932936	12.0853209	11.6076535
20	14.2124033	13.5903263	13.0079365	12.4622103	11.9503825
21	14.6979742	14.0291600	13.4047239	12.8211527	12.2752441
22	15.1671248	14.4511153	13.7844248	13.1630026	12.5831697
23	15.6204105	14.8568417	14.1477749	13.4885739	12.8750424
24	16.0583676	15.2469631	14.4954784	13.7986418	13.1516990
25	16.4815146	15.6220799	14.8282090	14.0939446	13.4139327
26	16.8903523	15.9827692	15.1466115	14.3751853	13.6624954
27	17.2853645	16.3295858	15.4513028	14.6430336	13.8980999
28	17.6670189	16.6630632	15.7428735	14.8981273	14.1214217
29	18.0357670	16.9837146	16.0218885	15.1410736	14.3331012
30	18.3920454	17.2920333	16.2888885	15.3724510	14.5337452
31	18.7362758	17.5884936	16.5443910	15.5928105	14.7239291
32	19.0688655	17.8735515	16.7888909	15.8026767	14.9041982
33	19.3902082	18.1476457	17.0228621	16.0025492	15.0750694
34	19.7006842	18.4111978	17.2467580	16.1929040	15.2370326
35	20.0006611	18.6646132	17.4610124	16.3741943	15.3905522
36	20.2904938	18.9082820	17.6660406	16.5468517	15.5360684
37	20.5705254	19.1425788	17.8622398	16.7112873	15.6739985
38	20.8410874	19.3678642	18.0499902	16.8678927	15.8047379
39	21.1024999	19.5844848	18.2296557	17.0170407	15.9286615
40	21.3550723	19.7927739	18.4015844	17.1590864	16.0461247
41	21.5991037	19.9930518	18.5661095	17.2943680	16.1574642
42	21.8348828	20.1856267	18.7235498	17.4232076	16.2629992
43	22.0626887	20.3707949	18.8742103	17.5459120	16.3630324
44	22.2827910	20.5488413	19.0183831	17.6627733	16.4578506
45	22.4954503	20.7200397	19.1563474	17.7740698	16.5477257
46	22.7009181	20.8846536	19.2883707	17.8800665	16.6329154
47	22.8994378	21.0429361	19.4147088	17.9810157	16.7136639
48	23.0912443	21.1951309	19.5356065	18.0771578	16.7902027
49	23.2765645	21.3414720	19.6512981	18.1687217	16.8627514
50	23.4556179	21.4821846	19.7620078	18.2559255	16.9315179

PRESENT VALUE OF ANNUITY $[1 - (1 + i)^{-n}]/i$
(Continued)

Years	Rate *i*				
n	.06(6 %)	.065(6½ %)	.07(7 %)	.075(7½ %)	.08(8 %)
1	0.94339623	0.93896714	0.93457944	0.93023256	0.92592593
2	1.83339267	1.82062642	1.80801817	1.79556517	1.78326475
3	2.67301195	2.64847551	2.62431604	2.60052574	2.57709699
4	3.46510561	3.42579860	3.38721126	3.34932627	3.31212684
5	4.21236379	4.15567944	4.10019744	4.04588490	3.99271004
6	4.91732433	4.84101356	4.76653966	4.69384642	4.62287966
7	5.58238144	5.48451977	5.38928940	5.29660132	5.20637006
8	6.20979381	6.08875096	5.97129851	5.85730355	5.74663894
9	6.80169227	6.65610419	6.51523225	6.37888703	6.24688791
10	7.36008705	7.18883022	7.02358154	6.86408096	6.71008140
11	7.88687458	7.68904246	7.49867434	7.31542415	7.13896426
12	8.38384394	8.15872532	7.94268630	7.73527827	7.53607802
13	8.85268296	8.59974208	8.35765074	8.12584026	7.90377594
14	9.29498393	9.01384233	8.74546799	8.48915373	8.24423698
15	9.71224899	9.40266885	9.10791401	8.82711974	8.55947869
16	10.1058953	9.76776418	9.44664860	9.14150674	8.85136916
17	10.4772597	10.1105767	9.76322299	9.43395976	9.12163811
18	10.8276035	10.4324664	10.0590869	9.70600908	9.37188714
19	11.1581165	10.7347102	10.3355952	9.95907821	9.60359920
20	11.4699212	11.0185073	10.5940143	10.1944914	9.81814741
21	11.7640766	11.2849833	10.8355273	10.4134803	10.0168032
22	12.0415817	11.5351956	11.0612405	10.6171910	10.2007437
23	12.3033790	11.7701367	11.2721874	10.8066893	10.3710590
24	12.5503575	11.9907387	11.4693340	10.9829668	10.5287583
25	12.7833562	12.1978767	11.6535832	11.1469459	10.6747762
26	13.0031662	12.3923725	11.8257787	11.2994845	10.8099780
27	13.2105341	12.5749977	11.9867090	11.4413810	10.9351648
28	13.4061643	12.7464767	12.1371113	11.5733776	11.0510785
29	13.5907210	12.9074898	12.2776741	11.6961652	11.1584060
30	13.7648312	13.0586759	12.4090412	11.8103863	11.2577833
31	13.9290860	13.2006347	12.5318142	11.9166384	11.3497994
32	14.0840434	13.3339293	12.6465553	12.0154776	11.4349994
33	14.2302296	13.4590885	12.7537900	12.1074210	11.5138884
34	14.3681411	13.5766089	12.8540094	12.1929498	11.5869337
35	14.4982464	13.6869567	12.9476723	12.2725114	11.6545682
36	14.6209871	13.7905697	13.0352078	12.3465222	11.7171928
37	14.7367803	13.8878589	13.1170166	12.4153695	11.7751785
38	14.8460192	13.9792102	13.1934735	12.4794135	11.8288690
39	14.9490747	14.0649861	13.2649285	12.5389893	11.8785824
40	15.0462969	14.1455269	13.3317088	12.5944087	11.9246133
41	15.1380159	14.2211520	13.3941204	12.6459616	11.9672346
42	15.2245433	14.2921615	13.4524490	12.6939177	12.0066987
43	15.3061729	14.3588371	13.5069617	12.7385281	12.0432395
44	15.3831820	14.4214433	13.5579081	12.7800262	12.0770736
45	15.4558321	14.4802284	13.6055216	12.8186290	12.1084015
46	15.5243699	14.5354258	13.6500202	12.8545386	12.1374088
47	15.5890282	14.5872542	13.6916076	12.8879429	12.1642674
48	15.6500266	14.6359195	13.7304744	12.9190166	12.1891365
49	15.7075723	14.6816145	13.7667985	12.9479224	12.2121634
50	15.7618606	14.7245207	13.8007463	12.9748116	12.2334846

ANNUITY WHOSE PRESENT VALUE IS 1

$$\frac{1}{a_{\overline{n}|}} = a_{\overline{n}|}^{-1} = \frac{i}{1-(1+i)^{-n}} = \frac{i}{1-v^n} = s_{\overline{n}|}^{-1} + i$$

Years	Rate i				
n	.0025($\frac{1}{4}$ %)	.004167($\frac{5}{12}$ %)	.005($\frac{1}{2}$ %)	.005833($\frac{7}{12}$ %)	.0075($\frac{3}{4}$ %)
1	1.00250000	1.00416667	1.00500000	1.00583333	1.00750000
2	0.50187578	0.50312717	0.50375312	0.50437924	0.50563200
3	.33500139	.33611496	.33667221	.33722976	.33834579
4	.25156445	.25260958	.25313279	.25365644	.25470501
5	.20150250	.20250693	.20300997	.20351357	.20452242
6	.16812803	.16910564	.16959546	.17008594	.17106891
7	.14428928	.14524800	.14572854	.14620986	.14717488
8	.12641035	.12735512	.12782886	.12830351	.12925552
9	.11250462	.11343876	.11390736	.11437698	.11531929
10	.10138015	.10230596	.10277057	.10323632	.10417123
11	.09227840	.09319757	.09365903	.09412175	.09505094
12	.08469370	.08560748	.08606643	.08652675	.08745148
13	.07827595	.07918532	.07964224	.08010064	.08102188
14	.07277510	.07368082	.07413609	.07459295	.07551146
15	.06800777	.06891045	.06936436	.06981999	.07073639
16	.06383642	.06473655	.06518937	.06564401	.06655879
17	.06015587	.06105387	.06150579	.06195966	.06287321
18	.05688433	.05778053	.05823173	.05868499	.05959766
19	.05395722	.05485191	.05530253	.05575532	.05666740
20	.05132288	.05221630	.05266645	.05311889	.05403063
21	.04893947	.04983183	.05028163	.05073383	.05164543
22	.04677278	.04766427	.04811380	.04856585	.04947748
23	.04479455	.04568531	.04613465	.04658663	.04749846
24	.04298121	.04387139	.04432061	.04477258	.04568474
25	.04131298	.04220270	.04265186	.04310388	.04401650
26	.03977312	.04066247	.04111163	.04156376	.04247693
27	.03834736	.03923645	.03968565	.04013793	.04105176
28	.03702347	.03791239	.03836167	.03881415	.03972871
29	.03579093	.03667974	.03712914	.03758186	.03849723
30	.03464059	.03552936	.03597892	.03643191	.03734816
31	.03356449	.03445330	.03490304	.03535633	.03627352
32	.03255569	.03344458	.03389453	.03434815	.03526634
33	.03160806	.03249708	.03294727	.03340124	.03432048
34	.03071620	.03160540	.03205586	.03251020	.03343053
35	.02987533	.03076476	.03121550	.03167024	.03259170
36	.02908121	.02997090	.03042194	.03087710	.03179973
37	.02833004	.02922003	.02967139	.03012698	.03105082
38	.02761843	.02850875	.02896045	.02941649	.03034157
39	.02694335	.02783402	.02828607	.02874258	.02966893
40	.02630204	.02719310	.02764552	.02810251	.02903016
41	.02569204	.02638352	.02703631	.02749379	.02842276
42	.02511112	.02600303	.02645622	.02691420	.02784452
43	.02455724	.02544961	.02590320	.02636170	.02729338
44	.02402855	.02492141	.02537541	.02583443	.02676751
45	.02352339	.02441675	.02487117	.02533073	.02626521
46	.02304022	.02393409	.02438894	.02484905	.02578495
47	.02257762	.02347204	.02392733	.02438798	.02532532
48	.02213433	.02302929	.02348503	.02394624	.02488504
49	.02170915	.02260468	.02306087	.02352265	.02446292
50	.02130099	.02219711	.02265376	.02311611	.02405787

ANNUITY WHOSE PRESENT VALUE IS 1

$$a_{\overline{n}|}^{-1} = i/(1 - v^n) = s_{\overline{n}|}^{-1} + i \text{ (Continued)}$$

Years	Rate i				
n	.0025 ($\frac{1}{4}$%)	.004167 ($\frac{5}{12}$%)	.005 ($\frac{1}{2}$%)	.005833 ($\frac{7}{12}$%)	.0075 ($\frac{3}{4}$%)
50	.02130098	.02219711	.02265376	.02311611	.02405787
51	.02090886	.02180557	.02226269	.02272568	.02366888
52	.02053184	.02142916	.02188675	.02235027	.02329503
53	.02016906	.02106700	.02152507	.02198919	.02293546
54	.01981974	.02071830	.02117686	.02164157	.02258932
55	.01948314	.02038234	.02084139	.02130671	.0222[illegible]
56	.01915858	.02005843	.02051797	.02098390	.02193478
57	.01884542	.01974593	.02020598	.02067251	.02162495
58	.01854308	.01944426	.01990481	.02037196	.02132597
59	.01825101	.01915287	.01961392	.02008170	.02103727
60	.01796869	.01887123	.01933280	.01980120	.02075836
61	.01769564	.01859888	.01906096	[illegible]	.02048873
62	.01743142	.01833536	.01879796	.01926792	.02022795
63	.01717561	.01808025	.01854337	.01901388	.01997560
64	.01692780	.01783315	.01829681	.01876778	.01973127
65	.01668764	.01759371	.01805790	.01852944	.01949460
66	.01645476	.01736156	.01782627	.01829848	.01926524
67	.01622886	.01713643	.01760163	.01807449	.01904286
68	.01600961	.01691793	.01738366	.01785714	.01882716
69	.01579674	.01670574	.01717196	.01764622	.01861785
70	.01558996	.01649971	.01696657	.01744138	.01841464
71	.01538902	.01629952	.01676693	.01724239	.01821728
72	[illegible]	.01610493	.01657273	.01704900	.01802554
73	.01499670	.01591572	.01638422	.01686100	.01783917
74	.01481887	.01573165	.01620071	.01667814	.01765796
75	[illegible]	.01555258	.01602214	.01650024	.01748170
76	[illegible]	.01537816	.01584832	.01632709	.01731020
77	.01420227	.01520826	.01567888	.01615851	.01714328
78	.01412798	.01504265	.01551423	.01599432	.01698074
79	.01396511	.01488177	[illegible]	.01583433	.01682244
80	.01380721	.01472444	.01519704	.01567847	.01666821
81	.01365321	.01457144	.01504439	.01552649	.01651790
82	[illegible]	.01442250	.01489552	.01537839	.01637136
83	[illegible]	.01427759	.01475022	.01523403	.01622847
84	.01321359	.01413591	.01460855	.01509328	.01608908
85	.01307359	[illegible]	.01447021	[illegible]	[illegible]
86	.01293714	[illegible]	.01433513	.01482150	.01582034
87	[illegible]	.01372376	.01420323	[illegible]	.01569078
88	[illegible]	.01360790	.01407441	.01456115	.01556423
89	.01254325	.01347932	.01394857	.01443588	.01544084
90	.01242177	.01335720	[illegible]	.01431347	.01531999
91	[illegible]	.01322328	[illegible]	.01419398	.01520190
92	[illegible]	.01310852	.01358724	.01407879	.01508657
93	[illegible]	.01299236	.01347218	.01396239	.01497382
94	.01185064	.01287915	.01336050	.01385042	.01486356
95	[illegible]	.01276867	.01324889	.01374090	.01475571
96	.01172457	.01266092	[illegible]	.01363372	.01465020
97	[illegible]	.01255574	[illegible]	.01352880	.01454693
98	[illegible]	.01245276	.01293292	.01342608	.01444592
99	.01142500	.01234791	[illegible]	.01332549	.01434701
100	.01131446	[illegible]	[illegible]	.01322698	.01425017

ANNUITY WHOSE PRESENT VALUE IS 1

$a_{\overline{n}|}^{-1} = i/(1 - v^n) = s_{\overline{n}|}^{-1} + i$ (Continued)

Years	Rate i				
n	.01(1%)	.01125(1⅛%)	.0125(1¼%)	.015(1½%)	.0175(1¾%)
1	1.01000000	1.01125000	1.01250000	1.01500000	1.01750000
2	0.50751244	0.50845323	0.50939441	0.51127792	0.51316295
3	.34002211	.34086130	.34170117	.34338296	.34506746
4	.25628109	.25707058	.25786102	.25944478	.26103237
5	.20603980	.20680034	.20756211	.20908932	.21062142
6	.17254837	.17329034	.17403381	.17552521	.17702256
7	.14862828	.14935762	.15008872	.15155616	.15303059
8	.13069029	.13141071	.13213314	.13358402	.13504292
9	.11674037	.11745432	.11817055	.11960982	.12105813
10	.10558208	.10629131	.10700307	.10843418	.10987534
11	.09645408	.09715984	.09786839	.09929384	.10073038
12	.08884879	.08955203	.09025831	.09167999	.09311377
13	.08241482	.08311626	.08382100	.08524036	.08667283
14	.07690117	.07760138	.07830515	.07972332	.08115562
15	.07212378	.07282321	.07352646	.07494436	.07637739
16	.06794460	.06864363	.06934672	.07076508	.07219958
17	.06425806	.06495698	.06566023	.06707966	.06851623
18	.06098205	.06168113	.06238479	.06380578	.06524492
19	.05805175	.05875120	.05945548	.06087847	.06232061
20	.05541532	.05611531	.05682039	.05824574	.05969122
21	.05303075	.05373145	.05443748	.05586550	.05731464
22	.05086371	.05156525	.05227238	.05370331	.05515638
23	.04888584	.04958833	.05029666	.05173075	.05318796
24	.04707347	.04777701	.04848665	.04992410	.05138565
25	.04540675	.04611144	.04682247	.04826345	.04972952
26	.04386888	.04457479	.04528729	.04673196	.04820269
27	.04244553	.04315273	.04386677	.04531527	.04679079
28	.04112444	.04183299	.04254863	.04400108	.04548151
29	.03989502	.04060498	.04132228	.04277878	.04426424
30	.03874811	.03945953	.04017854	.04163919	.04312975
31	.03767573	.03838866	.03910942	.04057430	.04207005
32	.03667089	.03738535	.03810791	.03957710	.04107812
33	.03572744	.03644349	.03716786	.03864144	.04014779
34	.03483997	.03555763	.03628387	.03776189	.03927363
35	.03400368	.03472299	.03545111	.03693363	.03845082
36	.03321431	.03393529	.03466533	.03615240	.03767507
37	.03246805	.03319072	.03392270	.03541437	.03694257
38	.03176150	.03248589	.03321983	.03471613	.03624990
39	.03109160	.03181773	.03255365	.03405463	.03559399
40	.03045560	.03118349	.03192141	.03342710	.03497209
41	.02985102	.03058069	.03132063	.03283106	.03438170
42	.02927563	.03000709	.03074906	.03226426	.03382057
43	.02872737	.02946064	.03020466	.03172465	.03328666
44	.02820441	.02893949	.02968557	.03121038	.03277810
45	.02770505	.02844197	.02919012	.03071976	.03229321
46	.02722775	.02796652	.02871675	.03025125	.03183043
47	.02677111	.02751173	.02826406	.02980342	.03138836
48	.02633384	.02707632	.02783075	.02937500	.03096569
49	.02591474	.02665910	.02741563	.02896478	.03056124
50	.02551273	.02625898	.02701763	.02857168	.03017391

ANNUITY WHOSE PRESENT VALUE IS 1

$$a_{\overline{n|}}^{-1} = i/(1 - v^n) = s_{\overline{n|}}^{-1} + i \text{ (Continued)}$$

Years	Rate i				
n	.01(1%)	.01125(1⅛%)	.0125(1¼%)	.015(1½%)	.0175(1¾%)
50	.02551273	.02625898	.02701763	.02857168	.03017391
51	.02512680	.02587494	.02663571	.02819469	.02980269
52	.02475603	.02550606	.02626897	.02783287	.02944665
53	.02439956	.02515149	.02591653	.02748537	.02910492
54	.02405658	.02481043	.02557760	.02715138	.02877672
55	.02372637	.02448213	.02525145	.02683018	.02846129
56	.02340823	.02416592	.02493739	.02652106	.02815795
57	.02310156	.02386116	.02463478	.02622341	.02786606
58	.02280573	.02356726	.02434303	.02593661	.02758503
59	.02252020	.02328366	.02406158	.02566012	.02731430
60	.02224445	.02300985	.02378993	.02539343	.02705336
61	.02197800	.02274534	.02352758	.02513604	.02680172
62	.02172041	.02248969	.02327410	.02488751	.02655892
63	.02147125	.02224247	.02302904	.02464741	.02632455
64	.02123013	.02200329	.02279203	.02441534	.02609821
65	.02099667	.02177178	.02256268	.02419094	.02587952
66	.02077052	.02154758	.02234065	.02397386	.02566813
67	.02055136	.02133037	.02212560	.02376376	.02546372
68	.02033888	.02111985	.02191724	.02356033	.02526596
69	.02013280	.02091571	.02171527	.02336329	.02507459
70	.01993282	.02071769	.02151941	.02317235	.02488930
71	.01973870	.02052552	.02132941	.02298727	.02470985
72	.01955019	.02033896	.02114501	.02280779	.02453600
73	.01936706	.02015779	.02096600	.02263368	.02436750
74	.01918910	.01998177	.02079215	.02246473	.02420413
75	.01901609	.01981072	.02062325	.02230072	.02404570
76	.01884784	.01964442	.02045910	.02214146	.02389200
77	.01868416	.01948269	.02029953	.02198676	.02374284
78	.01852488	.01932536	.02014435	.02183645	.02359806
79	.01836984	.01917226	.01999341	.02169036	.02345748
80	.01821885	.01902323	.01984652	.02154832	.02332093
81	.01807180	.01887812	.01970356	.02141019	.02318828
82	.01792851	.01873678	.01956437	.02127583	.02305936
83	.01778886	.01859908	.01942881	.02114509	.02293406
84	.01765273	.01846489	.01929675	.02101784	.02281223
85	.01751998	.01833409	.01916808	.02089396	.02269375
86	.01739050	.01820654	.01904267	.02077333	.02257850
87	.01726417	.01808215	.01892041	.02065584	.02246636
88	.01714089	.01796081	.01880119	.02054138	.02235724
89	.01702056	.01784240	.01868490	.02042984	.02225102
90	.01690306	.01772684	.01857146	.02032113	.02214760
91	.01678832	.01761403	.01846076	.02021516	.02204690
92	.01667624	.01750387	.01835271	.02011182	.02194882
93	.01656673	.01739629	.01824724	.02001104	.02185327
94	.01645971	.01729119	.01814425	.01991273	.02176017
95	.01635511	.01718851	.01804366	.01981681	.02166944
96	.01625284	.01708816	.01794540	.01972321	.02158101
97	.01615284	.01699007	.01784941	.01963186	.02149480
98	.01605503	.01689418	.01775560	.01954268	.02141074
99	.01595936	.01680041	.01766391	.01945560	.02132876
100	.01586574	.01670870	.01757428	.01937057	.02124880

ANNUITY WHOSE PRESENT VALUE IS 1

$a_{\overline{n}|}^{-1} = i/(1 - v^n) = s_{\overline{n}|}^{-1} + i$ (Continued)

Years	Rate i				
n	.02(2 %)	.0225(2¼ %)	.025(2½ %)	.0275(2¾ %)	.03(3 %)
1	1.02000000	1.02250000	1.02500000	1.02750000	1.03000000
2	0.51504950	0.51693758	0.51882716	0.52071825	0.52261084
3	.34675467	.34844458	.35013717	.35183243	.35353036
4	.26262375	.26421893	.26581788	.26742059	.26902705
5	.21215839	.21370021	.21524686	.21679832	.21835457
6	.17852581	.18003496	.18154997	.18307083	.18459750
7	.15451196	.15600025	.15749543	.15899747	.16050635
8	.13650980	.13798462	.13946735	.14095795	.14245639
9	.12251544	.12398170	.12545689	.12694095	.12843386
10	.11132653	.11278768	.11425876	.11573972	.11723051
11	.10217794	.10363649	.10510596	.10658629	.10807745
12	.09455960	.09601740	.09748713	.09896871	.10046209
13	.08811835	.08957686	.09104827	.09253252	.09402954
14	.08260197	.08406230	.08553653	.08702457	.08852634
15	.07782547	.07928852	.08076646	.08225917	.08376658
16	.07365013	.07511663	.07659899	.07809710	.07961085
17	.06996984	.07144039	.07292777	.07443186	.07595253
18	.06670210	.06817720	.06967008	.07118063	.07270870
19	.06378177	.06526182	.06676062	.06827802	.06981388
20	.06115672	.06264207	.06414713	.06567173	.06721571
21	.05878477	.06027572	.06178733	.06331941	.06487178
22	.05663140	.05812821	.05964661	.06118640	.06274739
23	.05466810	.05617097	.05769638	.05924410	.06081390
24	.05287110	.05438023	.05591282	.05746863	.05904742
25	.05122044	.05273599	.05427592	.05583997	.05742787
26	.04969923	.05122134	.05276875	.05434116	.05593829
27	.04829309	.04982188	.05137687	.05295776	.05456421
28	.04698967	.04852525	.05008793	.05167738	.05329323
29	.04577836	.04732081	.04889127	.05048935	.05211467
30	.04464992	.04619934	.04777764	.04938442	.05101926
31	.04359635	.04515280	.04673900	.04835453	.04999893
32	.04261061	.04417415	.04576831	.04739263	.04904662
33	.04168653	.04325722	.04485938	.04649253	.04815612
34	.04081867	.04239655	.04400675	.04564875	.04732196
35	.04000221	.04158731	.04320558	.04485645	.04653929
36	.03923285	.04082522	.04245158	.04411132	.04580379
37	.03850678	.04010643	.04174090	.04340953	.04511162
38	.03782057	.03942753	.04107012	.04274764	.04445934
39	.03717114	.03878543	.04043615	.04212256	.04384385
40	.03655575	.03817738	.03983623	.04153151	.04326238
41	.03597188	.03760087	.03926786	.04097200	.04271241
42	.03541729	.03705364	.03872876	.04044175	.04219167
43	.03488993	.03653364	.03821688	.03993871	.04169811
44	.03438794	.03603901	.03773037	.03946100	.04122985
45	.03390962	.03556805	.03726752	.03900693	.04078518
46	.03345342	.03511921	.03682676	.03857493	.04036254
47	.03301792	.03469107	.03640669	.03816358	.03996051
48	.03260184	.03428233	.03600599	.03777158	.03957777
49	.03220396	.03389179	.03562348	.03739773	.03921314
50	.03182321	.03351836	.03525806	.03704092	.03886550

ANNUITY WHOSE PRESENT VALUE IS 1

$$a_{\overline{n}|}^{-1} = i/(1 - v^n) = s_{\overline{n}|}^{-1} + i \text{ (Continued)}$$

Years	Rate i				
n	.02(2%)	.0225(2¼%)	.025(2½%)	.0275(2¾%)	.03(3%)
50	.03182321	.03351836	.03525806	.03704092	.03886550
51	.03145856	.03316102	.03490870	.03670014	.03853382
52	.03110909	.03281884	.03457446	.03637444	.03821718
53	.03077392	.03249094	.03425449	.03606297	.03791471
54	.03045226	.03217654	.03394799	.03576491	.03762558
55	.03014337	.03187489	.03365419	.03547953	.03734907
56	.02984656	.03158530	.03337243	.03520612	.03708447
57	.02956120	.03130712	.03310204	.03494404	.03683114
58	.02928667	.03103977	.03284244	.03469270	.03658848
59	.02902243	.03078268	.03259307	.03445153	.03635593
60	.02876797	.03053533	.03235340	.03422002	.03613296
61	.02852278	.03029724	.03212294	.03399767	.03591908
62	.02828643	.03006795	.03190126	.03378402	.03571385
63	.02805848	.02984704	.03168790	.03357866	.03551682
64	.02783855	.02963411	.03148249	.03338118	.03532760
65	.02762624	.02942878	.03128463	.03319120	.03514581
66	.02742122	.02923070	.03109398	.03300837	.03497110
67	.02722316	.02903955	.03091021	.03283236	.03480313
68	.02703173	.02885500	.03073300	.03266285	.03464159
69	.02684665	.02867677	.03056206	.03249955	.03448618
70	.02666765	.02850458	.03039712	.03234218	.03433663
71	.02649446	.02833816	.03023790	.03219048	.03419266
72	.02632683	.02817728	.03008417	.03204420	.03405404
73	.02616454	.02802169	.02993568	.03190311	.03392053
74	.02600736	.02787118	.02979222	.03176698	.03379191
75	.02585508	.02772554	.02965358	.03163560	.03366796
76	.02570751	.02758457	.02951956	.03150878	.03354849
77	.02556447	.02744808	.02938997	.03138633	.03343331
78	.02542576	.02731589	.02926463	.03126806	.03332224
79	.02529123	.02718784	.02914338	.03115382	.03321510
80	.02516071	.02706376	.02902605	.03104342	.03311175
81	.02503405	.02694350	.02891248	.03093674	.03301201
82	.02491110	.02682692	.02880254	.03083361	.03291576
83	.02479173	.02671387	.02869608	.03073389	.03282284
84	.02467581	.02660423	.02859298	.03063747	.03273313
85	.02456321	.02649787	.02849310	.03054420	.03264650
86	.02445381	.02639467	.02839633	.03045397	.03256284
87	.02434750	.02629452	.02830255	.03036667	.03248202
88	.02424416	.02619730	.02821165	.03028219	.03240393
89	.02414370	.02610291	.02812353	.03020041	.03232848
90	.02404602	.02601126	.02803809	.03012125	.03225556
91	.02395101	.02592224	.02795523	.03004460	.03218508
92	.02385859	.02583577	.02787486	.02997038	.03211694
93	.02376868	.02575176	.02779690	.02989850	.03205107
94	.02368118	.02567012	.02772126	.02982887	.03198737
95	.02359602	.02559078	.02764786	.02976141	.03192577
96	.02351313	.02551366	.02757662	.02969605	.03186619
97	.02343242	.02543868	.02750747	.02963272	.03180856
98	.02335383	.02536578	.02744034	.02957134	.03175281
99	.02327729	.02529489	.02737517	.02951185	.03169886
100	.02320274	.02522594	.02731188	.02945418	.03164667

ANNUITY WHOSE PRESENT VALUE IS 1

$a_{\overline{n}|}^{-1} = i/(1 - v^n) = s_{\overline{n}|}^{-1} + i$ (Continued)

Years	Rate i				
n	.035(3½ %)	.04(4 %)	.045(4½ %)	.05(5 %)	.055(5½ %)
1	1.03500000	1.04000000	1.04500000	1.05000000	1.05500000
2	0.52640049	0.53019608	0.53399756	0.53780488	0.54161800
3	.35693418	.36034854	.36377336	.36720856	.37065407
4	.27225114	.27549005	.27874365	.28201183	.28529449
5	.22148137	.22462711	.22779164	.23097480	.23417644
6	.18766821	.19076190	.19387839	.19701747	.20017895
7	.16354449	.16660961	.16970147	.17281982	.17596442
8	.14547665	.14852783	.15160965	.15472181	.15786401
9	.13144601	.13449299	.13757447	.14069008	.14383946
10	.12024137	.12329094	.12637882	.12950458	.13266777
11	.11109197	.11414904	.11724818	.12038889	.12357065
12	.10348395	.10655217	.10966619	.11282541	.11602923
13	.09706157	.10014373	.10327535	.10645577	.10968426
14	.09157073	.09466897	.09782032	.10102397	.10427912
15	.08682507	.08994110	.09311381	.09634229	.09962560
16	.08268483	.08582000	.08901537	.09226991	.09558254
17	.07904313	.08219852	.08541758	.08869914	.09204197
18	.07581684	.07899333	.08223690	.08554622	.08891992
19	.07294033	.07613862	07940734	.08274501	.08615006
20	.07036108	.07358175	.07687614	.08024259	.08367933
21	.06803659	.07128011	.07460057	.07799611	.08146478
22	.06593207	.06919881	.07254565	.07597051	.07947123
23	.06401880	.06730906	.07068249	.07413682	.07766965
24	.06227283	.06558683	.06898703	.07247090	.07603580
25	.06067404	.06401196	.06743903	.07095246	.07454935
26	.05920540	.06256738	.06602137	.06956432	.07319307
27	.05785241	.06123854	.06471946	.06829186	.07195228
28	.05660265	.06001298	.06352081	.06712253	.07081440
29	.05544538	.05887993	.06241461	.06604551	.06976857
30	.05437133	.05783010	.06139154	.06505144	.06880539
31	.05337240	.05685535	.06044345	.06413212	.06791665
32	.05244150	.05594859	.05956320	.06328042	.06709519
33	.05157242	.05510357	.05874453	.06249004	.06633469
34	.05075966	.05431477	.05798191	.06175545	.06562958
35	.04999835	.05357732	.05727045	.06107171	.06497493
36	.04928416	.05288688	.05660578	.06043446	.06436635
37	.04861325	.05223957	.05598402	.05983979	.06379993
38	.04798214	.05163192	.05540169	.05928423	.06327217
39	.04738775	.05106083	.05485567	.05876462	.06277991
40	.04682728	.05052349	.05434315	.05827816	.06232034
41	.04629822	.05001738	.05386158	.05782229	.06189090
42	.04579828	.04954020	.05340868	.05739471	.06148927
43	.04532539	.04908989	.05298235	.05699333	.06111337
44	.04487768	.04866454	.05258071	.05661625	.06076128
45	.04445343	.04826246	.05220202	.05626173	.06043127
46	.04405108	.04788205	.05184471	.05592820	.06012175
47	.04366919	.04752189	.05150734	.05561421	.05983129
48	.04330646	.04718065	.05118858	.05531843	.05955854
49	.04296167	.04685712	.05088722	.05503965	.05930230
50	.04263371	.04655020	.05060215	.05477674	.05906145

ANNUITY WHOSE PRESENT VALUE IS 1

$$a_{\overline{n|}}^{-1} = i/(1 - v^n) = s_{\overline{n|}}^{-1} + i \text{ (Continued)}$$

Year	Rate i				
n	.06(6%)	.065(6½%)	.07(7%)	.075(7½%)	.08(8%)
1	1.06000000	1.06500000	1.07000000	1.07500000	1.08000000
2	0.54543689	0.54926150	0.55309179	0.55692771	0.56076923
3	.37410981	.37757570	.38105166	.38453763	.38803351
4	.28859149	.29190274	.29522812	.29856751	.30192080
5	.23739640	.24063454	.24389069	.24716472	.25045645
6	.20336263	.20656831	.20979580	.21304489	.21631539
7	.17913502	.18233137	.18555322	.18880032	.19207240
8	.16103594	.16423730	.16746776	.17072702	.17401476
9	.14702224	.15023803	.15348647	.15676716	.16007971
10	.13586796	.13910469	.14237750	.14568593	.14902949
11	.12679294	.13005521	.13335690	.13669747	.14007634
12	.11927703	.12256817	.12590199	.12927783	.13269502
13	.11296011	.11628256	.11965085	.12306420	.12652181
14	.10758491	.11094048	.11434494	.11779737	.12129685
15	.10296276	.10635278	.10979462	.11328724	.11682954
16	.09895214	.10237757	.10585765	.10939116	.11297687
17	.09544480	.09890633	.10242519	.10600003	.10962943
18	.09235654	.09585461	.09941260	.10302896	.10670210
19	.08962086	.09315575	.09675301	.10041090	.10412763
20	.08718456	.09075640	.09439293	.09809219	.10185221
21	.08500455	.08861333	.09228900	.09602937	.09983225
22	.08304557	.08669120	.09040577	.09418687	.09803207
23	.08127848	.08496078	.08871393	.09253528	.09642217
24	.07967900	.08339770	.08718902	.09105008	.09497796
25	.07822672	.08198148	.08581052	.08971067	.09367878
26	.07690435	.08069480	.08456103	.08849961	.09250713
27	.07569717	.07952288	.08342573	.08740204	.09144809
28	.07459255	.07845305	.08239193	.08640520	.09048891
29	.07357961	.07747440	.08144865	.08549811	.08961854
30	.07264891	.07657744	.08058640	.08467124	.08882743
31	.07179222	.07575393	.07979691	.08391628	.08810728
32	.07100234	.07499665	.07907292	.08322599	.08745081
33	.07027293	.07429924	.07840807	.08259397	.08685163
34	.06959843	.07365610	.07779674	.08201461	.08630411
35	.06897386	.07306226	.07723396	.08148291	.08580326
36	.06839483	.07251332	.07671531	.08099447	.08534467
37	.06785743	.07200534	.07623685	.08054533	.08492440
38	.06735812	.07153480	.07579505	.08013197	.08453894
39	.06689377	.07109854	.07538676	.07975124	.08418513
40	.06646154	.07069373	.07500914	.07940031	.08386016
41	.06605886	.07031779	.07465962	.07907663	.08356149
42	.06568342	.06996842	.07433591	.07877789	.08328684
43	.06533312	.06964352	.07403590	.07850201	.08303414
44	.06500606	.06934119	.07375769	.07824710	.08280152
45	.06470050	.06905968	.07349957	.07801146	.08258728
46	.06441485	.06879743	.07325996	.07779353	.08238991
47	.06414768	.06855300	.07303744	.07759190	.08220799
48	.06389766	.06832506	.07283070	.07740527	.08204027
49	.06366356	.06811240	.07263853	.07723247	.08188557
50	.06344429	.06791393	.07245985	.07707241	.08174286

COMPOUND AMOUNT OF 1 FOR FRACTIONAL PERIODS $(1 + i)^{\frac{1}{p}}$

p	$\frac{1}{4}$ %	$\frac{5}{12}$ %	$\frac{1}{2}$ %	$\frac{7}{12}$ %	$\frac{3}{4}$ %
2	1.0012 492	1.0020 812	1.0024 969	1.0029 124	1.0037 430
3	1.0008 326	1.0013 870	1.0016 639	1.0019 407	1.0024 938
4	1.0006 244	1.0010 400	1.0012 477	1.0014 552	1.0018 697
6	1.0004 162	1.0006 932	1.0008 316	1.0009 699	1.0012 461
12	1.0002 089	1.0003 466	1.0004 157	1.0004 848	1.0006 229
13	1.0001 921	1.0003 199	1.0003 837	1.0004 475	1.0005 749
26	1.0000 960	1.0001 599	1.0001 919	1.0002 237	1.0002 874
52	1.0000 480	1.0000 800	1.0000 959	1.0001 119	1.0001 437
365	1.0000 068	1.0000 114	1.0000 137	1.0000 159	1.0000 205
p	1 %	$1\frac{1}{8}$ %	$1\frac{1}{4}$ %	$1\frac{1}{2}$ %	$1\frac{3}{4}$ %
2	1.0049 876	1.0056 093	1.0062 306	1.0074 721	1.0087 121
3	1.0033 223	1.0037 360	1.0041 494	1.0049 752	1.0057 996
4	1.0024 907	1.0028 008	1.0031 105	1.0037 291	1.0043 466
6	1.0016 598	1.0018 663	1.0020 726	1.0024 845	1.0028 956
12	1.0008 295	1.0009 327	1.0010 357	1.0012 415	1.0014 468
13	1.0007 657	1.0008 609	1.0009 560	1.0011 459	1.0013 354
26	1.0003 828	1.0004 304	1.0004 779	1.0005 728	1.0006 675
52	1.0001 914	1.0002 152	1.0002 389	1.0002 864	1.0003 337
365	1.0000 273	1.0000 307	1.0000 340	1.0000 408	1.0000 475
p	2 %	$2\frac{1}{4}$ %	$2\frac{1}{2}$ %	$2\frac{3}{4}$ %	3 %
2	1.0099 505	1.0111 874	1.0124 228	1.0136 568	1.0148 892
3	1.0066 227	1.0074 444	1.0082 648	1.0090 839	1.0099 016
4	1.0049 629	1.0055 782	1.0061 922	1.0068 052	1.0074 171
6	1.0033 059	1.0037 153	1.0041 239	1.0045 317	1.0049 386
12	1.0016 516	1.0018 559	1.0020 598	1.0022 633	1.0024 663
13	1.0015 244	1.0017 130	1.0019 012	1.0020 890	1.0022 763
26	1.0007 619	1.0008 562	1.0009 502	1.0010 440	1.0011 375
52	1.0003 809	1.0004 280	1.0004 750	1.0005 218	1.0005 686
365	1.0000 543	1.0000 610	1.0000 676	1.0000 743	1.0000 810
p	$3\frac{1}{2}$ %	4 %	$4\frac{1}{2}$ %	5 %	$5\frac{1}{2}$ %
2	1.0173 495	1.0198 039	1.0222 524	1.0246 951	1.0271 319
3	1.0115 331	1.0131 594	1.0147 805	1.0163 964	1.0180 071
4	1.0086 374	1.0098 534	1.0110 650	1.0122 722	1.0134 752
6	1.0057 500	1.0065 582	1.0073 631	1.0081 649	1.0089 634
12	1.0028 709	1.0032 737	1.0036 748	1.0040 741	1.0044 717
13	1.0026 498	1.0030 215	1.0033 916	1.0037 601	1.0041 270
26	1.0013 240	1.0015 096	1.0016 944	1.0018 783	1.0020 614
52	1.0006 618	1.0007 545	1.0008 468	1.0009 387	1.0010 302
365	1.0000 942	1.0001 075	1.0001 206	1.0001 337	1.0001 467
p	6 %	$6\frac{1}{2}$ %	7 %	$7\frac{1}{2}$ %	8 %
2	1.0295 630	1.0319 884	1.0344 080	1.0368 221	1.0392 305
3	1.0196 128	1.0212 135	1.0228 091	1.0243 998	1.0259 856
4	1.0146 738	1.0158 683	1.0170 585	1.0182 446	1.0194 265
6	1.0097 588	1.0105 511	1.0113 403	1.0121 264	1.0129 095
12	1.0048 676	1.0052 617	1.0056 541	1.0060 449	1.0064 340
13	1.0044 923	1.0048 560	1.0052 181	1.0055 786	1.0059 376
26	1.0022 436	1.0024 250	1.0026 056	1.0027 854	1.0029 644
52	1.0011 212	1.0012 118	1.0013 020	1.0013 918	1.0014 811
365	1.0001 596	1.0001 726	1.0001 854	1.0001 982	1.0002 109

NOMINAL RATES CONVERTIBLE p TIMES PER YEAR EQUIVALENT TO EFFECTIVE RATE i GIVEN IN HEADING, $j_p = p[(1+i)^{\frac{1}{p}} - 1]$

p	$\frac{1}{4}$ %	$\frac{5}{12}$ %	$\frac{1}{2}$ %	$\frac{7}{12}$ %	$\frac{3}{4}$ %
$\frac{1}{4}$	.0025 094	.0041 928	.0050 376	.0058 846	.0075 848
$\frac{1}{2}$	.0025 032	.0041 754	.0050 125	.0058 504	.0075 281
2	.0024 984	.0041 623	.0049 938	.0058 249	.0074 860
4	.0024 977	.0041 602	.0049 907	.0058 206	.0074 790
6	.0024 974	.0041 595	.0049 896	.0058 192	.0074 767
12	.0024 971	.0041 587	.0049 886	.0058 178	.0074 743
13	.0024 971	.0041 587	.0049 885	.0058 177	.0074 742
52	.0024 969	.0041 582	.0049 878	.0058 167	.0074 725
365	.0024 969	.0041 580	.0049 876	.0058 164	.0074 721
∞	.0024 969	.0041 580	.0049 875	.0058 164	.0074 720

p	1 %	$1\frac{1}{8}$ %	$1\frac{1}{4}$ %	$1\frac{1}{2}$ %	$1\frac{3}{4}$ %
$\frac{1}{4}$	.0101 510	.0114 413	.0127 363	.0153 409	.0179 648
$\frac{1}{2}$	.0100 500	.0113 133	.0125 781	.0151 125	.0176 531
2	.0099 751	.0112 185	.0124 612	.0149 442	.0174 241
4	.0099 627	.0112 029	.0124 418	.0149 164	.0173 863
6	.0099 586	.0111 976	.0124 354	.0149 071	.0173 737
12	.0099 545	.0111 924	.0124 290	.0148 979	.0173 612
13	.0099 541	.0111 920	.0124 285	.0148 971	.0173 602
52	.0099 513	.0111 884	.0124 240	.0148 907	.0173 515
365	.0099 505	.0111 874	.0124 227	.0148 889	.0173 490
∞	.0099 503	.0111 872	.0124 225	.0148 886	.0173 486

p	2 %	$2\frac{1}{4}$ %	$2\frac{1}{2}$ %	$2\frac{3}{4}$ %	3 %
$\frac{1}{4}$	.0206 080	.0232 708	.0259 532	.0286 553	.0313 772
$\frac{1}{2}$	.0202 000	.0227 531	.0253 125	.0278 781	.0304 500
2	.0199 010	.0223 748	.0248 457	.0273 135	.0297 783
4	.0198 517	.0223 126	.0247 690	.0272 209	.0296 683
6	.0198 353	.0222 919	.0247 435	.0271 901	.0296 317
12	.0198 190	.0222 713	.0247 180	.0271 594	.0295 952
13	.0198 177	.0222 697	.0247 161	.0271 570	.0295 924
52	.0198 064	.0222 554	.0246 985	.0271 358	.0295 672
365	.0198 032	.0222 513	.0246 934	.0271 297	.0295 600
∞	.0198 026	.0222 506	.0246 926	.0271 287	.0295 588

p	$3\frac{1}{2}$ %	4 %	$4\frac{1}{2}$ %	5 %	$5\frac{1}{2}$ %
$\frac{1}{4}$	.0368 808	.0424 647	.0481 297	.0538 766	.0597 062
$\frac{1}{2}$	.0356 125	.0408 000	.0460 125	.0512 500	.0565 125
2	.0346 990	.0396 078	.0445 048	.0493 902	.0542 639
4	.0345 498	.0394 136	.0442 600	.0490 889	.0539 007
6	.0345 002	.0393 492	.0441 787	.0489 891	.0537 804
12	.0344 508	.0392 849	.0440 977	.0488 895	.0536 604
13	.0344 470	.0392 799	.0440 915	.0488 818	.0536 512
52	.0344 128	.0392 355	.0440 355	.0488 131	.0535 683
365	.0344 030	.0392 228	.0440 195	.0487 934	.0535 447
∞	.0344 014	.0392 207	.0440 169	.0487 902	.0535 408

p	6 %	$6\frac{1}{2}$ %	7 %	$7\frac{1}{2}$ %	8 %
$\frac{1}{4}$	.0656 193	.0716 166	.0776 990	.0838 673	.0901 223
$\frac{1}{2}$	.0618 000	.0671 125	.0724 500	.0778 125	.0832 000
2	.0591 260	.0639 767	.0688 161	.0736 441	.0784 610
4	.0586 954	.0634 731	.0682 341	.0729 784	.0777 062
6	.0585 528	.0633 064	.0680 416	.0727 583	.0774 567
12	.0584 106	.0631 403	.0678 497	.0725 390	.0772 084
13	.0583 997	.0631 276	.0678 350	.0725 222	.0771 893
52	.0583 016	.0630 129	.0677 027	.0723 710	.0770 180
365	.0582 736	.0629 802	.0676 649	.0723 278	.0769 692
∞	.0582 689	.0629 748	.0676 586	.0723 207	.0769 610

AMOUNT FOR YEAR OF p DEPOSITS OF $1/p$, p TIMES PER YEAR, i/j_p

p	$\frac{1}{4}$ %	$\frac{5}{12}$ %	$\frac{1}{2}$ %	$\frac{7}{12}$ %	$\frac{3}{4}$ %
$\frac{1}{4}$	0.9962 5	0.9937 717	0.9925 312	0 9912 924	0.9888 201
$\frac{1}{2}$	0.9974 8	0.9979 210	0.9975 062	0.9970 918	0.9962 640
2	1.0006 246	1.0010 406	1.0012 484	1.0014 562	1.0018 715
4	1.0009 370	1.0015 611	1.0018 730	1.0021 848	1.0028 081
6	1.0010 412	1.0017 347	1.0020 813	1.0024 278	1.0031 205
12	1.0011 453	1.0019 083	1.0022 896	1.0026 708	1.0034 329
13	1.0011 533	1.0019 216	1.0023 056	1.0026 895	1.0034 569
52	1.0012 254	1.0020 418	1.0024 498	1.0028 577	1.0036 732
365	1.0012 461	1.0020 762	1.0024 911	1.0029 058	1.0037 351
∞	1.0012 495	1.0020 819	1.0024 979	1.0029 138	1.0037 453

p	1 %	$1\frac{1}{8}$ %	$1\frac{1}{4}$ %	$1\frac{1}{2}$ %	$1\frac{3}{4}$ %
$\frac{1}{4}$	0.9851 244	0.9832 823	0.9814 441	0.9777 791	0.9741 295
$\frac{1}{2}$	0.9950 249	0.9944 065	0.9937 888	0.9925 558	0.9913 259
2	1.0024 938	1.0028 046	1.0031 153	1.0037 360	1.0043 618
4	1.0037 422	1.0042 089	1.0046 754	1.0056 076	1.0065 388
6	1.0041 586	1.0046 773	1.0051 958	1.0062 319	1.0072 671
12	1.0045 751	1.0051 458	1.0057 163	1.0068 565	1.0079 957
13	1.0046 071	1.0051 819	1.0057 564	1.0069 046	1.0080 518
52	1.0048 956	1.0055 063	1.0061 169	1.0073 372	1.0085 564
365	1.0049 780	1.0055 991	1.0062 199	1.0074 608	1.0087 007
∞	1.0049 917	1.0056 145	1.0062 371	1.0074 814	1.0087 247

p	2 %	$2\frac{1}{4}$ %	$2\frac{1}{2}$ %	$2\frac{3}{4}$ %	3 %
$\frac{1}{4}$	0.9704 950	0.9668 757	0.9632 715	0.9596 824	0.9561 082
$\frac{1}{2}$	0.9900 990	0.9888 752	0.9876 543	0.9864 365	0.9852 217
2	1.0049 752	1.0055 937	1.0062 114	1.0068 284	1.0074 446
4	1.0074 686	1.0083 984	1.0093 268	1.0102 542	1.0111 807
6	1.0083 013	1.0093 344	1.0103 667	1.0113 979	1.0124 282
12	1.0091 339	1.0102 711	1.0114 072	1.0125 424	1.0136 766
13	1.0091 980	1.0103 431	1.0114 873	1.0126 305	1.0137 727
52	1.0097 747	1.0109 919	1.0122 082	1.0134 234	1.0146 376
365	1.0099 396	1.0111 775	1.0124 143	1.0136 502	1.0148 850
∞	1.0099 670	1.0112 083	1.0124 486	1.0136 878	1.0149 261

p	$3\frac{1}{2}$ %	4 %	$4\frac{1}{2}$ %	5 %	$5\frac{1}{2}$ %
$\frac{1}{4}$	0.9490 046	0.9419 6	0.9349 7	0.9280 5	0.9211 8
$\frac{1}{2}$	0.9828 010	0.9803 922	0.9779 951	0.9756 098	0.9732 360
2	1.0086 748	1.0099 020	1.0111 262	1.0123 475	1.0135 660
4	1.0130 309	1.0148 774	1.0167 203	1.0185 594	1.0203 950
6	1.0144 858	1.0165 396	1.0185 895	1.0206 357	1.0226 781
12	1.0159 420	1.0182 035	1.0204 611	1.0227 148	1.0249 647
13	1.0160 541	1.0183 316	1.0206 051	1.0228 748	1.0251 407
52	1.0170 632	1.0194 847	1.0219 623	1.0243 160	1.0267 259
365	1.0173 517	1.0198 145	1.0222 733	1.0247 282	1.0271 793
∞	1.0173 997	1.0198 693	1.0223 349	1.0247 967	1.0272 546

p	6 %	$6\frac{1}{2}$ %	7 %	$7\frac{1}{2}$ %	8 %
$\frac{1}{4}$	0.9143 7	0.9076 1	0.9009 1	0.8942 7	0.8876 8
$\frac{1}{2}$	0.9708 738	0.9685 230	0.9661 836	0.9638 554	0.9615 385
2	1.0147 815	1.0159 942	1.0172 040	1.0184 110	1.0196 152
4	1.0222 269	1.0240 552	1.0258 800	1.0277 013	1.0295 190
6	1.0247 168	1.0267 517	1.0287 830	1.0308 106	1.0328 346
12	1.0272 107	1.0294 529	1.0316 914	1.0339 262	1.0361 572
13	1.0274 027	1.0296 609	1.0319 154	1.0341 661	1.0364 131
52	1.0291 319	1.0315 340	1.0339 324	1.0363 270	1.0387 179
365	1.0296 265	1.0320 699	1.0345 095	1.0369 453	1.0393 774
∞	1.0297 087	1.0321 589	1.0346 053	1.0370 480	1.0394 870

AMERICAN EXPERIENCE MORTALITY TABLE

Based on 100,000 living at age 10, giving: l_x, number of living; d_x, number of deaths; p_x, probability of living; q_x, probability of dying for age x from 10 to 95.

x	l_x	d_x	p_x	q_x	x	l_x	d_x	p_x	q_x
10	100000	749	.992510	.007490	**55**	64563	1199	.981429	.018571
11	99251	746	.992484	.007516	56	63364	1260	.980115	.019885
12	98505	743	.992457	.007543	57	62104	1325	.978665	.021335
13	97762	740	.992431	.007569	58	60779	1394	.977064	.022936
14	97022	737	.992404	.007596	59	59385	1468	.975280	.024720
15	96285	735	.992366	.007634	**60**	57917	1546	.973307	.026693
16	95550	732	.992339	.007661	61	56371	1628	.971120	.028880
17	94818	729	.992312	.007688	62	54743	1713	.968708	.031292
18	94089	727	.992273	.007727	63	53030	1800	.966057	.033943
19	93362	725	.992235	.007765	64	51230	1889	.963127	.036873
20	92637	723	.992195	.007805	**65**	49341	1980	.959871	.040129
21	91914	722	.992145	.007855	66	47361	2070	.956293	.043707
22	91192	721	.992094	.007906	67	45291	2158	.952353	.047647
23	90471	720	.992042	.007958	68	43133	2243	.947998	.052002
24	89751	719	.991989	.008011	69	40890	2321	.943238	.056762
25	89032	718	.991935	.008065	**70**	38569	2391	.938007	.061993
26	88314	718	.991870	.008130	71	36178	2448	.932335	.067665
27	87596	718	.991803	.008197	72	33730	2487	.926267	.073733
28	86878	718	.991736	.008264	73	31243	2505	.919822	.080178
29	86160	719	.991655	.008345	74	28738	2501	.912972	.087028
30	85441	720	.991573	.008427	**75**	26237	2476	.905629	.094371
31	84721	721	.991490	.008510	76	23761	2431	.897689	.102311
32	84000	723	.991393	.008607	77	21330	2369	.888936	.111064
33	83277	726	.991282	.008718	78	18961	2291	.879173	.120827
34	82551	729	.991169	.008831	79	16670	2196	.868266	.131734
35	81822	732	.991054	.008946	**80**	14474	2091	.855534	.144466
36	81090	737	.990911	.009089	81	12383	1964	.841395	.158605
37	80353	742	.990766	.009234	82	10419	1816	.825703	.174297
38	79611	749	.990592	.009408	83	8603	1648	.808439	.191561
39	78862	756	.990414	.009586	84	6955	1470	.788641	.211359
40	78106	765	.990206	.009794	**85**	5485	1292	.764448	.235552
41	77341	774	.989992	.010008	86	4193	1114	.734319	.265681
42	76567	785	.989748	.010252	87	3079	933	.696980	.303020
43	75782	797	.989483	.010517	88	2146	744	.653308	.346692
44	74985	812	.989171	.010829	89	1402	555	.604137	.395863
45	74173	828	.988837	.011163	**90**	847	385	.545455	.454545
46	73345	848	.988438	.011562	91	462	246	.467532	.532468
47	72497	870	.988000	.012000	92	216	137	.365741	.634259
48	71627	896	.987491	.012509	93	79	58	.265823	.734177
49	70731	927	.986894	.013106	94	21	18	.142857	.857143
50	69804	962	.986219	.013781	**95**	3	3	.000000	1.000000
51	68842	1001	.985459	.014541					
52	67841	1044	.984611	.015389					
53	66797	1091	.983667	.016333					
54	65706	1143	.982604	.017396					

COMMUTATION COLUMNS 3%

$$\mathbb{N}_x = D_x + D_{x+1} + D_{x+2} \cdots + D_{95}$$
$$M_x = C_x + C_{x+1} + C_{x+2} \cdots + C_{95}$$

$1 + a_x = \mathbb{N}_x/D_x$ $\qquad$ $A_x = M_x/D_x$

$D_x = v^x l_x$ $\qquad$ $C_x = v^{x+1} d_x$

x	D_x	$\mathbb{N}_x$	C_x	M_x	$1 + a_x$	A_x
10	74409.4	1811 346	541.094	21651.7	24.3430	.290981
11	71701.0	1736 936	523.229	21110.7	24.2247	.294426
12	69089.4	1665 235	505.947	20587.4	24.1026	.297982
13	66571.2	1596 146	489.227	20081.5	23.9765	.301654
14	64143.0	1529 575	473.052	19592.3	23.8463	.305447
15	61801.7	1465 432	458.028	19119.2	23.7118	.309364
16	59543.6	1403 630	442.872	18661.2	23.5731	.313403
17	57366.4	1344 086	428.211	18218.3	23.4298	.317578
18	55267.4	1286 720	414.598	17790.1	23.2817	.321891
19	53243.0	1231 453	401.415	17375.5	23.1289	.326343
20	51290.9	1178 210	388.648	16974.1	22.9711	.330938
21	49408.3	1126 919	376.806	16585.4	22.8083	.335681
22	47592.4	1077 510	365.325	16208.6	22.6404	.340571
23	45840.9	1029 918	354.192	15843.3	22.4672	.345615
24	44151.5	984 077	343.398	15489.1	22.2886	.350817
25	42522.2	939 926	332.933	15145.7	22.1044	.356184
26	40950.7	897 403	323.236	14812.8	21.9142	.361722
27	39434.8	856 453	313.821	14489.5	21.7182	.367431
28	37972.4	817 018	304.681	14175.7	21.5161	.373317
29	36561.7	779 046	296.218	13871.0	21.3077	.379387
30	35200.6	742 484	287.991	13574.8	21.0930	.385642
31	33887.3	707 283	279.991	13286.8	20.8716	.392089
32	32620.3	673 396	272.590	13006.8	20.6435	.398734
33	31397.6	640 776	265.749	12734.2	20.4084	.405580
34	30217.4	609 378	259.074	12468.5	20.1665	.412627
35	29078.2	579 161	252.564	12209.4	19.9174	.419883
36	27978.7	550 082	246.882	11956.9	19.6608	.427356
37	26916.9	522 104	241.318	11710.0	19.3969	.435042
38	25891.6	495 187	236.499	11468.7	19.1254	.442949
39	24901.0	469 295	231.757	11232.2	18.8465	.451073
40	23943.9	444 394	227.685	11000.4	18.5598	.459423
41	23018.8	420 450	223.654	10772.7	18.2655	.467996
42	22124.7	397 432	220.226	10549.1	17.9632	.476799
43	21260.1	375 307	217.080	10328.8	17.6531	.485832
44	20423.8	354 047	214.724	10111.8	17.3350	.495097
45	19614.2	333 623	212.578	9897.03	17.0093	.504585
46	18830.3	314 009	211.371	9684.45	16.6757	.514301
47	18070.5	295 178	210.539	9473.08	16.3348	.524229
48	17333.6	277 108	210.515	9262.54	15.9867	.534368
49	16618.3	259 774	211.455	9052.03	15.6318	.544703
50	15922.8	243 156	213.048	8840.57	15.2709	.555215
51	15246.0	227 233	215.228	8627.53	14.9045	.565889
52	14586.7	211 987	217.935	8412.30	14.5329	.576711
53	13943.9	197 401	221.113	8194.36	14.1568	.587667
54	13316.6	183 457	224.905	7973.25	13.7765	.598743

COMMUTATION COLUMNS 3% (Continued)

x	D_x	N_x	C_x	M_x	$1 + a_x$	A_x
55	12703.9	170140	229.052	7748.34	13.3928	.609920
56	12104.8	157436	233.695	7519.29	13.0061	.621182
57	11518.5	145331	238.593	7285.60	12.6172	.632510
58	10944.5	133813	243.706	7047.00	12.2265	.643888
59	10382.0	122868	249.168	6803.30	11.8348	.655298
60	9830.43	112486	254.764	6554.13	11.4427	.666718
61	9289.34	102656	260.463	6299.37	11.0509	.678128
62	8758.32	93366.6	266.080	6038.90	10.6603	.689505
63	8237.14	84608.2	271.450	5772.82	10.2716	.700828
64	7725.77	76371.1	276.575	5501.37	9.88524	.712080
65	7224.18	68645.3	281.455	5224.80	9.50217	.723238
66	6732.31	61421.2	285.678	4943.34	9.12334	.734272
67	6250.54	54688.8	289.148	4657.67	8.74945	.745162
68	5779.34	48438.3	291.784	4368.52	8.38128	.755885
69	5319.23	42659.0	293.136	4076.73	8.01976	.766415
70	4871.16	37339.7	293.182	3783.60	7.66547	.776734
71	4436.10	32468.6	291.428	3490.42	7.31916	.786820
72	4015.47	28032.5	287.447	3198.99	6.98112	.796666
73	3611.07	24017.0	281.095	2911.54	6.65094	.806283
74	3224.79	20405.9	272.472	2630.45	6.32783	.815694
75	2858.40	17181.1	261.892	2357.97	6.01076	.824929
76	2513.25	14322.7	249.643	2096.08	5.69889	.834013
77	2190.41	11809.5	236.190	1846.44	5.39146	.842967
78	1890.42	9619.09	221.761	1610.25	5.08834	.851796
79	1613.60	7728.67	206.374	1388.49	4.78972	.860494
80	1360.22	6115.07	190.783	1182.12	4.49563	.869059
81	1129.82	4754.85	173.976	991.333	4.20849	.877423
82	922.940	3625.02	156.180	817.357	3.92769	.885601
83	739.878	2702.08	137.604	661.177	3.65207	.893629
84	580.725	1962.21	119.166	523.573	3.37889	.901586
85	444.644	1381.48	101.686	404.407	3.10694	.909507
86	330.007	936.837	85.1229	302.721	2.83884	.917315
87	235.272	606.829	69.2159	217.598	2.57926	.924876
88	159.204	371.557	53.5871	148.382	2.33384	.932024
89	100.980	212.353	38.8099	94.7949	2.10292	.938750
90	59.2288	111.373	26.1381	55.9850	1.88039	.945231
91	31.3657	52.1442	16.2148	29.8469	1.66249	.951579
92	14.2373	20.7785	8.76715	13.6321	1.45944	.957492
93	5.05551	6.54120	3.60354	4.86499	1.29388	.962314
94	1.30473	1.48569	1.08577	1.26146	1.13870	.966834
95	0.180961	0.180961	0.175690	0.175690	1.00000	.970874

COMMUTATION COLUMNS $3\frac{1}{2}\%$

$$\mathbb{N}_x = D_x + D_{x+1} + D_{x+2} \cdot \cdot \cdot \cdot + D_{95}$$
$$M_x = C_x + C_{x+1} + C_{x+2} \cdot \cdot \cdot \cdot + C_{95}$$
$$1 + a_x = \mathbb{N}_x/D_x \qquad A_x = M_x/D_x$$

x	D_x	$\mathbb{N}_x$	C_x	M_x	$1 + a_x$	A_x
10	70891.9	1575 535	513.024	17612.9	22.2245	.24845
11	67981.5	1504 643	493.690	17099.9	22.1331	.25154
12	65189.0	1436 662	475.077	16606.2	22.0384	.25474
13	62509.4	1371 473	457.159	16131.1	21.9403	.25806
14	59938.4	1308 963	439.908	15674.0	21.8385	.26151
15	57471.6	1249 025	423.879	15234.1	21.7329	.26508
16	55104.2	1191 553	407.873	14810.2	21.6236	.26877
17	52832.9	1136 449	392.465	14402.3	21.5102	.27261
18	50653.9	1083 616	378.153	14009.8	21.3926	.27659
19	48562.8	1032 962	364.360	13631.7	21.2707	.28071
20	46556.2	984 400	351.068	13267.3	21.1443	.28497
21	44630.8	937 843	338.727	12916.3	21.0134	.28940
22	42782.8	893 213	326.819	12577.5	20.8779	.29399
23	41009.2	850 430	315.329	12250.7	20.7375	.29873
24	39307.1	809 421	304.243	11935.4	20.5922	.30365
25	37673.6	770 114	293.545	11631.1	20.4417	.30873
26	36106.1	732 440	283.619	11337.6	20.2858	.31401
27	34601.5	696 334	274.028	11054.0	20.1244	.31947
28	33157.4	661 732	264.761	10779.9	19.9573	.32512
29	31771.3	628 575	256.164	10515.2	19.7843	.33097
30	30440.8	596 804	247.846	10259.0	19.6054	.33702
31	29163.5	566 363	239.797	10011.2	19.4202	.34328
32	27937.5	537 199	232.331	9771.37	19.2286	.34976
33	26760.5	509 262	225.406	9539.04	19.0304	.35646
34	25630.1	482 501	218.683	9313.64	18.8256	.36339
35	24544.7	456 871	212.158	9094.96	18.6138	.37055
36	23502.5	432 327	206.383	8882.80	18.3949	.37795
37	22501.4	408 824	200.757	8676.41	18.1688	.38560
38	21539.7	386 323	195.798	8475.66	17.9354	.39349
39	20615.5	364 783	190.945	8279.86	17.6946	.40163
40	19727.4	344 167	186.684	8088.91	17.4461	.41003
41	18873.6	324 440	182.493	7902.23	17.1901	.41869
42	18052.9	305 566	178.828	7719.74	16.9262	.42762
43	17263.6	287 513	175.422	7540.91	16.6543	.43681
44	16504.4	270 250	172.679	7365.49	16.3744	.44628
45	15773.6	253 745	170.127	7192.81	16.0867	.45600
46	15070.0	237 972	168.345	7022.68	15.7911	.46600
47	14392.1	222 902	166.872	6854.34	15.4878	.47626
48	13738.5	208 510	166.047	6687.47	15.1770	.48677
49	13107.9	194 771	165.982	6521.42	14.8591	.49752
50	12498.6	181 663	166.424	6355.44	14.5346	.50849
51	11909.6	169 165	167.315	6189.01	14.2041	.51967
52	11339.5	157 255	168.602	6021.70	13.8679	.53104
53	10787.4	145 916	170.234	5853.09	13.5264	.54258
54	10252.4	135 128	172.317	5682.86	13.1801	.55430

COMMUTATION COLUMNS 3½% (Continued)

x	D_x	N_x	C_x	M_x	$1 + a_x$	A_x
55	9733.40	124876	174.646	5510.54	12.8296	.56615
56	9229.60	115142	177.325	5335.90	12.4753	.57813
57	8740.17	105913	180.167	5158.57	12.1179	.59022
58	8264.44	97172.6	183.140	4978.41	11.7579	.60239
59	7801.82	88908.2	186.340	4795.27	11.3958	.61463
60	7351.65	81106.4	189.604	4608.93	11.0324	.62692
61	6913.44	73754.7	192.909	4419.32	10.6683	.63924
62	6486.75	66841.3	196.117	4226.41	10.3043	.65155
63	6071.27	60354.5	199.109	4030.30	9.9410	.66383
64	5666.85	54283.3	201.887	3831.19	9.5791	.67607
65	5273.33	48616.4	204.457	3629.30	9.2193	.68824
66	4890.55	43343.1	206.522	3424.84	8.8626	.70030
67	4518.65	38452.5	208.021	3218.32	8.5097	.71223
68	4157.82	33933.9	208.903	3010.30	8.1615	.72401
69	3808.32	29776.1	208.858	2801.40	7.8187	.73560
70	3470.67	25967.7	207.881	2592.54	7.4820	.74698
71	3145.43	22497.1	205.639	2384.66	7.1523	.75813
72	2833.42	19351.6	201.851	2179.02	6.8298	.76904
73	2535.75	16518.2	196.436	1977.17	6.5141	.77972
74	2253.57	13982.5	189.491	1780.73	6.2046	.79018
75	1987.87	11728.9	181.253	1591.24	5.9002	.80048
76	1739.39	9741.03	171.940	1409.99	5.6002	.81062
77	1508.63	8001.63	161.889	1238.05	5.3039	.82064
78	1295.73	6493.00	151.265	1076.16	5.0111	.83054
79	1100.65	5197.27	140.089	924.894	4.7220	.84032
80	923.338	4096.62	128.880	784.805	4.4368	.84997
81	763.234	3173.29	116.959	655.925	4.1577	.85940
82	620.465	2410.05	104.488	538.966	3.8843	.86865
83	494.995	1789.59	91.6153	434.478	3.6154	.87774
84	386.641	1294.59	78.9564	342.862	3.3483	.88677
85	294.610	907.951	67.0490	263.906	3.0819	.89578
86	217.598	613.342	55.8566	196.857	2.8187	.90468
87	154.383	395.744	45.1992	141.000	2.5634	.91332
88	103.963	241.361	34.8243	95.8011	2.3216	.92149
89	65.6231	137.398	25.0993	60.9768	2.0937	.92920
90	38.3047	71.7747	16.8224	35.8775	1.8738	.93664
91	20.1869	33.4700	10.3854	19.0551	1.6580	.94393
92	9.11888	13.2831	5.58815	8.66969	1.4567	.95074
93	3.22236	4.16421	2.28578	3.08155	1.2923	.95630
94	0.827611	0.941843	0.685392	0.795762	1.1380	.96152
95	0.114232	0.114232	0.110369	0.110369	1.0000	.96618

COMMUTATION COLUMNS 4%

$$\mathbb{N}_x = D_x + D_{x+1} + D_{x+2} \cdots + D_{96}$$
$$M_x = C_x + C_{x+1} + C_{x+2} \cdots + C_{96}$$
$$1 + a_x = \mathbb{N}_x / D_x \qquad A_x = M_x / D_x$$

x	D_x	$\mathbb{N}_x$	C_x	M_x	$1 + a_x$	A_x
10	67556.4	1379 083	486.536	14514.8	20.4138	.214854
11	64471.6	1311 527	465.949	14028.2	20.3427	.217588
12	61525.9	1247 055	446.227	13562.3	20.2688	.220432
13	58713.3	1185 529	427.332	13116.0	20.1918	.223391
14	56027.8	1126 816	409.230	12688.7	20.1117	.226472
15	53463.6	1070 788	392.423	12279.5	20.0283	.229679
16	51014.9	1017 325	375.789	11887.1	19.9417	.233011
17	48677.0	966 310	359.855	11511.3	19.8515	.236483
18	46445.0	917 633	345.065	11151.4	19.7574	.240099
19	44313.6	871 188	330.881	10806.4	19.6596	.243861
20	42278.3	826 874	317.277	10475.5	19.5579	.247774
21	40335.0	784 596	304.652	10158.2	19.4520	.251846
22	38479.0	744 261	292.529	9853.54	19.3420	.256076
23	36706.5	705 782	280.887	9561.01	19.2277	.260472
24	35013.8	669 075	269.709	9280.12	19.1089	.265042
25	33397.4	634 062	258.975	9010.42	18.9854	.269794
26	31853.9	600 664	249.014	8751.44	18.8568	.274737
27	30379.7	568 810	239.437	8502.43	18.7233	.279872
28	28971.9	538 431	230.228	8262.99	18.5846	.285207
29	27627.3	509 459	221.681	8032.76	18.4404	.290754
30	26343.1	481 831	213.451	7811.08	18.2906	.296514
31	25116.4	455 488	205.527	7597.63	18.1351	.302497
32	23944.9	430 372	198.170	7392.10	17.9735	.308713
33	22825.7	406 427	191.339	7193.93	17.8056	.315168
34	21756.5	383 601	184.740	7002.59	17.6316	.321862
35	20735.0	361 845	178.366	6817.85	17.4510	.328810
36	19759.1	341 110	172.677	6639.49	17.2634	.336022
37	18826.5	321 351	167.162	6466.81	17.0691	.343496
38	17935.2	302 524	162.249	6299.65	16.8676	.351245
39	17083.1	284 589	157.467	6137.40	16.6591	.359267
40	16268.6	267 506	153.213	5979.93	16.4431	.367575
41	15489.7	251 237	149.053	5826.72	16.2196	.376168
42	14744.9	235 748	145.357	5677.67	15.9884	.385060
43	14032.4	221 003	141.903	5532.31	15.7494	.394252
44	13350.8	206 970	139.013	5390.41	15.5025	.403752
45	12698.3	193 619	136.300	5251.40	15.2477	.413551
46	12073.6	180 921	134.224	5115.10	14.9849	.423659
47	11475.0	168 848	132.409	4980.87	14.7144	.434063
48	10901.3	157 373	131.122	4848.46	14.4362	.444762
49	10350.9	146 471	130.441	4717.34	14.1507	.455744
50	9822.30	136 120	130.159	4586.90	13.8583	.466988
51	9314.36	126 298	130.227	4456.74	13.5595	.478481
52	8825.89	116 984	130.597	4326.51	13.2546	.490207
53	8355.84	108 158	131.227	4195.92	12.9440	.5021[illegible]4
54	7903.23	99802.1	132.194	4064.69	12.6280	.514307

COMMUTATION COLUMNS 4% (Continued)

x	D_x	N_x	C_x	M_x	$1 + a_x$	A_x
55	7467.07	91898.8	133.337	3932.50	12.3072	.526645
56	7046.53	84431.8	134.732	3799.16	11.9820	.539153
57	6640.78	77385.2	136.233	3664.43	11.6530	.551806
58	6249.13	70744.5	137.815	3528.19	11.3207	.564589
59	5870.97	64495.3	139.549	3390.38	10.9855	.577482
60	5505.61	58624.4	141.311	3250.83	10.6481	.590457
61	5152.55	53118.7	143.083	3109.52	10.3092	.603492
62	4811.29	47966.2	144.763	2966.44	9.96951	.616557
63	4481.48	43154.9	146.264	2821.67	9.62962	.629630
64	4162.85	38673.4	147.593	2675.41	9.29014	.642687
65	3855.15	34510.6	148.753	2527.82	8.95182	.655699
66	3558.12	30655.4	149.533	2379.06	8.61563	.668630
67	3271.74	27097.3	149.894	2229.53	8.28225	.681452
68	2996.01	23825.6	149.806	2079.64	7.95245	.694137
69	2730.97	20829.6	149.053	1929.83	7.62718	.706647
70	2476.88	18098.6	147.643	1780.78	7.30702	.718961
71	2233.97	15621.7	145.349	1633.13	6.99281	.731046
72	2002.70	13387.8	141.985	1487.79	6.68486	.742890
73	1783.69	11385.1	137.512	1345.80	6.38288	.754505
74	1577.57	9601.37	132.012	1208.29	6.08617	.765917
75	1384.89	8023.80	125.666	1076.28	5.79384	.777160
76	1205.95	6638.91	118.636	950.612	5.50511	.788265
77	1040.94	5432.96	111.164	831.975	5.21931	.799257
78	889.735	4392.02	103.369	720.811	4.93633	.810141
79	752.145	3502.29	95.2720	617.442	4.65640	.820908
80	627.945	2750.14	87.2275	522.170	4.37960	.831554
81	516.565	2122.20	78.7785	434.942	4.10829	.841989
82	417.919	1605.63	70.0404	356.164	3.84197	.852232
83	331.805	1187.72	61.1163	286.124	3.57956	.862325
84	257.927	855.910	52.4184	225.007	3.31842	.872368
85	195.588	597.983	44.2991	172.589	3.05736	.882409
86	143.767	402.395	36.7269	128.290	2.79895	.892348
87	101.510	258.629	29.5766	91.5628	2.54781	.902007
88	68.0293	157.118	22.6781	61.9863	2.30957	.911171
89	42.7347	89.0892	16.2664	39.3082	2.08470	.919819
90	24.8246	46.3544	10.8499	23.0418	1.86728	.928182
91	13.0199	21.5298	6.66604	12.1919	1.65360	.936400
92	5.85311	8.50988	3.56960	5.52581	1.45391	.94408
93	2.05838	2.65677	1.45310	1.95621	1.29071	.95036
94	0.52612	0.59839	0.43362	0.50311	1.1374	.9563
95	0.07227	0.07227	0.06949	0.06949	1.0000	.962

VALUATION COLUMNS 3½%

$u_x = D_x/D_{x+1}$ $k_x = C_x/D_{x+1}$

x	u_x	k_x	x	u_x	k_x
10	1.042 811	0.007 546	**55**	1.054 585	0.018 922
11	1.042 838	.007 573	56	1.055 999	.020 289
12	1.042 866	.007 600	57	1.057 563	.021 800
13	1.042 894	.007 627	58	1.059 296	.023 474
14	1.042 922	.007 654	59	1.061 234	.025 347
15	1.042 962	0.007 692	**60**	1.063 385	0.027 425
16	1.042 990	.007 720	61	1.065 780	.029 739
17	1.043 019	.007 748	62	1.068 433	.032 303
18	1.043 059	.007 787	63	1.071 365	.035 136
19	1.043 100	.007 826	64	1.074 625	.038 285
20	1.043 141	0.007 866	**65**	1.078 270	0.041 807
21	1.043 195	.007 917	66	1.082 304	.045 704
22	1.043 248	.007 969	67	1.086 782	.050 031
23	1.043 303	.008 022	68	1.091 774	.054 855
24	1.043 358	.008 076	69	1.097 284	.060 178
25	1.043 415	0.008 130	**70**	1.103 403	0.066 090
26	1.043 484	.008 197	71	1.110 117	.072 576
27	1.043 554	.008 264	72	1.117 388	.079 602
28	1.043 625	.008 333	73	1.125 218	.087 167
29	1.043 710	.008 415	74	1.133 660	.095 323
30	1.043 796	0.008 498	**75**	1.142 852	0.104 204
31	1.043 884	.008 583	76	1.152 960	.113 971
32	1.043 986	.008 682	77	1.164 314	.124 941
33	1.044 102	.008 795	78	1.177 243	.137 433
34	1.044 221	.008 910	79	1.192 031	.151 720
35	1.044 343	0.009 027	**80**	1.209 771	0.168 861
36	1.044 493	.009 172	81	1.230 099	.188 502
37	1.044 647	.009 320	82	1.253 477	.211 089
38	1.044 830	.009 498	83	1.280 245	.236 952
39	1.045 018	.009 679	84	1.312 384	.268 004
40	1.045 238	0.009 891	**85**	1.353 917	0.308 133
41	1.045 463	.010 109	86	1.409 469	.361 806
42	1.045 721	.010 359	87	1.484 979	.434 762
43	1.046 001	.010 629	88	1.584 244	.530 671
44	1.046 331	.010 947	89	1.713 188	.655 254
45	1.046 684	0.011 289	**90**	1.897 500	0.833 333
46	1.047 106	.011 697	91	2.213 750	1.138 889
47	1.047 571	.012 146	92	2.829 873	1.734 177
48	1.048 111	.012 668	93	3.893 571	2.761 905
49	1.048 745	.013 280	94	7.245 000	6.000 000
50	1.049 463	0.013 974	**95**	....	....
51	1.050 272	.014 755			
52	1.051 177	.015 629			
53	1.052 185	.016 604			
54	1.053 323	.017 704			

CALCULUS

Differentials

$d\,ax = a dx$

$d(u + v) = du + dv$

$d\,uv = udv + vdu$

$d\frac{u}{v} = \frac{vdu - udv}{v^2}$

$d\,x^n = n\,x^{n-1}dx$

$dx^y = yx^{y-1}dx + x^y \log_e x\,dy$

$d\,e^x = e^x\,dx$

$d\,e^{ax} = a\,e^{ax}dx$

$d\,a^x = a^x \log_e a\,dx$

$d \log_e x = x^{-1}dx$

$d \log_a x = x^{-1} \log_a e\,dx$

$d\,x^x = x^x\,(1 + \log_e x)\,dx$

$d \sin x = \cos x\,dx$

$d \cos x = -\sin x\,dx$

$d \tan x = \sec^2 x\,dx$

$d \cot x = -\csc^2 x\,dx$

$d \sec x = \tan x \sec x\,dx$

$d \csc x = -\cot x \cdot \csc x\,dx$

$d \operatorname{vers} x = \sin x\,dx$

$d \sin^{-1}x = (1 - x^2)^{-\frac{1}{2}}dx$

$d \cos^{-1}x = -(1 - x^2)^{-\frac{1}{2}}dx$

$d \tan^{-1}x = (1 + x^2)^{-1}dx$

$d \cot^{-1}x = -(1 + x^2)^{-1}dx$

$d \sec^{-1}x = x^{-1}(x^2 - 1)^{-\frac{1}{2}}dx$

$d \csc^{-1}x = -x^{-1}\,(x^2 - 1)^{-\frac{1}{2}}dx$

$d \operatorname{vers}^{-1} x = (2x - x^2)^{-\frac{1}{2}}\,dx$

$d \sinh x = \cosh x\,dx$

$d \cosh x = \sinh x\,dx$

$d \tanh x = \operatorname{sech}^2 x\,dx$

$d \coth x = -\operatorname{csch}^2 x\,dx$

$d \operatorname{sech} x = -\operatorname{sech} x \tanh x\,dx$

$d \operatorname{csch} x = -\operatorname{csch} x \coth x\,dx$

$d \sinh^{-1} x = (x^2 + 1)^{-\frac{1}{2}}dx$

$d \cosh^{-1} x = (x^2 - 1)^{-\frac{1}{2}}dx$

$d \tanh^{-1} x = (1 - x^2)^{-1}dx$

$d \coth^{-1} x = -(x^2 - 1)^{-1}dx$

$d \operatorname{sech}^{-1} x = -x(1 - x^2)^{-\frac{1}{2}}dx$

$d \operatorname{csch}^{-1} x = -x(x^2 + 1)^{-\frac{1}{2}}dx$

INTEGRALS

Elementary Forms

1. $\int a\,dx = ax.$

2. $\int a \cdot f(x)dx = a \int f(x)dx.$

3. $\int \phi(y)dx = \int \frac{\phi(y)}{y'}\,dy,$ where $y' = dy/dx.$

4. $\int (u + v)\,dx = \int u\,dx + \int v\,dx$, where u and v are any functions of x.

5. $\int u\,dv = uv - \int v\,du.$

6. $\int u \frac{dv}{dx}\,dx = uv - \int v \frac{du}{dx}\,dx.$

7. $\int x^n\,dx = \frac{x^{n+1}}{n+1},$ except $n = -1.$

8. $\int \frac{f'(x)\,dx}{f(x)} = \log f(x),$ $[d\,f(x) = f'(x)\,dx].$

9. $\int \frac{dx}{x} = \log x, \text{ or } \log(-x).$

10. $\int \frac{f'(x)\,dx}{2\sqrt{f(x)}} = \sqrt{f(x)}.$ $[d\,f(x) = f'(x)\,dx].$

11. $\int e^x\,dx = e^x.$

12. $\int e^{ax}\,dx = e^{ax}/a.$

13. $\int b^{ax}\,dx = \frac{b^{ax}}{a \log b}.$

14. $\int \log x\,dx = x \log x - x.$

15. $\int a^x \log a\,dx = a^x.$

16. $\int \frac{dx}{a^2 + x^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right), \text{ or } -\frac{1}{a}\cot^{-1}\left(\frac{x}{a}\right).$

17. $\int \frac{dx}{a^2 - x^2} = \frac{1}{a}\tanh^{-1}\left(\frac{x}{a}\right), \text{ or } \frac{1}{2a}\log\frac{a+x}{a-x}.$

18. $\int \frac{dx}{x^2 - a^2} = -\frac{1}{a}\coth^{-1}\left(\frac{x}{a}\right), \text{ or } \frac{1}{2a}\log\frac{x-a}{x+a}.$

19. $\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1}\left(\frac{x}{a}\right), \text{ or } -\cos^{-1}\left(\frac{x}{a}\right).$

20. $\int \frac{dx}{\sqrt{x^2 \pm a^2}} = \log\left(x + \sqrt{x^2 \pm a^2}\right).$

21. $\int \frac{dx}{x\sqrt{x^2 - a^2}} = \frac{1}{a}\cos^{-1}\left(\frac{a}{x}\right).$

22. $\int \frac{dx}{x\sqrt{a^2 \pm x^2}} = -\frac{1}{a}\log\left(\frac{a + \sqrt{a^2 \pm x^2}}{x}\right).$

23. $$\int \frac{dx}{x\sqrt{a+bx}} = \frac{2}{\sqrt{-a}} \tan^{-1} \sqrt{\frac{a+bx}{-a}}, \text{ or } \frac{-2}{\sqrt{a}} \tanh^{-1} \sqrt{\frac{a+bx}{a}}.$$

Forms Containing $(a + bx)$

24. $$\int (a+bx)^n dx = \frac{(a+bx)^{n+1}}{(n+1)b}, \text{ except } n = -1.$$

25. $$\int x\,(a+bx)^n dx = \frac{1}{b^2(n+2)}(a+bx)^{n+2} - \frac{a}{b^2(n+1)}(a+bx)^{n+1}, \text{ except } n = -1 \text{ or } -2.$$

26. $$\int x^2 (a+bx)^n\, dx = \frac{1}{b^3}\left[\frac{(a+bx)^{n+3}}{n+3} - 2a\,\frac{(a+bx)^{n+2}}{n+2} + a^2\,\frac{(a+bx)^{n+1}}{n+1}\right].$$

27. $$\int x^m (a+bx)^n\, dx = \frac{x^{m+1}(a+bx)^n}{m+n+1} + \frac{an}{m+n+1}\int x^m (a+bx)^{n-1}\, dx.$$

28. $$\int \frac{dx}{a+bx} = \frac{1}{b}\log(a+bx).$$

29. $$\int \frac{dx}{(a+bx)^2} = -\frac{1}{b\,(a+bx)}$$

30. $$\int \frac{dx}{(a+bx)^3} = -\frac{1}{2\,b\,(a+bx)^2}.$$

31. $$\int \frac{xdx}{a+bx} = \frac{1}{b^2}[a+bx - a\log(a+bx)].$$

32. $$\int \frac{xdx}{(a+bx)^2} = \frac{1}{b^2}\left[\log(a+bx) + \frac{a}{a+bx}\right].$$

33. $$\int \frac{xdx}{(a+bx)^3} = \frac{1}{b^2}\left[-\frac{1}{a+bx} + \frac{a}{2(a+bx)^2}\right].$$

34. $$\int \frac{x^2\,dx}{a+bx} = \frac{1}{b^3}\left[\frac{1}{2}(a+bx)^2 - 2\,a\,(a+bx) + a^2\log(a+bx)\right]$$

35. $$\int \frac{x^2\,dx}{(a+bx)^2} = \frac{1}{b^3}\left[a+bx - 2\,a\log(a+bx) - \frac{a^2}{a+bx}\right]$$

36. $$\int \frac{x^2\,dx}{(a+bx)^3} = \frac{1}{b^3}\left[\log(a+bx) + \frac{2a}{a+bx} - \frac{a^2}{2(a+bx)^2}\right]$$

37. $\int \frac{dx}{x(a+bx)} = -\frac{1}{a}\log\frac{a+bx}{x}.$

38. $\int \frac{dx}{x(a+bx)^2} = \frac{1}{a(a+bx)} - \frac{1}{a^2}\log\frac{a+bx}{x}.$

39. $\int \frac{dx}{x^2(a+bx)} = -\frac{1}{ax} + \frac{b}{a^2}\log\frac{a+bx}{x}$

40. $\int \frac{dx}{x^2\,(a+bx)^2} = -\frac{a+2\,bx}{a^2x\,(a+bx)} + \frac{2b}{a^3}\log\frac{a+bx}{x}.$

FORMS CONTAINING $c^2 \pm x^2$, $x^2 - c^2$

41. $\int \frac{dx}{c^2+x^2} = \frac{1}{c}\tan^{-1}\frac{x}{c}$, or $\frac{1}{c}\sin^{-1}\frac{x}{\sqrt{c^2+x^2}}.$

42. $\int \frac{dx}{c^2-x^2} = \frac{1}{2\,c}\log\frac{c+x}{c-x}$, or $\frac{1}{c}\tanh^{-1}\left(\frac{x}{c}\right).$

43. $\int \frac{dx}{x^2-c^2} = \frac{1}{2\,c}\log\frac{x-c}{x+c}$, or $-\frac{1}{c}\coth^{-1}\left(\frac{x}{c}\right).$

FORMS CONTAINING $a + bx$ AND $a' + b'x$

44. $\int \frac{dx}{(a+bx)(a'+b'x)} = \frac{1}{ab'-a'b}\cdot\log\left(\frac{a'+b'x}{a+bx}\right).$

45. $\int \frac{x\,dx}{(a+bx)(a'+b'x)} = \frac{1}{ab'-a'b}\left[\frac{a}{b}\log\,(a+bx) - \frac{a'}{b'}\log\,(a'+b'x)\right].$

46. $\int \frac{dx}{(a+bx)^2(a'+b'x)} = \frac{1}{ab'-a'b}\left(\frac{1}{a+bx} + \frac{b'}{ab'-a'b}\log\frac{a'+b'x}{a+bx}\right).$

47. $\int \frac{x\,dx}{(a+bx)^2(a'+b'x)} = \frac{-a}{b(ab'-a'b)(a+bx)} - \frac{a'}{(ab'-a'b)^2}\log\frac{a'+b'x}{a+bx}.$

48. $\int \frac{x^2\,dx}{(a+bx)^2(a'+b'x)} = \frac{a^2}{b^2(ab'-a'b)(a+bx)} + \frac{1}{(ab'-a'b)^2}\left[\frac{a'^2}{b'}\log\,(a'+b'x) + \frac{a(ab'-2\,a'b)}{b^2}\log\,(a+bx)\right].$

49. $\int \frac{dx}{(a+bx)^n(a'+b'x)^m} = \frac{1}{(m-1)(ab'-a'b)}\left(\frac{1}{(a+bx)^{n-1}(a'+b'x)^{m-1}} - (m+n-2)b\int\frac{dx}{(a+bx)^n(a'+b'x)^{m-1}}\right).$

FORMS CONTAINING $\sqrt{a+bx}$ AND $\sqrt{a'+b'x}$ $\quad u = a + bx$
$v = a' + b'x \quad k = ab' - a'b$

50. $$\int \sqrt{uv}\,dx = \frac{k+2\,bv}{4\,bb'}\sqrt{uv} - \frac{k^2}{8\,bb'}\int \frac{dx}{\sqrt{uv}}.$$

51. $$\int \frac{dx}{v\sqrt{u}} = \frac{1}{\sqrt{kb'}}\log\frac{b'\sqrt{u}-\sqrt{kb'}}{b'\sqrt{u}+\sqrt{kb'}} = \frac{2}{\sqrt{-kb'}}\tan^{-1}\frac{b'\sqrt{u}}{\sqrt{-kb'}}.$$

52. $$\int \frac{dx}{\sqrt{uv}} = \frac{2}{\sqrt{bb'}}\log\left(\sqrt{bb'u}+b\sqrt{v}\right) = \frac{2}{\sqrt{-bb'}}\tan^{-1}\sqrt{\frac{-b'u}{bv}},$$

or $$\frac{2}{\sqrt{bb'}}\tanh^{-1}\sqrt{\frac{b'u}{bv}} = \frac{1}{\sqrt{-bb'}}\sin^{-1}\frac{2bb'x+a'b+ab'}{k}.$$

53. $$\int \frac{xdx}{\sqrt{uv}} = \frac{\sqrt{uv}}{bb'} - \frac{ab'+a'b}{2bb'}\int \frac{dx}{\sqrt{uv}}.$$

54. $$\int \frac{dx}{v\sqrt{uv}} = -\frac{2\sqrt{u}}{k\sqrt{v}}.$$

55. $$\int \frac{\sqrt{v}\,dx}{\sqrt{u}} = \frac{1}{b}\sqrt{uv} - \frac{k}{2b}\int \frac{dx}{\sqrt{uv}}.$$

56. $$\int v^m\sqrt{u}\,dx = \frac{1}{(2m+3)b'}\left(2v^{m+1}\sqrt{u} + k\int \frac{v^m dx}{\sqrt{u}}\right).$$

57. $$\int \frac{dx}{v^m\sqrt{u}} = -\frac{1}{(m-1)k}\left(\frac{\sqrt{u}}{v^{m-1}} + \left(m-\frac{3}{2}\right)b\int \frac{dx}{v^{m-1}\sqrt{u}}\right).$$

FORMS CONTAINING $(a + bx^n)$

58. $$\int \frac{dx}{a+bx^2} = \frac{1}{\sqrt{ab}}\tan^{-1}\frac{x\sqrt{ab}}{a}.$$

59. $$\int \frac{dx}{a+bx^2} = \frac{1}{2\sqrt{-ab}}\log\frac{a+x\sqrt{-ab}}{a-x\sqrt{-ab}},\text{ or }\frac{1}{\sqrt{-ab}}\tanh^{-1}\frac{x\sqrt{-ab}}{a}.$$

60. $$\int \frac{xdx}{a+bx^2} = \frac{1}{2b}\log\left(x^2+\frac{a}{b}\right).$$

61. $$\int \frac{x^2\,dx}{a+bx^2} = \frac{x}{b} - \frac{a}{b}\int \frac{dx}{a+bx^2}.$$

62. $\int \frac{dx}{(a + bx^2)^2} = \frac{x}{2a(a + bx^2)} + \frac{1}{2a} \int \frac{dx}{a + bx^2}.$

63. $\int \frac{dx}{(a + bx^2)^{m+1}} = \frac{1}{2\,ma} \frac{x}{(a + bx^2)^m} + \frac{2m - 1}{2\,ma} \int \frac{dx}{(a + bx^2)^m}.$

64. $\int \frac{xdx}{(a + bx^2)^{m+1}} = \frac{1}{2} \int \frac{dz}{(a + bz)^{m+1}},$ $[z = x^2].$

65. $\int \frac{x^2dx}{(a + bx^2)^{m+1}} = \frac{-x}{2\,mb(a + bx^2)^m} + \frac{1}{2\,mb} \int \frac{dx}{(a + bx^2)^m}.$

66. $\int \frac{dx}{x^2(a + bx^2)^{m+1}} = \frac{1}{a} \int \frac{dx}{x^2(a + bx^2)^m} - \frac{b}{a} \int \frac{dx}{(a + bx^2)^{m+1}}.$

67. $\int \frac{dx}{x(a + bx^2)} = \frac{1}{2\,a} \log \frac{x^2}{a + bx^2}.$

68. $\int \frac{dx}{x^2(a + bx^2)} = -\frac{1}{ax} - \frac{b}{a} \int \frac{dx}{a + bx^2}.$

69. $\int \frac{dx}{a + bx^3} = \frac{k}{3\,a}\left[\frac{1}{2} \log \frac{(k + x)^2}{k^2 - kx + x^2} + \sqrt{3} \tan^{-1} \frac{2\,x - k}{k\sqrt{3}}\right],$ $[bk^3 = a].$

70. $\int \frac{xdx}{a + bx^3} = \frac{1}{3bk}\left[\frac{1}{2} \log \frac{k^2 - kx + x^2}{(k + x)^2} + \sqrt{3} \tan^{-1} \frac{2x - k}{k\sqrt{3}}\right],$ $[bk^3 = a].$

71. $\int \frac{dx}{x(a + bx^n)} = \frac{1}{an} \log \frac{x^n}{a + bx^n}.$

72. $\int \frac{dx}{(a + bx^n)^{m+1}} = \frac{1}{a} \int \frac{dx}{(a + bx^n)^m} - \frac{b}{a} \int \frac{x^n dx}{(a + bx^n)^{m+1}}.$

73. $\int \frac{x^m dx}{(a + bx^n)^{p+1}} = \frac{1}{b} \int \frac{x^{m-n} dx}{(a + bx^n)^p} - \frac{a}{b} \int \frac{x^{m-n} dx}{(a + bx^n)^{p+1}}.$

74. $\int \frac{dx}{x^m(a + bx^n)^{p+1}} = \frac{1}{a} \int \frac{dx}{x^m(a + bx^n)^p} - \frac{b}{a} \int \frac{dx}{x^{m-n}(a + bx^n)^{p+1}}.$

75. $\int x^m(a + bx^n)^p dx = \frac{x^{m-n+1}(a + bx^n)^{p+1}}{b(np + m + 1)} - \frac{a(m - n + 1)}{b(np + m + 1)} \int x^{m-n}(a + bx^n)^p\, dx.$

76. $\int x^m(a + bx^n)^p\,dx = \frac{x^{m+1}(a + bx^n)^p}{np + m + 1} + \frac{anp}{np + m + 1}\int x^m(a + bx^n)^{p-1}\,dx.$

77. $\int x^{m-1}(a + bx^n)^p\,dx = \frac{1}{b(m + np)}[x^{m-n}(a + bx^n)^{p+1} - (m - n)\,a\int x^{m-n-1}(a + bx^n)^p\,dx].$

78. $\int x^{m-1}(a + bx^n)^p\,dx = \frac{1}{m + np}\,[x^m(a + bx^n)^p + npa\int x^{m-1}(a + bx^n)^{p-1}\,dx].$

79. $\int x^{m-1}(a + bx^n)^p\,dx = \frac{1}{ma}\,[x^m(a + bx^n)^{p+1} - (m + np + n)b\int x^{m+n-1}(a + bx^n)^p\,dx].$

80. $\int x^{m-1}(a + bx^n)^p\,dx = \frac{1}{an(p + 1)}[-x^m(a + bx^n)^{p+1} + (m + np + n)\int x^{m-1}(a + bx^n)^{p+1}\,dx].$

Forms Containing $(a + bx + cx^2)$

$X = a + bx + cx^2$ and $q = 4\,ac - b^2$

81. $\int\frac{dx}{X} = \frac{2}{\sqrt{q}}\tan^{-1}\frac{2\,cx + b}{\sqrt{q}}.$

82. $\int\frac{dx}{X} = \frac{-\,2}{\sqrt{-\,q}}\tanh^{-1}\frac{2\,cx + b}{\sqrt{-\,q}}.$

83. $\int\frac{dx}{X} = \frac{1}{\sqrt{-\,q}}\log\frac{2\,cx + b - \sqrt{-\,q}}{2\,cx + b + \sqrt{-\,q}}.$

84. $\int\frac{dx}{X^2} = \frac{2\,cx + b}{qX} + \frac{2\,c}{q}\int\frac{dx}{X}.$

85. $\int\frac{dx}{X^3} = \frac{2\,cx + b}{q}\left(\frac{1}{2\,X^2} + \frac{3\,c}{qX}\right) + \frac{6\,c^2}{q^2}\int\frac{dx}{X}.$

86. $\int\frac{dx}{X^{n+1}} = \frac{2\,cx + b}{nqX^n} + \frac{2\,(2\,n - 1)\,c}{qn}\int\frac{dx}{X^n}.$

87. $\int\frac{xdx}{X} = \frac{1}{2\,c}\log X - \frac{b}{2\,c}\int\frac{dx}{X}.$

88. $\int\frac{xdx}{X^2} = -\,\frac{bx + 2a}{qX} - \frac{b}{q}\int\frac{dx}{X}.$

89. $\int\frac{xdx}{X^{n+1}} = -\,\frac{2\,a + bx}{nqX^n} - \frac{b\,(2\,n - 1)}{nq}\int\frac{dx}{X^n}.$

90. $\int\frac{x^2}{X}\,dx = \frac{x}{c} - \frac{b}{2\,c^2}\log X + \frac{b^2 - 2\,ac}{2\,c^2}\int\frac{dx}{X}.$

91. $\int\frac{x^2}{X^2}\,dx = \frac{(b^2 - 2\,ac)x + ab}{cqX} + \frac{2\,a}{q}\int\frac{dx}{X}.$

92. $\int \frac{x^m\,dx}{X^{n+1}} = -\frac{x^{m-1}}{(2n-m+1)cX^n} - \frac{n-m+1}{2n-m+1}\cdot\frac{b}{c}\int \frac{x^{m-1}\,dx}{X^{n+1}} + \frac{m-1}{2n-m+1}\cdot\frac{a}{c}\int\frac{x^{m-2}\,dx}{X^{n+1}}.$

93. $\int \frac{dx}{xX} = \frac{1}{2a}\log\frac{x^2}{X} - \frac{b}{2a}\int\frac{dx}{X}.$

94. $\int \frac{dx}{x^2X} = \frac{b}{2a^2}\log\frac{X}{x^2} - \frac{1}{ax} + \left(\frac{b^2}{2a^2} - \frac{c}{a}\right)\int\frac{dx}{X}.$

95. $\int \frac{dx}{xX^n} = \frac{1}{2a(n-1)X^{n-1}} - \frac{b}{2a}\int\frac{dx}{X^n} + \frac{1}{a}\int\frac{dx}{xX^{n-1}}.$

96. $\int \frac{dx}{x^mX^{n+1}} = -\frac{1}{(m-1)ax^{m-1}X^n} - \frac{n+m-1}{m-1}\cdot\frac{b}{a}\int\frac{dx}{x^{m-1}X^{n+1}} - \frac{2n+m-1}{m-1}\cdot\frac{c}{a}\int\frac{dx}{x^{m-2}X^{n+1}}.$

Forms Containing $\sqrt{a+bx}$

97. $\int \sqrt{a+bx}\,dx = \frac{2}{3b}\sqrt{(a+bx)^3}.$

98. $\int x\sqrt{a+bx}\,dx = -\frac{2(2a-3bx)\sqrt{(a+bx)^3}}{15b^2}.$

99. $\int x^2\sqrt{a+bx}\,dx = \frac{2(8a^2-12abx+15b^2x^2)\sqrt{(a+bx)^3}}{105b^3}.$

100. $\int \frac{\sqrt{a+bx}}{x}\,dx = 2\sqrt{a+bx} + a\int\frac{dx}{x\sqrt{a+bx}}.$

101. $\int \frac{dx}{\sqrt{a+bx}} = \frac{2\sqrt{a+bx}}{b}.$

102. $\int \frac{xdx}{\sqrt{a+bx}} = -\frac{2(2a-bx)}{3b^2}\sqrt{a+bx}.$

103. $\int \frac{x^2dx}{\sqrt{a+bx}} = \frac{2(8a^2-4abx+3b^2x^2)}{15b^3}\sqrt{a+bx}.$

104. $\int \frac{x^mdx}{\sqrt{a+bx}} = \frac{2x^m\sqrt{a+bx}}{(2m+1)b} - \frac{2ma}{(2m+1)b}\int\frac{x^{m-1}dx}{\sqrt{a+bx}}.$

105. $\int \frac{dx}{x\sqrt{a+bx}} = \frac{1}{\sqrt{a}}\log\left(\frac{\sqrt{a+bx}-\sqrt{a}}{\sqrt{a+bx}+\sqrt{a}}\right).$

106. $\int \frac{dx}{x\sqrt{a+bx}} = \frac{-2}{\sqrt{a}}\tanh^{-1}\sqrt{\frac{a+bx}{a}}.$

107. $\int \frac{dx}{x^2\sqrt{a+bx}} = -\frac{\sqrt{a+bx}}{ax} - \frac{b}{2a}\int \frac{dx}{x\sqrt{a+bx}}.$

108. $\int \frac{dx}{x^n\sqrt{a+bx}} = -\frac{\sqrt{a+bx}}{(n-1)ax^{n-1}} - \frac{(2n-3)b}{(2n-2)a}$

$\int \frac{dx}{x^{n-1}\sqrt{a+bx}}.$

109. $\int (a+bx)^{\pm n/2}dx = \frac{2(a+bx)^{\frac{2\pm n}{2}}}{b(2\pm n)}.$

110. $\int x(a+bx)^{\pm n/2}dx = \frac{2}{b^2}\left[\frac{(a+bx)^{\frac{4\pm n}{2}}}{4\pm n} - \frac{a(a+bx)^{\frac{2\pm n}{2}}}{2\pm n}\right].$

111. $\int \frac{dx}{x(a+bx)^{m/2}} = \frac{1}{a}\int \frac{dx}{x(a+bx)^{\frac{m-2}{2}}} - \frac{b}{a}\int \frac{dx}{(a+bx)^{m/2}}.$

112. $\int \frac{(a+bx)^{n/2}dx}{x} = b\int (a+bx)^{\frac{n-2}{2}}dx + a$

$\int \frac{(a+bx)^{\frac{n-2}{2}}}{x}dx.$

Forms Containing $\sqrt{x^2 \pm a^2}$

113. $\int \sqrt{x^2 \pm a^2}\,dx = \frac{1}{2}[x\sqrt{x^2 \pm a^2} \pm a^2 \log$

$(x + \sqrt{x^2 \pm a^2})].$

114. $\int \frac{dx}{\sqrt{x^2 \pm a^2}} = \log(x + \sqrt{x^2 \pm a^2}).$

115. $\int \frac{dx}{x\sqrt{x^2 - a^2}} = \frac{1}{a}\cos^{-1}\left(\frac{a}{x}\right)$, or $\frac{1}{a}\sec^{-1}\left(\frac{x}{a}\right).$

116. $\int \frac{dx}{x\sqrt{x^2 + a^2}} = -\frac{1}{a}\log\left(\frac{a + \sqrt{x^2 + a^2}}{x}\right).$

117. $\int \frac{\sqrt{x^2 + a^2}}{x}dx = \sqrt{x^2 + a^2} - a\log\left(\frac{a + \sqrt{x^2 + a^2}}{x}\right).$

118. $\int \frac{\sqrt{x^2 - a^2}}{x}dx = \sqrt{x^2 - a^2} - a\cos^{-1}\frac{a}{x}.$

119. $\int \frac{x\,dx}{\sqrt{x^2 \pm a^2}} = \sqrt{x^2 \pm a^2}.$

120. $\int x\sqrt{x^2 \pm a^2}dx = \frac{1}{3}\sqrt{(x^2 \pm a^2)^3}.$

121. $\int \sqrt{(x^2 \pm a^2)^3}\, dx = \frac{1}{4}\Big[x\sqrt{(x^2 \pm a^2)^3} \pm \frac{3a^2x}{2}\sqrt{x^2 \pm a^2} + \frac{3a^4}{2}\log\left(x + \sqrt{x^2 \pm a^2}\right)\Big].$

122. $\int \frac{dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{\pm x}{a^2\sqrt{x^2 \pm a^2}}.$

123. $\int \frac{x\, dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{-1}{\sqrt{x^2 \pm a^2}}.$

124. $\int x\sqrt{(x^2 \pm a^2)^3}\, dx = \frac{1}{5}\sqrt{(x^2 \pm a^2)^5}.$

125. $\int x^2\sqrt{x^2 \pm a^2}\, dx = \frac{x}{4}\sqrt{(x^2 \pm a^2)^3} \mp \frac{a^2}{8}x\sqrt{x^2 \pm a^2} - \frac{a^4}{8}\log\left(x + \sqrt{x^2 \pm a^2}\right).$

126. $\int \frac{x^2\, dx}{\sqrt{x^2 \pm a^2}} = \frac{x}{2}\sqrt{x^2 \pm a^2} \mp \frac{a^2}{2}\log\left(x + \sqrt{x^2 \pm a^2}\right).$

127. $\int \frac{dx}{x^2\sqrt{x^2 \pm a^2}} = \mp \frac{\sqrt{x^2 \pm a^2}}{a^2x}.$

128. $\int \frac{\sqrt{x^2 \pm a^2}\, dx}{x^2} = -\frac{\sqrt{x^2 \pm a^2}}{x} + \log\left(x + \sqrt{x^2 \pm a^2}\right).$

129. $\int \frac{x^2\, dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{-x}{\sqrt{x^2 \pm a^2}} + \log\left(x + \sqrt{x^2 \pm a^2}\right).$

Forms Containing $\sqrt{a^2 - x^2}$

130. $\int \sqrt{a^2 - x^2}\, dx = \frac{1}{2}\left[x\sqrt{a^2 - x^2} + a^2\sin^{-1}\left(\frac{x}{a}\right)\right].$

131. $\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1}\left(\frac{x}{a}\right)$, or $-\cos^{-1}\left(\frac{x}{a}\right).$

132. $\int \frac{dx}{x\sqrt{a^2 - x^2}} = -\frac{1}{a}\log\left(\frac{a + \sqrt{a^2 - x^2}}{x}\right).$

133. $\int \frac{\sqrt{a^2 - x^2}}{x}\, dx = \sqrt{a^2 - x^2} - a\log\left(\frac{a + \sqrt{a^2 - x^2}}{x}\right).$

134. $\int \frac{x\, dx}{\sqrt{a^2 - x^2}} = -\sqrt{a^2 - x^2}.$

135. $\int x\sqrt{a^2 - x^2}\, dx = -\frac{1}{3}\sqrt{(a^2 - x^2)^3}.$

136. $\int \sqrt{(a^2 - x^2)^3}\, dx = \frac{1}{4}\Big[x\sqrt{(a^2 - x^2)^3} + \frac{3a^2x}{2}\sqrt{a^2 - x^2} + \frac{3a^4}{2}\sin^{-1}\frac{x}{a}\Big].$

137. $\int \frac{dx}{\sqrt{(a^2 - x^2)^3}} = \frac{x}{a^2\sqrt{a^2 - x^2}}.$

138. $\int \frac{x\,dx}{\sqrt{(a^2 - x^2)^3}} = \frac{1}{\sqrt{a^2 - x^2}}.$

139. $\int x\sqrt{(a^2 - x^2)^3}\,dx = -\tfrac{1}{5}\sqrt{(a^2 - x^2)^5}.$

140. $\int x^2\sqrt{a^2 - x^2}\,dx = -\frac{x}{4}\sqrt{(a^2 - x^2)^3} + \frac{a^2}{8}\left(x\sqrt{a^2 - x^2} + a^2 \sin^{-1}\frac{x}{a}\right).$

141. $\int \frac{x^2\,dx}{\sqrt{a^2 - x^2}} = -\frac{x}{2}\sqrt{a^2 - x^2} + \frac{a^2}{2}\sin^{-1}\frac{x}{a}.$

142. $\int \frac{dx}{x^2\sqrt{a^2 - x^2}} = -\frac{\sqrt{a^2 - x^2}}{a^2 x}.$

143. $\int \frac{\sqrt{a^2 - x^2}}{x^2}\,dx = -\frac{\sqrt{a^2 - x^2}}{x} - \sin^{-1}\frac{x}{a}.$

144. $\int \frac{x^2\,dx}{\sqrt{(a^2 - x^2)^3}} = \frac{x}{\sqrt{a^2 - x^2}} - \sin^{-1}\frac{x}{a}.$

Forms Containing $\sqrt{a + bx + cx^2}$

$X = a + bx + cx^2$, $q = 4\,ac - b^2$, and $k = \frac{4\,c}{q}.$

145. $\int \frac{dx}{\sqrt{X}} = \frac{1}{\sqrt{c}} \log\left(\sqrt{X} + x\sqrt{c} + \frac{b}{2\sqrt{c}}\right).$

146. $\int \frac{dx}{\sqrt{X}} = \frac{1}{\sqrt{c}} \sinh^{-1}\left(\frac{2cx + b}{\sqrt{4\,ac - b^2}}\right),$ if $c > 0$.

147. $\int \frac{dx}{\sqrt{X}} = \frac{1}{\sqrt{-c}} \sin^{-1}\left(\frac{-2\,cx - b}{\sqrt{b^2 - 4\,ac}}\right),$ if $c < 0$.

148. $\int \frac{dx}{X\sqrt{X}} = \frac{2\,(2\,cx + b)}{q\sqrt{X}}.$

149. $\int \frac{dx}{X^2\sqrt{X}} = \frac{2(2\,cx + b)}{3q\sqrt{X}}\left(\frac{1}{X} + 2\,k\right).$

150. $\int \frac{dx}{X^n\sqrt{X}} = \frac{2\,(2\,cx + b)\sqrt{X}}{(2\,n - 1)qX^n} + \frac{2k\,(n - 1)}{2n - 1}\int \frac{dx}{X^{n-1}\sqrt{X}}.$

151. $\int \sqrt{X}\,dx = \frac{(2\,cx + b)\sqrt{X}}{4\,c} + \frac{1}{2\,k}\int \frac{dx}{\sqrt{X}}.$

152. $\int X\sqrt{X}\,dx = \frac{(2cx+b)\sqrt{X}}{8c}\left(X + \frac{3}{2k}\right) + \frac{3}{8k^2}\int\frac{dx}{\sqrt{X}}.$

153. $\int X^2\sqrt{X}\,dx = \frac{(2cx+b)\sqrt{X}}{12c}\left(X^2 + \frac{5X}{4k} + \frac{15}{8k^2}\right) + \frac{5}{16k^3}\int\frac{dx}{\sqrt{X}}.$

154. $\int X^n\sqrt{X}\,dx = \frac{(2cx+b)X^n\sqrt{X}}{4(n+1)c} + \frac{2n+1}{2(n+1)k}\int\frac{X^n\,dx}{\sqrt{X}}.$

155. $\int\frac{x\,dx}{\sqrt{X}} = \frac{\sqrt{X}}{c} - \frac{b}{2c}\int\frac{dx}{\sqrt{X}}.$

156. $\int\frac{x\,dx}{X\sqrt{X}} = -\frac{2(bx+2a)}{q\sqrt{X}}.$

157. $\int\frac{x\,dx}{X^n\sqrt{X}} = -\frac{\sqrt{X}}{(2n-1)cX^n} - \frac{b}{2c}\int\frac{dx}{X^n\sqrt{X}}.$

158. $\int\frac{x^2\,dx}{\sqrt{X}} = \left(\frac{x}{2c} - \frac{3b}{4c^2}\right)\sqrt{X} + \frac{3b^2-4ac}{8c^2}\int\frac{dx}{\sqrt{X}}.$

159. $\int\frac{x^2\,dx}{X\sqrt{X}} = \frac{(2b^2-4ac)x+2ab}{cq\sqrt{X}} + \frac{1}{c}\int\frac{dx}{\sqrt{X}}.$

160. $\int\frac{x^2\,dx}{X^n\sqrt{X}} = \frac{(2b^2-4ac)x+2ab}{(2n-1)cqX^{n-1}\sqrt{X}} + \frac{4ac+(2n-3)b^2}{(2n-1)cq}\int\frac{dx}{X^{n-1}\sqrt{X}}.$

161. $\int\frac{x^3\,dx}{\sqrt{X}} = \left(\frac{x^2}{3c} - \frac{5bx}{12c^2} + \frac{5b^2}{8c^3} - \frac{2a}{3c^2}\right)\sqrt{X} + \left(\frac{3ab}{4c^2} - \frac{5b^3}{16c^3}\right)\int\frac{dx}{\sqrt{X}}.$

162. $\int x\sqrt{X}\,dx = \frac{X\sqrt{X}}{3c} - \frac{b}{2c}\int\sqrt{X}\,dx.$

163. $\int xX\sqrt{X}\,dx = \frac{X^2\sqrt{X}}{5c} - \frac{b}{2c}\int X\sqrt{X}\,dx.$

164. $\int\frac{xX^n\,dx}{\sqrt{X}} = \frac{X^n\sqrt{X}}{(2n+1)c} - \frac{b}{2c}\int\frac{X^n dx}{\sqrt{X}}.$

165. $\int x^2 \sqrt{X} dx = \left(x - \frac{5\,b}{6\,c}\right) \frac{X\sqrt{X}}{4\,c} + \frac{5\,b^2 - 4\,ac}{16\,c^2} \int \sqrt{X}\,dx.$

166. $\int \frac{dx}{x\sqrt{X}} = -\frac{1}{\sqrt{a}} \log \left(\frac{\sqrt{X} + \sqrt{a}}{x} + \frac{b}{2\sqrt{a}}\right),$ if $a > 0$.

167. $\int \frac{dx}{x\sqrt{X}} = \frac{1}{\sqrt{-a}} \sin^{-1} \left(\frac{bx + 2\,a}{x\sqrt{b^2 - 4\,ac}}\right),$ if $a < 0$.

168. $\int \frac{dx}{x\sqrt{X}} = -\frac{2\sqrt{X}}{bx},$ if $a = 0$.

169. $\int \frac{dx}{x^2\sqrt{X}} = -\frac{\sqrt{X}}{ax} - \frac{b}{2\,a} \int \frac{dx}{x\sqrt{X}}.$

170. $\int \frac{\sqrt{X}\,dx}{x} = \sqrt{X} + \frac{b}{2} \int \frac{dx}{\sqrt{X}} + a \int \frac{dx}{x\sqrt{X}}.$

171. $\int \frac{\sqrt{X}\,dx}{x^2} = -\frac{\sqrt{X}}{x} + \frac{b}{2} \int \frac{dx}{x\sqrt{X}} + c \int \frac{dx}{\sqrt{X}}.$

Miscellaneous Algebraic Forms

172. $\int \sqrt{2\,ax - x^2}\,dx = \frac{1}{2} [\,(x - a)\sqrt{2\,ax - x^2} + a^2 \sin^{-1} (x - a)/a].$

173. $\int \sqrt{ax^2 + c}\,dx = \frac{x}{2} \sqrt{ax^2 + c} + \frac{c}{2\sqrt{a}} \log (x\sqrt{a} + \sqrt{ax^2 + c}),$ $[a > 0]$.

$= \frac{x}{2} \sqrt{ax^2 + c} + \frac{c}{2\sqrt{-a}} \sin^{-1} \left(x\sqrt{\frac{-a}{c}}\right),$ $[a < 0]$.

174. $\int \frac{dx}{\sqrt{2\,ax - x^2}} = \cos^{-1} \left(\frac{a - x}{a}\right).$

175. $\int \frac{dx}{\sqrt{a + bx} \cdot \sqrt{a' + b'x}} = \frac{2}{\sqrt{-bb'}} \tan^{-1} \sqrt{\frac{-b'(a + bx)}{b(a' + b'x)}}.$

176. $\int \sqrt{\frac{1 + x}{1 - x}}\,dx = \sin^{-1} x - \sqrt{1 - x^2}.$

177. $\int \frac{dx}{\sqrt{a \pm 2bx + cx^2}} = \frac{1}{\sqrt{c}} \log (\pm b + cx + \sqrt{c}\sqrt{a \pm 2bx + cx^2}).$

178. $\int \frac{dx}{\sqrt{a \pm 2bx - cx^2}} = \frac{1}{\sqrt{c}} \sin^{-1} \frac{cx \mp b}{\sqrt{b^2 + ac}}.$

179. $\int \frac{xdx}{\sqrt{a \pm 2bx + cx^2}} = \frac{1}{c} \sqrt{a \pm 2bx + cx^2} - \frac{b}{\sqrt{c^3}} \log (\pm b + cx + \sqrt{c} \sqrt{a \pm 2bx + cx^2}).$

180. $\int \frac{xdx}{\sqrt{a \pm 2bx - cx^2}} = \frac{1}{c} \sqrt{a \pm 2bx - cx^2} + \frac{b}{\sqrt{c^3}} \sin^{-1} \frac{cx \mp b}{\sqrt{b^2 + ac}}.$

Trigonometric Forms

181. $\int \sin x \, dx = -\cos x$, or versin x.

182. $\int \cos x \, dx = \sin x$, or $-$ coversin x.

183. $\int \tan x \, dx = -\log \cos x.$

184. $\int \cot x \, dx = \log \sin x.$

185. $\int \sec x \, dx = \log \tan \left(\frac{\pi}{4} + \frac{x}{2}\right).$

186. $\int \csc x \, dx = \log \tan \frac{1}{2} x.$

187. $\int \sin^2 x \, dx = -\frac{1}{2} \cos x \sin x + \frac{1}{2} x = \frac{1}{2} x - \frac{1}{4} \sin 2x.$

188. $\int \sin^3 x \, dx = -\frac{1}{3} \cos x (\sin^2 x + 2).$

189. $\int \sin^n x \, dx = -\frac{\sin^{n-1} x \cos x}{n} + \frac{n-1}{n} \int \sin^{n-2} x \, dx.$

190. $\int \cos^2 x \, dx = \frac{1}{2} \sin x \cos x + \frac{1}{2} x = \frac{1}{2} x + \frac{1}{4} \sin 2x.$

191. $\int \cos^3 x \, dx = \frac{1}{3} \sin x (\cos^2 x + 2).$

192. $\int \cos^n x \, dx = \frac{1}{n} \cos^{n-1} x \sin x + \frac{n-1}{n} \int \cos^{n-2} x \, dx.$

193. $\int \sin \frac{x}{a} \, dx = -a \cos \frac{x}{a}.$

194. $\int \cos \frac{x}{a} \, dx = a \sin \frac{x}{a}.$

195. $\int \sin (a + bx) \, dx = -\frac{1}{b} \cos (a + bx).$

196. $\int \cos (a + bx) \, dx = \frac{1}{b} \sin (a + bx).$

197. $\int \frac{dx}{\sin x} = -\frac{1}{2} \log \frac{1 + \cos x}{1 - \cos x} = \log \tan \frac{x}{2}.$

198. $\int \frac{dx}{\cos x} = \log \tan \left(\frac{\pi}{4} + \frac{x}{2}\right) = \frac{1}{2} \log \left(\frac{1 + \sin x}{1 - \sin x}\right).$

199. $\int \frac{dx}{\cos^2 x} = \tan x.$

200. $\int \frac{dx}{\cos^n x} = \frac{1}{n-1} \cdot \frac{\sin x}{\cos^{n-1} x} + \frac{n-2}{n-1} \int \frac{dx}{\cos^{n-2} x}.$

201. $\int \frac{dx}{1 \pm \sin x} = \mp \tan \left(\frac{\pi}{4} \mp \frac{x}{2}\right).$

202. $\int \frac{dx}{1 + \cos x} = \tan \frac{x}{2}.$

203. $\int \frac{dx}{1 - \cos x} = -\cot \frac{x}{2}.$

204. $\int \frac{dx}{a + b \sin x} = \frac{2}{\sqrt{a^2 - b^2}} \tan^{-1} \frac{a \tan \frac{1}{2} x + b}{\sqrt{a^2 - b^2}},$

$$= \frac{1}{\sqrt{b^2 - a^2}} \log \frac{a \tan \frac{1}{2} x + b - \sqrt{b^2 - a^2}}{a \tan \frac{1}{2} x + b + \sqrt{b^2 - a^2}}.$$

205. $\int \frac{dx}{a + b \cos x} = \frac{2}{\sqrt{a^2 - b^2}} \tan^{-1} \frac{\sqrt{a^2 - b^2} \tan \frac{1}{2} x}{a + b},$

$$= \frac{1}{\sqrt{b^2 - a^2}} \log \left(\frac{\sqrt{b^2 - a^2} \tan \frac{1}{2} x + a + b}{\sqrt{b^2 - a^2} \tan \frac{1}{2} x - a - b}\right).$$

206. $\int \sin mx \sin nx \, dx = \frac{\sin (m-n) x}{2(m-n)} - \frac{\sin (m+n) x}{2(m+n)},$

$[m^2 \neq n^2].$

207. $\int x \sin^2 x \, dx = \frac{x^2}{4} - \frac{x \sin 2x}{4} - \frac{\cos 2x}{8}.$

208. $\int x^2 \sin^2 x \, dx = \frac{x^3}{6} - \left(\frac{x^2}{4} - \frac{1}{8}\right) \sin 2x - \frac{x \cos 2x}{4}.$

209. $\int x \sin^3 x \, dx = \frac{x \cos 3x}{12} - \frac{\sin 3x}{36} - \frac{3}{4} x \cos x + \frac{3}{4} \sin x.$

210. $\int \sin^4 x \, dx = \frac{3x}{8} - \frac{\sin 2x}{4} + \frac{\sin 4x}{32}.$

211. $\int \cos mx \cos nx \, dx = \frac{\sin (m-n)x}{2(m-n)} + \frac{\sin (m+n)x}{2(m+n)},$

$[m^2 \neq n^2].$

212. $\int x \cos^2 x \, dx = \frac{x^2}{4} + \frac{x \sin 2x}{4} + \frac{\cos 2x}{8}.$

213. $\int x^2 \cos^2 x \, dx = \frac{x^3}{6} + \left(\frac{x^2}{4} - \frac{1}{8}\right) \sin 2x + \frac{x \cos 2x}{4}.$

214. $\int x \cos^3 x \, dx = \frac{x \sin 3x}{12} + \frac{\cos 3x}{36} + \frac{3}{4} x \sin x + \frac{3}{4} \cos x.$

215. $\int \cos^4 x \, dx = \frac{3x}{8} + \frac{\sin 2x}{4} + \frac{\sin 4x}{32}.$

216. $\int \frac{\sin x\, dx}{x^m} = -\frac{\sin x}{(m-1)\, x^{m-1}} + \frac{1}{m-1} \int \frac{\cos x\, dx}{x^{m-1}}.$

217. $\int \frac{\cos x\, dx}{x^m} = -\frac{\cos x}{(m-1) x^{m-1}} - \frac{1}{m-1} \int \frac{\sin x\, dx}{x^{m-1}}.$

218. $\int \tan^3 x\, dx = \frac{1}{2} \tan^2 x + \log \cos x.$

219. $\int \tan^4 x\, dx = \frac{1}{3} \tan^3 x - \tan x + x.$

220. $\int \cot^3 x\, dx = -\frac{1}{2} \cot^2 x - \log \sin x.$

221. $\int \cot^4 x\, dx = -\frac{1}{3} \cot^3 x + \cot x + x.$

222. $\int \cot^n x\, dx = -\frac{\cot^{n-1} x}{n-1} - \int \cot^{n-2} x\, dx, \ [n \neq 1].$

223. $\int \sin x \cos x\, dx = \frac{1}{2} \sin^2 x$

224. $\int \sin mx \cos nx\, dx = -\frac{\cos (m-n)x}{2(m-n)} - \frac{\cos (m+n)x}{2(m+n)}.$

225. $\int \sin^2 x \cos^2 x\, dx = -\frac{1}{8}(\frac{1}{4} \sin 4x - x).$

226. $\int \sin x \cos^m x\, dx = -\frac{\cos^{m+1} x}{m+1}.$

227. $\int \sin^m x \cos x\, dx = \frac{\sin^{m+1} x}{m+1}.$

228. $\int \cos^m x \sin^n x\, dx = \frac{\cos^{m-1} x \sin^{n+1} x}{m+n} + \frac{m-1}{m+n} \int \cos^{m-2} x \sin^n x\, dx.$

229. $\int \cos^m x \sin^n x\, dx = -\frac{\sin^{n-1} x \cos^{m+1} x}{m+n} + \frac{n-1}{m+n} \int \cos^m x \sin^{n-2} x\, dx.$

230. $\int \frac{\cos^m x\, dx}{\sin^n x} = -\frac{\cos^{m+1} x}{(n-1) \sin^{n-1} x} - \frac{m-n+2}{n-1} \int \frac{\cos^m x\, dx}{\sin^{n-2} x}.$

231. $\int \frac{\cos^m x\, dx}{\sin^n x} = \frac{\cos^{m-1} x}{(m-n) \sin^{n-1} x} + \frac{m-1}{m-n} \int \frac{\cos^{m-2} x\, dx}{\sin^n x}.$

232. $\int \frac{\sin^m x\, dx}{\cos^n x} = -\int \frac{\cos^m \left(\frac{\pi}{2} - x\right) d\left(\frac{\pi}{2} - x\right)}{\sin^n \left(\frac{\pi}{2} - x\right)}.$

233. $\int \frac{\sin x\, dx}{\cos^2 x} = \frac{1}{\cos x} = \sec x.$

234. $\int \frac{\sin^2 x\, dx}{\cos x} = -\sin x + \log \tan\left(\frac{\pi}{4} + \frac{x}{2}\right).$

235. $\int \frac{\cos x\, dx}{\sin^2 x} = \frac{-1}{\sin x} = -\operatorname{cosec} x.$

236. $\int \frac{dx}{\sin x \cos x} = \log \tan x.$

237. $\int \frac{dx}{\sin x \cos^2 x} = \frac{1}{\cos x} + \log \tan \frac{x}{2}.$

238. $\int \frac{dx}{\sin x \cos^n x} = \frac{1}{(n-1)\cos^{n-1} x} + \int \frac{dx}{\sin x \cos^{n-2} x},$ $[n \neq 1].$

239. $\int \frac{dx}{\sin^2 x \cos x} = -\frac{1}{\sin x} + \log \tan\left(\frac{\pi}{4} + \frac{x}{2}\right).$

240. $\int \frac{dx}{\sin^2 x \cos^2 x} = -2 \cot 2x.$

241. $\int \frac{dx}{\sin^m x \cos^n x} = -\frac{1}{m-1} \cdot \frac{1}{\sin^{m-1} x \cdot \cos^{n-1} x} + \frac{m+n-2}{m-1} \int \frac{dx}{\sin^{m-2} x \cdot \cos^n x}.$

242. $\int \frac{dx}{\sin^m x} = -\frac{1}{m-1} \cdot \frac{\cos x}{\sin^{m-1} x} + \frac{m-2}{m-1} \int \frac{dx}{\sin^{m-2} x}.$

243. $\int \frac{dx}{\sin^2 x} = -\cot x.$

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244. $\int \tan^2 x\, dx = \tan x - x.$

245. $\int \tan^n x\, dx = \frac{\tan^{n-1} x}{n-1} - \int \tan^{n-2} x\, dx.$

246. $\int \cot^2 x\, dx = -\cot x - x.$

247. $\int \cot^n x\, dx = -\frac{\cot^{n-1} x}{n-1} - \int \cot^{n-2} x\, dx.$

248. $\int \sec^2 x\, dx = \tan x.$

249. $\int \sec^n x\, dx = \int \frac{dx}{\cos^n x}.$

250. $\int \csc^2 x\, dx = -\cot x.$

251. $\int \csc^n x\, dx = \int \frac{dx}{\sin^n x}.$

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252. $\int x \sin x\, dx = \sin x - x \cos x.$

253. $\int x^2 \sin x\, dx = 2x \sin x - (x^2 - 2) \cos x.$

254. $\int x^3 \sin x\, dx = (3x^2 - 6) \sin x - (x^3 - 6x) \cos x.$

255. $\int x^m \sin x\, dx = -x^m \cos x + m \int x^{m-1} \cos x\, dx.$

256. $\int x \cos x \, dx = \cos x + x \sin x.$

257. $\int x^2 \cos x \, dx = 2\,x \cos x + (x^2 - 2) \sin x.$

258. $\int x^3 \cos x \, dx = (3\,x^2 - 6) \cos x + (x^3 - 6\,x) \sin x.$

259. $\int x^m \cos x \, dx = x^m \sin x - m \int x^{m-1} \sin x \, dx.$

260. $\int \frac{\sin x}{x} dx = x - \frac{x^3}{3 \cdot 3!} + \frac{x^5}{5 \cdot 5!} - \frac{x^7}{7 \cdot 7!} + \frac{x^9}{9 \cdot 9!} \cdots$

261. $\int \frac{\cos x}{x} dx = \log x - \frac{x^2}{2 \cdot 2!} + \frac{x^4}{4 \cdot 4!} - \frac{x^6}{6 \cdot 6!} + \frac{x^8}{8 \cdot 8!} \cdots$

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262. $\int \sin^{-1} x \, dx = x \sin^{-1} x + \sqrt{1 - x^2}.$

263. $\int \cos^{-1} x \, dx = x \cos^{-1} x - \sqrt{1 - x^2}.$

264. $\int \tan^{-1} x \, dx = x \tan^{-1} x - \tfrac{1}{2} \log (1 + x^2).$

265. $\int \cot^{-1} x \, dx = x \cot^{-1} x + \tfrac{1}{2} \log (1 + x^2).$

266. $\int \sec^{-1} x \, dx = x \sec^{-1} x - \log (x + \sqrt{x^2 - 1}).$

267. $\int \csc^{-1} x \, dx = x \csc^{-1} x + \log (x + \sqrt{x^2 - 1}).$

268. $\int \text{vers}^{-1} x \, dx = (x - 1) \text{vers}^{-1} x + \sqrt{2x - x^2}.$

269. $\int \sin^{-1} \frac{x}{a} dx = x \sin^{-1} \frac{x}{a} + \sqrt{a^2 - x^2}.$

270. $\int \cos^{-1} \frac{x}{a} dx = x \cos^{-1} \frac{x}{a} - \sqrt{a^2 - x^2}.$

271. $\int \tan^{-1} \frac{x}{a} dx = x \tan^{-1} \frac{x}{a} - \frac{a}{2} \log (a^2 + x^2).$

272. $\int \cot^{-1} \frac{x}{a} dx = x \cot^{-1} \frac{x}{a} + \frac{a}{2} \log (a^2 + x^2).$

273. $\int (\sin^{-1} x)^2 \, dx = x(\sin^{-1} x)^2 - 2x + 2\sqrt{1 - x^2}\,(\sin^{-1} x).$

274. $\int (\cos^{-1} x)^2 \, dx = x(\cos^{-1} x)^2 - 2x - 2\sqrt{1 - x^2}\,(\cos^{-1} x).$

275. $\int x \cdot \sin^{-1} x \, dx = \tfrac{1}{4} [(2\,x^2 - 1) \sin^{-1} x + x \sqrt{1 - x^2}].$

276. $\int x^n \sin^{-1} x \, dx = \frac{x^{n+1} \sin^{-1} x}{n + 1} - \frac{1}{n + 1} \int \frac{x^{n+1} \, dx}{\sqrt{1 - x^2}}.$

277. $\int x^n \cos^{-1} x \, dx = \frac{x^{n+1} \cos^{-1} x}{n + 1} + \frac{1}{n + 1} \int \frac{x^{n+1} \, dx}{\sqrt{1 - x^2}}.$

278. $\int x^n \tan^{-1} x \, dx = \frac{x^{n+1} \tan^{-1} x}{n + 1} - \frac{1}{n + 1} \int \frac{x^{n+1} \, dx}{1 + x^2}.$

279. $\int \frac{\sin^{-1} x \, dx}{x^2} = \log \left(\frac{1 - \sqrt{1 - x^2}}{x}\right) - \frac{\sin^{-1} x}{x}.$

280. $\int \frac{\tan^{-1} x \, dx}{x^2} = \log x - \tfrac{1}{2} \log (1 + x^2) - \frac{\tan^{-1} x}{x}.$

Logarithmic Forms

281. $\int \log x \, dx = x \log x - x.$

282. $\int x \log x \, dx = \frac{x^2}{2} \log x - \frac{x^2}{4}.$

283. $\int x^2 \log x \, dx = \frac{x^3}{3} \log x - \frac{x^3}{9}.$

284. $\int x^p \log (ax) \, dx = \frac{x^{p+1}}{p+1} \log (ax) - \frac{x^{p+1}}{(p+1)^2} \; [p \neq -1].$

285. $\int (\log x)^2 \, dx = x (\log x)^2 - 2x \log x + 2x.$

286. $\int (\log x)^n \, dx = x (\log x)^n - n \int (\log x)^{n-1} \, dx, \quad [n \neq -1].$

287. $\int \frac{(\log x)^n}{x} \, dx = \frac{1}{n+1} (\log x)^{n+1}.$

288. $\int \frac{dx}{\log x} = \log (\log x) + \log x + \frac{(\log x)^2}{2 \cdot 2!} + \frac{(\log x)^3}{3 \cdot 3!} + \cdots$

289. $\int \frac{dx}{x \log x} = \log (\log x)$

290. $\int \frac{dx}{x (\log x)^n} = -\frac{1}{(n-1)(\log x)^{n-1}}.$

291. $\int \frac{x^m \, dx}{(\log x)^n} = -\frac{x^{m+1}}{(n-1)(\log x)^{n-1}} + \frac{m+1}{n-1} \int \frac{x^m \, dx}{(\log x)^{n-1}}.$

292. $\int x^m \log x \, dx = x^{m+1} \left[\frac{\log x}{m+1} - \frac{1}{(m+1)^2} \right].$

293. $\int x^m (\log x)^n \, dx = \frac{x^{m+1} (\log x)^n}{m+1} - \frac{n}{m+1} \int x^m (\log x)^{n-1} \, dx, \quad [m, n \neq -1].$

294. $\int \sin \log x \, dx = \frac{1}{2} x \sin \log x - \frac{1}{2} x \cos \log x.$

295. $\int \cos \log x \, dx = \frac{1}{2} x \sin \log x + \frac{1}{2} x \cos \log x.$

Exponential Forms

296. $\int e^x \, dx = e^x.$

297. $\int e^{-x} \, dx = -e^{-x}.$

298. $\int e^{ax} \, dx = \frac{e^{ax}}{a}.$

299. $\int x \, e^{ax} \, dx = \frac{e^{ax}}{a^2} (ax - 1).$

300. $\int x^m e^{ax} \, dx = \frac{x^m e^{ax}}{a} - \frac{m}{a} \int x^{m-1} e^{ax} \, dx.$

301. $\int \frac{e^{ax} \, dx}{x} = \log x + \frac{ax}{1!} + \frac{a^2 x^2}{2 \cdot 2!} + \frac{a^3 x^3}{3 \cdot 3!} + \cdots$

302. $\int \frac{e^{ax}}{x^m} \, dx = -\frac{1}{m-1} \frac{e^{ax}}{x^{m-1}} + \frac{a}{m-1} \int \frac{e^{ax}}{x^{m-1}} \, dx.$

303. $\int e^{ax} \log x \, dx = \frac{e^{ax} \log x}{a} - \frac{1}{a} \int \frac{e^{ax}}{x} \, dx.$

304. $\int e^{ax} \cdot \sin px \, dx = \frac{e^{ax} (a \sin px - p \cos px)}{a^2 + p^2}.$

305. $\int e^{ax} \cdot \cos px \, dx = \frac{e^{ax} (a \cos px + p \sin px)}{a^2 + p^2}.$

306. $\int \frac{dx}{1 + e^x} = x - \log (1 + e^x) = \log \frac{e^x}{1 + e^x}.$

307. $\int \frac{dx}{a + be^{px}} = \frac{x}{a} - \frac{1}{ap} \log (a + be^{px}).$

308. $\int \frac{dx}{ae^{mx} + be^{-mx}} = \frac{1}{m\sqrt{ab}} \tan^{-1} \left(e^{mx}\sqrt{\frac{a}{b}}\right).$

309. $\int e^{ax} \sin px \, dx = \frac{e^{ax} (a \sin px - p \cos px)}{a^2 + p^2}.$

310. $\int e^{ax} \cos px \, dx = \frac{e^{ax} (a \cos px + p \sin px)}{a^2 + p^2}.$

311. $\int e^{ax} \sin^n bx \, dx = \frac{1}{a^2 + n^2b^2}\Big((a \sin bx - nb \cos bx)$

$e^{ax} \sin^{n-1} bx + n (n - 1)b^2 \int e^{ax} \sin^{n-2} bx \cdot dx\Big).$

312. $\int e^{ax} \cos^n bx \, dx = \frac{1}{a^2 + n^2b^2}\Big((a \cos bx + nb \sin bx)$

$e^{ax} \cos^{n-1} bx + n (n - 1)b^2 \int e^{ax} \cos^{n-2} bx \, dx\Big).$

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313. $\int \sinh x \, dx = \cosh x.$
314. $\int \cosh x \, dx = \sinh x.$
315. $\int \tanh x \, dx = \log \cosh x.$
316. $\int \coth x \, dx = \log \sinh x.$
317. $\int \operatorname{sech} x \, dx = 2 \tan^{-1} (e^x).$

318. $\int \operatorname{csch} x \, dx = \log \tanh \left(\frac{x}{2}\right).$

319. $\int x \sinh x \, dx = x \cosh x - \sinh x.$
320. $\int x \cosh x \, dx = x \sinh x - \cosh x.$
321. $\int \operatorname{sech} x \tanh x \, dx = - \operatorname{sech} x.$
322. $\int \operatorname{csch} x \coth x \, dx = - \operatorname{csch} x.$

DEFINITE INTEGRALS

323. $\int_0^\infty x^{n-1} e^{-x} \, dx = \int_0^1 \left(\log \frac{1}{x}\right)^{n-1} dx = \Gamma (n).$

324. $\Gamma (n)$, the gamma function is finite if $n > 0$.

325. $\Gamma (n + 1) = n\Gamma (n).$

326. $\Gamma(n) \cdot \Gamma(1-n) = \dfrac{\pi}{\sin n\pi}$.

327. $\Gamma(n) = (n-1)!$ if $n =$ integer > 0.

328. $\Gamma(\frac{1}{2}) = \sqrt{\pi}$.

(See values of $\Gamma(n)$ at end of integral table.)

329. $$\int_0^1 x^{m-1}(1-x)^{n-1}\,dx = \int_0^\infty \frac{x^{m-1}\,dx}{(1+x)^{m+n}} = \frac{\Gamma(m)\,\Gamma(n)}{\Gamma(m+n)}.$$

330. $$\int_1^\infty \frac{dx}{x^m} = \frac{1}{m-1}, \qquad [m > 1].$$

331. $$\int_0^\infty \frac{dx}{(1+x)x^p} = \pi \csc p\pi, \qquad [p < 1].$$

332. $$\int_0^\infty \frac{dx}{(1-x)x^p} = -\pi \cot p\pi, \qquad [p < 1].$$

333. $$\int_0^\infty \frac{x^{p-1}\,dx}{1+x} = \frac{\pi}{\sin p\pi}, \qquad [0 < p < 1].$$

334. $$\int_0^\infty \frac{x^{m-1}\,dx}{1+x^n} = \frac{\pi}{n \sin \dfrac{m\pi}{n}}, \qquad [0 < m < n].$$

335. $$\int_0^\infty \frac{dx}{(1+x)\sqrt{x}} = \pi.$$

336. $$\int_0^\infty \frac{a\,dx}{a^2+x^2} = \frac{\pi}{2}, \text{ if } a > 0;\ 0, \text{ if } a = 0;\ -\frac{\pi}{2}, \text{ if } a < 0.$$

337. $$\int_0^{\pi/2} \sin^n x\,dx = \int_0^{\pi/2} \cos^n x\,dx$$
$$= \frac{1 \cdot 3 \cdot 5 \cdots (n-1)}{2 \cdot 4 \cdot 6 \cdots (n)} \cdot \frac{\pi}{2}, \qquad [n \text{ an even integer}],$$
$$= \frac{2 \cdot 4 \cdot 6 \cdots (n-1)}{1 \cdot 3 \cdot 5 \cdot 7 \cdots n}, \qquad [n \text{ an odd integer}],$$
$$= \frac{1}{2}\sqrt{\pi}\,\frac{\Gamma\left(\dfrac{n+1}{2}\right)}{\Gamma\left(\dfrac{n}{2}+1\right)}, \qquad [n > -1].$$

338. $$\int_0^\infty \frac{\sin mx\,dx}{x} = \frac{\pi}{2}, \text{ if } m > 0;\ 0, \text{ if } m = 0;\ -\frac{\pi}{2}, \text{ if } m < 0.$$

339. $$\int_0^\infty \frac{\cos x\,dx}{x} = \infty.$$

340. $$\int_0^\infty \frac{\tan x\,dx}{x} = \frac{\pi}{2}.$$

341. $\int_0^\pi \sin kx \cdot \sin mx\, dx = \int_0^\pi \cos kx \cdot \cos mx\, dx = 0,$

$[k \neq m;\ m,\ n = \text{integers}].$

342. $\int_0^\infty \frac{\sin x \cos mx\, dx}{x} = 0,\ m < -1 \text{ or } m > 1,$

$= \frac{\pi}{4},\ \text{if } m = \pm 1;\ = \frac{\pi}{2},\ \text{if } m^2 < 1.$

343. $\int_0^\pi \sin^2 mx\, dx = \int_0^\pi \cos^2 mx\, dx = \frac{\pi}{2}.$

344. $\int_0^\infty \frac{\sin^2 x\, dx}{x^2} = \frac{\pi}{2}.$

345. $\int_0^\infty \frac{\cos mx}{1 + x^2}\, dx = \frac{\pi}{2} e^{-m},$ $[m > 0],$

$= \frac{\pi}{2} e^{m},$ $[m < 0].$

346. $\int_0^\infty \cos (x^2)\, dx = \int_0^\infty \sin (x^2)\, dx = \frac{1}{2}\sqrt{\frac{\pi}{2}}.$

347. $\int_0^\infty \frac{\sin x\, dx}{\sqrt{x}} = \int_0^\infty \frac{\cos x\, dx}{\sqrt{x}} = \sqrt{\frac{\pi}{2}}.$

348. $\int_0^{\pi/2} \frac{dx}{1 + a \cos x} = \frac{\cos^{-1} a}{\sqrt{1 - a^2}},$ $[a < 1].$

349. $\int_0^{2\pi} \frac{dx}{1 + a \cos x} = \frac{2\pi}{\sqrt{1 - a^2}},$ $[a^2 < 1].$

350. $\int_0^\infty e^{-ax}\, dx = \frac{1}{a}.$

351. $\int_0^\infty x^n e^{-ax}\, dx = \frac{\Gamma(n + 1)}{a^{n+1}},$ $[n > -1,\ a > 0],$

$= \frac{n!}{a^{n+1}},$ $[n \text{ pos. integ.},\ a > 0].$

352. $\int_0^\infty e^{-a^2x^2}\, dx = \frac{1}{2a}\sqrt{\pi} = \frac{1}{2a}\Gamma\left(\frac{1}{2}\right),$ $[a > 0].$

353. $\int_0^\infty x e^{-x^2}\, dx = \frac{1}{2}.$

354. $\int_0^\infty x^2 e^{-x^2}\, dx = \frac{\sqrt{\pi}}{4}.$

355. $\int_0^\infty x^{2n} e^{-ax^2}\, dx = \frac{1 \cdot 3 \cdot 5 \cdots (2n - 1)}{2^{n+1} a^n}\sqrt{\frac{\pi}{a}}.$

356. $\int_0^\infty e^{(-x^2 - a^2/x^2)}\, dx = \frac{e^{-2a}\sqrt{\pi}}{2}.$

357. $\int_0^\infty e^{-nx}\sqrt{x}\,dx = \frac{1}{2n}\sqrt{\frac{\pi}{n}}.$

358. $\int_0^\infty \frac{e^{-nx}}{\sqrt{x}}\,dx = \sqrt{\frac{\pi}{n}}.$

359. $\int_0^\infty e^{-ax}\cos mx\,dx = \frac{a}{a^2+m^2},$ $[a > 0].$

360. $\int_0^\infty e^{-ax}\sin mx\,dx = \frac{m}{a^2+m^2},$ $[a > 0].$

361. $\int_0^\infty e^{-a^2x^2}\cos bx\,dx = \frac{\sqrt{\pi}\cdot e^{-b^2/4a^2}}{2a},$ $[a > 0].$

362. $\int_0^1 (\log x)^n\,dx = (-1)^n\cdot n!.$

363. $\int_0^1 \left(\log\frac{1}{x}\right)^{\frac{1}{2}} dx = \frac{\sqrt{\pi}}{2}.$

364. $\int_0^1 \left(\log\frac{1}{x}\right)^{-\frac{1}{2}} dx = \sqrt{\pi}.$

365. $\int_0^1 \left(\log\frac{1}{x}\right)^{n} dx = n!.$

366. $\int_0^1 x\log(1-x)\,dx = -\frac{3}{4}.$

367. $\int_0^1 x\log(1+x)\,dx = \frac{1}{4}.$

368. $\int_0^1 \frac{\log x}{1+x}\,dx = -\frac{\pi^2}{12}.$

369. $\int_0^1 \frac{\log x}{1-x}\,dx = -\frac{\pi^2}{6}.$

370. $\int_0^1 \frac{\log x}{1-x^2}\,dx = -\frac{\pi^2}{8}.$

371. $\int_0^1 \log\left(\frac{1+x}{1-x}\right)\cdot\frac{dx}{x} = \frac{\pi^2}{4}.$

372. $\int_0^1 \frac{\log x\,dx}{\sqrt{1-x^2}} = -\frac{\pi}{2}\log 2.$

373. $\int_0^1 x^m\log\left(\frac{1}{x}\right)^n dx = \frac{\Gamma(n+1)}{(m+1)^{n+1}},$ if $m+1 > 0,$
$n+1 > 0.$

374. $\int_0^1 \frac{(x^p - x^q)dx}{\log x} = \log\left(\frac{p+1}{q+1}\right),$ $[p+1 > 0, q+1 > 0].$

375. $\int_0^1 \frac{dx}{\sqrt{\log\left(\frac{1}{x}\right)}} = \sqrt{\pi}.$

376. $\int^{\infty} \log\left(\frac{e^x + 1}{e^x - 1}\right) dx = \frac{\pi^2}{4}.$

377. $\int_0^{\pi} x \cdot \log \sin x\, dx = -\frac{\pi^2}{2} \log 2.$

378. $\int_0^{\pi/2} \log \sin x\, dx = \int_0^{\pi/2} \log \cos x\, dx = -\frac{\pi}{2} \cdot \log 2.$

379. $\int_0^{\pi/2} \sin x \log \sin x\, dx = \log 2 - 1.$

380. $\int_0^{\pi/2} \log \tan x\, dx = 0.$

381. $\int_0^{\pi} \log(a \pm b \cos x)\, dx = \pi \log\left(\frac{a + \sqrt{a^2 - b^2}}{2}\right), [a \geqq b].$

Values of Γ (n)

n	Γ (n)	n	Γ (n)	n	Γ (n)	n	Γ (n)
1.00	1.00000	1.25	.90640	1.50	.88623	1.75	.91906
1.01	.99433	1.26	.90440	1.51	.88659	1.76	.92137
1.02	.98884	1.27	.90250	1.52	.88704	1.77	.92376
1.03	.98355	1.28	.90072	1.53	.88757	1.78	.92623
1.04	.97844	1.29	.89904	1.54	.88818	1.79	.92877
1.05	.97350	1.30	.89747	1.55	.88887	1.80	.93138
1.06	.96874	1.31	.89600	1.56	.88964	1.81	.93408
1.07	.96415	1.32	.89464	1.57	.89049	1.82	.93685
1.08	.95973	1.33	.89338	1.58	.89142	1.83	.93969
1.09	.95546	1.34	.89222	1.59	.89243	1.84	.94261
1.10	.95135	1.35	.89115	1.60	.89352	1.85	.94561
1.11	.94739	1.36	.89018	1.61	.89468	1.86	.94869
1.12	.94359	1.37	.88931	1.62	.89592	1.87	.95184
1.13	.93993	1.38	.88854	1.63	.89724	1.88	.95507
1.14	.93642	1.39	.88785	1.64	.89864	1.89	.95838
1.15	.93304	1.40	.88726	1.65	.90012	1.90	.96177
1.16	.92980	1.41	.88676	1.66	.90167	1.91	.96523
1.17	.92670	1.42	.88636	1.67	.90330	1.92	.96878
1.18	.92373	1.43	.88604	1.68	.90500	1.93	.97240
1.19	.92088	1.44	.88580	1.69	.90678	1.94	.97610
1.20	.91817	1.45	.88565	1.70	.90864	1.95	.97988
1.21	.91558	1.46	.88560	1.71	.91057	1.96	.98374
1.22	.91311	1.47	.88563	1.72	.91258	1.97	.98768
1.23	.91075	1.48	.88575	1.73	.91466	1.98	.99171
1.24	.90852	1.49	.88595	1.74	.91683	1.99	.99581
						2.00	1.00000

ALGEBRA

Factors and Expansions

$$(a \pm b)^2 = a^2 \pm 2ab + b^2.$$
$$(a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3.$$
$$(a \pm b)^4 = a^4 \pm 4a^3b + 6a^2b^2 \pm 4ab^3 + b^4.$$
$$a^2 - b^2 = (a - b)(a + b).$$
$$a^2 + b^2 = \left(a + b\sqrt{-1}\right)\left(a - b\sqrt{-1}\right).$$
$$a^3 - b^3 = (a - b)(a^2 + ab + b^2).$$
$$a^3 + b^3 = (a + b)(a^2 - ab + b^2).$$
$$a^4 + b^4 = \left(a^2 + ab\sqrt{2} + b^2\right)\left(a^2 - ab\sqrt{2} + b^2\right).$$
$$a^n - b^n = (a - b)(a^{n-1} + a^{n-2}b + \ldots. + b^{n-1}).$$
$$a^n - b^n = (a + b)(a^{n-1} - a^{n-2}b + \ldots. - b^{n-1}),$$
for even values of n.
$$a^n + b^n = (a + b)\ (a^{n-1} - a^{n-2}b + \ldots. + b^{n-1}),$$
for odd values of n.
$$a^4 + a^2b^2 + b^4 = (a^2 + ab + b^2)(a^2 - ab + b^2).$$
$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc.$$
$$(a + b + c)^3 = a^3 + b^3 + c^3 + 3a^2(b + c) + 3b^2(a + c) + 3c^2(a + b) + 6abc.$$
$$(a + b + c + d + \ldots)^2 = a^2 + b^2 + c^2 + d^2 + \ldots + 2a(b + c + d + \ldots) + 2b(c + d + \ldots) + 2c(d + \ldots) + \ldots$$

See also under Series

Powers and Roots

$$a^x \times a^y = a^{(x+y)}. \qquad a^0 = 1 \text{ [if } a \neq 0]. \qquad (ab)^x = a^x b^x.$$

$$\frac{a^x}{a^y} = a^{(x-y)}. \qquad a^{-x} = \frac{1}{a^x}. \qquad \left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}.$$

$$(a^x)^y = a^{xy}. \qquad a^{\frac{1}{x}} = \sqrt[x]{a}. \qquad \sqrt[x]{ab} = \sqrt[x]{a}\,\sqrt[x]{b}.$$

$$\sqrt[x]{\sqrt[y]{a}} = \sqrt[xy]{a}. \qquad a^{\frac{x}{y}} = \sqrt[y]{a^x}. \qquad \sqrt[x]{\frac{a}{b}} = \frac{\sqrt[x]{a}}{\sqrt[x]{b}}.$$

Proportion

If $\dfrac{a}{b} = \dfrac{c}{d}$, then $\dfrac{a + b}{b} = \dfrac{c + d}{d}$,

$$\frac{a - b}{b} = \frac{c - d}{d}, \qquad \frac{a - b}{a + b} = \frac{c - d}{c + d}.$$

ALGEBRA—(Continued)

SUMS OF NUMBERS

The sum of the first n numbers,—

$$\Sigma(n) = 1+2+3+4+5\ \ldots\ +n = \frac{n(n+1)}{2}$$

The sum of the squares of the first n numbers,

$$\Sigma(n^2) = 1^2+2^2+3^2+4^2+5^2\ \ldots\ +n^2 = \frac{n(n+1)(2n+1)}{6}$$

The sum of the cubes of the first n numbers,

$$\Sigma(n^3) = 1^3+2^3+3^3+4^3+5^3\ \ldots\ +n^3 = \frac{n^2(n+1)^2}{4}$$

ARITHMETICAL PROGRESSION

If a is the first term; l, the last term; d, the common difference; n, the number of terms and s, the sum of n terms,—

$$l = a + (n-1)d \qquad s = \frac{n}{2}(a+l)$$

$$s = \frac{n}{2}\left\{2a+(n-1)d\right\}$$

GEOMETRICAL PROGRESSION

If a is the first term; l, the last term; r, the common ratio; n, the number of terms and s, the sum of n terms,—

$$l = ar^{n-1} \qquad s = a\frac{(1-r^n)}{1-r}$$

$$s = a\frac{(r^n-1)}{r-1} \qquad s = \frac{lr-a}{r-1}$$

If n is infinity and r^2 less than unity,—

$$s = \frac{a}{1-r}$$

FACTORIALS

$$\lfloor n = n! = e^{-n}n^n\sqrt{2\pi n}, \text{ approximately.}$$

PERMUTATIONS

If M denote the number of permutations of n things taken p at a time,—

$$M = n(n-1)(n-2)\ \ldots\ (n-p+1)$$

COMBINATIONS

If M denote the number of combinations of n things taken p at a time,—

$$M = \frac{n(n-1)(n-2)\ \ldots\ (n-p+1)}{p!}$$

$$M = \frac{n!}{p!(n-p)!}$$

ALGEBRA (Continued)

Quadratic Equations

Any quadratic equation may be reduced to the form, —

$$ax^2 + bx + c = 0$$

Then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

If $b^2 - 4ac$ is positive the roots are real and unequal.
If $b^2 - 4ac$ is zero the roots are real and equal.
If $b^2 - 4ac$ is negative the roots are imaginary and unequal.
If $b^2 - 4ac$ is a perfect square the roots are rational and unequal.

Cubic Equations

A cubic equation, $y^3 + py^2 + qy + r = 0$ may be reduced to the form, —

$$x^3 + ax + b = 0$$

by substituting for y the value, $\left(x - \frac{p}{3}\right)$. Here

$$a = \tfrac{1}{3}(3q - p^2) \text{ and } b = \tfrac{1}{27}(2p^3 - 9pq + 27r).$$

For solution let, —

$$A = \sqrt[3]{-\frac{b}{2} + \sqrt{\frac{b^2}{4} + \frac{a^3}{27}}}, \qquad B = \sqrt[3]{-\frac{b}{2} - \sqrt{\frac{b^2}{4} + \frac{a^3}{27}}},$$

then the values of x will be given by,

$$x = A + B, \quad -\frac{A+B}{2} + \frac{A-B}{2}\sqrt{-3}, \quad -\frac{A+B}{2} - \frac{A-B}{2}\sqrt{-3}$$

If $\dfrac{b^2}{4} + \dfrac{a^3}{27} > 0$, there will be one real root and two conjugate imaginary roots.

If $\dfrac{b^2}{4} + \dfrac{a^3}{27} = 0$, there will be three real roots of which two at least are equal

If $\dfrac{b^2}{4} + \dfrac{a^3}{27} < 0$, there will be three real and unequal roots.

In the last case a trigonometric solution is useful. Compute the value of the angle ϕ in the expression, —

$$\cos\phi = \sqrt{\frac{b^2}{4} \div \left(-\frac{a^3}{27}\right)},$$

then x will have the following values:—

$$\mp 2\sqrt{-\frac{a}{3}}\cos\frac{\phi}{3}, \qquad \mp 2\sqrt{-\frac{a}{3}}\cos\left(\frac{\phi}{3} + 120°\right),$$

$$\mp 2\sqrt{-\frac{a}{3}}\cos\left(\frac{\phi}{3} + 240°\right).$$

APPROXIMATIONS

If a and b are small quantities, the following relations are approximately true,—

$$(1 \pm a)^m = 1 \pm ma,$$

$$(1 \pm a)^m (1 \pm b)^n = 1 \pm ma \pm nb.$$

If n is nearly equal to m,

$$\sqrt{mn} = \frac{n+m}{2}, \text{ approximately.}$$

If θ is a very small angle expressed in radians,—

$$\frac{\sin\theta}{\theta} = 1 \text{ and } \frac{\tan\theta}{\theta} = 1, \text{ approximately.}$$

SERIES

The expression in parentheses following certain of the series indicates the region of convergence. If not otherwise indicated it is to be understood that the series converges for all finite values of x.

Binomial

$$(x+y)^n = x^n + nx^{n-1}y + \frac{n(n-1)}{2!}x^{n-2}y^2 + \frac{n(n-1)(n-2)}{3!}x^{(n-3)}y^3 + \ldots \quad (y^2 < x^2)$$

$$(1 \pm x)^n = 1 \pm nx + \frac{n(n-1)x^2}{2!} \pm \frac{n(n-1)(n-2)x^3}{3!} + \ldots \text{ etc.} \quad (x^2 < 1)$$

$$(1 \pm x)^{-n} = 1 \mp nx + \frac{n(n+1)x^2}{2!} \mp \frac{n(n+1)(n+2)x^3}{3!} + \ldots \text{ etc.} \quad (x^2 < 1)$$

$$(1 \pm x)^{-1} = 1 \mp x + x^2 \mp x^3 + x^4 \mp x^5 + \ldots \quad (x^2 < 1)$$

$$(1 \pm x)^{-2} = 1 \mp 2x + 3x^2 \mp 4x^3 + 5x^4 \mp 6x^5 + \ldots \quad (x^2 < 1)$$

Taylor's Series

$$f(x+h) = f(x) + hf'(x) + \frac{h^2}{2!}f''(x) + \frac{h^3}{3!}f'''(x) + \ldots$$

$$= f(h) + xf'(h) + \frac{x^2}{2!}f''(h) + \frac{x^3}{3!}f'''(h) + \ldots$$

Maclaurin's Series

$$f(x) = f(o) + xf'(o) + \frac{x^2}{2!}f''(o) + \frac{x^3}{3!}f'''(o) + \ldots$$

Exponential

$$e = 1 + \frac{1}{1} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \ldots$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots$$

$$a^x = 1 + x\log a + \frac{(x\log a)^2}{2!} + \frac{(x\log a)^3}{3!} + \ldots$$

Logarithmic

$$\log_e x = \frac{x-1}{x} + \frac{1}{2}\left(\frac{x-1}{x}\right)^2 + \frac{1}{3}\left(\frac{x-1}{x}\right)^3 + \ldots \qquad (x > \tfrac{1}{2})$$

$$\log_e x = (x-1) - \tfrac{1}{2}(x-1)^2 + \tfrac{1}{3}(x-1)^3 - \ldots \qquad (2 > x > 0)$$

$$\log_e x = 2\left[\frac{x-1}{x+1} + \frac{1}{3}\left(\frac{x-1}{x+1}\right)^3 + \frac{1}{5}\left(\frac{x-1}{x+1}\right)^5 + \ldots\right] \qquad (x > 0)$$

$$\log_e(1+x) = x - \tfrac{1}{2}x^2 + \tfrac{1}{3}x^3 - \tfrac{1}{4}x^4 + \ldots \qquad (-1 < x < 1)$$

$$\log_e(n+1) - \log_e(n-1) = 2\left[\frac{1}{n} + \frac{1}{3n^3} + \frac{1}{5n^5} + \ldots\right]$$

$$\log_e(a+x) = \log_e a + 2\left[\frac{x}{2a+x} + \frac{1}{3}\left(\frac{x}{2a+x}\right)^3 + \frac{1}{5}\left(\frac{x}{2a+x}\right)^5 + \ldots\right] \qquad (a > 0,\ -a < x < +\infty)$$

Trigonometric

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \frac{17x^7}{315} + \frac{62x^9}{2835} + \ldots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$\sin^{-1} x = x + \frac{x^3}{6} + \frac{1}{2}\cdot\frac{3}{4}\cdot\frac{x^5}{5} + \frac{1}{2}\cdot\frac{3}{4}\cdot\frac{5}{6}\cdot\frac{x^7}{7} + \ldots \qquad (x^2 < 1)$$

$$\tan^{-1} x = x - \tfrac{1}{3}x^3 + \tfrac{1}{5}x^5 - \tfrac{1}{7}x^7 + \ldots \qquad (x^2 < 1)$$

$$= \frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \ldots \qquad (x^2 > 1)$$

$$\log_e \sin x = \log_e x - \frac{x^2}{6} - \frac{x^4}{180} - \frac{x^6}{2835} - \ldots \qquad (x^2 < \pi^2)$$

$$\log_e \cos x = -\frac{x^2}{2} - \frac{x^4}{12} - \frac{x^6}{45} - \frac{17x^8}{2520} - \ldots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$\log_e \tan x = \log_e x + \frac{x^2}{3} + \frac{7x^4}{90} + \frac{62x^6}{2835} + \ldots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$e^{\sin x} = 1 + x + \frac{x^2}{2!} - \frac{3x^4}{4!} - \frac{8x^5}{5!} - \frac{3x^6}{6!} + \ldots$$

$$e^{\cos x} = e\left(1 - \frac{x^2}{2!} + \frac{4x^4}{4!} - \frac{31x^6}{6!} + \ldots\right)$$

$$e^{\tan x} = 1 + x + \frac{x^2}{2!} + \frac{3x^3}{3!} + \frac{9x^4}{4!} + \frac{37x^5}{5!} + \ldots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

ALGEBRA (Continued)

MISCELLANEOUS

The Sum (Σ, = Sigma) and Product (Π, = Pi) Notations

Σ denotes the **sum**, and Π, the **product** of all quantities of a given collection. In particular,

$$\sum_{i=m}^{m+n} x_i \text{ means } x_m + x_{m+1} + \ldots + x_{m+n}, \ (n + 1 \text{ terms in all}),$$

$$\prod_{i=m}^{m+n} x_i \text{ means } x_m x_{m+1} \ldots x_{m+n}, \ (n + 1 \text{ factors in all}).$$

For indicated **range**, R, (such as $m \leqq i \leqq m + n$), one may write $\sum_R x_i$, $\prod_R x_i$, respectively. Where the range is clear from the context one writes Σx_i, Πx_i, or even Σx, Πx, respectively. For c a constant and for x_i and y_i with common range (say of n elements),

$$\Sigma c x_i = c \Sigma x_i, \ \Sigma(x_i + y_i) = \Sigma x_i + \Sigma y_i, \ \Sigma(x_i + c) = nc + \Sigma x_i.$$

Special Numerical Relations

(i) For range, $i = 1, 2, \ldots, n$, with $x_i = i$.
$\Sigma x_i = n(n + 1)/2$, $\Sigma(2x_i - 1) = n^2$,
$\Sigma x_i^2 = n(n + 1)(2n + 1)/6$.
$\Sigma x_i^3 = (\Sigma x_i)^2$, $\Sigma x_i^4 = (\Sigma x_i^2)[6(\Sigma x_i) - 1]/5$.
$\Pi(c + 1 - x_i) = c^{(n)}$, $\Pi x_i = n^{(n)} = n!$ ("**factorial** n").
Hence $n! = n \cdot (n - 1)!$ $0!$ is defined to be 1.
Stirling's formula (used for n large),

$$\sqrt{2n\pi}(n/e)^n < n! < \sqrt{2n\pi}(n/e)^n\left(1 + \frac{1}{12n - 1}\right),$$
$$(\pi = 3.14159\ldots, e = 2.71828\ldots).$$

$n!/m!$ gives the number of **permutations of** n **distinct things taken** m **at a time.**

(ii) For range, $i = -\left(\frac{n-1}{2}\right), -\left(\frac{n-1}{2}\right) + 1, \ldots, \left(\frac{n-1}{2}\right) - 1, \left(\frac{n-1}{2}\right)$, with $x_i = i$ (whether n is odd or even),

$$\sum x_i = \sum x_i^3 = 0, \sum x_i^2 = \frac{n(n^2 - 1)}{12}, \sum x_i^4 = \frac{3n^2 - 7}{20}\sum x_i^2.$$

ALGEBRA (Continued)

(iii) The Binomial Coefficients, $\binom{n}{m}$.
$\binom{n}{m} = n!/[(n-m)!m!]$, for integers m, n, $0 \leqq m \leqq n$. $\binom{n}{0} = \binom{n}{n} = 1$.

$(x+c)^n = \sum_r \binom{n}{r} x^{n-r} c^r$, $(0 \leqq r \leqq n)$. The **binomial expansion** $\binom{n}{m}$ gives also the number of **combinations of n distinct things taken m at a time.**

$\binom{n}{m} + \binom{n}{m+1} = \binom{n+1}{m+1}$, **recursion relation** for binomial coefficients.

$$\binom{n}{n-m} = \binom{n}{m}, \quad \sum_r (-1)^r \binom{n}{r} = 0, \quad \sum_r \binom{n}{r}^2 = \binom{2n}{n}, \quad \sum_{s=m}^{n} \binom{s}{m} = \binom{n+1}{m+1}.$$

Table of Binomial Coefficients

n	$\binom{n}{0}$	$\binom{n}{1}$	$\binom{n}{2}$	$\binom{n}{3}$	$\binom{n}{4}$	$\binom{n}{5}$	$\binom{n}{6}$	$\binom{n}{7}$	$\binom{n}{8}$	$\binom{n}{9}$	$\binom{n}{10}$
0	1										
1	1	1									
2	1	2	1								
3	1	3	3	1							
4	1	4	6	4	1						
5	1	5	10	10	5	1					
6	1	6	15	20	15	6	1				
7	1	7	21	35	35	21	7	1			
8	1	8	28	56	70	56	28	8	1		
9	1	9	36	84	126	126	84	36	9	1	
10	1	10	45	120	210	252	210	120	45	10	1
11	1	11	55	165	330	462	462	330	165	55	11
12	1	12	66	220	495	792	924	792	495	220	66
13	1	13	78	286	715	1287	1716	1716	1287	715	286
14	1	14	91	364	1001	2002	3003	3432	3003	2002	1001
15	1	15	105	455	1365	3003	5005	6435	6435	5005	3003
16	1	16	120	560	1820	4368	8008	11440	12870	11440	8008
17	1	17	136	680	2380	6188	12376	19448	24310	24310	19448
18	1	18	153	816	3060	8568	18564	31824	43758	48620	43758
19	1	19	171	969	3876	11628	27132	50388	75582	92378	92378
20	1	20	190	1140	4845	15504	38760	77520	125970	167960	184756

NOTE: $\binom{n}{m} = \dfrac{n(n-1)(n-2)\ldots(n-m+1)}{m(m-1)(m-2)\ldots 3.2.1}$; $\binom{n}{0} = 1$; $\binom{n}{1} = n$.

For coefficients missing from the above table, use the relation

$\binom{n}{m} = \binom{n}{n-m}$, e.g. $\binom{20}{11} = \binom{20}{9} = 167960$.

ALGEBRA (Continued)

Finite Differences

For equi-spaced arguments x_i, and associated y_i, the successive **advancing** y**-differences** are, $\Delta^0 y_i = y_i$, $\Delta y_i = y_{i+1} - y_i$, $\Delta^2 y_i = \Delta y_{i+1} - \Delta y_i = y_{i+2} - 2y_{i+1} + y_i, \ldots,$ $\Delta^m y_i = \Delta^{m-1} y_{i+1} - \Delta^{m-1} y_i = \sum_r (-1)^r \binom{m}{r} y_{i+m-r}$. With arbitrary origin A and class-interval length, $x_{i+1} - x_i = h$, using $u_i = (x_i - A)/h$, write $y(u_i)$ for y_i. Then if for some fixed m, for the portion of the table considered, the values of $\Delta^{m+1} y_i$ be zero (or approximately, if these be regarded as negligible) **Newton's formula** gives

$$y(u) = \sum \frac{u^{(r)}}{r!} \Delta^r y(0) = y(0) + u\Delta y(0) + \frac{u(u-1)}{1 \cdot 2} \Delta^2 y(0) + \cdots + \frac{u(u-1)\ldots(u-m+1)}{m!} \Delta^m y(0).$$

This formula reduces to an identity for $u = u_0, u_1, \ldots, u_n$, $(u_i = i)$, and may be used to interpolate for intermediate values.

Example. Given

x	-4,	-2,	0,	2,	4,	6,	8,	. . .
y	10,	14,	30,	64,	122,	210,	334,	. . .

to find a value for y when $x = 10$, and when $x = 1$. Suppose for some reason A has been taken at $x = 2$. The work may be arranged as follows:

u	x	y	Δ	Δ^2	Δ^3	Δ^4
-3	-4	10				
			4			
-2	-2	14		12		
			16		6	
-1	0	30		18		0
			34		6	
0	2	64		24		0
			58		6	
1	4	122		30		0
			88		6	
2	6	210		36		—
			124		—	
3	8	334		—		—
			—		—	
—	—	—		—		—

$$y(u) = 64 + 58u + 30\frac{u(u-1)}{1 \cdot 2} + 6\frac{u(u-1)(u-2)}{1 \cdot 2 \cdot 3}$$
$$= 64 + 58u + 15u(u-1) + u(u-1)(u-2).$$

At $x = 10$, $u = 4$. Substituting $u = 4$, one has $y|_{x=10} = 500$.
At $x = 1$, $u = -\frac{1}{2}$. Substituting $u = -\frac{1}{2}$, one has $y|_{x=1} = 44\frac{3}{8}$.

STATISTICS

Central Measures

Here the range of i is from 1 to n. With each value x_i is associated a weighting factor $f_i \geq 0$ (such as the frequency, the probability, the mass, the reliability, or other multiplier).

N, the **total weight,** $= \Sigma f_i$.

$\bar{x}$, the **arithmetic mean,** $= \Sigma f_i x_i / N = \Sigma f_i x_i / \Sigma f_i$.

GM, the **geometric mean** (available when each x_i is positive), $= \sqrt[N]{\Pi x_i^{f_i}}$. $\text{Log } GM = \Sigma f_i \log x_i / N$.

Mo, the **mode,** = value among $(x_1, \ldots, x_n)$ having maximum associated f_i (usually obtained by interpolating after the data are graduated). For unweighted items, x_i, a mode is a value about which the values of x_i cluster most densely.

RMS, the **root-mean-square,** $= \sqrt{\Sigma f_i x_i^2 / N}$.

Md, the **median** (see below). For unweighted items, the median is the value, equaled or exceeded by exactly half of the values x_i in the given list. In case of a central pair, the median is usually taken as the arithmetic mean of this pair.

Mm, the **mid-mean** (see below). For unweighted items, the mid-mean is the arithmetic mean of the half-list obtained upon dropping out the highest quarter and lowest quarter of the items.

Cum $f|_X$, the value of "cumulative f" at X, $= \sum_{x_i < X} f_i$ (interpolation being used for X if necessary).

The M-Tiles

For **ungrouped data,** X is called the rth **m-tile** (or rth **m-tile mark**) ($r = 0, 1, \ldots, m$) if simultaneously, $\sum_{x_i < X} f_i/N \leq r/m$, and $\sum_{x_i > X} f_i/N \leq (m - r)/m$. In particular the zeroth m-tile is **min,** the minimal value among the list $(x_1, \ldots, x_n)$, and the mth m-tile is **max,** the maximal value among the list.

For **grouped data,** the rth m-tile mark, X, is such that

$$\text{Cum } f|_X = Nr/m, \quad (r = 0, 1, 2, \ldots, m).$$

$$\text{Cum } f|_{\min} = 0, \qquad \text{Cum } f|_{\max} = N.$$

In particular, certain intermediate $(0 < r < m)$ m-tile marks are named as follows:

m	$r = 1$	2	3	. . .
2	Md (median)			
3	T_1 (lower tertile)	T_2 (upper tertile)		
4	Q_1 (lower quartile)	Md	Q_3 (upper quartile)	
10	D_1 (first decile)	D_2	D_3	etc.
100	PC_1 (first percentile)	PC_2	PC_3	etc.

STATISTICS (Continued)

The term "rth m-tile" ($r = 1, \ldots, m$) is also used to denote the class interval extending from the $(r - 1)$st to rth m-tile mark as defined above.

Mm, the **mid-mean,** =

$$2 \sum_{Q_1 \leq x_i \leq Q_3} f_i x_i / N = \sum_{Q_1 \leq x_i \leq Q_3} f_i x_i \Big/ \sum_{Q_1 \leq x_i \leq Q_3} f_i.$$

When each x_i is positive, and not all are equal, one always has $0 < \min < GM < \bar{x} < RMS < \max$.

For moderately-skewed distributions, one has approximately $Mo - \bar{x} = 3(Md - \bar{x})$, or $3Md = Mo + 2\bar{x}$.

Measures of Dispersion and Skewness

Here A is an arbitrary reference value, usually a convenient integral measure near $\bar{x}$.

ν_k, kth **moment about** A, $= \Sigma f_i(x_i - A)^k/N$, $(k = 0, 1, \ldots)$.

$\nu_0 = 1$, $\nu_1 = \bar{x} - A$. ν_2 as function of A is minimum for $A = \bar{x}$.

μ_k, kth **moment about** $\bar{x}$, $= \Sigma f_i(x_i - \bar{x})^k/N$, $(k = 0, 1, \ldots)$.

$$\begin{aligned}
\mu_0 &= 1, \\
\mu_1 &= 0, \\
\mu_2 &= \nu_2 - \nu_1^2 \ (\mu_2 = \text{variance}), \\
\mu_3 &= \nu_3 - 3\nu_1\nu_2 + 2\nu_1^3, \\
\mu_4 &= \nu_4 - 4\nu_1\nu_3 + 6\nu_1\nu_2^2 - 3\nu_1^4. \\
\beta_1 &= \mu_3^2/\mu_2^3,\ \beta_2 = \mu_4/\mu_2^2.
\end{aligned}$$

σ, **standard deviation,** $= \sqrt{\mu_2}$.

$\alpha_3/2$, **momental skewness;** $\alpha_3 = \sqrt{\beta_1} = \mu_3/\sigma^3$.

$(\alpha_4 - 3)/2$, **kurtosis;** $\alpha_4 = \beta_2$.

MD, **mean deviation** (from the mean), $= \Sigma f_i|x_i - \bar{x}|/N$

$$= 2\left[\bar{x} \sum_{x_i < \bar{x}} f_i - \sum_{x_i < \bar{x}} f_i x_i\right]/N.$$

(This latter form is convenient for computation.)

s, **quartile deviation,** $= |Q_3 - Q_1|/2$.

$P.E.$, **probable error,** $= 0.6745\sigma$.

V, **coefficient of variation,** $= 100\sigma/\bar{x}\ \%$.

Pearson's measure of skewness $= (\bar{x} - Mo)/\sigma$. (Usually approximately $\alpha_3/2$.)

Bowley's measure of skewness $= (Q_3 - 2Md + Q_1)/(2s)$.

(Bowley's measure of skewness lies between -1 and $+1$.)

STATISTICS (Continued)

The Class Interval

$$\Delta x_i = x_{i+1} - x_i.$$

For equi-spaced arguments, $\Delta x_i = h$, the **length of the class interval**, x_i is the **mid-value** or **class mark**. The interval from $x_i - (h/2)$ to $x_i + (h/2)$ is the **class interval** with these as given **initial** and **terminal end values.**

$$u_i = (x_i - A)/h.$$
$$\bar{u} = \Sigma f_i u_i / N,\ \bar{x} = h\bar{u} + A.$$
$$(\mu_k)_x = h^k(\mu_k)_u,\ (k = 0, 1, \ldots).$$
$$\sigma_u^2 = [\Sigma f_i u_i^2/N] - \bar{u}^2,\ \sigma_x = h\sigma_u.$$
$$(\beta_1)_x = (\beta_1)_u,\ (\beta_2)_x = (\beta_2)_u.$$

Sheppard's corrections (to correct approximately for the error due to treating all elements in a given class interval of length h as though concentrated at the class mark).

For μ_0, μ_1, μ_3, no corrections.

In x-units,

corrected $(\mu_2)_x$ = uncorrected $(\mu_2)_x - h^2/12$,

corrected $(\mu_4)_x$ = uncorrected $(\mu_4)_x - h^2$ uncorrected $(\mu_2)_x/2 + 7h^4/240$.

In u-units, replace h by 1 in the formulae given above.

Least Squares

The **normal equations** for finding coefficients, $a_0, a_1, \ldots, a_m$, in fitting a curve of the form $y = a_0 + a_1 x + \ldots + a_m x^m$ to data (X_i, Y_i), $i = 1, \ldots, n$, $(n > m)$, are $m + 1$ in number as follows:

$$\Sigma Y_i = a_0 n + a_1 \Sigma X_i + a_2 \Sigma X_i^2 + \ldots + a_m \Sigma X_i^m,$$
$$\Sigma X_i Y_i = a_0 \Sigma X_i + a_1 \Sigma X_i^2 + a_2 \Sigma X_i^3 + \ldots + a_m \Sigma X_i^{m+1},$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$\Sigma X_i^m Y_i = a_0 \Sigma X_i^m + a_1 \Sigma X_i^{m+1} + a_2 \Sigma X_i^{m+2} + \ldots + a_m \Sigma X_i^{2m}.$$

Deviation from fitted curve,

$$d_i = Y_i - (a_0 + a_1 X_i + \ldots + a_m X_i^m).$$

$$\Sigma d_i^2 = \Sigma Y_i^2 - (a_0 \Sigma Y_i + a_1 \Sigma X_i Y_i + \ldots + a_m \Sigma X_i^m Y_i).$$

For $z = ab^x$, use $y = \log z$, $a_0 = \log a$, $a_1 = \log b$.

For $z = at^p$, use $y = \log z$, $a_0 = \log a$, $a_1 = p$, $x = \log t$.

S_y, **standard error of estimate,** = root-mean-square of the y-deviations about a fitted curve $= \sqrt{\Sigma d_i^2/n}$.

Simple Correlation

Product Moment Method

Given n equi-spaced measurements X_i, $i = 1, 2, \ldots, n$, with $h = X_{i+1} - X_i$, $x_i = X_i - \bar{X}$; and m equi-spaced measurements Y_j, $j = 1, 2, \ldots, m$, with $k = Y_{j+1} - Y_j$, $y_j = Y_j - \bar{Y}$; and a weight (frequency, probability, etc.) e_{ij} (≥ 0), associated with (X_i, Y_j). Here e_{ij} is an entry in the table.

STATISTICS (Continued)

$$f_i = \sum_j e_{ij},\ g_j = \sum_i e_{ij}.$$

$$N = \sum_{ij} e_{ij} = \sum_i f_i = \sum_j g_j. \quad \text{(Check)}$$

$$\bar{x} = \sum_{ij} e_{ij} X_i / N = \sum_i f_i X_i / N;\ \bar{y} = \sum_{ij} e_{ij} Y_j / N = \sum_j g_j Y_j / N.$$

Let A and B be arbitrary reference values, usually convenient integral measures near $\bar{X}$ and $\bar{Y}$, respectively.

$$u_i = (X_i - A)/h,\ v_j = (Y_j - B)/k;$$

$$\bar{u} = \Sigma f_i u_i / N,\ \bar{X} = h\bar{u} + A,\ \bar{v} = \Sigma g_j v_j / N,\ \bar{Y} = k\bar{v} + B.$$

$$\left.\begin{aligned} \sigma_u^2 &= (\mu_2)_u = (\Sigma f_i u_i^2/N) - \bar{u}^2,\ \sigma_x = h\sigma_u. \\ \sigma_v^2 &= (\mu_2)_v = (\Sigma g_j v_j^2/N) - \bar{v}^2,\ \sigma_y = k\sigma_v. \end{aligned}\right\} \text{Apply Sheppard's corrections.}$$

$$U_j = \sum_i e_{ij} u_i,\ V_i = \sum_j e_{ij} v_j,\ P = \sum u_i V_i = \sum v_j U_j. \quad \text{(Check)}$$

$$p_{uv} = \sum_{ij} e_{ij}(u_i - \bar{u})(v_j - \bar{v})/N$$

$$= (P/N) - \bar{u}\bar{v}.$$

$$p_{xy} = hkp_{uv}.$$

$r = p_{uv}/(\sigma_u\sigma_v) = p_{xy}/(\sigma_x\sigma_y)$ **(product-moment) coefficient of correlation.** In every case $-1 \leq r \leq 1$.

$Y - \bar{Y} = r\dfrac{\sigma_y}{\sigma_x}(X - \bar{X})$, or $y = r\dfrac{\sigma_y}{\sigma_x}x$, **regression line of y on x.**

$X - \bar{X} = r\dfrac{\sigma_x}{\sigma_y}(Y - \bar{Y})$, or $x = r\dfrac{\sigma_x}{\sigma_y}y$, **regression line of x on y.**

Example of Computation for Product-Moment Coefficient of Correlation

v_j	y_j \ u_i / x_i	-3 / 12	-2 / 16	-1 / 20	0 / 24	1 / 28	2 / 32	g_j	g_jv_j	$g_jv_j^2$	$U_j\ \left(= \sum_i e_{ij}u_i\right)$	v_jU_j
2	21			1	5	7	1	14	28	56	8	16
1	18		1	3	7	5	2	18	18	18	4	4
0	15		2	3	4	1		10	0	0		0
-1	12		3	1	1			5	-5	5	-7	7
-2	9	2	1					3	-6	12	-8	16
	f_i	2	7	8	17	13	3	50	35	91		43
	f_iu_i	-6	-14	-8	0	13	6	-9				
	$f_iu_i^2$	18	28	8	0	13	12	79				
	$V_i\ \left(= \sum_j e_{ij}v_j\right)$	-4	-4	4		19	4					
	u_iV_i	12	8	-4	0	19	8	43				

$A = 24$, $B = 15$,
$h = 4$, $k = 3$,
$N = \Sigma f_i = \Sigma g_j = 50$,
$\Sigma f_i u_i = -9$, $\Sigma g_j v_j = 35$,
$\Sigma f_i u_i^2 = 79$, $\Sigma g_j v_j^2 = 91$,
$P = \Sigma u_i V_i = \Sigma v_j U_j = 43$.

$\bar{u} = -9/50 = -.18 \qquad \bar{v} = 35/50 = .70$

$\sigma_u^2 = (79/50) - (-.18)^2 - .083 = 1.173, \qquad \sigma_u = 1.083$

$\sigma_v^2 = (91/50) - (.70)^2 - .083 = 1.247, \qquad \sigma_v = 1.117$

$p_{uv} = (43/50) - (-.18)(.70) = +0.986$

$r = +0.986/(1.083 \times 1.117) = +.815 \qquad$ Ans. $r = +.815$

STATISTICS (Continued)

Rank Difference Method

Given n corresponding pairs of measured items (X_i, Y_i), $(i = 1, \ldots, n)$. Let (u_i, v_i) be the corresponding rank numbers. Here $u_i = 1$ for the largest X_i, 2 for the next largest X_i, etc., and similarly $v_i = 1$ for the largest Y_i, 2 for the next largest Y_i, etc. $\rho = 1 - \dfrac{6\Sigma(u_i - v_i)^2}{n(n^2 - 1)}$, **(rank difference) coefficient of correlation.** In every case $-1 \leq \rho \leq 1$. Check: $\Sigma(u_i - v_i) = 0$.

Example of Computation for Rank-Difference Coefficient of Correlation

X_i	Y_i	u_i	v_i	$u_i - v_i$	$(u_i - v_i)^2$	
76	52	3	1	+2	4	Check: $\Sigma(u_i - v_i) = 0$.
66	34	8	9	−1	1	
63	32	10	10	0	0	
74	45	4	4	0	0	$\rho = 1 - \dfrac{6 \times 62}{10(10^2 - 1)}$
79	50	1	2	−1	1	
69	37	7	7	0	0	
77	35	2	8	−6	36	$= +0.63$
65	42	9	5	+4	16	
71	40	6	6	0	0	Ans. $\rho = +.63$
73	48	5	3	+2	4	
$N = 10$				0	62	

Probability

If among $a + b$ equi-probable and mutually exclusive events, a are regarded as favorable and b unfavorable, then for a single trial

p, probability of favorable outcome, $= \dfrac{a}{a + b}$,

q, probability of unfavorable outcome, $= 1 - p = \dfrac{b}{a + b}$.

The successive terms in the binomial expansion $(p + q)^n = \sum\limits_r \binom{n}{r} p^{n-r}q^r$ give the respective probabilities than in n trials, the event will be favorable exactly $n - r$ times, $r = 0, \ldots, n$.

The mean number of favorable events is np, of unfavorable, nq; the standard deviation is $\sigma = \sqrt{npq}$, $\alpha_3 = (p - q)/\sigma$ (the positive direction being that of increasing unfavorability).

Normal curve (x measured in σ-units from the mean, and with area = 1):

$$y = \frac{1}{\sqrt{2\pi}} e^{-x^2/2} = 0.3989e^{-x^2/2}.$$

STATISTICS (Continued)

MD (mean deviation from the mean) $= \sigma\sqrt{2/\pi} = 0.7979\sigma$.
s (quartile deviation from the mean) $= 0.6745\sigma = 0.845\ MD$.
Percentage areas, under normal curve, for successive class intervals measured from the mean:

Multiples of σ: 34 %, 14 %, 2 %.
Multiples of s: 25 %, 16 %, 7 %, 2 %.

Normal surface (x measured in σ_x-units y in σ_y-units from their means),

$$z = \frac{1}{2\pi\sqrt{1 - r^2}} e^{-(x^2 - 2rxy + y^2)/[2(1-r^2)]}.$$

Goodness of Fit. For a universe of objects falling into n mutually exclusive classes with class marks, $x_i (i = 1, 2, \ldots, n)$, let p_i be the probability for the ith class. Given a sample of N items, with f_i items in the ith class ($\Sigma f_i = N$), the probability that a random sample of N items gives no better fit, expressed in terms of n and χ^2 ("Chi square"), $= \Sigma(f_i - Np_i)^2/(Np_i)$, is given by a table, portions of which are as follows:

Probability that a Random Sample Gives no Better Fit

n \ χ^2	1	2	3	4	6	8	10	15	20
3	.607	.368	.223	.135	.050	.018	.007	.001	.000
4	.801	.572	.392	.261	.112	.046	.019	.002	.000
5	.910	.736	.558	.406	.199	.092	.040	.005	.000
6	.963	.849	.700	.549	.306	.156	.075	.010	.001
7	.986	.920	.809	.677	.423	.238	.125	.020	.003
8	.995	.960	.885	.780	.540	.333	.189	.036	.006
9	.998	.981	.934	.857	.647	.433	.265	.059	.010
10	.999	.991	.964	.911	.740	.534	.350	.091	.018
11	1.000	.996	.981	.947	.815	.629	.440	.132	.029
12	1.000	.998	.991	.970	.873	.713	.530	.182	.045

n \ χ^2	8	10	12	14	16	18	20	25	30
10	.534	.350	.213	.122	.067	.035	.018	.003	.000
11	.629	.440	.285	.173	.100	.055	.029	.005	.001
12	.713	.530	.363	.233	.141	.082	.045	.009	.002
13	.785	.616	.446	.301	.191	.116	.067	.015	.003
14	.844	.694	.528	.374	.249	.158	.095	.023	.005
15	.889	.762	.606	.450	.313	.207	.130	.035	.008
16	.924	.820	.679	.526	.382	.263	.172	.050	.012
17	.949	.867	.744	.599	.453	.324	.220	.070	.018
18	.967	.904	.800	.667	.524	.389	.274	.095	.026
19	.979	.932	.847	.729	.593	.456	.333	.125	.037
20	.987	.953	.886	.784	.657	.522	.395	.161	.052

MENSURATION FORMULÆ

Plane Figures Bounded by Straight Lines

The **area of a triangle** whose base is b and altitude h

$$= \frac{hb}{2}.$$

The area of a **triangle** with angles A, B, and C and sides opposite a, b, and c, respectively

$$= \tfrac{1}{2}ab \sin C.$$

or $$= \sqrt{s(s-a)(s-b)(s-c)},$$
where $s = \frac{1}{2}(a + b + c)$.

A **rectangle** with sides a and b has an area $= ab$.

The area of a **parallelogram** with side b and the perpendicular distance to the parallel side h

$$= bh.$$

The area of a **parallelogram** with sides a and b and the included angle θ

$$= ab \sin \theta.$$

The area of a **rhombus** with diagonals c and d,

$$= \tfrac{1}{2}cd.$$

The area of a **trapezoid** whose parallel sides are a and b and altitude h

$$= \tfrac{1}{2}(a + b)h.$$

The area of any **quadrilateral** with diagonals a and b and the angle between them θ

$$= \tfrac{1}{2}ab \sin \theta.$$

The area of a **regular polygon** with n sides, each of length l,

$$= \tfrac{1}{4}nl^2 \cot \frac{180}{n}.$$

For a regular polygon of n sides, each side of length l, the radius of the **inscribed circle**,

$$= \frac{l}{2} \cot \frac{180}{n}.$$

The radius of the **circumscribed circle**,

$$= \frac{l}{2} \operatorname{cosec} \frac{180}{n}.$$

Area, Radius of Inscribed and Circumscribed Circles for Regular Polygons

l = length of one side.

Name.	Number of sides.	Area.	Radius of inscribed circle.	Radius of circumscribed circle.
Triangle, equilateral	3	$0.43301l^2$	$0.28867l$	$0.57735l$
Square............	4	$1.00000l^2$	$0.50000l$	$0.70710l$
Pentagon..........	5	$1.72048l^2$	$0.68819l$	$0.85065l$
Hexagon...........	6	$2.59808l^2$	$0.86602l$	$1.0000l$
Heptagon..........	7	$3.63391l^2$	$1.0383l$	$1.1523l$
Octagon...........	8	$4.82843l^2$	$1.2071l$	$1.3065l$
Nonagon...........	9	$6.18182l^2$	$1.3737l$	$1.4619l$
Decagon...........	10	$7.69421l^2$	$1.5388l$	$1.6180l$
Undecagon.........	11	$9.36564l^2$	$1.7028l$	$1.7747l$
Dodecagon.........	12	$11.19615l^2$	$1.8660l$	$1.9318l$

Radius of circle inscribed in any triangle, whose sides are a, b, and c, where $s = \frac{1}{2}(a + b + c)$

$$= \frac{\sqrt{s(s-a)(s-b)(s-c)}}{s}.$$

The radius of the circumscribed circle

$$= \frac{abc}{4\sqrt{s(s-a)(s-b)(s-c)}}.$$

The perimeter of a polygon inscribed in a circle of radius r, where n is the number of sides,

$$= 2nr \sin \frac{\pi}{n}. \qquad (\pi \text{ radians} = 180°)$$

The area of the inscribed polygon,

$$= \tfrac{1}{2}nr^2 \sin \frac{2\pi}{n}.$$

The perimeter of a polygon circumscribed about a circle of radius r, number of sides n

$$= 2nr \tan \frac{\pi}{n}.$$

The area of the circumscribed polygon

$$= nr^2 \tan \frac{\pi}{n}.$$

Plane Figures Bounded by Curved Lines

The **circumference of a circle** whose radius is r and diameter $d (d = 2r)$

$$= 2\pi r = \pi d. \qquad (\pi = 3.14159)$$

The area of a circle

$$= \pi r^2 = \tfrac{1}{4}\pi d^2 = .7854 d^2.$$

The length of an arc of a circle for an arc of θ degrees

$$= \frac{\pi r \theta}{180}.$$

NOTE. — In this and following similar formulæ r denotes the radius of the circle, (OC, Fig. 1).

For an arc of θ radians the length

$$= r\theta.$$

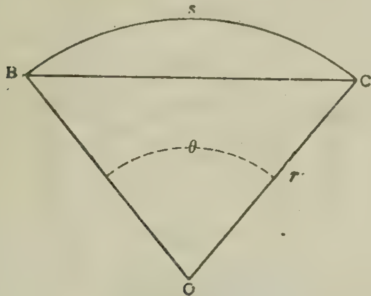


FIG 1.

The length of a chord subtending an angle θ

$$= 2r \sin \tfrac{1}{2}\theta.$$

The **area of a sector** where θ is the angle between the radii in degrees

$$= \frac{\pi r^2 \theta}{360}.$$

If s is the length of the arc, the area of the sector

$$= \frac{sr}{2}.$$

The **area of a segment** where θ is the angle between the two radii in degrees

$$= \frac{\pi r^2 \theta}{360} - \frac{r^2 \sin \theta}{2}.$$

If θ is in radians the area $= \frac{1}{2}r^2(\theta - \sin\theta)$.

The area of the segment of a circle

$$= \frac{\pi r^2}{2} - \left[x\sqrt{r^2 - x^2} + r^2 \sin^{-1}\left(\frac{x}{r}\right) \right]$$

where r is the radius of the circle and x the perpendicular distance of the chord from the center. The angle must be expressed in radians.

The area of the ring between two circles of radius r_1 and r_2, one of which encloses the other,

$$= \pi(r_1 + r_2)(r_1 - r_2).$$

The two circles are not necessarily concentric.

Area of the sector of an annulus. (Fig. 2.)—If angle $GOH = \theta$ and the lines GO and $JO = r_1$ and r_2 respectively, the area $GHIJ = \frac{1}{2}\theta(r_1 + r_2)(r_1 - r_2)$.

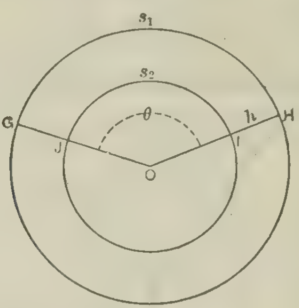


Fig. 2

If s_1 = the length of the arc GH and s_2 = the arc JI and $h = HI = r_1 - r_2$, the area $GHIJ = \frac{1}{2}h(s_1 + s_2)$.

The circumference of an ellipse whose semiaxes are a and b

$$= 2\pi\sqrt{\frac{a^2 + b^2}{2}}, \text{ approximately.}$$

The area of an ellipse $= \pi ab$.

The length of the arc of a parabola, as arc SPQ in Fig. 3, where $x = PR$, and $y = QR$

$$= 2\sqrt{y^2 + \frac{4x^2}{3}}, \text{ approximately.}$$

The area of the section of the parabola $PQRS$, $= \frac{4}{3}xy$.

Solids Bounded by Planes

The lateral area of a regular prism = perimeter of a right section $\times$ the length.

The volume of a regular prism = area of base $\times$ the altitude.

The lateral area of a regular pyramid, slant height l, length of one side of base a, and a number of sides n,

$$= \tfrac{1}{2}nal.$$

The volume of a pyramid = $\frac{1}{3}$ area of base $\times$ altitude.

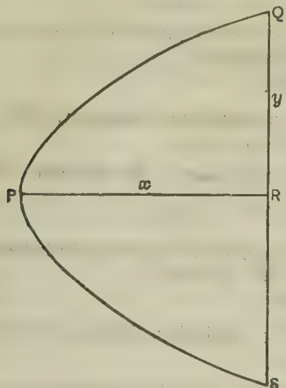


FIG. 3.

Surface and Volume of Regular Polyhedra

Surface and volume of regular polyhedra in terms of the length of one edge l.

Name.	Nature of surface.	Surface.	Volume.
Tetrahedron . . .	4 equilateral triangles	$1.73205l^2$	$0.11785l^3$
Hexahedron or cube	6 squares	$6.00000l^2$	$1.00000l^3$
Octahedron	8 equilateral triangles	$3.46410l^2$	$0.47140l^3$
Dodecahedron .	12 pentagons	$20.64578l^2$	$7.66312l^3$
Icosahedron . . .	20 equilateral triangles	$8.66025l^2$	$2.18170l^3$

Solids Bounded by Curved Surfaces

The surface of a sphere of radius r and diameter $d (= 2r)$

$$= 4\pi r^2 = \pi d^2 = 12.57r^2.$$

The volume of a sphere

$$= \tfrac{4}{3}\pi r^3 = \tfrac{1}{6}\pi d^3 = 4.189r^3.$$

The area of a lune on the surface of a sphere of radius r, included between two great circles whose inclination is θ radians.

$$= 2r^2\theta.$$

The area of a spherical triangle whose angles are A, B, and C (radians) on a sphere of radius r

$$= (A + B + C - \pi)r^2.$$

The area of a spherical polygon of n sides where θ is the sum of its angles in radians

$$= [\,\theta - (n - 2)\pi\,]r^2.$$

The area of the curved surface of a spherical segment of height h, radius of sphere r

$$= 2\pi\, rh.$$

The volume of a spherical segment, data as above

$$= \tfrac{1}{3}\pi h^2\,(3r - h).$$

If a = radius of the base of the segment, the volume

$$= \tfrac{1}{6}\pi h\,(h^2 + 3a^2).$$

The curved surface of a right cylinder where r = the radius of the base and h, the altitude,

$$= 2\pi rh.$$

The volume of a cylinder, data as above,

$$= \pi r^2 h.$$

The curved surface of a right cone whose altitude is h and radius of base r

$$= \pi r\,\sqrt{r^2 + h^2}.$$

The volume of a cone, data as above,

$$= \frac{\pi}{3}r^2 h = 1.047\ r^2 h.$$

The curved surface of the frustum of a right cone, radius of base r_1, of top r_2 and altitude h,

$$= \pi(r_1 + r_2)\ \sqrt{h^2 + (r_1 - r_2)^2}.$$

The volume of the frustum of a cone, data as above,

$$= \pi\frac{h}{3}\,(r_1^2 + r_1\,r_2 + r_2^2).$$

The oblate spheroid is formed by the rotation of an ellipse about its minor axis. If a and b are the major and minor semi-axes respectively, and e the eccentricity, the surface

$$= 2\pi a^2 + \pi\frac{b^2}{e}\log_e\frac{1 + e}{1 - e},$$

and volume $= \tfrac{4}{3}\pi a^2 b.$

The **prolate spheroid** is formed by the rotation of an ellipse about its major axis ($2a$), data as above.

Surface $= 2\pi b^2 + 2\pi \frac{ab}{e} \sin^{-1} e,$

volume $= \frac{4}{3}\pi ab^2.$

SIMPSON'S RULE FOR IRREGULAR AREAS

Divide the area into n panels (where n is some even number) by means of $n+1$ parallel lines, or ordinates, drawn at constant distance h apart; and denote the lengths of the ordinates by $y_0, y_1, y_2, \ldots y_n$. The first and last ordinate may be zero. The area will then be:

$$A = \tfrac{1}{3}h[(y_0+y_n)+4(y_1+y_3+y_5 \cdots)+2(y_2+y_4+y_6 \cdots)]$$

The greater the number of divisions, the more accurate the result. Simpson's rule may be applied to finding volumes if the ordinates y_0, y_1, y_2 be interpreted as the areas of plane sections, at constant distance h apart.

PRISMOIDAL FORMULA

The volume of a solid figure extending between two parallel planes in which the area of every cross-section parallel to those planes is a quadratic function of the distance of the section from a fixed plane parallel to them is given by the equation

$$V = \tfrac{1}{6}H(S_0+4S_1+S_2)$$

where H is the distance between the two limiting parallel planes; S_0 and S_2 the cross-sections in these planes (lower and upper bases) and S_1 the cross-section of the mid section. The formula applies to such figures as the cone, sphere, ellipsoid and prismoid.

TRIGONOMETRIC FUNCTIONS IN A RIGHT-ANGLED TRIANGLE

If A, B, and C are the vertices (C the right angle), and a, b, and h the sides opposite respectively,

$$\text{sine } A = \sin A = \frac{a}{h}, \qquad \text{cosine } A = \cos A = \frac{b}{h},$$

$$\text{tangent } A = \tan A = \frac{a}{b}, \qquad \text{cotangent } A = \cot A = \text{ctn } A = \frac{b}{a},$$

$$\text{secant } A = \sec A = \frac{h}{b}, \qquad \text{cosecant } A = \csc A = \frac{h}{a}.$$

$$\text{exsecant } A = \text{exsec } A = \sec A - 1$$

$$\text{versine } A = \text{vers } A = 1 - \cos A$$

$$\text{coversine } A = \text{covers } A = 1 - \sin A$$

$$\text{haversine } A = \text{hav } A = \tfrac{1}{2} \text{ vers } A$$

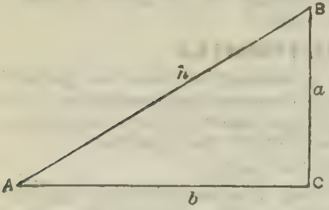


FIG. 4.

SIGNS AND LIMITS OF VALUE ASSUMED BY THE FUNCTIONS

Function.	Quadrant I.		Quadrant II.		Quadrant III.		Quadrant IV.	
	Sign.	Value.	Sign.	Value.	Sign.	Value.	Sign.	Value.
sin	+	0 to 1	+	1 to 0	−	0 to 1	−	1 to 0
cos	+	1 to 0	−	0 to 1	−	1 to 0	+	0 to 1
tan	+	0 to ∞	−	∞ to 0	+	0 to ∞	−	∞ to 0
cot	+	∞ to 0	−	0 to ∞	+	∞ to 0	−	0 to ∞
sec	+	1 to ∞	−	∞ to 1	−	1 to ∞	+	∞ to 1
cosec . . .	+	∞ to 1	+	1 to ∞	−	∞ to 1	−	1 to ∞

VALUE OF THE FUNCTIONS OF VARIOUS ANGLES

	0°	30°	45°	60°	90°	180°	270°
sin	0	$\frac{1}{2}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}\sqrt{3}$	1	0	−1
cos	1	$\frac{1}{2}\sqrt{3}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}$	0	−1	0
tan	0	$\frac{1}{3}\sqrt{3}$	1	$\sqrt{3}$	∞	0	∞
cot	∞	$\sqrt{3}$	1	$\frac{1}{3}\sqrt{3}$	0	∞	0

RELATIONS OF THE FUNCTIONS

$$\sin x = \frac{1}{\operatorname{cosec} x}. \qquad \operatorname{cosec} x = \frac{1}{\sin x}.$$

$$\cos x = \frac{1}{\sec x}. \qquad \sec x = \frac{1}{\cos x}.$$

$$\tan x = \frac{1}{\cot x} = \frac{\sin x}{\cos x}. \qquad \sin^2 x + \cos^2 x = 1$$

$$1 + \tan^2 x = \sec^2 x$$

$$\cot x = \frac{1}{\tan x} = \frac{\cos x}{\sin x}. \qquad 1 + \cot^2 x = \operatorname{cosec}^2 x$$

$$\sin x = \sqrt{1 - \cos^2 x}. \qquad \cos x = \sqrt{1 - \sin^2 x}.$$

$$\tan x = \sqrt{\sec^2 x - 1}. \qquad \sec x = \sqrt{\tan^2 x + 1}.$$

$$\cot x = \sqrt{\operatorname{cosec}^2 x - 1}. \qquad \operatorname{cosec} x = \sqrt{\cot^2 x + 1}.$$

$$\sin x = \cos (90 - x) = \sin (180 - x).$$

$$\cos x = \sin (90 - x) = -\cos (180 - x).$$

$$\tan x = \cot (90 - x) = -\tan (180 - x).$$

$$\cot x = \tan (90 - x) = -\cot (180 - x).$$

$$\operatorname{cosec} x = \cot \frac{x}{2} - \cot x.$$

FUNCTIONS OF SUMS OF ANGLES

$$\sin (x + y) = \sin x \cos y + \cos x \sin y.$$

$$\sin (x - y) = \sin x \cos y - \cos x \sin y.$$

$$\cos (x + y) = \cos x \cos y - \sin x \sin y.$$

$$\cos (x - y) = \cos x \cos y + \sin x \sin y.$$

$$\tan (x + y) = \frac{\tan x + \tan y}{1 - \tan x \tan y}.$$

$$\tan (x - y) = \frac{\tan x - \tan y}{1 + \tan x \tan y}.$$

FUNCTIONS OF MULTIPLE ANGLES

$\sin 2x = 2 \sin x \cos x.$
$\cos 2x = \cos^2 x - \sin^2 x = 2 \cos^2 x - 1 = 1 - 2 \sin^2 x.$
$\sin 3x = 3 \sin x - 4 \sin^3 x.$
$\cos 3x = 4 \cos^3 x - 3 \cos x.$
$\sin 4x = 8 \cos^3 x \sin x - 4 \cos x \sin x.$
$\cos 4x = 8 \cos^4 x - 8 \cos^2 x + 1.$
$\sin 5x = 5 \sin x - 20 \sin^3 x + 16 \sin^5 x.$
$\cos 5x = 16 \cos^5 x - 20 \cos^3 x + 5 \cos x.$
$\sin 6x = 32 \cos^5 x \sin x - 32 \cos^3 x \sin x + 6 \cos x \sin x.$
$\cos 6x = 32 \cos^6 x - 48 \cos^4 x + 18 \cos^2 x - 1.$

$$\tan 2x = \frac{2 \tan x}{1 - \tan^2 x}.$$

$$\cot 2x = \frac{\cot^2 x - 1}{2 \cot x}.$$

$$\tan 3x = \frac{3 \tan x - \tan^3 x}{1 - 3 \tan^2 x}.$$

$$\sin \tfrac{1}{2}x = \pm \sqrt{\frac{1 - \cos x}{2}}.$$

$$\cos \tfrac{1}{2}x = \pm \sqrt{\frac{1 + \cos x}{2}}.$$

$$\tan \tfrac{1}{2}x = \pm \sqrt{\frac{1 - \cos x}{1 + \cos x}} = \frac{1 - \cos x}{\sin x} = \frac{\sin x}{1 + \cos x}.$$

MISCELLANEOUS RELATIONS

$\sin x \pm \sin y = 2 \sin \tfrac{1}{2}(x \pm y) . \cos \tfrac{1}{2}(x \mp y).$
$\cos x + \cos y = 2 \cos \tfrac{1}{2}(x + y) . \cos \tfrac{1}{2}(x - y).$
$\cos x - \cos y = -2 \sin \tfrac{1}{2}(x + y) . \sin \tfrac{1}{2}(x - y).$

$$\tan x \pm \tan y = \frac{\sin (x \pm y)}{\cos x . \cos y}. \quad \cot x \pm \cot y = \frac{\pm \sin (x \pm y)}{\sin x \cdot \sin y}.$$

$$\frac{1 + \tan x}{1 - \tan x} = \tan (45 + x) \qquad \frac{\cot x + 1}{\cot x - 1} = \cot (45 - x)$$

$$\frac{\sin x \pm \sin y}{\cos x + \cos y} = \tan \tfrac{1}{2}(x \pm y).$$

$$\frac{\sin x \pm \sin y}{\cos x - \cos y} = -\cot \tfrac{1}{2}(x \mp y).$$

$$\frac{\sin x + \sin y}{\sin x - \sin y} = \frac{\tan \tfrac{1}{2}(x + y)}{\tan \tfrac{1}{2}(x - y)}.$$

$\sin^2 x - \sin^2 y = \sin (x + y) . \sin (x - y).$
$\cos^2 x - \cos^2 y = -\sin (x + y) \sin (x - y).$
$\cos^2 x - \sin^2 y = \cos (x + y) \cos (x - y).$

RELATIONS BETWEEN SIDES AND ANGLES OF ANY PLANE TRIANGLE

In a triangle with angles A, B, and C and sides opposite a, b, and c respectively,

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}.$$

$$a^2 = b^2 + c^2 - 2bc \cos A.$$

$$a = b \cos C + c \cos B.$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}.$$

$$\tan \frac{A - B}{2} = \frac{a - b}{a + b} \cot \frac{C}{2}.$$

$$\sin A = \frac{2}{bc}\sqrt{s(s-a)(s-b)(s-c)},$$

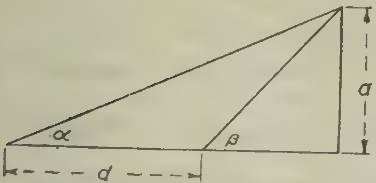
where $s = \frac{1}{2}(a+b+c)$ and $r = \sqrt{\frac{(s-a)(s-b)(s-c)}{s}}$.

$$\sin \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}.$$

$$\cos \frac{A}{2} = \sqrt{\frac{s(s-a)}{bc}}.$$

$$\tan \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}} = \frac{r}{s-a}.$$

$$\frac{a+b}{a-b} = \frac{\sin A + \sin B}{\sin A - \sin B} = \frac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)} = \frac{\cot \frac{1}{2} C}{\tan \frac{1}{2}(A-B)}.$$



$$a = \frac{d}{\cot \alpha - \cot \beta}$$

FIG. 5.

RELATIONS IN ANY SPHERICAL TRIANGLE

If A, B and C be the three angles and a, b, and c the opposite sides,

$$\frac{\sin A}{\sin a}=\frac{\sin B}{\sin b}=\frac{\sin C}{\sin c}.$$

$$\cos a=\cos b\cos c+\sin b\sin c\cos A=\frac{\cos b\cos(c\pm\theta)}{\cos\theta}.$$

where $\tan\theta=\tan b\cos A.$

$$\cos A=-\cos B\cos C+\sin B\sin C\cos a.$$

$$\sin\tfrac{1}{2}A=\sqrt{\frac{\sin(s-b)\sin(s-c)}{\sin b\sin c}}.$$

where $s=\tfrac{1}{2}(a+b+c).$

$$\cos\tfrac{1}{2}A=\sqrt{\frac{\sin s\sin(s-a)}{\sin b\sin c}}.$$

$$\tan\tfrac{1}{2}A=\frac{r}{\sin(s-a)}.$$

where $r=\sqrt{\dfrac{\sin(s-a)\sin(s-b)\sin(s-c)}{\sin s}}.$

$$\cos\tfrac{1}{2}a=\sqrt{\frac{\cos(S-B)\cos(S-C)}{\sin B\sin C}}.$$

where $S=\tfrac{1}{2}(A+B+C).$

$$\sin\tfrac{1}{2}a=\sqrt{-\frac{\cos S\cos(S-A)}{\sin B\sin C}}.$$

$$\tan\tfrac{1}{2}a=R\cos(S-A)$$

where $R=\sqrt{\dfrac{-\cos S}{\cos(S-A)\cos(S-B)\cos(S-C)}}.$

$$\frac{\tan\frac{a+b}{2}}{\tan\frac{c}{2}}=\frac{\cos\frac{A-B}{2}}{\cos\frac{A+B}{2}},\quad\frac{\tan\frac{A+B}{2}}{\cot\frac{c}{2}}=\frac{\cos\frac{a-b}{2}}{\cos\frac{a+b}{2}}.$$

$$\frac{\tan\frac{a-b}{2}}{\tan\frac{c}{2}}=\frac{\sin\frac{A-B}{2}}{\sin\frac{A+B}{2}},\quad\frac{\tan\frac{A-B}{2}}{\cot\frac{c}{2}}=\frac{\sin\frac{a-b}{2}}{\sin\frac{a+b}{2}}$$

ANALYTICAL GEOMETRY

The distance between two points x_1, y_1, and x_2, y_2, — **rectangular coördinates:**

$$d = \pm \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

For polar coördinates and points r_1, θ_1, and r_2, θ_2:

$$d = \pm \sqrt{r_1^2 + r_2^2 - 2r_1r_2 \cos(\theta_1 - \theta_2)}$$

The area of a triangle whose vertices are x_1, y_1; x_2, y_2, and x_3, y_3:

$$A = \tfrac{1}{2}(x_1y_2 - x_2y_1 + x_2y_3 - x_3y_2 + x_3y_1 - x_1y_3)$$

For polar coördinates and vertices, r_1, θ_1; r_2, θ_2, and r_3, θ_3:

$$A = \tfrac{1}{2}\{(r_1r_2 \sin(\theta_2 - \theta_1) + r_2r_3 \sin(\theta_3 - \theta_2) + r_3r_1 \sin(\theta_1 - \theta_3)\}$$

The equation of a straight line where m is the tangent of the angle of inclination and c, the distance of intersection with the Y axis from the origin:

$$y = mx + c$$

If a line of inclination m passes through the point x_1, y_1 its equation is:

$$y - y_1 = m(x - x_1)$$

The equation of a line through the points x_1, y_1, and x_2, y_2 is:

$$\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$$

If the intercepts on the X and Y axes are a and b respectively, the equation is:

$$\frac{x}{a} + \frac{y}{b} = 1$$

If the length of the perpendicular from the origin is p and its angle of inclination θ the equation is:

$$x \cos\theta + y \sin\theta = p$$

General equation of the straight line:

$$Ax + By + C = 0$$

The equation of a circle whose center is at a, b, and whose radius is c:

$$(x - a)^2 + (y - b)^2 = c^2$$

If the origin is at the center:

$$x^2 + y^2 = c^2$$

The polar equation of a circle with the origin on the circumference and its center at point c, α:

$$r = 2c \cos(\theta - \alpha).$$

If the origin is not on the circumference, the radius a and the center at a point l, α, the equation becomes:

$$a^2 = r^2 + l^2 - 2rl \cos(\theta - \alpha) .$$

The equation of a parabola with the origin at the vertex, where f is the distance from the focus to the vertex:

$$y^2 = 4fx$$

If p is the semi-latus rectum $(=2f)$ the equation is:

$$y^2 = 2px$$

The polar equation where the pole is at the focus and l the semi-latus rectum is:

$$\frac{l}{r} = 1 - \cos\theta$$

If the pole is at the vertex and p as above:

$$r = \frac{4p\cos\theta}{\sin^2\theta}$$

The equation of the ellipse with the origin at the center and semi-axes a and b:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Polar equation where the pole is at the center:

$$r^2 = \frac{a^2b^2}{a^2\sin^2\theta + b^2\cos^2\theta}$$

The equation of the hyperbola with the origin at the center, semi-axes a and b:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

Polar equation, pole at center:

$$r^2 = \frac{a^2b^2}{a^2\sin^2\theta - b^2\cos^2\theta}$$

PROPERTIES AND PHYSICAL CONSTANTS

ATOMIC WEIGHTS

Values in parentheses are approximate only and have not been adopted by the Committee on Atomic Weights.

Name	Symbol	At. No.	International atomic weight 1925	International atomic weight 1935	Valence
Actinium	Ac	89	....	(227)	......
Alabamine	Ab	85	....	(221)	1, 3, 5, 7
Aluminum	Al	13	26.97	26.97	3
Antimony, stibium	Sb	51	121.77	121.76	3, 5
Argon	A	18	39.91	39.944	0
Arsenic	As	33	74.96	74.91	3, 5
Barium	Ba	56	137.37	137.36	2
Beryllium, glucinum	Be	4	9.02	9.02	2
Bismuth	Bi	83	209.00	209.00	3, 5
Boron	B	5	10.82	10.82	3
Bromine	Br	35	79.916	79.916	1, 3, 5, 7
Cadmium	Cd	48	112.41	112.41	2
Calcium	Ca	20	40.07	40.08	2
Carbon	C	6	12.000	12.00	2, 4
Cerium	Ce	58	140.25	140.13	3, 4
Cesium	Cs	55	132.81	132.91	1
Chlorine	Cl	17	35.457	35.457	1, 3, 5, 7
Chromium	Cr	24	52.01	52.01	2, 3, 6
Cobalt	Co	27	58.94	58.94	2, 3
Columbium, niobium	Cb	41	93.1	92.91	3, 5
Copper	Cu	29	63.57	63.57	1, 2
Dysprosium	Dy	66	162.52	162.46	3
Erbium	Er	68	167.7	167.64	3
Europium	Eu	63	152.0	152.0	2, 3
Fluorine	F	9	19.00	19.000	1
Gadolinium	Gd	64	157.26	157.3	3
Gallium	Ga	31	69.72	69.72	2, 3
Germanium	Ge	32	72.60	72.60	4
Gold, aurum	Au	79	197.2	197.2	1, 3
Hafnium, celtium	Hf	72	....	178.6	4
Helium	He	2	4.00	4.002	0
Holmium	Ho	67	163.4	163.5	3
Hydrogen	H	1	1.008	1.0078	1
Illinium	Il	61	....	(146)	(3)
Indium	In	49	114.8	114.76	3
Iodine	I	53	126.932	126.92	1, 3, 5, 7
Iridium	Ir	77	193.1	193.1	3, 4
Iron, ferrum	Fe	26	55.84	55.84	2, 3
Krypton	Kr	36	82.9	83.7	0

ATOMIC WEIGHTS (Continued)

Name	Symbol	At. No.	International atomic weight		Valence
			1925	1935	
Lanthanum	La	57	138.90	138.92	3
Lead, plumbum	Pb	82	207.20	207.22	2, 4
Lithium	Li	3	6.940	6.940	1
Lutecium	Lu	71	175.0	175.0	3
Magnesium	Mg	12	24.32	24.32	2
Manganese	Mn	25	54.93	54.93	2, 4, 6, 7
Masurium	Ma	43	....	....	......
Mercury, hydrargyrum	Hg	80	200.61	200.61	1, 2
Molybdenum	Mo	42	96.0	96.0	3, 4, 6
Neodymium	Nd	60	144.27	144.27	3
Neon	Ne	10	20.2	20.183	0
Nickel	Ni	28	58.69	58.69	2, 3
Nitrogen	N	7	14.008	14.008	3, 5
Osmium	Os	76	190.8	191.5	2, 3, 4, 8
Oxygen	O	8	16.000	16.000	2
Palladium	Pd	46	106.7	106.7	2, 4
Phosphorus	P	15	31.027	31.02	3, 5
Platinum	Pt	78	195.23	195.23	2, 4
Polonium	Po	84	....	(210)	......
Potassium, kalium	K	19	39.096	39.096	1
Praseodymium	Pr	59	140.92	140.92	3
Protoactinium	Pa	91	....	....	......
Radium	Ra	88	225.95	225.97	2
Radon, niton	Rn	86	222	222	0
Rhenium	Re	75	....	186.31	......
Rhodium	Rh	45	102.91	102.91	3
Rubidium	Rb	37	85.44	85.44	1
Ruthenium	Ru	44	101.7	101.7	3, 4, 6, 8
Samarium	Sm, Sa	62	150.43	150.43	3
Scandium	Sc	21	45.10	45.10	3
Selenium	Se	34	79.2	78.96	2, 4, 6
Silicon	Si	14	28.06	28.06	4
Silver, argentum	Ag	47	107.880	107.880	1
Sodium, natrium	Na	11	22.997	22.997	1
Strontium	Sr	38	87.63	87.63	2
Sulfur	S	16	32.064	32.06	2, 4, 6
Tantalum	Ta	73	181.5	181.4	5
Tellurium	Te	52	127.5	127.61	2, 4, 6
Terbium	Tb	65	159.2	159.2	3
Thallium	Tl	81	204.39	204.39	1, 3
Thorium	Th	90	232.15	232.12	4
Thulium	Tm	69	169.4	169.4	3
Tin, stannum	Sn	50	118.70	118.70	2, 4
Titanium	Ti	22	48.1	47.90	3, 4
Tungsten, wolframium	W	74	184.0	184.0	6
Uranium	U	92	238.17	238.14	4, 6
Vanadium	V	23	50.96	50.95	3, 5
Virginium	Vi	87	....	(224)	1
Xenon	Xe	54	130.2	131.3	0
Ytterbium	Yb	70	173.6	173.04	3
Yttrium	Y	39	88.9	88.92	3
Zinc	Zn	30	65.38	65.38	2
Zirconium	Zr	40	91	91.22	4

ARRANGEMENT OF ELECTRONS IN ORBITS

The following table gives, for each element, the atomic number and the arrangement of electrons in orbits. For a complete explanation of the significance of the data presented a text on the subject should be consulted.

Element	At. No.	Shell																
		K	L		M			N				O			P			Q
		Orbit																
		1s	2s	2p	3s	3p	3d	4s	4p	4d	4f	5s	5p	5d	6s	6p	6d	7s
H	1	1																
He	2	2																
Li	3	2	1															
Be	4	2	2															
B	5	2	2	1														
C	6	2	2	2														
N	7	2	2	3														
O	8	2	2	4														
F	9	2	2	5														
Ne	10	2	2	6	(3s)	(3p)	(3d)											
Na	11	2	2	6	1													
Mg	12				2													
Al	13				2	1												
Si	14				2	2												
P	15	(10, Ne Core)			2	3												
S	16				2	4												
Cl	17				2	5												
A	18				2	6		(4s)	(4p)	(4d)	(4f)							
K	19	2	2	6	2	6	....	1										
Ca	20						....	2										
Sc	21						1	2										
Ti	22						2	2										
V	23						3	2										
Cr	24	(18, A Core)					5	1										
Mn	25						5	2										
Fe	26						6	2										
Co	27						7	2										
Ni	28						8	2										
Cu	29	2	2	6	2	6	10	1										
Zn	30							2										
Ga	31							2	1									
Ge	32							2	2									
As	33	(28, Cu Core)						2	3									
Se	34							2	4									
Br	35							2	5									
Kr	36							2	6			(5s)	(5p)	(5d)				
Rb	37	2	2	6	2	6	10	2	6	....	....	1						
Sr	38									....	....	2						
Y	39									1	....	2						
Zr	40									2	....	2						
Cb	41									4	....	1						
Mo	42	(36, Kr Core)								5	....	1						
Ma	43									6	....	1						
Ru	44									7	....	1						
Rh	45									8	....	1						
Pd	46									10								

ARRANGEMENT OF ELECTRONS IN ORBITS (Continued)

Element	At. No.	Shell																
		K	L		M			N				O			P			Q
		Orbit																
		1s	2s	2p	3s	3p	3d	4s	4p	4d	4f	5s	5p	5d	6s	6p	6d	7s
Ag	47	2	2	6	2	6	10	2	6	10	....	1						
Cd	48											2						
In	49											2	1					
Sn	50											2	2					
Sb	51						(46, Ag Core)					2	3					
Te	52											2	4					
I	53											2	5					
Xe	54											2	6		(6s)	(6p)	(6d)	
Cs	55	2	2	6	2	6	10	2	6	10		2	6	....	1			
Ba	56						(54, Xe Core)							....	2			
La	57													1	2			
Ce	58	2	2	6	2	6	10	2	6	10	1	2	6	1	2			
Pr	59										2			1	2			
Nd	60										3			1	2			
Il	61										4			1	2			
Sa	62										5			1	2			
Eu	63										6			1	2			
Gd	64										7			1	2			
Tb	65						(46, La)				8	(8, La)		1	2			
Ds	66										9			1	2			
Ho	67										10			1	2			
Er	68										11			1	2			
Tu	69										12			1	2			
Yb	70										13			1	2			
Lu	71										14			1	2			
Hf	72	2	2	6	2	6	10	2	6	10	14	2	6	2	2			
Ta	73													3	2			
W	74													4	2			
Re	75													5 6	2 1			
Os	76							(68, Hf Core)						6 7	2 1			
Ir	77													7 8	2 1			
Pt	78													9 10	1			
Au	79	2	2	6	2	6	10	2	6	10	14	2	6	10	1			
Hg	80														2			
Tl	81														2	1		
Pb	82														2	2		
Bi	83							(78, Au Core)							2	3		
Po	84														2	4		
—	85														2	5		
Rn	86														2	6		(7s)
—	87	2	2	6	2	6	10	2	6	10	14	2	6	10	2	6	....	1
Ra	88																....	2
Ac	89																1	2
Th	90								(86, Rn Core)								2	2
Pa	91																3	2
U	92																4	2

ISOTOPES

Compiled by F. B. Haynes

Where no abundance is given the isotopes are listed in order of decreasing abundance unless otherwise noted.

In several cases the results of different observers are included, appearing in the table as a second group of isotopes. This will explain the duplication of mass numbers under the same element.

Parentheses indicate approximation or estimate.

2G indicates that there are two isotopes having mass numbers greater than the following mass number.

2L indicates two less than the preceding mass number, etc.

S indicates single.

Element	Symbol	Atomic Number	Atomic Weight	Mass Number	Abundance	Reference
Actinium	Ac	89	(227)			
Alabamine	Ab	85	(221)			
Aluminum	Al	13	26.97	27	S	1
Antimony	Sb	51	121.76	121	56	1
				123	44	
Argon	A	18	39.944	36	(0.6)	1
				40	(99.4)	
				38		2
Arsenic	As	33	74.91	75	S	1
Barium	Ba	56	137.36	135	5.9	1
				136	8.9	
				137	11.1	
				138	74.1	
Beryllium	Be	4	9.02	(8)	(0.05)	1
				9	99.9	
Bismuth	Bi	83	209.00	209	S	1
				211, 210, 209, 212, 215, 214, 213, 216, 207, 205, 206, 208, 219, 217		3
Boron	B	5	10.82	10	20	1
				11	80	
Bromine	Br	35	79.916	79	50	1
				81	50	
Cadmium	Cd	48	112.41	106	1.5	4
				108	1.0	
				110	15.2	
				111	15.2	
				112	21.8	
				113	14.9	
				114	23.7	
				115	0.8	
				116	5.9	
Calcium	Ca	20	40.08	40	96.76	4
				42	0.77	
				43	0.17	
				44	2.30	
Carbon	C	6	12.00	12	99.3	4
				13	0.7	
Cerium	Ce	58	140.13	140	89	5
				142	11	
Cesium	Cs	55	132.91	133	S	1
				2G, 133, 3L		11
Chlorine	Cl	17	35.457	35	76	1
				37	24	

ISOTOPES (Continued)

Element	Symbol	Atomic Number	Atomic Weight	Mass Number	Abundance	Reference
Chromium	Cr	24	52.01	50	4.9	1
				52	81.6	
				53	10.4	
				54	3.1	
Cobalt	Co	27	58.94	59	S	1
Columbium	Cb	41	92.91	93	S	1
Copper	Cu	29	63.57	63	(68)	1
				65	(32)	
Dysprosium	Dy	66	162.46	161	22	5
				162	25	
				163	25	
				164	28	
Erbium	Er	68	167.64	166	36	5
				167	24	
				168	30	
				170	10	
Europium	Eu	63	152.0	151	50.6	5
				153	49.4	
Fluorine	F	9	19.000	19	S	1
Gadolinium	Gd	64	157.3	155	21	5
				156	23	
				157	17	
				158	23	
				160	16	
Gallium	Ga	31	69.72	69	61.5	4
				71	38.5	
Germanium	Ge	32	72.60	70	21.2	1
				72	27.3	
				73	7.9	
				74	37.1	
				76	6.5	
Gold	Au	79	197.2			
Hafnium	Hf	72	178.6	176	5	4
				177	19	
				178	28	
				179	18	
				180	30	
Helium	He	2	4.002	4	S	1
Holmium	Ho	67	163.5	165	S	5
Hydrogen	H	1	1.0078	1	99.9	1
				2	0.003	
Illinium	Il	61	(146)			
Indium	In	49	114.76	113	4.5	4
				115	95.5	
Iodine	I	53	126.92	127	S	1
Iridium	Ir	77	193.1			
Iron	Fe	26	55.84	54	6.5	4
				56	90.7	
				57	2.8	
Krypton	Kr	36	83.7	78	0.42	1
				80	2.45	
				82	11.79	
				83	11.79	
				84	56.85	
				86	16.70	
Lanthanum	La	57	138.92	139	S	1

ISOTOPES (Continued)

Element	Symbol	Atomic Number	Atomic Weight	Mass Number	Abundance	Reference
Lead, ordinary...	Pb	82	207.22	203	0.04	1, 12
				204	1.50	
				205	0.03	
				206	27.75	
				207	20.20	
				208	49.55	
				209	0.85	
				210	0.08	
				208, 206, 207, 205, 212, 210, 204, 202, 203, 211, 201, 209, 216, 215, 214, 213		6
Lead, radio derived.........	Pb			206, 207, 208	various	12
Lithium.........	Li	3	6.940	6	8.3	1
				7	91.7	
Lutecium.......	Lu	71	175.0	175	S	5
Magnesium.....	Mg	12	24.32	24	77.4	1
				25	11.5	
				26	11.1	
Manganese......	Mn	25	54.93	55	S	1
				3G, 55, 3L		10
Masurium.......	Ma	43				
Mercury........	Hg	80	200.61	196	0.10	1
				197	0.01	
				198	9.89	
				199	16.45	
				200	23.77	
				201	13.67	
				202	29.27	
				203	0.006	
				204	6.85	
Molybdenum....	Mo	42	96.0	92	14.2	1
				94	10.0	
				95	15.5	
				96	17.8	
				97	9.6	
				98	23.0	
				100	9.8	
Neodymium.....	Nd	60	144.27	142	36	5
				143	11	
				144	30	
				145	5	
				146	18	
Neon...........	Ne	10	20.183	20	90.4	1
				21	0.6	
				22	9.0	
Nickel..........	Ni	28	58.69	58	67.5	4
				60	27.0	
				61	1.7	
				62	3.8	
Nitrogen........	N	7	14.008	14	99.86	1
				15	0.14	
Osmium........	Os	76	191.5	186	1.0	1
				187	0.6	
				188	13.4	
				189	17.4	
				190	25.1	
				192	42.5	

ISOTOPES (Continued)

Element	Symbol	Atomic Number	Atomic Weight	Mass Number	Abundance	Reference
Oxygen	O	8	16.000	16	99.81	1
				17	0.03	
				18	0.16	
Palladium	Pd	46	106.7			
Phosphorus	P	15	31.02	31	S	1
Platinum	Pt	78	195.23			
Polonium	Po	84	(210)			
Potassium	K	19	39.096	39	5.4	1
				41	94.6	
Praseodymium	Pr	59	140.92	141	S	1
Proactinium	Pa	91				
Radium	Ra	88	225.97	226, 228, 230, 232		7
Radon	Rn	86	222			
Rhenium	Re	75	186.31	185	38.2	1
				187	61.8	
Rhodium	Rh	45	102.91	103	S	4
Rubidium	Rb	37	85.44	85	75	1
				87	25	
Ruthenium	Ru	44	101.7	96	(5)	1
				98	?	
				99	(12)	
				100	(14)	
				101	(22)	
				102	(30)	
				104	(17)	
Samarium	Sm	62	150.43	144	3	5
				147	17	
				148	14	
				149	15	
				150	5	
				152	26	
				154	20	
Scandium	Sc	21	45.10	45	S	1
Selenium	Se	34	78.96	74	0.9	1
				76	9.5	
				77	8.3	
				78	24.0	
				80	48.0	
				82	9.3	
Silicon	Si	14	28.06	28	(94)	1
				29	(4)	
				30	(2)	
Silver	Ag	47	107.880	107	52.5	4
				109	47.5	
Sodium	Na	11	22.997	23	S	1
				1G, 23, 1L		11
Strontium	Sr	38	87.63	86	10.0	1
				87	6.6	
				88	83.4	
Sulfur	S	16	32.06	32	(96)	1
				33	(1)	
				34	(3)	
Tantalum	Ta	73	181.4	181	S	1
Tellurium	Te	52	127.61	122	2.9	1
				123	1.6	
				124	4.5	
				125	6.0	
				126	19.0	
				(127)	?	
				128	32.8	
				130	33.1	

ISOTOPES (Continued)

Element	Symbol	Atomic Number	Atomic Weight	Mass Number	Abundance	Reference
Terbium	Tb	65	159.2	159	S	5
Thallium	Tl	81	204.39	203	29.4	1
				205	70.6	
				207, 205, 211, 203, 201, 209, 215, 213		8
Thorium	Th	90	232.12	232	S	4
				232, 230, 234, 235, 236, 229, 233, 231		8
Thulium	Tm	69	169.4	169	S	5
Tin	Sn	50	118.70	112	1.07	1
				114	0.74	
				115	0.44	
				116	14.19	
				117	9.81	
				118	21.48	
				119	11.02	
				120	27.04	
				121	2.96	
				122	5.03	
				124	6.19	
Titanium	Ti	22	47.90	46	8.5	4
				47	7.8	
				48	78.3	
				49	5.5	
				50	6.9	
Tungsten	W	74	184.0	182	22.6	1
				183	17.3	
				184	30.2	
				186	29.9	
Uranium	U	92	238.14	238	S	1
				238, 239, 240, 234, 237, 235, 233, 236		8
Vanadium	V	23	50.95	51	S	1
Virginium	Vi	87	(224)			
Xenon	Xe	54	131.3	124	0.08	1
				126	0.08	
				128	2.30	
				129	27.13	
				130	4.18	
				131	20.67	
				132	26.45	
				134	10.31	
				136	8.79	
Ytterbium	Yb	70	173.04	171	9	5
				172	24	
				173	17	
				174	38	
				176	12	
Yttrium	Y	39	88.92	89	S	1
Zinc	Zn	30	65.38	64	50.4	1, 9
				66	27.2	
				67	4.2	
				68	17.8	
				70	0.4	
Zirconium	Zr	40	91.22	90	48	4
				91	11.5	
				92	22	
				94	17	
				96	1.5	

ISOTOPES (Continued)

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THE ELEMENTS

Revised by Harrison Hale

Actinium (Gr. *aktis*, *aktinos*, beam or ray), Ac; at. wt. 227 (approx.); at. no. 89. Discovered in 1899 by Andre Debierne and independently by F. Giesel in 1902. Radioactive, decomposing into other elements of smaller atomic weight at certain intervals of time. (See Radioactive Elements.)

Alabamine (State of Alabama), Ab; at. wt. 221; at. no. 85; valence 1, 3, 5 or 7. Discovered in 1931 by Dr. Fred Allison and co-workers at Alabama Polytechnic Institute, by the magneto-optic method of analysis. Minima for HAb, HAbO, $HAbO_2$, $HAbO_3$ and $HAbO_4$ were measured. Ab can be oxidized in alkaline solution but more readily in acid solution. The peralabamates are the most stable compounds.

Aluminum (L *alumen*, alum), Al; at. wt. 26.97; at. no. 13; m.p. 658.7° C; b.p. 1800° C; sp. gr. 2.70 (20°); valence 3. Discovered in 1827 by Wöhler; the first really practical electrical method of extraction was patented by Cowles in England and the United States in 1885, but this was finally supplanted by methods of Heroult in France and Hall in America. Aluminum is not found in the metallic form but occurs as silicate in clays, feldspar, etc., as the most abundant metal in the earth's crust. It is extracted chiefly from bauxite, an impure hydrated oxide, by electrolysis of the pure alumina in molten cryolite. Aluminum is a white, somewhat soft metal resembling tin in appearance; among the metals it stands second in the scale of malleability and sixth in ductility. It is but slightly magnetic and is strongly electro-positive, so that in contact with most other metals it rapidly corrodes. The electrical conductivity is about 60% that of copper per area of cross-section, but aluminum is much lighter; it is highly sonorous in the bar but has a weak, cracked sound when cast into a bell. It takes a high polish but this is likely to become frosted in appearance due to the formation of an oxide coating. Alloys with the following metals have been prepared: zinc, copper, magnesium, cerium, beryllium, cobalt, tungsten and molybdenum. Some of these alloys are finding increasing use in airplanes, automobiles and railway coaches. The compounds of aluminum of greatest importance are its oxide and its sulfate. The oxide, alumina, occurs naturally as ruby, sapphire, corundum and emery and is very hard, ranking next to the diamond. In 1856 the price was about $90 a pound; at the time of Hall's discovery in 1886 about $5; in 1935, 23¢.

Antimony (L. *antimonium*), Sb (L. *stibium*, mark); at. wt. 121.76; at. no. 51; m.p. 630° C; b.p. 1635 ± 8° C; sp. gr. 6.68 (25°); valence 3 or 5. Discovered in 1450 by Johann Thölden of Hesse, who wrote under the name of Basil Valentine. Antimony is a metallic element occurring native in rare instances but derived chiefly from *stibnite* or gray antimony ore (Sb_2S_3), *kermesite* or red antimony ($2Sb_2S_3.Sb_2O_3$), *valentinite* or white

antimony (Sb_2O_3), *senarmontite* (Sb_2O_3), *cervantite* ($Sb_2O_3.Sb_2O_2$), and certain ores of gold, silver and lead. It is extracted from the sulfide by roasting to the oxide, which is reduced by salt and scrap iron; from the oxides it is also prepared by reduction with carbon. Antimony is an extremely brittle metal of a flaky, crystalline texture, blue-white color and metallic luster; hardness, 3 to 3.5; not acted on by air at room temperature, but when heated burns brilliantly with the formation of the white fumes of the oxide Sb_2O_3. It is a poor conductor of heat or electricity. The most important metal alloys include type metal, stereotype metal and Babbitt metal. The principal compounds of antimony are the sulfides, chlorides and tartar emetic. In 1928 the price was 10–11¢ a pound, which dropped to 6¢ in 1933, but was 14½¢ in 1935.

Argon (Gr. *argon*, inactive), A; at. wt. 39.944; at. no. 18; m.p. −189.2° C; b.p. −185.7° C; density 1.782 g/l; valence 0 (does not combine with any other element). Its presence in air was suspected by Cavendish in 1785; discovered by Lord Rayleigh and Sir William Ramsay in 1894. Argon is prepared from air, the atmosphere containing about 0.8% argon. It is 2½ times as soluble in water as nitrogen and has about the same solubility as oxygen; it is best recognized by the characteristic lines in the red end of the spectrum. It is used as a filler for incandescent electric lamps. The price of argon in 1928 was about $18 per 10 cu. ft.

Arsenic [L. *arsenicum*, Gr. *arsenikon*, yellow orpiment (identified with *arsenikos*, male, from the belief that metals were of different sexes), Arab. *az-zernikh*, the orpiment from Persian *zerni* (*zar*, gold)], As; at. wt. 74.91; at. no. 33; m.p. sublimes (500° C m.p. under pressure); b.p. 615° C; sp. gr. 5.73; valence 3 or 5. The amorphous form of arsenic has a sp. gr. of 3.70. It is believed that arsenic was obtained in 1250 by Albertus Magnus. In 1649 Schroeder published two methods of preparing it. It is rarely found native, occurring mostly as *realgar* (As_2S_2), arsenical iron and mispickel or arsenical *pyrites* (FeSAs); it is usually prepared by heating mispickel, the arsenic subliming leaving ferrous sulfide. Arsenic is a steel-gray, very brittle, crystalline, semi-metallic solid which sublimes on heating, being deposited partly as crystals and partly as a black, amorphous solid; it tarnishes in air and when heated is rapidly oxidized to arsenious oxide (As_2O_3). The free element is not considered poisonous, although many of its compounds are extremely so, being used as insecticides. Arsenic is also used in bronzing, pyrotechny, and for hardening and improving the sphericity of shot. The most important compounds are white arsenic or arsenious oxide (As_2O_3), cupric arsenite or Paris green ($CuHAsO_3$), and *orpiment* (As_2S_3). The price of the metal in 1935 was 44¢ a pound.

Barium (Gr. *barys*, heavy), Ba; at. wt. 137.36; at. no. 56; m.p. 850° C; b.p. 1140° C; sp. gr. 3.5 (20° C); valence 2. Baryta was distinguished from lime by Scheele in 1779; the element

was discovered by Sir Humphry Davy in 1808. It is found only in combination with other elements, chiefly in *heavy spar* (sulfate) and *witherite* (carbonate) and is prepared by electrolysis. Barium is a metallic element, soft and silvery white like lead; it belongs to the alkaline earth group resembling calcium chemically. The most important compounds of barium are the peroxide, (BaO_2), chloride ($BaCl_2$), sulfate (permanent white or *blanc fixé*, $BaSO_4$), nitrate ($Ba(NO_3)_2$) and chlorate ($Ba(ClO_3)_2$); the nitrate and chlorate are used in pyrotechny for production of green colors; the sulfate in paint manufacture. The sulfide (BaS) phosphoresces after exposure to light. The compounds are not expensive, and the price of the metal has been reduced to \$7.50–\$10.00 per pound in 1932.

Beryllium (L. fr. *beryl;* also called *Glucinum*, Gr. *glykys*, sweet), Be or Gl; at. wt. 9.02; at. no. 4; m.p. 1350° C; b.p. 1530° C (5 mm); sp. gr. 1.85; valence 2. Discovered as the oxide by Vauquelin in beryl and in emerald in 1798; the metal was isolated in 1828 by Wöhler and Bussy independently. Beryllium aluminum silicates are the chief source of the metal today. It is prepared by electrolysis. It is hard enough to scratch glass, and resembles magnesium in appearance and chemical properties. Its soluble compounds are sweet. Its alloys are strong, light and resistant to corrosion. The metal is widely found and the use of the light alloys is expected to increase with the fall in price, which has ranged from \$80–\$300 per pound according to the degree of purity.

Bismuth (etymology dubious; Ger. *Wismuth*), Bi; at. wt. 209.00; at. no. 83; m.p. 271° C; b.p. 1450° C; sp. gr. 9.78 (20° C); valence 3 or 5. In early times bismuth was confused with tin and lead. Claude Geoffroy showed it to be distinct from lead in 1753. Bismuth is a white, crystalline, brittle metal with a pinkish tinge that occurs in many places free as well as in combination as sulfide, oxide and carbonate; it is extracted from the ore by melting out the free metal, the oxides and sulfides being decomposed by the addition of carbon and iron. Bismuth is also recovered as a by-product in lead smelting. It is a poor conductor of electricity, is very diamagnetic, solidifies with expansion, heated in air burns with a blue flame forming yellow fumes of the oxide; its soluble salts are characterized by forming insoluble basic salts on the addition of water—a property sometimes used in its detection. Bismuth forms many alloys with metals, which are often used for their property of low melting point and because of their expansion on cooling, thus particularly suited for making sharp castings of objects subject to damage by high temperatures. The important compounds of bismuth are the trioxide (Bi_2O_3), and the subnitrate of medicinal use (*pearl white, pearl powder, blanc de fard* and *blanc d'Espagne*). The price of the metal in 1935 was \$1.10 per pound in cases.

Boron (Ar. *būraq*, Pers. *būrah*), B; at. wt. 10.82; at. no. 5; m.p. 2000–2500° C; b.p. sublimes 2550° C; sp. gr. of crystals

2.54, of amorphous variety 2.45; valence 3. Discovered in 1808 by Sir Humphry Davy and by Gay-Lussac and Thenard. Boron is an element found in combination in boric acid, native borax or *tincal*, *boracite* and several other minerals. Boron is obtained by heating boron trioxide with magnesium powder; it has no commercial value. The most important compounds are boric acid or boracic acid (H_3BO_3) and borax ($Na_2B_4O_7.10H_2O$).

Bromine (Gr. *bromos*, stench), Br; at. wt. 79.916; at. no. 35; m.p. −7.2° C; b.p. 58.8° C; density of gas 7.59 g/l, liquid 3.12 (20°); valence 1, 3, 5 or 7. Discovered in 1826 by Balard, but it was not prepared in any quantity until 1860. A member of the halogen group of elements, it is obtained from natural brines by displacement with chlorine or electrolytically; it is the only liquid non-metallic element, a heavy, mobile, reddish-brown liquid, volatilizing readily at room temperatures to a red vapor with a strong disagreeable odor resembling chlorine and having a very irritating effect on the eyes and throat; it is readily soluble in water or carbon disulfide forming a red solution; it is less active than chlorine but more so than iodine; it unites readily with many elements and has a bleaching action; when spilled on the skin it produces painful sores. It is chiefly employed for the preparation of its compounds which are useful in photography, medicine, coal tar derivatives, etc. The most important compounds are the bromides of sodium and potassium. The price in 1935 was 36–38¢ a pound.

Cadmium (Gr. *kadmia*, Cadmean earth), Cd; at. wt. 112.41; at. no. 48; m.p. 320.9° C; b.p. 778° C; sp. gr. 8.65 (20°); valence 2. Discovered in 1817 by Stromeyer from an impurity in zinc carbonate. Cadmium occurs in small quantities associated with zinc. It comes off before zinc in the preparation of the metal, condensing as the brown oxide which is then reduced with carbon. It tarnishes in air and burns when heated, forming the oxide. It is a soft, bluish-white metal, malleable and ductile. It forms a number of salts of which the sulfate ($CdSO_4$) is the most common. Cadmium is a component of one of the lowest melting alloys and is alloyed with silver in electroplating. The price of cadmium in 1935 was 55¢ a pound.

Calcium (L. *calx*, lime), Ca; at. wt. 40.08; at. no. 20; m.p. 810° C; b.p. 1439 ± 5 (1170)° C; sp. gr. 1.54 (29°); valence 2. Discovered in 1808 by Davy, and by Berzelius and Pontin independently by preparation of an amalgam electrolytically and removal of the mercury by distillation. Calcium is a metallic element, fifth in abundance in the earth's crust, of which it forms 3.5%; an essential constituent in leaves, bones, teeth and shells. It is prepared by electrolysis of the fused chloride. Chemically it is one of the alkaline earth elements; it tarnishes readily in air, reacts with water, burns with a brilliant crimson flame to the oxide and forms many compounds of which the following are the most important: carbide (CaC_2),

carbonate in the various forms known as limestone, marble, *calcite*, *aragonite*, stalactites and stalagmites ($CaCO_3$), chloride ($CaCl_2$), cyanamide ($CaCN_2$), fluoride (CaF_2), hydroxide or slaked lime ($Ca(OH)_2$), hypochlorite or bleaching powder ($Ca(ClO)_2$ or $CaClOCl$), nitrate ($Ca(NO_3)_2$), oxide or quick lime (CaO), phosphate or *apatite* ($Ca_3(PO_4)_2$), sulfate or *gypsum* ($CaSO_4$), and sulfide (CaS).

Carbon (L. *carbo*, charcoal), C; at. wt. 12.00; at. no. 6; m.p. sublimes above 3500° C; b.p. 4200° C; sp. gr. amorphous 1.88, graphite 2.25, diamond 3.51; valence 2, 3 or 4. Carbon, an element of prehistoric discovery, is very widely distributed in nature, occurring free as diamond and graphite, and in an impure form as coal; in combination it occurs as carbon dioxide, carbonates and as a constituent of all living things. It occurs in three allotropic forms, the diamond, graphite, and amorphous, all forms being solids, insoluble in any common solvent but dissolving in melted metals from which they crystallize on cooling in the form of graphite; when the cooling takes place under pressure some of the carbon is obtained as diamond. Carbon is unique in forming an almost infinite number of compounds, there being at the present time half a million known compounds; the most common are the carbonates, carbon dioxide (CO_2); carbon monoxide (CO); carbon disulfide (CS_2); chloroform ($CHCl_3$); carbon tetrachloride (CCl_4); alcohol (C_2H_6O); acetic acid ($HC_2H_3O_2$) and oxalic acid ($H_2C_2O_4$).

Cerium (named after the planetoid *Ceres* which was discovered in 1801 only a short time before the element), Ce; at. wt. 140.13; at. no. 58; m.p. 640° C; b.p. 1400° C; sp. gr. 6.90 (20°); valence 3 or 4. Discovered in 1803 by Klaproth and by Berzelius and Hisinger. Metal prepared by Hillebrand and Norton in 1875. Cerium is found in a few rare minerals, *orthite*, *cerite*, and the *samarskite* of North Carolina. It is a steel-gray lustrous metal prepared by the electrolysis of the chloride. It is used as the oxide as an important constituent of incandescent gas mantles, and as a pyrophoric alloy with iron which gives off showers of sparks when struck.

Cesium (L. *caesius*, sky blue), Cs; at. wt. 132.91; at. no. 55; m.p. 28.5° C; b.p. 670° C; sp. gr. 1.87 (26°); valence 1. The first metal discovered by Bunsen and Kirchoff with the spectroscope. This was in 1860, the source being a mineral water from Durkheim. Cesium is an alkali metal occurring in *lepidolite*, *pollucite* and some mineral springs; it is isolated by electrolysis of the fused cyanide. Cesium is characterized by a spectrum containing two bright lines in the blue along with several others in the red, yellow and green. Because of its great affinity for oxygen the metal is used as a "getter" in radio tubes. It is also used as a catalyst in the hydrogenation of certain organic compounds. Its chief compounds are $CsCl$ and $CsNO_3$.

Chlorine (Gr. *chloros*, green), Cl; at. wt. 35.457; at. no. 17; m.p. −101.6° C; b.p. −34.6° C; density 3.214^0 g/l; sp. gr. 1.56 (−33.6°); valence 1, 3, 5 or 7. Discovered in 1774 by Scheele,

who thought it contained oxygen; named by Davy in 1810. In nature it is found in the combined state only, chiefly with sodium as common salt (NaCl), *carnallite* ($KMgCl_3.6H_2O$), and *sylvite* (KCl). A member of the halogen group of elements, it is obtained from chlorides by the action of oxidizing agents or by electrolysis; it is a greenish-yellow gas, with an irritating and suffocating odor, attacking the respiratory tract producing symptoms of pneumonia (war gas), combining directly with nearly all elements. At 10° C one volume of water dissolves 3.10 volumes of chlorine; at 30° C, 1.77 volumes of chlorine. The most important compounds are the chlorides, hypochlorites and chlorates. In 1933 the price was about 2¢ a pound as a liquid in tanks at the works where it is produced.

Chromium (Gr. *chroma*, color), Cr; at. wt. 52.01; at. no. 24; m.p. (1520) 1615° C; b.p. 2200° C; sp. gr. 7.1 (20°); valence 2, 3 or 6. Discovered in 1797 by Vauquelin, who prepared the metal the next year. Chromium is a metallic element resembling iron, occurring chiefly in chrome iron ore ($FeO.Cr_2O_3$) and is prepared by the reduction of the oxide with aluminum; it is a very infusible, hard gray metal used to harden steel. The most important compounds are the sodium and potassium chromates (K_2CrO_4), dichromates ($K_2Cr_2O_7$), and the potassium and ammonium chrome alums $CrK(SO_4)_2.12H_2O$. The metal is widely used in stainless steel and in chromium plating. The price of the ore in 1933 was $14 to $18 a ton.

Cobalt (G. *Kobold*, goblin or evil spirit), Co; at. wt. 58.94; at. no. 27; m.p. 1480° C; b.p. 2900° C; sp. gr. 8.9 (20°); valence 2 or 3. Discovered by Brandt in 1735. Cobalt is a metallic element occurring in ores which are sparingly distributed; most frequently in *smaltite* ($CoAs_3$), *linnaeite*, *wad* or *cobalt bloom* (Co_3S_4) and *cobalite* or *cobalt glance* (CoSAs). The metal is prepared by reducing the oxide with aluminum; it is brittle, hard, very magnetic, and of a gray color with a reddish tinge. It is used to alloy with other metals, and the salts are chiefly used for the production of brilliant and permanent blue colors in porcelain, glass, pottery, tiles, and enamels, being the principal ingredient in *Sevres blue* and *Thenard's blue*. The chief compounds are the oxide (CoO), the chloride ($CoCl_2.6H_2O$) and the nitrate ($Co(NO_3)_2.6H_2O$). The price of the metal in 1935 was about $2.50 a pound.

Columbium (*Columbia*, also called Niobium), Cb or Nb; at. wt. 92.91; at. no. 41; m.p. 1950° C; b.p. > 3300° C; sp. gr. 8.4; valence 3 or 5. Discovered in 1801 by Hatchett in an ore sent to England by John Winthrop, first governor of Connecticut, more than a century before; metal prepared by Blomstrand, who reduced the chloride by heating in hydrogen, in 1864. Columbium is a very rare metallic element, occurring chiefly in *niobite* or *columbite*; it is prepared by reducing the oxide with carbon in the electric furnace; it is a gray metal, forming an acid oxide, Cb_2O_5, from which the salts are derived. Balke in 1929 prepared extremely white and beautifully polished sheets and rods.

Copper (L. *Cyprium*, from the Island of Cyprus) Cu (cuprum); at. wt. 63.57; at. no. 29; m.p. 1083° C; b.p. 2310° C; sp. gr. 8.93–8.95; valence 1 or 2. The discovery of copper dates from prehistoric times; it is said to have been mined for more than 5000 years. Copper is a metallic element, reddish colored, bright, metallic luster, malleable, ductile, a good conductor of heat and electricity (second to silver in electrical conductivity) occurring native and in various ores: *chalcocite* (Cu_2S), *chalcopyrite* ($CuFeS_2$), *bornite* (Cu_3FeS_3), *covelite* (CuS), *malachite* ($CuCO_3.Cu(OH)_2$), *azurite* ($Cu_3(OH)_2(CO_3)_2$), *cuprite* (Cu_2O), *tenorite* (CuO), *chrysocolla* ($CuSiO_3.2H_2O$), *chalcanthite* ($CuSO_4.5H_2O$) and *tetrahedrite* ($4Cu_2S.Sb_2S_3$). It is obtained from ores by smelting, leaching or electrolysis. The most important compounds are the oxide (CuO) and the sulfate (blue vitriol, $CuSO_4.5H_2O$). The price of copper in 1917 was 35¢ a pound, and in 1935, 9¢ a pound.

Dysprosium (Gr. *dysprositos*, hard to speak with), Dy; at. wt. 162.46; at. no. 66; m.p. . . . .; b.p. . . . .; sp. gr. . . . .; valence 3. Discovered in 1886 by Lecoq de Boisbaudran. Dysprosium is a member of the erbium family of rare earths and occurs in the minerals *xenotime*, *fergusonite*, *gadolinite*, *euxonite*, *polycrase* and *blomstrandine*. The free element has never been isolated; it forms highly colored salts.

Erbium (Ytterby, a town in Sweden), Er; at. wt. 167.64; at. no. 68; m.p. . . . .; b.p. . . . .; sp. gr. 4.77(?); valence 3. Discovered in 1843 by Mosander. Erbium is a member of the family of rare earths which includes thulium, erbium, holmium and dysprosium in the order of increasing basicity. It forms highly colored salts and an oxide Er_2O_3. It occurs in the minerals *xenotime*, *fergusonite*, *gadolinite*, *euxonite*, *polycrase* and *blomstrandine*.

Europium (Europe), Eu; at. wt. 152.0; at. no. 63; m.p. . . . .; b.p. . . . .; sp. gr. . . . .; valence 2 or 3. *See Terbium.* Discovered in 1901 by Demarcay. Europium is the most sparsely distributed of the terbium family of rare earths which includes europium, gadolinium, and terbium in the order of decreasing basicity. Salts of the type EuX_3 and EuX_2, where X is a univalent atom or radical, are known. The general characteristics of this family resemble those of the cerium family.

Fluorine (L. *fluo*, flow), F; at. wt. 19.000; at. no. 9; m.p. −223° C; b.p. −187° C; density 1.69 g/l (15°); sp. gr. of liquid 1.11 (−187°); valence 1. Discovered by Scheele in 1771; isolated by Moissan in 1886. It occurs chiefly in *fluor spar* (CaF_2) and *cryolite* (Na_3AlF_6). Fluorine, a member of the halogen family of elements, is obtained by electrolyzing a solution of potassium hydrogen fluoride in anhydrous hydrogen fluoride; it is a pale yellow gas, uniting directly with silicon, carbon, hydrogen and nearly all other elements in the dark; decomposes almost all compounds to form fluorides, except in the case of oxygen, with which it forms no compounds. The most important compounds are hydrogen fluoride, which is

used in etching glass, and calcium fluoride. Both the element and hydrofluoric acid are dangerous poisons. The presence of fluorides in drinking water is the cause of mottled enamel in teeth.

Gadolinium (*Gadolin*, a Swedish chemist), Gd; at. wt. 157.3; at. no. 64; m.p. . . . . ; b.p. . . . . ; sp. gr. . . . . ; valence 3. Separated by Marignac in 1880 and by Lecoq de Boisbaudran in 1886. Gadolinium is a member of the terbium family of rare earths which includes terbium and europium. The general characteristics of this family resemble those of the cerium family; the free element has never been isolated; the element forms oxides of the type R_2O_3, and its salts are usually more soluble than the corresponding terbium salts. Gadolinium is the most plentiful of the three terbium family elements. These elements decrease in basicity in the order Eu, Gd and Tb.

Gallium (L. *Gallia*, France), Ga; at. wt. 69.72; at. no. 31; m.p. 29.75° C; b.p. 2000 ± 150° C; sp. gr. 5.91 (20°); valence 2 or 3. Discovered spectroscopically by Lecoq de Boisbaudran in 1875 in the zinc blend of Pierrefitte, Hautes-Pyrenees, although its occurrence was predicted before that time by Mendeleeff, who named it eka-aluminum. Gallium is a rare metal belonging to the aluminum group and is the only metal besides mercury, cesium and rubidium which can be a liquid at near room temperatures. This makes possible its use in high temperature thermometers. The solid is a hard, grayish-white substance. It forms two sets of chlorides, bromides, iodides, nitrates, sulfates and oxides in which it appears as divalent and trivalent. The price of gallium in 1932 was $2.50 a gram.

Germanium (L. *Germania*, Germany), Ge; at. wt. 72.60; at. no. 32; m.p. 958° C; b.p. volatilizes at 2700° C; sp. gr. 5.36 (20°); valence 4. Discovered by Winkler in 1886, although it was predicted before that time by Mendeleeff, who named it eka-silicon. It is prepared by reducing the oxide obtained from a silver ore (*argyrodite*) with carbon or with hydrogen. Germanium is a metallic element of the silicon group lying between silicon and tin in chemical properties; it is a gray-white, brittle, crystalline metal that retains its luster in air at room temperatures. The most important compounds are the oxide (GeO_2) and the halides ($GeCl_4$), the latter being volatile.

Glucinum, see *Beryllium.*

Gold (Anglo-Saxon *gold*), Au (L. *aurum*, shining dawn); at. wt. 197.2; at. no. 79; m.p. 1063° C; b.p. 2600° C; sp. gr. 19.32 (17.5°); valence 1 or 3. Valued highly from earliest times. Often occurs native or uncombined, principally in rock deposits or in alluvial deposits; obtained from its ores by cyanidation, amalgamation and smelting. It is a metallic element, having a yellow color when in mass, but when finely divided may be black, ruby or purple; it is the most malleable and ductile, and also one of the softest of the metals; it is a good conductor of heat and electricity and is not affected by air and most reagents. Its chief use is in coinage and jewelry; when used as a standard

of value by U. S., 1 Troy ounce was worth $20.67+. The commonest compounds are the auric chloride ($AuCl_3$) and the chloroauric acid ($HAuCl_4$), the latter used in photography for toning the silver image.

Hafnium (*Hafnia*, Copenhagen), Hf; at. wt. 178.6; at. no. 72; m.p. 2207 (1700?)° C; b.p. > 3200° C; sp. gr. 13.3; valence 4. Discovered in 1922 by D. Coster and G. von Hevesy in a *zircon* from Norway by means of Röntgen spectroscopic analysis. On the basis of the Bohr theory the new element, atomic number 72, was expected to be associated with zirconium. On treatment of the mineral with potassium bifluoride and separation of K_2ZrF_6, the mother liquors became richer in the new element. All the zirconium minerals investigated except *polymignite* (Zr-Ti) contained hafnium, most of them having it present to the extent of 5% of the zirconium content. It has been separated from zirconia by repeated recrystallization of the double ammonium or potassium fluorides. Metallic hafnium was prepared by van Arkel and de Boer by passing the vapor of the tetraiodide over a heated tungsten filament; it has the same crystalline structure as zirconium. Hafnium also resembles zirconium in chemical properties.

Helium (Gr. *helios*, the sun), He; at. wt. 4.002; at. no. 2; m.p. −272.2° C (26 atm.); b.p. −268.9° C; density 0.177 g/l; valence 0. Evidence of the existence of helium was first obtained by Sir Norman Lockyer during the eclipse of 1868 when he detected a new line in the solar spectrum; in 1895 Ramsay isolated helium from *uraninite*. Helium is a gas, inert chemically, obtained by compression and fractionation of the gas from certain wells and from the minerals *uraninite*, *cleveite*, *fergusonite*, *monazite*, *thorianite* and many radioactive minerals. H. K. Onnes has cooled the element to the lowest temperature ever obtained, −272.918° C; and expressed the opinion that helium may remain a liquid even at absolute zero under normal pressure. In June 1926, Keesom succeeded in producing solidification at −271.9° C under a pressure of 26 atmospheres. Although slightly heavier than hydrogen it is a valuable gas for inflating balloons because of its non-inflammability. The price of helium in 1920 was $104 per cu. ft., but by 1933 this had been reduced to $7.10 per 1000 cu. ft.

Holmium (L. *Holmia*, for Stockholm), Ho; at. wt. 163.5; at. no. 67; m.p. . . . .; b.p. . . . .; sp. gr. . . . .; valence 3. Discovered by Cleve while working on erbia earth in 1879; pure holmia earth was isolated by Holmberg in 1911. Holmium is a member of the erbium family of rare earths which includes thulium, erbium, holmium and dysprosium in the order of increasing basicity. It is obtained from *xenotime*, *fergusonite*, *gadolinite*, *euxenite*, *polycrase* and *blomstrandine*. The element forms highly colored salts; the free element has never been isolated.

Hydrogen (Gr. *hydro*, water, and *genes*, forming), H; at. wt. 1.0078; at. no. 1; m.p. −259° C; b.p. −252.8° C; density 0.0899 g/l; sp. gr. liquid 0.070 (−252° C); valence 1. First

recognised as a distinct substance in 1766 by Cavendish; named by Lavoisier. Hydrogen occurs chiefly in combination with oxygen as water; also in acids, bases and alcohols as well as in petroleum and other hydrocarbons. It is usually a constituent of organic compounds, especially those used as fuels and as food. It is the lightest of all gases, insoluble in water, uniting with many elements to form compounds; it is used as a reducing agent, as a means of obtaining high temperature flames, and for inflating balloons. It is prepared by the electrolysis of water, by displacement from acids with metals, or by the action of steam on heated carbon. Isotope-2 announced by Urey in 1932.

Illinium (University and State of Illinois), Il; at. wt. estimated 146; at. no. 61; m.p. ....; b.p. ....; sp. gr. ....; valence doubtless 3. The discovery of Illinium was announced in 1926 by Hopkins, Yntema and Harris, on the basis of absorption, arc, and X-ray emission spectra. Later in the same year Rolla and Fernandez in Italy claimed prior discovery and proposed the name "florentium." The late Charles James at the University of New Hampshire concentrated considerable illinium and other investigators have since confirmed the existence of the element. Illinium is a member of the cerium group of rare earths which includes lanthanum, cerium, praseodymium, neodymium, illinium and samarium, in the order of decreasing basicity. It occurs in exceedingly minute traces in *monazite*, *gadolinite*, and *xenotime*. Neither the metal nor its salts have been prepared pure.

Indium (From its indigo spectrum), In; at. wt. 114.76; at. no. 49; m.p. 155° C; b.p. > 1450° C; sp. gr. 7.28; valence 3. Discovered in 1863 by the use of the spectroscope by Reich and Richter, who later isolated the metal. Indium is a rare metallic element occurring in some zinc ores; it belongs to the aluminum group in properties, being a very soft, silvery metal, not acted on by water or air, burning to the sesquioxide (In_2O_3) with a blue-violet flame.

Iodine (Gr. *iodes*, violet), I; at. wt. 126.92; at. no. 53; m.p. 113.5° C; b.p. 183° C; density of gas 11.27 g/l, solid 4.93 (20°); valence 1, 3, 5 or 7. Discovered by Courtois in 1811. Iodine, a member of the halogen group of elements, occurs sparingly in the form of iodides in sea water from which it is assimilated by seaweeds, in Chile saltpeter, and in caliche (as sodium iodate); from iodides it is obtained on distillation with sulfuric acid and some oxidizing agent (MnO_2) and from the iodates by heating with sodium bisulfite. It is a grayish-black, lustrous solid, volatilizing at ordinary temperatures into a blue-violet gas with an irritating odor; it forms compounds with many elements but is less active than the other halogens, which displace it from iodides; it combines only partly with hydrogen when heated and has little or no action on hydrocarbons; it forms brown solutions with water (slightly soluble) and with alcohol or aqueous potassium iodide; with carbon disulfide, chloroform or carbon tetrachloride purple solutions are obtained. The most important compounds are the iodides of sodium and

potassium (KI) and the iodates (KIO_3). Its production from brines has lowered the price to about $2 a pound in 1933.

Iridium (L. *iris*, rainbow), Ir; at. wt. 193.1; at. no. 77; m.p. 2440 ± 15° C; b.p. 4400° C; sp. gr. 22.42 (17°); valence 3 or 4. Discovered in 1803 by Tennant. Iridium, a metallic element belonging to the platinum family, is a very hard, brittle, white metal, occurring in alluvial deposits along with platinum; it is used in apparatus for high temperatures; alloyed with platinum, it is used for standard weights and measures; alloys with osmium are used in tipping pens and compass bearings; iridium black, prepared by exposing alcoholic solutions of the sulfate to light, is used as a catalytic agent; the most important salt is the chloride ($IrCl_4$). The price in 1933 was about $160 an ounce.

Iron (Anglo-Saxon, *iron*), Fe (L., *ferrum*); at. wt. 55.84; at. no. 26; m.p. 1535° C; b.p. 3000° C; sp. gr. 7.85–7.88; valence 2 or 3. Iron articles are said to have been made by the Egyptians 3000 years B.C. Its most common ore is *hematite*, (Fe_2O_3) from which the metal is obtained by reduction with carbon. Iron is the most abundant of metals, though aluminum occurs in larger percentage in the earth's crust than iron. The pure metal, which is practically unknown in the Arts (although some grades of soft steel are almost chemically pure), is silver-white, very ductile and magnetic; the pure metal may be prepared by electrolytic deposition from ferrous sulfate or by reduction of pure oxide with hydrogen or aluminum; pig iron is hard, brittle and fairly fusible, containing about 3% carbon and varying amounts of sulfur, silicon, manganese and phosphorus; wrought iron is tough, grayish-white, and malleable, having usually a fibrous structure, very infusible, with only a few tenths per cent or less of carbon; steel is a solid solution of iron carbide in iron with a carbon content usually below 2%. Iron is the cheapest metal known, pig iron usually costing less than a cent a pound and steel about twice as much.

Krypton (Gr. *kryptos*, hidden), Kr; at. wt. 83.7 at. no. 36; m.p. −157° C; b.p. −152.9° C; density 3.708 g/l (0°); valence 0. Discovered in 1898 by Ramsay and Travers in the residue left after liquid air had nearly boiled away. Krypton is an inert, rare, gaseous element, occurring in small amounts in the atmosphere, and is characterized by a brilliant green and yellow line in its spectrum. The price of krypton in 1928 was about $7 per cm^3.

Lanthanum (Gr. *lanthano*, to conceal), La; at. wt. 138.92; at. no. 57; m.p. 885 ± 5° C; b.p. 1800° C; sp. gr. 6.155; valence 3. Discovered by Mosander in 1839. Lanthanum occurs in the ores *cerite*, *orthite*, and *monazite;* it is prepared from the chloride by treatment with sodium, or by electrolysis of a fused bath of $LaCl_3$, KCl and CaF_2. Lanthanum is a metallic element of the rare earths, resembling iron in its physical properties, burning brilliantly in air to form the oxide (La_2O_3).

Lead (Anglo-Saxon, *lead*), Pb (L., *plumbum*); at. wt. 207.22; at. no. 82; m.p. 327.5° C; b.p. 1620° C; sp. gr. 11.35; valence

2 or 4. Long known; mentioned in Exodus. Lead is obtained chiefly from *galena* (PbS) by a roasting process. It is a metallic element of bluish-white color and bright luster, very soft, highly malleable, has slight tenacity, is ductile and a poor conductor of electricity. It is used in making pipe and containers for corrosive liquids, and is a constituent of many useful alloys including solder, type metal and various antifriction metals. Important lead salts are the nitrate ($Pb(NO_3)_2$), sulfate ($PbSO_4$), acetate ($Pb(C_2H_3O_2)_2$), carbonate ($PbCO_3$), the basic carbonate or *White Lead* ($2PbCO_3.Pb(OH)_2$). Lead salts are used in medicine for washes and lotions because of the astringent properties of the solutions. The price of lead during the World War reached 11¢ a pound, dropping to about 3¢ in 1933.

Lithium (Gr. *lithos*, stone), Li; at. wt. 6.940; at. no. 3; m.p. 186° C; b.p. 1336° C; sp. gr. 0.534; valence 1. Discovered by Arfvedson in 1817. Lithium is widely distributed in combination with other elements occurring in the soil, waters and the minerals *lepidolite* and *spodumene* (silicates occurring in California and South Dakota respectively) *amblygonite* (phosphate); it is produced electrolytically. Lithium is a soft white metal, belonging to the alkali-metal group, the lightest metal known. When burned in air it forms the oxide lithia (Li_2O); it also forms a number of salts analogous to the salts of sodium or potassium. The carbonate and citrate are used in medicine to remove uric acid from the body, lithium urate being a soluble salt. The price in 1930 was about $20 a pound.

Lutecium (*Lutetia*, ancient name of Paris) Lu; at. wt. 175.0; at. no. 71; m.p. . . . . ; b.p. . . . . ; sp. gr. . . . . ; valence 3. In 1907 Urbain and in 1908 von Welsbach described a process by which Marignac's ytterbium (1879) could be separated into the two elements ytterbium (neoytterbium) and lutecium. Both elements occur in very small amounts in nearly all minerals containing yttrium. The best sources are probably *gadolinite*, *xenotime*, *polycrase* and *blomstrandine*. The oxide, chloride and sulfate have been prepared.

Magnesium (*Magnesia*, district in Thessaly), Mg; at. wt. 24.32; at. no. 12; m.p. 651° C; b.p. 1110° C; sp. gr. 1.74 (20°); valence 2. Recognized by Black in 1755; isolated by Davy in 1808; prepared in coherent form by Bussy in 1831. Magnesium occurs very widely distributed in combination as *magnesite* ($MgCO_3$), *dolomite* (Mg and Ca carbonates), Epsom salts ($MgSO_4.7H_2O$) and *kainite* ($KCl.MgSO_4.3H_2O$). It is obtained by electrolysis of the fused chloride. It is a light, white, and fairly tough metal; tarnishes slightly in air and when in the form of ribbon, wire or powder it ignites on heating, burning with a dazzling white heat. It is useful in flash-light photography, and for pyrotechnic purposes. It is often alloyed with copper and aluminum; the most important compounds are the oxide (MgO), the sulfate ($MgSO_4$), the chloride ($MgCl_2$) and the citrate ($Mg_3(C_6H_5O_7)_2$). The first metallic magnesium

produced commercially in the U. S. brought \$10 a pound, but the price with the large production in 1933 was 30¢ a pound.

Manganese (L. *magnes*, magnet), Mn; at. wt. 54.93; at. no. 25; m.p. 1260° C; b.p. 1900° C; sp. gr. 7.2; valence 2. 4, 6 or 7. Discovered in 1774 by Gahn. Manganese ores are *pyrolusite* (MnO_2) and *psilomelane* ($RO.4MnO_2$, where R is Ba, Li, K or Mn); other ores found in smaller amounts are *braunite* ($3Mn_2O_3.MnSiO_3$) and *manganite* ($Mn_2O_3.H_2O$). The metal is obtained by reduction of the oxide with sodium, magnesium, aluminum or by electrolysis. It is a gray-white metal resembling iron, but harder and very brittle. It is used in the production of alloys with iron (spiegeleisen), copper, brass and nickel. The most important compounds are the chloride ($MnCl_2$), sulfate ($MnSO_4$), oxide (MnO), dioxide (MnO_2), and potassium permanganate ($KMnO_4$).

Masurium (Masurian province, once belonging to Germany), Ma; at. wt. ....; at. no. 43; m.p. 2300° C; b.p. ....; sp. gr. ....; valence .... Masurium is one of the eka-manganeses discovered by Noddack, Tacke (now Frau Noddack) and Berg in 1925 and occurs in the minerals *columbite*, *sperrylite*, *gadolinite* and *fergusonite*. The element was detected with the aid of the Röntgen spectrum and the relative occurrence in the earth's crust is estimated at 10^{-13}.

Mercury (Planet *Mercury*), Hg (hydrargyrum); at. wt. 200.61; at. no. 80; m.p. −38.87° C; b.p. 356.9° C; sp. gr. 13.595 (4°); valence 1 or 2. Known to ancient Chinese and Hindus; found in Egyptian tombs of 1500 B.C. Mercury or quicksilver occurs free in nature to a limited extent, but the chief source is the sulfide (*cinnabar*, HgS) from which it is obtained by heating in a current of air. It is a heavy, silver-white, shining metal, liquid, a fair conductor of heat and electricity, having a regular coefficient of expansion; it tarnishes but slightly in air except when heated to near the boiling point, where it is slowly converted to the oxide (HgO) from which the oxygen is again set free at higher temperatures. The most important salts are mercuric chloride (corrosive sublimate, $HgCl_2$), mercurous chloride (calomel, HgCl), and mercuric sulfide (vermilion, HgS). Mercury dissolves many metals forming *amalgams* with them. The price of mercury, usually as much as \$1 a pound, was as low as 71¢ in 1933.

Molybdenum (Gr. *molybdos*, lead), Mo; at. wt. 96.0; at. no. 42; m.p. 2620° C; b.p. 3700° C; sp. gr. 10.2; valence 3, 4 or 6. Discovered in 1782 by Hjelm. Molybdenum does not occur native, being obtained from *molybdenite* (MoS_2) and from *wulfenite* ($PbMoO_4$). The metal is prepared by reduction of the oxide with carbon in the electric furnace. It is a very hard, silver-white metal; it is used chiefly in the manufacture of certain grades of tool steel, boiler plate, rifle barrels, and large cranks, as well as in making filaments, screens and grids for radios.

Neodymium (Gr. *neos*, new and *didymos*, twin), Nd; at. wt. 144.27; at. no. 60; m.p. 840° C; b.p. ....; sp. gr. 6.95;

valence 3. In 1843 Mosander reported the supposed element didymium obtained from *cerite.* In 1885 von Welsbach separated didymium into two new elements, neodymium and praseodymium by repeated fractionation of ammonium didymium nitrate. Neodymium is a metallic element, belonging to the rare earths, forming a series of pink salts with a characteristic absorption spectrum.

Neon (Gr. *neos,* new), Ne; at. wt. 20.183; at. no. 10; m.p. −248.67° C; b.p. −245.9° C; density 0.9002 g/l (0°); valence 0. Discovered by Ramsay and Travers in 1898. Neon is a gaseous element present in the atmosphere to the extent of one or two parts per 100,000. It is obtained by liquefaction of air and separated from the other elements by fractional distillation. It is an inert element forming no compounds. Neon glows red-orange in a vacuum tube and is marked by pronounced red and green lines in its spectrum. The price of neon in 1928 was about $10 per liter.

Nickel (Sw. abbr. of *kupparnickel*), Ni; at. wt. 58.69; at. no. 28; m.p. 1452° C; b.p. 2900° C; sp. gr. 8.90; valence 2 or 3. Discovered by Cronstedt in 1751. Nickel is obtained chiefly from the nickeliferous *pyrrhotite* of Ontario and the *garnierite* (hydrated silicate of nickel, iron and magnesia found in New Caledonia) by roasting to the oxide, which is then reduced by carbon or carbon monoxide. It is a hard, malleable, ductile and tenacious metal, of a white color, somewhat magnetic, a fair conductor of heat and electricity; it belongs to the iron-cobalt group of elements. It is chiefly valuable for the alloys which it forms with other metals—nickel steel, German silver (brass and 15–20% Ni), coinage with 75% copper, and Monel metal ($2\frac{1}{2}$ parts Ni and 1 part copper); electrodeposition of nickel plate is used as a protective coating for metals. The most important compounds are the sulfate ($NiSO_4$), and the oxides (NiO and Ni_2O_3). The price of the metal in 1935 was 35¢ a pound.

Niobium, see *Columbium.*

Nitrogen (L. niter forming), N; at. wt. 14.008; at. no. 7; m.p. −209.9° C; b.p. −195.8° C; density 1.2506 g/l; sp. gr. liquid 0.808 (−195.8° C), solid 1.026 (−252° C); valence 3 or 5. Discovered by Daniel Rutherford in 1772. Nitrogen is a gaseous element which occurs free in the atmosphere, of which it forms about four-fifths, and from which it can be obtained by liquefaction and fractional distillation. It is easily obtained by heating a water solution of ammonium nitrite (mixture of ammonium chloride and sodium nitrite). It is a colorless, odorless and relatively inert element, combining directly with magnesium, lithium and calcium when heated with them. When mixed with oxygen and subjected to electric sparks it forms nitrogen peroxide. It occurs in all living things as an essential ingredient and also occurs in the deposits of saltpeter (sodium and potassium nitrate). The chief compounds are the nitrates of many metals, the five oxides (N_2O, NO, N_2O_3, NO_2 and N_2O_5) and ammonia (NH_3).

Osmium (Gr. *osme*, odor), Os; at. wt. 191.5; at. no. 76; m.p. 2700° C; b.p. 4450° C; sp. gr. 22.48; valence 2, 3, 4 or 8. Discovered in 1803 by Tennant. Osmium occurs in *iridosmine* and in platinum bearing river sands of the Urals, North America and South America. It is a bluish-white, hard, crystalline metal belonging to the platinum family of elements. It is the heaviest known form of matter, is very infusible, oxidizing when heated in the air to the oxide (OsO_4) with a pungent, irritating and poisonous vapor, which is easily reduced by organic matter. Osmium was used in making lamp filaments, and with iridium forms the alloy osmiridium which is used because of its hardness in tipping gold pens and for fine machine bearings. The price in 1928 was about $78 per ounce.

Oxygen (Gr. acid former) O; at. wt. 16.000; at. no. 8; m.p. −218.4° C; b.p. −183.0° C; density 1.429 g/l (0°); sp. gr. liquid 1.14 (−183° C); valence 2. Discovered in 1774 by Priestley, who obtained it by heating mercuric oxide, using the sun's rays with a burning glass. Oxygen is a gaseous element which occurs free in the atmosphere, of which it forms about one-fifth and from which it can be obtained by liquefaction and fractional distillation; it is also prepared by heating barium peroxide (BaO_2), heating potassium chlorate ($KClO_3$), by electrolysis of water containing a small amount of sulfuric acid, and by adding sodium peroxide (Na_2O_2) to water. The critical temperature and pressure are −118° C and 50 atmospheres. Gaseous oxygen is colorless, odorless and tasteless; the liquid and solid forms are a pale blue color and are magnetic, but much less so than iron. Oxygen is very reactive, capable of combining with all elements except the inert elements of the atmosphere and bromine and fluorine. Under suitable conditions it may be converted into an allotropic form known as ozone (O_3). It is used in combination with combustible gases in the oxygen blow pipes and flames; in medicine it is used to aid respiration.

Palladium (Planet *Pallas*), Pd; at. wt. 106.7; at. no. 46; m.p. 1555° C; b.p. 2200° C; sp. gr. 11.40 (22.5°); valence 2 or 4. Discovered in 1803 by Wollaston. Palladium is obtained in working up platinum, with which it occurs native. It is a steel-white metal, belonging to the platinum family of elements. It does not tarnish in air and has the property of absorbing large volumes of hydrogen to form the hydride (Pd_2H). It is used in the construction of non-magnetic watches and parts of delicate balances. The most important compound is the chloride, ($PdCl_2$). The price of the metal in 1931 was about $18 an ounce.

Phosphorus (Gr. *light bearing*) P; at. wt. 31.02; at. no. 15; m.p. 44.1° C; b.p. 280° C; sp. gr. yellow 1.82, red 2.20; valence 3 or 5. Discovered in 1669 by Brand, who prepared it from urine. Phosphorus occurs in three allotropic forms—*viz.*, yellow, red and black. Though never found free in nature, it is widely distributed in combination in minerals, the most important being the *apatites* ($3Ca_3(PO_4)_2CaF_2$ and $3Ca_3(PO_4)_2.CaCl_2$)

which are the chief ingredients of commercial phosphates derived from South Carolina, Canada and Spain; it is an essential ingredient of all cell protoplasm, nervous tissue and bones. It is obtained from phosphates by treatment with dilute sulfuric acid to form o-phosphoric acid, the concentrated solution of which is mixed with crushed charcoal or coke and dried; on heating this mixture in retorts, the phosphorus distils and is condensed. It is also prepared by heating crude phosphate with sand and coke in the electric furnace, the phosphorus distilling off. Ordinary phosphorus is a waxy solid which is colorless when very pure, insoluble in water and soluble in carbon disulfide; it takes fire spontaneously in air, burning to the pentoxide; it is very poisonous; when heated in its own vapor to 250° C it is converted into the red variety which does not glow in air and which does not ignite spontaneously and is not poisonous. The most important compounds are the pentoxide or phosphoric anhydride (P_2O_5), the chlorides (PCl_3 and PCl_5) and the phosphates of the alkali metals. The prices of the red and yellow varieties in 1933 were about 44¢ and 32¢ a pound respectively.

Platinum (Sp. *platina*, little silver) Pt; at. wt. 195.23; at. no. 78; m.p. 1755° C; b.p. 4050° C; sp. gr. 21.45; valence 2 or 4. Discovered in South America by Ulloa in 1735 and by Wood in 1744. Platinum occurs native in alluvial deposits or in rock forming minerals found principally in the Ural mountains, in Colombia, in California, Oregon, Arizona and Alaska. It is a tin-white metal of metallic luster, tenacious, malleable and ductile. It is welded at a red heat, has a coefficient of linear expansion approximately equal to that of glass; does not oxidize in air at any temperature but is corroded by halogens, cyanide, sulfur and caustic alkalies; it forms alloys with lead; it has a catalytic effect of bringing about combinations such as sulfur dioxide and oxygen. The most important compound is chloroplatinic acid (H_2PtCl_6). The price of platinum has varied widely, being nearly eight times as valuable as gold in 1920 and approaching the price of gold ($20.67 an ounce) in 1933.

Polonium (Poland, native country of Mme. Curie). Po; at. wt. approximately 210; at. no. 84. First element discovered by Marie Curie (1898) in seeking cause of radioactivity of pitchblende from Joachimisthal, Bohemia. The electroscope, claimed to be 500,000 times more sensitive than the spectroscope, showed it separating with the bismuth. Polonium is also called Radium F. (See Radioactive Elements.)

Potassium (Eng. *potash*), K (*kalium*); at. wt. 39.096; at. no. 19; m.p. 62.3° C; b.p. 760° C; sp. gr. 0.86; valence 1. Discovered in 1807 by Davy; the first metal to be isolated from an earth by the electric current. The principal sources of potassium are: the mines of Stassfurt in Prussian Saxony from the minerals *kainite* ($MgSO_4.KCl.3H_2O$), *sylvin* (KCl), and *carnallite* ($KCl.MgCl_2.6H_2O$); crude potassium carbonate or potash obtained by extraction of wood ashes; potassium salts

from natural brines, from cement mill and blast furnace dust, from kelp, from Searles Lake, California. Potassium is never found free but is obtained by electrolysis of the hydroxide (KOH). On exposure to moist air it becomes coated with a film of the oxide, and is preserved by immersion in kerosene or naphtha. It is a soft, bright silvery metal belonging to the alkali group. The chief compounds are the hydroxide, the carbonate (K_2CO_3), nitrate (KNO_3), chloride (KCl), chlorate ($KClO_3$), bromide (KBr), iodide (KI), cyanide (KCN), sulfate (K_2SO_4), dichromate ($K_2Cr_2O_7$), chromate (K_2CrO_4) and silicate (K_2SiO_3).

Praseodymium (Gr. *praesos*, green, and *didymos*, twin), Pr; at. wt. 140.92; at. no. 59; m.p. 940° C; b.p. ....; sp. gr. 6.5 (20°); valence 3. Discovered in 1885 by von Welsbach, who separated it and neodymium from didymium, which had been obtained from *cerite*. Praseodymium is a metallic element belonging to the group of rare earths. It forms green salts with a characteristic absorption spectrum.

Protoactinium (Gr. *protos*, first), Pa; at. wt. ....; at. no. 91. The first element of the actinium series of radioactive elements was discovered by Soddy and Cranston and independently by Hahn and Meitner, both in 1917. It has been called the "mother substance" or the "parent" of actinium, which it forms by the loss of an alpha particle, and the "patriarch" of the series; known also as ekatantalum and uranium X_2. (See Radioactive Elements.)

Radium (L. *radius*, ray) Ra; at. wt. 225.97; at. no. 88; m.p. 960° C; b.p. 1140° C; sp. gr. 5 (?); valence 2. Obtained in 1911 by Mme. Curie and Debierne by the electrolysis of a pure solution of radium chloride, employing a mercury cathode; the amalgam on distillation in an atmosphere of hydrogen yielded the pure metal. In the form of a salt it was first isolated by M. and Mme. Curie in 1898 from the *pitchblende* in North Bohemia, in which it occurs in about one part in three million. The *carnotite* sands of Colorado yield about 2% uranium nitrate; the amount of radium in uranium is one part in 3,200,000. Richer ores have been found in the Belgian Congo and in the Great Bear Lake region of Canada. Radium is obtained commercially as the bromide or chloride. The metal, which is a brilliant white, alters very rapidly in contact with air, decomposes water and is somewhat more volatile than barium. The primary uses are in producing self-luminous paints and in the treatment of cancer and certain types of skin affections. One gram of radium produces about 0.1 cubic millimeter of emanation per day; this is pumped from the radium and sealed in minute tubes, which are then applied to the diseased parts. Radium loses about 1% of its activity in 25 years, being transformed into elements of lower atomic weight. (See Radioactive Elements.)

Radon (niton), Rn; at. wt. 222; at. no. 86; valence 0; m.p. −71° C; b.p. −61.8° C; density 9.73 g/l. Discovered in 1900 by Dorn and called radium emanation; isolated in 1908

by Ramsay and Gray, who named it niton, from the Latin word *nitens*, shining. They determined its density, finding it to be the heaviest gas known. It occupies the last place in the zero group of gases in the Periodic Table. Since 1923 it has been called radon to show its origin from radium. Thoron and actinon are isotopes. (See Radioactive Elements.)

Rhenium (Rhine, province once belonging to Germany), Re; at. wt. 186.31; at. no. 75; m.p. 3440° C; b.p. . . . .; sp. gr. 20.53; valence . . . .; Rhenium or dwimanganese is one of the eka manganeses discovered in 1925 by Noddack, Tacke and Berg in the minerals *columbite*, *tantalite* and *wolframite*. The metal can be hot forged or rolled; dissolves readily in HNO_3, slowly in H_2SO_4, and hardly at all in HCl. The element was detected with the aid of the Röntgen spectrum and the relative occurrence in the earth's crust is estimated at 10^{-9}. Its arc spectrum has been carefully studied by Meggers. The price of $10,000 per gram in 1928 dropped to $3 in 1930, the production increasing a thousand fold.

Rhodium (Gr. *rhodon*, rose), Rh; at. wt. 102.91; at. no. 45; m.p. 1985 ± 15° C; b.p. > 2500° C; sp. gr. 12.5; valence 3. Discovered in 1803 by Wollaston. Rhodium is a silver-white metallic element belonging to the platinum family, occurring native with other members of this group in river sands in the Urals and in North and South America. The salts form red solutions. An alloy with platinum is used in connection with pure platinum to make thermojunctions in some forms of pyrometers. The price in 1931 was about $50 an ounce.

Rubidium (L. *rubidus*, red), Rb; at. wt. 85.44; at. no. 37; m.p. 38.5° C; b.p. 700° C; sp. gr. 1.53; valence 1. Discovered by the use of the spectroscope in *lepidolite* by Bunsen and Kirchoff in 1861. Rubidium occurs in small quantities in the mineral waters of Dürkheim in Rhenish Palatinate, in *lepidolite* and in the rare minerals *castor* and *pollux* found in Elba. It is prepared by the electrolysis of the cyanide. Rubidium is a soft, white, rare metallic element of the potassium group; it forms salts similar to those of potassium and colors the flame red when held in a burner.

Ruthenium (*Ruthenia*, Russia), Ru; at. wt. 101.7; at. no. 44; m.p. 2450° C; b.p. 4150° C; sp. gr. 12.2; valence 3, 4, 6 or 8. Discovered in 1844 by Claus, more than a century after the discovery of the other metals of the platinum family. Ruthenium, belonging to the platinum group, occurs native with the other metals of this group. It is a hard, brittle, gray metal; it forms red or brown salts; ruthenious chloride ($RuCl_3$) gives a characteristic fine black precipitate with water. The price in 1931 was about $52 per ounce.

Samarium (*Samarski*, a Russian), Sm; at. wt. 150.43; at. no. 62; m.p. 1300–1400° C; b.p. . . . .; sp. gr. 7.7–7.8; valence 3. Discovered in 1879 by Lecoq de Boisbaudran in the mineral *samarskite*, named in honor of a Russian mine official. Samarium is a metallic element belonging to the rare earth

group, occurring in very minute quantities in *samarskite, cerite* and certain Scandinavian minerals.

Scandium (*Scandinavia*), Sc; at. wt. 45.10; at. no. 21; m.p. 1200° C; b.p. 2400° C; sp. gr. 2.5 (?); valence 3. Discovered by Nilson in 1879. Scandium is a metal belonging to the rare earth group which has not been isolated in the elementary form; it forms colorless salts derived from the oxide Sc_2O_3.

Selenium (Gr. *selene*, moon), Se; at. wt. 78.96; at. no. 34; m.p. 217° C; b.p. 688° C; sp. gr. 4.47–4.80, amorphous 4.27; valence 2, 4 or 6. Discovered in 1817 by Berzelius. The principal source of selenium is the flue dust obtained in burning pyrites in the manufacture of sulfuric acid. It is prepared in a red amorphous form by reduction of selenic acid, and this on melting and keeping somewhat below the melting point becomes crystalline. It is a gray, crystalline, semi-metallic appearing element of the sulfur group. Its conductivity for electricity increases with the brightness of the light with which it is illuminated. The compounds of selenium resemble those of sulfur very closely. Its chief use is in the glass and ceramics industries.

Silicon (L. *silex*, flint), Si; at. wt. 28.06; at. no. 14; m.p. 1420° C; b.p. 2600° C; sp. gr. 2.42; valence 4. First prepared by Berzelius in 1823. Silicon is not found free but in combination, is probably more widely distributed in the solid matter of the earth than any other element except oxygen. It occurs chiefly as the oxide, silica (SiO_2) (quartz, rock crystal, amethyst, agate, flint, jasper, opal, etc.) both free and in combination with the metallic oxides as silicates (granite, hornblende, asbestos, feldspar, clay, mica, etc.). It is obtained as an amorphous, brown powder on fusion of potassium fluosilicate with sodium or potassium; the crystalline form is obtained by passing silicon tetrachloride over melted aluminum in an atmosphere of hydrogen, or by heating potassium fluosilicate with zinc and sodium at a temperature just below the boiling point of zinc. Silicon is a non-metallic element resembling graphite in appearance; it is not attacked by acids with the exception of a mixture of nitric and hydrofluoric acids; it is soluble in hot caustic potash or soda, evolving hydrogen and forming the corresponding silicate (K_2SiO_3 or Na_2SiO_3). Glass, cement and clay working are called silicate industries.

Silver (Anglo-Saxon, *soelfor*), Ag (L. *argentum*); at. wt. 107.880; at. no. 47; m.p. 960.5° C; b.p. 1950° C; sp. gr. 10.50; valence 1. Known to ancients. Silver occurs native and in many ores, the chief ones being *argentite* (Ag_2S), *stephanite* (Ag_5SbS_4), *pyragyrite* (Ag_3SbS_3) and horn silver ($AgCl$); lead and copper ores yield considerable silver. It is obtained from the ores by smelting with lead or copper or by amalgamation with mercury. Silver is a pure white metal having a brilliant luster, a little harder than gold and excelled only by that metal in malleability and ductility; it excels all other metals as a

conductor of heat and electricity; it undergoes no change in water or pure air, but absorbs 22 times its volume of oxygen when melted, which is again expelled on cooling; it tarnishes in the vapors of sulfur compounds forming the sulfide (Ag_2S). The most important compounds of silver are the nitrate ($AgNO_3$) or lunar caustic, the oxide (Ag_2O), and the halides ($AgCl$, $AgBr$) which darken on exposure to light, an action of which use is made in photography. The price, which was $1.35 an ounce in 1920, dropped as low as 28¢ in 1933.

Sodium (English, *soda*), Na (L. *natrium*); at. wt. 22.997; at. no. 11; m.p. 97.5° C; b.p. 880° C; sp. gr. 0.971; valence 1. First isolated by Davy in 1807 by electrolysis. Sodium is very widely distributed in combination chiefly as common salt or sodium chloride; it is never found free, but is obtained by electrolysis of the hydroxide. It is a soft, bright silvery metal belonging to the alkali group. On exposure to moist air it becomes coated with a film of the oxide and is preserved by immersing in kerosene or naphtha. It decomposes water with the formation of hydrogen and the hydroxide of sodium; it burns in air with the formation of the peroxide (Na_2O_2); formerly it was used as a reducing agent in the preparation of metals (aluminum and magnesium); it is still used for the reduction of organic compounds, in the preparation of the peroxide and cyanide, and for keeping the mercury clean and active in gold extraction. The chief compounds are the chloride ($NaCl$), bromide ($NaBr$), iodide (NaI), carbonate (Na_2CO_3), bicarbonate ($NaHCO_3$), sulfate (Glauber's salt, $Na_2SO_4.10H_2O$), nitrate (saltpeter, $NaNO_3$), nitrite ($NaNO_2$), sulfite ($Na_2SO_3.7H_2O$), thiosulfate (hypo, $Na_2S_2O_3.5H_2O$) borate (borax, $Na_2B_4O_7.10H_2O$) and hydroxide ($NaOH$).

Strontium (*Strontian*, town in Scotland), Sr; at. wt. 87.63; at. no. 38; m.p. 752 (800)° C; b.p. 1150° C; sp. gr. 2.6; valence 2. Discovered by Crawford, a Scotchman, in 1790; metal isolated by Davy by electrolysis in 1808. Strontium is found chiefly in *celestite* ($SrSO_4$) and *strontianite* ($SrCO_3$). It is prepared by electrolysis of the fused chloride and resembles metallic calcium in its properties; it is a hard, yellowish metal. The salts are generally soluble in water with the exception of the sulfate, phosphate and carbonate; they impart a brilliant crimson color to the flame, and are used in pyrotechny for red fire. The most important salts are the bromide ($SrBr_2$), iodide (SrI_2) and carbonate ($SrCO_3$).

Sulfur (L. *sulfur*), S; at. wt. 32.06; at. no. 16; m.p. rhombic 112.8° C, monoclinic 119.0° C; b.p. 444.6° C; sp. gr. rhombic 2.07; monoclinic 1.957; valence 2, 4 or 6. Known to ancients. Sulfur occurs widely distributed in nature in the free form, Texas being the largest producer. In combination it occurs mostly as *pyrites;* sulfides of iron (FeS_2), copper and arsenic pyrites; sulfide of lead (*galena*), zinc (*blende*), mercury (*cinnabar*) and antimony (*stibnite*); it is also widely distributed in the form of the sulfates of calcium (*gypsum*), strontium (*celestite*), magnesium (*Epsom salt*) and barium (*heavy spar*). Sulfur is

a pale yellow, odorless, brittle solid, which is insoluble in water and soluble in carbon disulfide. It occurs in two crystalline forms and an allotropic form known as plastic sulfur which is insoluble in carbon disulfide and which reverts to the crystalline form on standing; a finely divided form known as flowers of sulfur is obtained by sublimation. It readily forms compounds known as sulfides with many elements. Sulfur is chiefly employed as a component of gunpowder and as a parasiticide. It is easily ignited in air, burning to form the dioxide, which is used in fumigation and in the manufacture of sulfuric acid; sulfur is a good electrical insulating material. The price of sulfur in 1933 was about $18 a ton at the mines.

Tantalum (Gr. *Tantalus*, mythological character) Ta; at. wt. 181.4; at. no. 73; m.p. 2850° C; b.p. >4100° C; sp. gr. 16.6; valence 5. Discovered in 1802 by Ekeberg. Tantalum occurs principally in the mineral *tantalite* ($FeTa_2O_6$) and is prepared by reduction of potassium fluotantalate (K_2TaF_7) with hydrogen followed by fusion in a vacuum. It can be drawn into a wire with a very high point of fusion and great tenacity which has been used in the construction of filaments for incandescent electric lamps. It is also used to alloy with other metals. It is soluble in fused alkalies, insoluble in acids. it forms the oxide Ta_2O_5. The price in 1931 was $91 a kilogram;

Tellurium (L. *tellus*, earth), Te; at. wt. 127.61; at. no. 52; m.p. 452° C; b.p. 1390° C; sp. gr. 6.24; valence 2, 4 or 6. Discovered by Müller von Reichenstein in 1782; named by Klaproth in 1798. Tellurium occurs as gold telluride and with some copper ores. It is obtained by reduction of telluric oxide and forms a powder of grayish white metallic appearance. It is a semi-metallic element of the sulfur group and forms tellurides with hydrogen and metals similar to the sulfides; the compounds H_2TeO_3 and H_2TeO_4 are only slightly acidic. The inhalation of the vapors of tellurium produces the very offensive "tellurium breath." Tellurium is used in ceramics.

Terbium (Ytterby, town in Sweden), Tb; at. wt. 159.2; at. no. 65; m.p. . . . . ; b.p. . . . . ; sp. gr. . . . . ; valence 3. Discovered by Mosander in 1843. Terbium occurs in *gadolinite* and in the majority of ceria and ytteria minerals. The terbium family of rare earths includes europium, gadolinium and terbium. None of the metals of the terbium family has been isolated. The general characters of this family resemble those of the cerium family. Among the rare earths the decrease in basicity is in the order Sa, Eu, Gd, Tb, Dy. The elements are all trivalent and yield colorless oxides of the type R_2O_3, although terbium alone furnishes the higher oxide Tb_4O_7. The salts of terbium are generally less soluble than those of gadolinium. These salts are of the type RX_3, where X is a univalent atom or radical. Europium also forms salts of the type EuX_2. Europium is most sparsely distributed and gadolinium the most plentiful of these elements.

Thallium (Gr. *thallos*, budding twig), Tl; at. wt. 204.39; at. no. 81; m.p. 303.5° C; b.p. 1650° C; sp. gr. 11.85; valence 1

or 3. Discovered in 1861 by Crookes, who isolated the metal in 1862. Lamy also isolated the metal in 1862. Thallium occurs in *pyrites* and is prepared from the flue dust of sulfuric acid works. The metal is obtained by heating thallium iodide with metallic sodium; it resembles lead, having a hardness of 1.2 compared with 1.5 for lead; the malleability is high and the tenacity is low; it exists in two allotropic forms with a transition temperature of 226° C; it is a poor conductor of electricity, tarnishes in air forming the oxide Tl_2O or the hydroxide TlOH in the presence of water; the element is displaced from solutions of its salts by zinc. Thallium salts are poisonous, and are used in the control of rodents such as squirrels. The price of thallium for 1931 was about $14 a pound.

Thorium (*Thor*, Scandinavian god of war), Th; at. wt. 232.12; at. no. 90; m.p. 1845° C; b.p. $>$3000° C; sp. gr. 11.2; valence 4. Discovered by Berzelius in 1828. Thorium occurs chiefly in *thorite* and other rare minerals. In the U. S. it is obtained chiefly from *monazite* which contains from 3 to 9 per cent of the oxide. The free element has been obtained by heating the double chloride or fluoride of thorium and potassium with metallic sodium or potassium. The element belongs to the tin group of metals. It burns brightly in oxygen to form the oxide ThO_2, which is also obtained on heating the nitrate, a reaction of which use is made in the preparation of incandescent gas mantles. Thorium emits radiations similar to but not identical with those of radium. (See Radioactive Elements.)

Thulium (*Thule*, Northland), Tm; at. wt. 169.4; at. no. 69; m.p. . . . .; b.p. . . . .; sp. gr. . . . .; valence 3. Discovered in 1879 by Cleve; pure thulia was isolated in 1911 by James. Thulium belongs to the erbium family of the rare earths which includes dysprosium, holmium, erbium, and thulium. They are obtained from *xenotime*, *fergusonite*, *gadolinite*, *euxonite*, *polycrase* and *blomstrandine*. They are characterized by their absorption spectra and the formation of highly colored salts; they form basic oxides of the type M_2O_3 with the following order of increasing basicity: thulium, erbium, holmium and dysprosium. The free elements have not been isolated.

Tin (Anglo-Saxon, *tin*), Sn (L, *stannum*); at. wt. 118.70; at. no. 50; m.p. 231.9° C; b.p. 2270° C; sp. gr. gray 5.75 (20°), rhombic 6.55, tetragonal 7.31 (20°); valence 2 or 4. Known to the ancients. Tin is found chiefly in the mineral *cassiterite* (SnO_2) and is obtained by roasting to remove sulfur and arsenic and smelting with powdered anthracite in a reverberatory furnace. It is a silver white, malleable and somewhat ductile metal with a low tenacity and highly crystalline structure; it takes a high polish and is used to coat other metals to prevent corrosion, as it does not corrode easily in air. When heated in air it forms the dioxide (SnO_2) which is feebly acid, forming stannate salts with basic oxides. The most important salt is the chloride ($SnCl_2.2H_2O$) which is used as a reducing agent

and as a mordant in calico-printing. Tin is obtained chiefly from the Malay states, Bolivia, Banka, Billiton, Cornwall and Australia. The price of the metal was above 70¢ a pound in 1919 and in 1927, but below 20¢ in 1932. It was rising in 1933.

Titanium (L. *Titans*, sons of the earth), Ti; at. wt. 47.90; at. no. 22; m.p. 1800° C; b.p. >3000° C; sp. gr. 4.5; valence 3 or 4. Discovered by Gregor in 1791; named by Klaproth in 1795; pure metal prepared by Hunter in 1910. Titanium occurs naturally as the oxide (TiO_2) as *rutile*, *brookite* and *anastase;* it occurs also in various titanates, and with many iron ores. The free element is prepared by heating the oxide with aluminum or by electrolysis of the solution of the oxide in calcium chloride. It is a lustrous white metal of the tin group; it burns in air, and is the only element which burns in nitrogen. The most important compounds are the oxide (TiO_2) which is feebly acidic and from which the titanates are derived; the halides (TiX_4), some are volatile; the nitrides (Ti_2N_2, Ti_3N_4), metallic in appearance. The metal is used with steel to increase the tensile strength; most of the metallurgical titanium of the U. S. comes from the *rutile* of Virginia. The oxide is used in high-grade white pigments. The price of titanium oxide in 1933 was less than 20¢ a pound.

Tungsten (Sw., heavy stone), W (G. *Wolfram*); at. wt. 184.0; at. no. 74; m.p. 3370° C; b.p. 4727° C; sp. gr. 19.3; valence 6. Discovered by d'Elhujar brothers in 1783. Tungsten occurs in the form of the oxide (WO_3) in *wolframite*, *hubnerite*, *scheelite*. The metal is obtained by reduction of the oxide with hydrogen, carbon, or aluminum. It is hard, brittle, nonmagnetic and forms the oxide when heated in air. The only solvent for tungsten is a mixture of nitric and hydrofluoric acids. It forms alloys with iron and manganese and imparts hardness to steel. It is used in filaments for incandescent lamps. The price of tungsten powder in 1933 was about $1.50 a pound.

Uranium (Planet *Uranus*), U; at. wt. 238.14; at. no. 92; m.p. <1850° C; b.p. ....; sp. gr. 18.68; valence 4 or 6. Discovered by Klaproth in 1789; metal first prepared by Peligot in 1841. Uranium occurs in *pitchblende* (as uranous uranate, $U(UO_4)_2$). The free element is prepared by reduction of uranous chloride (UCl_4) with sodium and is a hard white metal; uranium is used chiefly in the form of the compounds which give a canary-yellow fluorescent glass, and a black pigment for china painting; and also in photography. Uranium compounds are radioactive (See Radioactive Elements).

Vanadium (Goddess *Vanadis*), V; at. wt. 50.95; at. no. 23; m.p. 1715° C; b.p. 3400° C; sp. gr. 5.87 (15°); valence 3 or 5. Discovered by Sefström in 1830; isolated by Roscoe in 1869. Vanadium occurs in *mettramite* (a lead-copper vanadate) and in *vanadinite* (a lead vanadate); Peru is the chief producer of the ore. The metal is obtained by reduction of the chloride in hydrogen forming a gray and very infusible metal. When alloyed with steel it increases the hardness. The vanadates

are employed in the preparation of aniline black and for coloring glass. The oxide is used as a catalyst.

Virginium (State of Virginia), Vi; at. wt. about 224; at. no. 87; valence 1. Discovered in 1929 by Dr. Fred Allison and co-workers of Alabama Polytechnic Institute by the magneto-optic method of analysis of *pollucite* and *lepidolite*. It has been found also in sea water, lake brine, Stassfurt deposits, *pitchblende*, *samarskite* and *monazite sands*. Virginium has the highest equivalent weight of any element. Named in honor of Virginia, where the discoverer was born.

Xenon (Gr. *xenon*, stranger), Xe; at. wt. 131.3; at. no. 54; m.p. −112; b.p. −107.1; density 5.85 g/l; sp. gr. 3.06 (−109.1°); valence 0. Discovered by Ramsay and Travers in 1898 in the residue left on evaporating liquid air. It is the rarest and heaviest of the gases of the argon family and is present in the atmosphere to the extent of about one part in twenty million. It is inert and forms no compounds with other elements. The price of xenon in 1928 was about $15 per cm^3.

Ytterbium (Ytterby, town in Sweden), Yb; at. wt. 173.04; at. no. 70; m.p. 1800° C; b.p. . . . . ; sp. gr. . . . . ; valence 3. Separated by Marignac in 1878. In 1907 Urbain and in 1908 von Welsbach described a process by which this ytterbium could be resolved into two elements—neo-ytterbium or simply ytterbium and lutecium. These elements occur in nearly all the minerals which contain yttrium but in very small amounts. The best sources are probably *gadolinite*, *xenotime*, *polycrase* and *blomstrandine*. The oxides, chlorides and sulfates of these elements have been prepared.

Yttrium (Ytterby, town in Sweden), Y; at. wt. 88.92; at. no. 39; m.p. 1490° C; b.p. 2500° C; sp. gr. 5.51; valence 3. Yttria was discovered by Gadolin in 1794; in 1843 Mosander showed that yttria could be resolved into three elements, the name yttria being reserved for the most basic one, the others being named erbia and terbia. Yttrium occurs in nearly all the rare earths but mostly in *gadolinite*, *xenotime*, *euxonite*, *polycrase* and *samarskite*. Wöhler obtained the free element by reduction of the chloride with potassium; it has also been obtained by electrolysis of a mixture of the chloride and sodium chloride. The metal forms small scales with a metallic luster and an iron-gray color; it is readily oxidized in air and is converted to the hydroxide by boiling water.

Zinc (G. *Zink*), Zn; at. wt. 65.38; at. no. 30; m.p. 419.4° C; b.p. 907° C; sp. gr. 7.14 (20°); valence 2. Early used for making brass, but not recognized as a separate metal until Marggraf obtained it by heating calamine with charcoal in 1746. The principal ores of zinc are the sulfide (*sphalerite* or *blende*), the carbonate (*smithsonite*), the oxide (*zincite*), and the silicates (*willemite* and *calamine*). The old retort method of heating the roasted ore with carbon has been replaced to some extent by the electrolytic process. Zinc is a bluish-white metal which is brittle at ordinary temperatures but becomes malleable at 100° C, a fair conductor of electricity and burns in air at a high

red heat with evolution of white clouds of the oxide. It is used to alloy with other metals—*e.g.*, with copper it forms brass. Galvanizing consists in coating other metals with zinc to prevent corrosion. It is used as the negative electrode in various types of electric batteries. The most important compounds are the oxide, the sulfate and the chloride. The price of the metal, which was very high during the World War, was below 4¢ a pound in 1933.

Zirconium (Arabic, *zargun*, gold color), Zr; at. wt. 91.22; at. no. 40; m.p. 1700° C; b.p. >2900° C; sp. gr. 6.4; valence 4. Discovered in *zircon* by Klaproth in 1789; isolated by Berzelius in 1824. Zirconium occurs as the silicate in *zircon* and *hyacinth*. It is prepared from the fluorine-potassium compound by displacement with aluminum or sodium and forms silvery gray scales or an amorphous black powder. The oxide has been used in the preparation of incandescent gas mantles, in paints and lacquers, in insulators, as an abrasive; and colored varieties of the naturally occurring silicates are used as gems. The price of the pure oxide in 1925 was about 45¢ to 50¢ per pound.

PERIODIC ARRANGEMENT OF THE ELEMENTS

Series	Period	ZERO GROUP	GROUP I R_2O	GROUP II RO	GROUP III R_2O_3	GROUP IV RH_4 RO_2
0						
1			Hydrogen H =1.0078 No. 1			
2	1	Helium He =4.002 No. 2	Lithium Li = 6.940 No. 3	Beryllium Be =9.02 No. 4	Boron B =10.82 No. 5	Carbon C =12.00 No. 6
3	2	Neon Ne =20.183 No. 10	Sodium Na =22.997 No. 11	Magnesium Mg =24.32 No. 12	Aluminum Al =26.97 No. 13	Silicon Si =28.06 No. 14
4	3	Argon A =39.944 No. 18	Potassium K =39.10 No. 19	Calcium Ca =40.08 No. 20	Scandium Sc =45.10 No. 21	Titanium Ti =47.90 No. 22
5			Copper Cu =63.57 No. 29	Zinc Zn =65.38 No. 30	Gallium Ga =69.72 No. 31	Germanium Ge =72.60 No. 32
6	4	Krypton Kr =82.9 No. 36	Rubidium Rb =85.44 No. 37	Strontium Sr =87.63 No. 38	Yttrium Y =88.92 No. 39	Zirconium Zr =91.22 No. 40
7			Silver Ag =107.880 No. 47	Cadmium Cd =112.41 No. 48	Indium In =114.8 No. 49	Tin Sn =118.70 No. 50
8	5	Xenon Xe =130.2 No. 54	Caesium Cs =132.81 No. 55	Barium Ba =137.36 No. 56	Lanthanum La =138.90 No. 57	Cerium Ce =140.13 No. 58
9						
10	6					Hafnium Hf =178.6 No. 72
11			Gold Au =197.2 No. 79	Mercury Hg =200.61 No. 80	Thallium Tl =204.39 No. 81	Lead Pb =207.22 No. 82
12	7	Radon Rn =222 No. 86	No. 87	Radium Ra =225.97 No. 88	No. 89	Thorium Th =232.12 No. 90

Elements not classified in the table above:

Praseodymium Pr =140.92 No. 59	Neodymium Nd =144.27 No. 60	Illinium Il =146(?) No. 61	Samarium Sm =150.43 No. 62	Europium Eu =152.0 No. 63
	Gadolinium Gd =157.3 No. 64	Terbium Tb =159.2 No. 65	Dysprosium Dy =162.46 No. 66	

MENDELEEFF'S

GROUP V RH_3 R_2O_5	GROUP VI RH_2 RO_3	GROUP VII RH R_2O_7	GROUP VIII		
Nitrogen N =14.008 No. 7	Oxygen O =16.000 No. 8	Fluorine F =19.00 No. 9			
Phosphorus P =31.02 No. 15	Sulfur S =32.06 No. 16	Chlorine Cl =35.457 No. 17			
Vanadium V =50.95 No. 23	Chromium Cr =52.01 No. 24	Manganese Mn =54.93 No. 25	Iron Fe =55.84 No. 26	Cobalt Co =58.94 No. 27	Nickel Ni =58.69 No. 28
Arsenic As =74.93 No. 33	Selenium Se =79.2 No. 34	Bromine Br =79.916 No. 35			
Columbium Cb =93.3 No. 41	Molybdenum Mo =96.0 No. 42	Masurium Ma =? No. 43	Ruthenium Ru =101.7 No. 44	Rhodium Rh =102.91 No. 45	Palladium Pd =106.7 No. 46
Antimony Sb =121.76 No. 51	Tellurium Te =127.5 No. 52	Iodine I =126.932 No. 53			
Tantalum Ta =181.4 No. 73	Tungsten W =184.0 No. 74	Rhenium Re =186.31 No. 75	Osmium Os =190.8 No. 76	Iridium Ir =193.1 No. 77	Platinum Pt =195.23 No. 78
Bismuth Bi =209.00 No. 83	No. 84				
No. 91	Uranium U =238.14 No. 92	No. 93			

Holmium Ho =163.5 No. 67	Erbium Er =167.64 No. 68	Thulium Tm =169.4 No. 69	Ytterbium Yb =173.5 No. 70	Lutecium Lu =175.0 No. 71

PERIODIC TABLE

0	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	0
	1 H 1.0078 K 1																	2 He 4.002 K **2**
(He)	3 Li 6.94 K L **2**·1	4 Be 9.02 K L **2**·2											5 B 10.82 K L **2**·3	6 C 12.00 K L **2**·4	7 N 14.008 K L **2**·5	8 O 16.000 K L **2**·6	9 F 19.00 K L **2**·7	10 Ne 20.183 K L **2·8**
(Ne)	11 Na 22.997 K L M **2·8**·1	12 Mg 24.32 K L M **2·8**·2											13 Al 26.97 K L M **2·8**·3	14 Si 28.06 K L M **2·8**·4	15 P 31.02 K L M **2·8**·5	16 S 32.06 K L M **2·8**·6	17 Cl 35.457 K L M **2·8**·7	18 A 39.944 K L M **2·8·8**
(A) K L **2·8**	19 K 39.096 M N 8·1	20 Ca 40.08 M N 8·2	21 Sc 45.10 M N 9·2	22 Ti 47.90 M N 10·2	23 V 50.95 M N 11·2	24 Cr 52.01 M N 13·1	25 Mn 54.93 M N 13·2	26 Fe 55.84 M N 14·2	27 Co 58.94 M N 15·2	28 Ni 58.69 M N 16·2	29 Cu 63.57 M N **18**·1	30 Zn 65.38 M N **18**·2	31 Ga 69.72 M N **18**·3	32 Ge 72.60 M N **18**·4	33 As 74.91 M N **18**·5	34 Se 78.96 M N **18**·6	35 Br 79.916 M N **18**·7	36 Kr 83.7 M N **18·8**
(Kr) K L M **2·8·18**	37 Rb 85.44 N O 8·1	38 Sr 87.63 N O 8·2	39 Yt 173.04 N O 9·2	40 Zr 91.22 N O 10·2	41 Cb 93.3 N O 12·1	42 Mo 96.0 N O 13·1	43 Ma 99 ± N O 13·2	44 Ru 101.7 N O 15·1	45 Rh 102.91 N O 16·1	46 Pd 106.7 N O 18·0	47 Ag 107.880 N O 18·1	48 Cd 112.41 N O 18·2	49 In 114.76 N O 18·3	50 Sn 118.70 N O 18·4	51 Sb 121.76 N O 18·5	52 Te 127.61 N O 18·6	53 I 126.92 N O 18·7	54 Xe 131.3 N O 18·8
(Xe) K L M **2·8·18**	55 Cs 132.91 N O P 18·8·1	56 Ba 137.36 N O P 18·8·2	57-71 Rare Earth Metals	72 Hf 178.6 N O P **32**·10·2	73 Ta 181.4 N O P **32**·11·2	74 W 184.0 N O P **32**·12·2	75 Re 186.31 N O P **32**·13·2	76 Os 191.5 N O P **32**·14·2	77 Ir 193.1 N O P **32**·15·2	78 Pt 195.23 N O P **32**·16·2	79 Au 197.2 N O P **32**·18·1	80 Hg 200.61 N O P **32**·18·2	81 Tl 204.39 N O P **32**·18·3	82 Pb 207.22 N O P **32**·18·4	83 Bi 209.00 N O P **32**·18·5	84 Po 210 N O P **32**·18·6	85 ? N O P **32**·18·7	86 Rn 222 N O P **32**·18·8
(Rn) K L M N **2·8·18·32**	87 ? O P Q 18·8·1	88 Ra 225.97 O P Q 18·8·2	89 Ac 227 ± O P Q 18·9·2	90 Th 232.12 O P Q 18·10·2	91 Pa 235 ± O P Q 18·11·2	92 U 238.14 O P Q 18·13·1												

Atomic Number → Atomic Weight → Electron Orbits → Electrons

THE RARE EARTH METALS ARE:

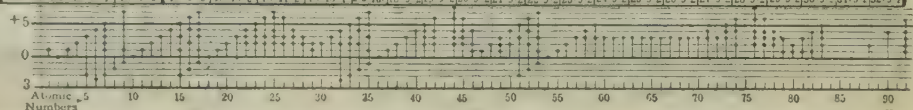
	57 La	58 Ce	59 Pr	60 Nd	61 Il	62 Sa	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
K L M	NOP	NOP	NOP	NOP	NOP	NOP	NOP	NOP	NOP	NOP	NOP	NOP	NOP	NOP	NOP
2·8·18	18·9·2	19·9·2	20·9·2	21·9·2	22·9·2	23·9·2	24·9·2	25·9·2	26·9·2	27·9·2	28·9·2	29·9·2	30·9·2	31·9·2	32·9·2

LIGHT METALS — HEAVY METALS — NON-METALS — INERT GASES

The different thicknesses of the sloping lines represent different degrees of similarity between A-Groups and B-Groups. Thus IVA and IVB are very closely related, but IA and IB only slightly.

The scale at the bottom of the table gives the most important valences (valence numbers) for each element. A valence number in excess of +3 is usually shown only when the given element is in association with another (commonly oxygen), Mn, for example, in permanganate-ion, MnO_4^-, has a valence number of +7

Figures in bold-faced type indicate completed groups of electrons



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INTERNATIONAL TABLE OF THE RADIOACTIVE ELEMENTS AND THEIR CONSTANTS

Name	Symbol	Atomic Wt.	Atomic No.	Half period T	Average life $\theta=\frac{1}{\lambda}$	Fraction transformed per sec, λ	Radiation ( ) weak radiation	Isotope
URANIUM AND RADIUM SERIES								
Uranium I	U I	238	92	4.67×10^{9} yrs.	6.75×10^{9} yrs.	4.7×10^{-18}	α	U
Uranium X_1	U-X_1	234	90	24.6 days	35.5 days	3.26×10^{-7}	β	Th
Uranium X_2	U-X_2	234	91	1.15 min.	1.65 min.	0.010	$\beta\ (\gamma)$	Pa
Uranium II (Brevium)	U II	234	92	2×10^{6} yrs.	3×10^{6} yrs.	10^{-14} (?)	α	U
Ionium	Io	230	90	6.9×10^{4} yrs.	10^{5} yrs.	3.2×10^{-13}	α	Th
Radium	Ra	226	88	1690 yrs.	2440 yrs.	1.30×10^{-11}	$\alpha\ (\beta+\gamma)$	Ra
Radon (Radium emanation, Niton)	Rn	222	86	3.85 days	5.55 days	2.085×10^{-6}	α	Rn
Radium A	Ra-A	218	84	3.0 min.	4.32 min.	3.85×10^{-3}	α	Po
Radium B	Ra-B	214	82	26.8 min.	38.7 min.	4.30×10^{-4}	$\beta\ (\gamma)$	Pb
Radium C	Ra-C	214	83	19.5 min.	28.1 min.	5.92×10^{-4}	99.97% β and γ	Bi
Radium C′	Ra-C′	214	84	10^{-6} sec	10^{-6} sec	10^{6} (?)	α	Po
Radium D (Radiolead)	Ra-D	210	82	16.5 yrs.	23.8 yrs.	1.33×10^{-9}	(β and γ)	Pb
Radium E	Ra-E	210	83	5.0 days	7.2 days	1.61×10^{-6}	β	Bi
Radium F (Polonium)	Ra-F	210	84	136 days	196 days	5.90×10^{-8}	$\alpha\ (\gamma)$	Po
Radium Ω′ (Lead)	Ra Ω′ Pb^{206}	206	82	....	....	....	....	Pb
Radium C	Ra-C	214	83	....	....	1.8×10^{-7}	0.03% α	Bi
Radium C″ (Radium C_2)	Ra-C″	210	81	1.4 min.	2.0 min.	8.3×10^{-3}	β	Tl
Radium Ω″	Ra Ω″	210	82	....	....	....	....	Pb
ACTINIUM SERIES								
Uranium ?	....	?	92	....	....	....	α	U
Uranium Y	U-Y	?	90	1.04 days	1.5 days	7.8×10^{-6}	β	Th
Protoactinium (Ekatantalum)	Pa	?	91	1.2×10^{4} yrs.	1.7×10^{4} yrs.	1.9×10^{-12}	α	Pa
Actinium	Ac	?	89	20 yrs.	28.8 yrs.	1.1×10^{-9}	....	Ac
Radioactinium	Rd-Ac	?	90	19.5 days	28.1 days	4.11×10^{-7}	$\alpha\ (\beta)$	Th
Actininium X	Ac-X	?	88	11.4 days	16.4 days	7.06×10^{-7}	α	Ra

INTERNATIONAL TABLE OF THE RADIOACTIVE ELEMENTS AND THEIR CONSTANTS—(Continued)

Name	Symbol	Atomic Wt.	Atomic No.	Half period T	Average life $\theta = \frac{1}{\lambda}$	Fraction transformed per sec. λ	Radiation ( ) weak radiation	Isotope
ACTINIUM SERIES (Continued)								
Actinon (Actinium emanation)	An	?	86	3.9 sec	5.6 sec	0.178	α	Rn
Actinium A	Ac-A	?	84	2.0×10^{-3} sec	2.9×10^{-3} sec	345	α	Po
Actinium B	Ac-B	?	82	36.1 min.	52.1 min.	3.2×10^{-4}	(β and γ)	Pb
Actinium C	Ac-C	?	83	2.15 min.	3.10 min.	5.37×10^{-3}	α	Bi
Actinium C″ (Actinium D)	Ac-C″	?	81	4.71 min.	6.83 min.	2.44×10^{-3}	β and γ	Tl
Actinium Ω″	Ac Ω″	?	82					Pb
THORIUM SERIES								
Thorium	Th	232	90	1.31×10^{10} yrs.	1.89×10^{10} yrs.	1.68×10^{-18}	α	Th
Mesothorium 1	Ms-Th1	228	88	6.7 yrs.	9.67 yrs.	3.28×10^{-9}	β	Ra
Mesothorium 2	Ms-Th2	228	89	6.2 hrs.	8.9 hrs.	3.12×10^{-5}	β	Ac
Radiothorium	Rd-Th	228	90	2.02 yrs.	2.91 yrs.	1.09×10^{-8}	α	Th
Thorium X	Th-X	224	88	3.64 days	5.25 days	2.20×10^{-6}	α	Ra
Thoron (Thorium emanation)	Tn	220	86	54 sec.	78 sec.	0.0128	α	Rn
Thorium A	Th-A	216	84	0.14 sec.	0.20 sec.	5.0	α	Po
Thorium B	Th-B	212	82	10.6 hrs.	15.3 hrs.	1.82×10^{-5}	β and γ	Pb
Thorium C	Th-C	212	83	60 min.	87 min.	1.92×10^{-4}	65% β	Bi
Thorium C′	Th-C′	212	84	10^{-11} sec.	10^{-11} sec.	1.25×10^{-4}	α	Po
Thorium Ω′ (Lead)	Th Ω′ Pb^{208}	208	82			10^{11} (?)		Pb
Thorium C	Th-C	212	83			6.7×10^{-5}	35% α	Bi
Thorium C″ (Thorium D)	Th-C″	208	81	3.1 min.	4.5 min.	3.70×10^{-3}	β and γ	Tl
Thorium Ω″ (Lead)	Th Ω″ Pb^{208}	208	82					Pb
Potassium	K	39.1	19				β	K
Rubidium	Rb	85.5	37				β	Rb

RADIOACTIVITY, PROPERTIES OF RAYS

Range of the α particle is given for air at 76 cm and 0°C. Velocity is given relative to that of light; values in cm/sec will be obtained by multiplying the value of V by 3×10^{10}.

If μ is the absorption coefficient, d the thickness of the absorbing medium, I_o the intensity before passage, I the intensity after passage,—$I = I_o e^{-d\mu}$. The absorption coefficient is given in terms of centimeters of aluminum or lead as indicated.

Name	α Rays		β Rays		γ Rays	
					Absorp. coeff.	
	Range in air cm	Velocity V	Absorp. coeff. Al cm	Velocity V	Al cm	Pb cm
URANIUM AND RADIUM SERIES						
Uranium I	2.37	0.0456	....	....	....	....
Uranium X_1	....	....	463	....	....	....
Uranium X_2	....	....	14.4	....	24; 0.7; 0.14	0.72
Uranium II	2.75	0.0479	....	....	....	....
Ionium	2.85	0.0485	....	....	....	....
Radium	3.13	0.0500	312	0.52; 0.65	354; 16; 0.27	....
Radon (Radium emanation, Niton)	3.94	0.0540	....	....	....	....
Radium A	4.50	0.0565	....	....	....	....
Radium B	....	....	13.1; 80	0.36; 0.41; 0.63; 0.70; 0.74	230; 40; 0.51	....
Radium C	....	....	13.2; 53	0.786; 0.862; 0.949; 0.957	0.115	0.50
Radium C′	6.57	0.0641	....	....	....	....
Radium D (Radiolead)	....	....	5500	0.33; 0.39	45; 0.99	....
Radium E	....	....	43.3	....	....	....
Radium F (Polonium)	3.58	0.0523	....	....	585	....
Radium C	?	....	....	....	....	....
ACTINIUM SERIES						
Uranium Y	....	....	About 300	....	....	....
Protoactinium (Eka-tantalum)	3.314	0.0510	....	....	....	....
Radioactinium	4.36	0.0559	About 170	0.38; 0.43; 0.49; 0.53; 0.60; 0.67; 0.73	25; 0.19	....

RADIOACTIVITY, PROPERTIES OF RAYS—(Continued)

Name	α Rays		β Rays		γ Rays	
					Absorp. coeff.	
	Range in air cm	Velocity V	Absorp. coeff. Al cm	Velocity V	Al cm	Pb cm
Actinium X	4.17	0.0550	......	......	......	......
Actinon (Actinium emanation)	5.40	0.0600	......	......	......	......
Actinium A	6.16	0.0627	......	......	......	......
Actinium B	......	......	Very large	......	120; 31; 0.45	......
Actinium C	5.12	0.0589	......	......	......	......
Actinium C″ (Actinium D)	......	......	28.5	......	0.198	1.2 to 1.8
THORIUM SERIES						
Thorium	2.58	0.0469	......	......	......	......
Mesothorium 2	......	......	20.2 to 38.5	0.37; 0.39; 0.43; 0.50; 0.57; 0.60; 0.66 and $>$ 0.70	26; 0.116	0.62
Radiothorium	3.67	0.0527	......	0.47; 0.51	......	......
Thorium X	4.08	0.0546	......	......	......	......
Thoron (Thorium emanation)	4.74	0.0574	......	......	......	......
Thorium A	5.40	0.0600	......	......	......	......
Thorium B	......	......	110	0.63; 0.72	160; 32; 0.36	......
Thorium C	......	......	14.4	(C+C″) 0.29; 0.36; 0.93 to 0.95	......	......
Thorium C′	8.16	0.0688	......	......	......	......
Thorium C	4.55	0.0572	......	......	......	......
Thorium C″ (Thorium D)	......	......	21.6	(See Th-C)	0.096	0.46
Potassium	......	......	22 to 38	......	......	......
Rubidium	......	......	308 to 347	......	......	......

PHYSICAL CONSTANTS OF INORGANIC AND METAL-ORGANIC COMPOUNDS

PHYSICAL CONSTANTS OF INORGANIC AND METAL-ORGANIC COMPOUNDS

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EXPLANATION OF TABLE

The table presents data for about thirty-five hundred compounds. It is intended to include all important, definite compounds for which information is available. It has been necessary to omit many compounds known to exist because of lack of data.

Arrangement.—The compounds have been listed under the names of the elements in alphabetical order. Ferrous and ferric salts will be found under iron, stannous and stannic, under tin and aurous and auric, under gold. The alums are generally listed under the name of the trivalent element. The **Metal-Organic Compounds** are given in a separate list following the main table. These compounds are also arranged in the alphabetical order of the elements. Double salts are not listed twice; if not found under the name first sought they should be looked for under the name of the other metal. The finding of compounds commonly known under names other than those listed is facilitated by a **Synonym Index** which precedes the table.

Molecular weights have been computed to the nearest hundredth, based on the **International Atomic Weights of 1933.**

The **Crystalline form and color** are stated in easily interpreted abbreviations. Other important characteristics are often added. **Indices of refraction** are given in the same column. For crystals with two or three indices, they are invariably given in the order ω, ϵ or α, β, γ. All indices are for Sodium light (λ = .5893μ) unless otherwise stated. The temperature is assumed to be normal room temperature unless otherwise indicated by a superior figure following the index. 1.536^{25} (Li) would be interpreted as giving the value for the index of refraction of a substance for the red line of Lithium at 25°C.

Specific gravity at 20°C, referred to water at 4°C, is normally given. Other temperatures are indicated by superior and inferior figures. For example: 2.64^{25}_{15} indicates a specific gravity of 2.64 at 25°C, referred to water at 15°C. It should be noted that values of specific gravity referred to water at 4°C are numerically equivalent to density in grams per milliliter. The **density of gases** is given in grams per liter indicated g/l.

Melting and boiling points are given in °C. The boiling point is stated at normal atmospheric pressure (760 mm of Hg) unless otherwise indicated by a superscript which is to be interpreted as the pressure in mm of Hg under which the compound boils at the temperature given. For example: 250^{732} indicates a boiling point of 250°C under a pressure of 732 mm Hg; $426^{2\,\mathrm{atm.}}$ indicates a boiling point of 426°C under a pressure of 2 atmospheres. Decomposition on heating is indicated by the abbreviation d. in melting or boiling point column. If decomposition occurs without change of state, the form d. 120 is used indicating the occurrence of decomposition at 120°C. The form 120 d. would indicate a melting or boiling point of 120°C with decomposition. Loss of water of crystallization or oxygen is indicated by the form $-2H_2O$ or -0. The figures $-5H_2O$, 350 indicate the loss of five molecules of water of crystallization at 350°C.

Solubilities are stated for normal room temperatures, 20°C, unless otherwise indicated by a superior figure. 6.8^{25} indicates a solubility of 6.8 grams of substance in 100 cm³ of the solvent at 25°C. The term insoluble (i.) must be usually understood to mean that a negligible quantity of the compound dissolves. A large proportion of salts commonly regarded as insoluble really dissolve to a very slight extent. The form s.d. indicates solubility with more or less decomposition. The abbreviation d. alone in the solubility column indicates that decomposition is the primary action occurring. Solubility in acids and alkalies is usually understood to be accompanied by decomposition.

ABBREVIATIONS

a.	acid
abs.	absolute
acet.	acetone
ac. a.	acetic acid
al.	alcohol
alk.	alkali
amor.	amorphous
anh.	anhydrous
appr.	approximately
aq.	aqua, water
aq. reg.	aqua regia
asym.	asymmetrical
atm.	atmospheres
bl.	blue
blk.	black
br.	brown
bz.	benzene
calc.	calculated
chl.	chloroform
cit. a.	citric acid
col.	colorless
coll.	colloidal
com'l.	commercial
compl.	completely
conc.	concentrated
cont.	contains
cr.	crystalline
cub.	cubic
d.	decomposes
deliq.	deliquescent
dibas.	dibasic
di-H.	dihydrogen
dil.	dilute
dimorph.	dimorphous
disg.	disagreeable
dk.	dark
doubt.	doubtful
effl.	efflorescent
eth.	ether
ev.	evolves
evln.	evolution
ex.	excess
exist.	existance
exp.	explodes
feath.	feathery
fl.	flakes
floc.	flocculent
form.	formic
fr.	from
fus.	fused
gel., gelat.	gelatinous
gl.	glass
glit.	glittering
glob.	globular
glyc.	glycerine
gran.	granular
grn.	green
h.	hot
hex.	hexagonal
ht.	heat
hyd.	hydrolyzed
hydx.	hydroxides
hyg.	hygroscopic
i.	insoluble
ind.	indigo
infus.	infusible
irid.	iridescent
leaf.	leaflets
lem.	lemon
lgr.	ligroin
lq. or liq.	liquid
lt.	light
lum.	luminous
lust.	lustrous
met.	metal or metallic
meth.	methyl
micr.	microscopic
min.	mineral
monbas.	monobasic
mon-H.	monohydrogen
monocl.	monoclinic
near.	nearly
org.	organic
need.	needles
nit.	nitrate
oct.	octahedral
odorl.	odorless
offen.	offensive
or.	orange
oxal.	oxalate or oxalic
pa.	pale
pet.	petroleum
pl.	plates
purp.	purple
pois.	poisonous
polymorph.	polymorphous
powd.	powder
ppt.	precipitate
pr.	prisms
pyr.	pyridine
quest.	questioned
quad.	quadrilateral
rect.	rectangular
reg.	regular
rhomb.	rhombic
rhbdr.	rhombohedral
s.	soluble
s., sld.	solid
sc.	scales
sl.	slightly
sly.	slowly
sm.	small
solv.	solvents
st.	steel
subl.	sublimes
suffoc.	suffocating
sulfd.	sulfides
tabl.	tablets
tart. a.	tartaric acid
tetr.	tetragonal
tetrah.	tetrahedral
tol.	toluene
translu.	translucent
tri.	trigonal
tribas.	tribasic
trim.	trimetric
tricl.	triclinic
tr. pt.	transition point
unst.	unstable
v.	very
vac.	vacuum
viol.	violent or violence
visc.	viscous
vitr.	vitreous
vlt.	violet
volt., volat.	volatilizes
wh.	white
wh. lt.	white light
yel.	yellow
∞	soluble in all proportions
>	greater than
<	less than

SYNONYM INDEX

Compound sought	Listed	Compound sought	Listed
Alum, ammonium	Aluminum ammonium sulfate	Alum, common	Aluminum potassium sulfate
Alum, ammonium chrome	Chromium ammonium sulfate	Alum, iron ammonium	Iron ammonium sulfate (ic)
Alum, ammonium gallium	Gallium ammonium sulfate	Alum, iron potassium	Iron potassium sulfate
Alum, cesium	Aluminium cesium sulfate	Alum, potassium (kalinite)	Aluminum potassium sulfate

SYNONYM INDEX (Continued)

Compound sought	Listed
Alum, potassium chrome	Chromium potassium sulfate
Alum, rubidium	Aluminum rubidium sulfate
Alum, sodium	Aluminum sodium sulfate
Alum, thallium	Aluminum thallium sulfate
Aluminates	under various metals
Arsenous salts	under Arsenic
Auric salts	under Gold
Aurichlorohydric acid	Gold, auric acid, chloro-
Aurobromohydric acid	Gold, auric acid, bromo-
Aurous salts	under Gold
Azoimide	Hydrazoic acid
Barium hyposulfate	Barium thionate, di-
Bicarbonate	Carbonate, acid
Bismuthic acid, meta-	Bismuth oxide, penta-
Borobutane	Boron hydride
Carbonyl compounds	under Carbon oxy-compounds
Ceric salts	under Cerium
Cerous salts	under Cerium
Chloroplatinic acid	Platinic acid, chloro-
Chromic salts	under Chromium
Chromous salts	under Chromium
Chromyl compounds	under Chromium oxy- compounds
Cobaltic salts	under Cobalt
Cobaltic chloride, luteo-	Cobalt complexes, Hexammine cobaltichloride
Cobaltic chloride, pupureo-	Cobalt complexes, Chloropentammine cobaltichloride
Cobaltic chloride, praseo-	Cobalt complexes, tetrammine cobaltichloride
Cobaltic chloride, roseo-	Cobalt complexes, Aquapentammine cobaltichloride
Cobalticyanic acid	Cyanic acid, cobalti-
Cobaltous salts	under Cobalt
Cupric salts	under Copper
Cuprous salts	under Copper
Disulfuryl chloride	under Sulfur pentoxydichloride
Ferric salts	under Iron
Ferrous salts	under Iron
Hexabromosilicoethane	Silicon bromide, tri-
Hexachlorosilicoethane	Silicon chloride, tri-
Hydriodic acid	Hydrogen iodide
Hydrobromic acid	Hydrogen bromide
Hydrochloric acid	Hydrogen chloride
Hydrocyanic acid	Hydrogen cyanide
Hydrofluoboric acid	Boric acid, fluo-
Hydrofluoric acid	Hydrogen fluoride
Hydrosulfides	under sulfhydrates
Hydrosulfuric acid	Hydrogen sulfide
Iodoplatinic acid	Platinic acid
Lead nitride	Lead azoimide
Mercuric salts	under Mercury
Mercurous salts	under Mercury
Nitrogen iodoazoimide	Nitrogen iodide, tri- (monoammonate)
Nitrosulfonic acid	Nitrosylsulfuric acid
Palladium potassium tetrachloride	Potassium chloropalladite
Per- acids	under Chlorine, bromine, sulfur, etc.
Peroxydisulfuric acid	Sulfuric acid, per-
Phosgene	Carbon oxychloride
Phosphine, gas	Hydrogen phosphide, H_3P
Phosphine, liquid	Hydrogen phosphide, H_4P_2
Phosphine, solid	Hydrogen phosphide $(H_2P_4)_3$
Phosphonitrile bromide	Phosphorus bromonitride
Phosphonitrile chloride	Phosphorus chloronitride
Potassium cobaltinitrite	Cobalt potassium nitrite (ic)
Potassium metabisulfite	Potassium *pyro*sulfite
Phosphoretted hydrogen	Hydrogen phosphide
Phosphorus hydride	Hydrogen phosphide
Platinum, ammonium hexabromide	Ammonium bromoplatinate
Platinum ammonium chloride	Ammonium chloroplatinite
Potassium cobaltinitrite	Cobalt potassium nitrite (ic)
Potassium cobaltosulfate	Cobalt potassium sulfate (ous)
Pyrosulfuryl chloride	Sulfur pentoxy dichloride
Selenium hydride	Hydrogen selenide
Silicane compounds	under Silicane
Silicanes	under Silicon hydrides
Silicobutane	Silicon hydride
Silicoethane	Silicon hydride
Silicopropane	Silicon hydride
Stannic salts	under Tin
Stannous salts	under Tin
Sulfuryl chloride	Sulfuric chloride
Sulfuryl fluoride	Sulfuric oxyfluoride
Tellurium hydride	Hydrogen telluride
Thiocyanic acid	Cyanic acid, thio-
Thionyl compounds	under Sulfur
Thiophosgene	Carbon thionyl chloride
Uranyl hydroxide	Uranic acid
Uranyl oxide	Uranium oxide, tri-

PHYSICAL CONSTANTS

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Aluminum**	Al	26.97	cub. silv. wh. duct. met.
2	ammonium chloride	$AlCl_3.NH_4Cl$	186.84	wh. cr.
3	" sulfate	$Al(NH_4)(SO_4)_2$	237.13	col. cr.
4	" "	$Al(NH_4)(SO_4)_2.12H_2O$	453.32	cub. col., 1.459
5	*ortho*arsenate	$AlAsO_4.8H_2O$	310.02	wh. powd
6	bromate	$Al(BrO_3)_3.9H_2O$	572.86	wh. cr., hyg
7	bromide	$AlBr_3$	266.72	trig. pl., col
8	"	$AlBr_3.6H_2O$	374.81	col.-yelsh. need., deliq.
9	"	$AlBr_3.15H_2O$	536.95	need., col
10	carbide	Al_4C_3	143.88	hex., yel-grn.
11	cesium sulfate	$AlCs(SO_4)_2.12H_2O$	568.09	cub. col., 1.4587
12	chlorate	$Al(ClO_3)_3.6H_2O$	385.43	rhbdr. col., deliq
13	chloride	$AlCl_3$	133.34	hex., wh.-col.; odor HCl; v. deliq.
14	"	$AlCl_3.6H_2O$	241.43	col. trig. deliq.; near. odorl.
15	ferrocyanide	$Al_4[Fe(CN)_6]_3.17H_2O$	1049.81	br. powd
16	fluoride	AlF_3	83.97	tricl. col.
17	" (fluellite)	$AlF_3.H_2O$	101.99	rhomb., 1.473, 1.490, 1.511
18	"	$AlF_3.3\frac{1}{2}H_2O$	147.02	cr. powd., wh.
19	fluosilicate	$Al_2(SiF_6)_3$	480.12	wh. powd
20	hydroxide, mono- (diaspore)	$Al_2O_3.H_2O$	119.96	rhomb., 1.702, 1.722, 1.750
21	hydroxide, di-	$Al_2O_3.2H_2O$	137.97	amor.
22	" tri- (gibbsite)	$Al(OH)_3$ (or $Al_2O_3.3H_2O$)	77.99	monocl. or amor. gelat. ppt., wh., 1.535, 1.535, 1.558
23	iodide	AlI_3	407.73	wh.-br. pl., cont. free I_2
24	"	$AlI_3.6H_2O$	515.82	wh.-yel. cr.
25	nitrate	$Al(NO_3)_3.9H_2O$	375.13	rhomb. col., deliq
26	nitride	AlN	40.98	rhomb. yel
27	oxide	Al_2O_3	101.94	hex. col.
28	" (corundum)	Al_2O_3	101.94	trig. wh., 1.773
29	" (diaspore)	$Al_2O_3.H_2O$	119.96	rhomb. col., 1.702, 1.722, 1.750
30	" (gibbsite)	$Al_2O_3.3H_2O$	155.99	amor. or monocl., 1.566, 1.566, 1.587.
31	*ortho*phosphate	$AlPO_4$	121.99	rhomb. pl., 1.546, 1.556, 1.578
32	potassium borate	$(AlO)_2K(BO_2)_3$	253.50	cub. wh., 1.6935
33	" sulfate (kalinite)	$AlK(SO_4)_2.12H_2O$	474.38	cub. or monocl. col., 1.4562; 1.430. 1.452, 1.458
34	rubidium sulfate	$AlRb(SO_4)_2.12H_2O$	520.72	cub. oct. col., 1.457
35	silicate	$Al_6O_4.Si_2O_4$	345.94	col
36	sodium chloride	$AlCl_3.NaCl$	191.80	wh.-yelsh. cr. powd., deliq
37	" fluoride (cryolite)	$AlF_3.3NaF$	209.96	monocl., col., β 1.364
38	" sulfate	$AlNa(SO_4)_2.12H_2O$	458.27	cub. oct. col., 1.4388
39	sulfate	$Al_2(SO_4)_3$	342.12	wh. powd

OF INORGANIC COMPOUNDS

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	2.702	658.7	1800	i.	i.	s. alk., HCl, H_2SO_4; i. HNO_3, ac. a.
2	....	304	....	s.	....	....
3	2.039	....	....	s.	....	s. glyc.; i. al.
4	1.64	93.5	$-10H_2O$, 120; $-12H_2O$, 200	15^{20}	∞	s. dil. a.; i. al.
5	3.011	$-H_2O$	....	i.	i.	sl. s. a.
6	....	62.3	d. 100	s.	s.	sl. s. a.
7	3.01^{25}	97.5	268	s. with viol.		s. al., CS_2, acet.
8	2.54	93	d. >100	s.	d.	s. al., CS_2, amyl. al.
9	....	−7.5	d. 7	s.	s.	s. al.
10	2.36	stab. to 1400	....	d. to CH_4	....	d. dil. a.; i. acet.
11	1.97	117	....	0.34^{0}	42.54^{100}	s. dil. a.; i. al.
12	....	d.	....	v. s.	v. s.	s. dil. HCl
13	2.44^{25}; lq. 1.31^{200}	$190^{2.5\ atm.}$	182.7^{752}; subl. 177.8	69.9^{15}; s. with viol.	s. d.	s. CCl_4, eth.; $100^{12.5}$ abs. al., $.072^{25}$ chl.; i. bz.
14	....	d.	182^{752}	s.	v. s., ev. HCl	s. eth., 50 abs. al.
15	....	....	....	sl. s.	sl. s.	s. dil. a.
16	3.07	1040	....	s.	s.	i. a., al., alk., acet.
17	2.17	....	....	sl. s.	....	....
18	....	$-2H_2O$, 120	$-3H_2O$, 250	i.	sl. s.	....
19	....	....	....	i.	....	....
20	3.413	d. 360	....	0.0001^{20}	....	i. a., alk.
21	....	....	....	i.	i.	i. a., alk.
22	2.423	$-2H_2O$, 300	....	0.00015^{20}	....	s. a., alk.; i. al.
23	3.98^{25}	191	360(382)	s. d.	s.	s. al., eth., CS_2
24	2.63	185 d.	360	v. s.	v. s.	s. al., CS_2
25	....	73	d. 100	63.7^{25}	v. s. d.	100 al., s. alk., acet., CS_2, HNO_3
26	3.05	$2200^{4\ atm.}$	d. >2200	d. ev. NH_3	....	d. a., al.
27	3.5–.9	2050	2250	$.00009^{829}$	i.	v. sl. s. a., alk.
28	4.00	2050	2250	$.00009^{829}$	i.	v. sl. s. a., alk.
29	3.413	d. 360	....	0.0001^{20}	i.	v. sl. s. a., alk.
30	2.423	d. 200	....	i.	i.	v. sl. s. a., alk.
31	2.566	>1500	....	i.	i.	s. a., alk.; i. al.
32	3.415	<1800	....	i.	i.	sl. s. HCl
33	1.75	92(84.5)	$-9H_2O$, 64.5	11.4^{20}	∞	s. dil. a.; i. al.
34	1.867^{0}	99	....	2.59^{20}	43.25^{80}	....
35	3.15	d. 1810	....	v. sl. s.	....	....
36	....	185	....	s.	s.	....
37	2.90	1000	....	sl. s.	....	d. alk.; i. HCl
38	1.675	61	....	anh. 110^{15}	anh. 146.3^{30}; d. >30°	s. dil. a.; i. al.
39	2.71	d. 770	....	31.3^{0}	98.1^{100}	s. dil. a.; sl. s. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Aluminum			
1	sulfate	$Al_2(SO_4)_3.9H_2O$	504.26	monocl. wh., 1.459
2	sulfate (alunogenite)	$Al_2(SO_4)_3.18H_2O$	666.40	monocl. col., 1.474, 1.476, 1.483
3	sulfide	Al_2S_3	150.12	hex. yel., odor. H_2S, d. moist air
4	thallium sulfate	$AlTl(SO_4)_2.12H_2O$	639.67	cub. oct. col., 1.4976
5	**Ammonia**	NH_3	17.03	col. gas, $1.325^{16.5}$ lq
	Ammonium			
6	*meta*antimonate	$NH_4SbO_3.2H_2O$	223.83	wh. cr
7	*ortho*arsenate, mon-H	$(NH_4)_2HAsO_4$	176.02	monocl. col., odor NH_3
8	" di-H	$NH_4H_2AsO_4$	158.98	tetr. col
9	*meta*arsenite	NH_4AsO_2	124.97	rhomb. pr., col
10	azide	NH_4N_3	60.06	col. plates
11	*tetra*borate, acid	$NH_4HB_4O_7.3H_2O$	228.37	col. cr., effl., $-NH_3$
12	*per*borate, meta-	NH_4BO_3	76.86	wh. cr
13	bromate	NH_4BrO_3	145.96	hex. col
14	bromide	NH_4Br	97.96	cub. col.; sl. hyg
15	bromoplatinate	$(NH_4)_2PtBr_6$	710.80	cub. red-br
16	bromoselenate	$(NH_4)_2SeBr_6$	594.77	cub. red
17	bromostannate	$(NH_4)_2SnBr_6$	634.27	cub. col
18	carbamate	$NH_4CO_2NH_2$	78.06	rhomb. col
19	carbonate	$(NH_4)_2CO_3.H_2O$	114.09	cub. col
20	" acid (bicarb.)	NH_4HCO_3	79.05	rhomb. or monocl. col., 1.423, 1.536, 1.555
21	" sesqui-	$(NH_4)_4H_2(CO_3)_3.H_2O$	272.19	rhomb. pr
22	chlorate	NH_4ClO_3	101.50	monocl. need. col
23	*per*chlorate	NH_4ClO_4	117.50	rhomb. col., β 1.486
24	chloride (sal ammoniac)	NH_4Cl	53.50	cubic, col., 1.642
25	chloroaurate	NH_4AuCl_4	357.07	rhomb. or monocl. yel
26	"	$(NH_4AuCl_4)_4.5H_2O$	1518.35	monocl. yel
27	chlorogallate	NH_4GaCl_4	229.59	wh. cr
28	chloroiridate	$(NH_4)_2IrCl_6$	441.92	cub. red-blk
29	chloropalladate	$(NH_4)_2PdCl_6$	355.52	cub. red-br
30	chloropalladite	$(NH_4)_2PdCl_4$	284.61	tetr. olive grn
31	chloroplatinate	$(NH_4)_2PtCl_6$	444.05	cub. yel
32	chloroplatinite	$(NH_4)_2PtCl_4$	373.14	rhomb. red (tetr.)
33	chloroplumbate	$(NH_4)_2PbCl_6$	456.04	cub. yel
34	chlorostannate	$(NH_4)_2SnCl_6$	367.52	cub. wh
35	chromate	$(NH_4)_2CrO_4$	152.09	monocl. yel
36	*di*chromate	$(NH_4)_2Cr_2O_7$	252.10	monocl. orange
37	*per*chromate	$(NH_4)_3CrO_8$	234.13	cub. red-br
38	cyanate	NH_4CNO	60.05	wh. cryst
39	cyanaurate (auricyanide)	$NH_4Au(CN)_4.H_2O$	337.29	col. pl
40	cyanaurite (aurocyanide)	$NH_4Au(CN)_2$	267.26	cub. col
41	cyanide	NH_4CN	44.05	cub. col
42	ferricyanide	$(NH_4)_3Fe(CN)_6$	266.01	red cryst
43	ferrocyanide	$(NH_4)_4Fe(CN)_6$	284.04	monocl. yel., turns bl. in air
44	fluoborate (borofluoride)	NH_4BF_4	104.86	hex. prisms
45	fluoride	NH_4F	37.04	hex. col., deliq
46	fluoride, acid (bifluoride)	NH_4HF_2	57.05	rhomb. or tetr., deliq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.705^{20}_{0}	d.	....	s.	s.	s. a., alk.
2	1.69^{17}	d. 86.5	....	s.	s.	i. al.
3	2.02^{13}	1100	subl. 1550 (N_2)	d.	....	s. a.; i. acet.
4	2.32	91	....	10^{20}	65.19^{60}	....
5	$.7710^{0}$ g/l; lq. 0.817^{-79}	−77.7	−33.35	89.9^{0}	7.4^{100}	13.2^{20} al.; s. eth., org. solv.
6	....	d.	....	i.	....	i. al.
7	1.989	d.	....	s.	d.	....
8	2.311^{9}	d.	....	sl. s.	s.	....
9	....	....	....	v. s.	d.	sl. s. NH_4OH; i. al., acet.
10	....	160	subl., exp.	s.	....	s. NH_3; sl. s. al.; i. eth.
11	2.38–.95	....	....	s.	....	....
12	....	d.	....	$1.55^{17.5}$	d.	....
13	....	exp.	....	v. s.	v. s.	sl. s. al.
14	2.548	subl. 542	$235^{vac.}$	59.8^{0}	145.6^{100}	s. al., acet., eth., NH_3
15	4.265^{24}	d. 145	....	0.40^{0} 0.59^{20}	0.36^{100}	....
16	3.326	....	....	d.	d.	sl. s. eth.
17	3.50	d.	....	v. s.	....	....
18	....	subl. 60	....	v. s.	d.	v. s. NH_4OH; sl. s. al.; i. acet.
19	....	d. 58	....	100^{15}	d.	i. al., CS_2, NH_3
20	1.58	d. 36–60	subl.	11.9^{0}	d.	i. al., acet.
21	....	d.	....	20^{15}	d.	sl. s. al.
22	....	exp. 102	....	v. s.	v. s.	sl. s. al.
23	1.95	d.	....	10.74^{0}	42.54^{95}	s. acet.; sl. s. al.
24	1.536	d. 350	subl. 520	29.7^{0}	75.8^{100}	0.6^{19} al.; s. NH_3
25	....	....	....	s.	....	sl. s. al.
26	....	$-5H_2O$, 100	....	s.	....	s. al.
27	....	275	....	v. s.	v. s.	s. al.; i. pet. eth.
28	2.856	d.	....	$.556^{0}$; $.69^{14}$	4.38^{80}	s. HCl; i. al.
29	2.418	d.	....	sl. s.	....	....
30	2.17	d.	....	s.	....	i. al.
31	3.065	d.	....	$.29^{0}$; $.67^{20}$	3.37^{100}	.005 al.; i. eth., c. HCl
32	2.936	d.	....	s.	s.	i. al.
33	2.925	d. 120	....	sl. s.	d.	s. a.
34	2.4	d.	....	$33^{14.5}$	v. s.	....
35	1.91^{12}	d.	....	40.5^{30}	d.	sl. s. NH_3, acet.; i. al.
36	2.15^{25}	d.	....	30.8^{15}	89^{30}	s. al.; i. acet.
37	....	d. 40	exp. 50	sl. s.	d.	sl. s. NH_3; i. al., eth.
38	....	d. 60	....	v. s.	d.	sl. s. al.; i. eth.
39	....	d. 200	....	v. s.	....	v. s. al.; i. eth.
40	....	d. 100	....	v. s.	v. s.	s. al.; i. eth.
41	1.02^{100} g/l	d. 36	subl. 40	v. s.	d.	v. s. al.
42	....	d.	....	v. s.	....	....
43	....	d.	....	s.	d.	i. al.
44	1.851^{17}	subl.	....	25^{16}	95^{100}	s. al.
45	....	subl.	....	v. s.	d.	s. al.; i. NH_3
46	liq. l. 21^{2}_{2}	subl.	....	v. s.	v. s.	sl. s. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Ammonium			
1	fluosilicate (cryptohalite)	$(NH_4)_2SiF_6$	178.14	cubic or hex., col., 1.370
2	fluotitanate	$(NH_4)_2TiF_6$	197.98	hex. prisms
3	hydrosulfide	NH_4SH	51.11	rhomb. wh
4	hydroxide	NH_4OH	35.05	in soln. only at ord. temp
5	iodate	NH_4IO_3	192.96	rhomb. or monocl.
6	*per*iodate	NH_4IO_4	208.96	tetr. col
7	iodide	NH_4I	144.96	cub. col. hyg., 1.703
8	*per*manganate	NH_4MnO_4	136.97	rhomb.
9	molybdate	$(NH_4)_2MoO_4$	196.08	monocl. pr., col
10	*para*molybdate (com'l am. molybdate)	variable	....	monocl. col.-yelsh
11	nitrate	NH_4NO_3	80.05	rhomb. col. (monocl. >32.1°)
12	nitrite	NH_4NO_2	64.05	wh.-yelsh. cr
13	*ortho*phosphate, mon-H.	$(NH_4)_2HPO_4$	132.11	monocl. col
14	*ortho*phosphate, di-H.	$NH_4H_2PO_4$	115.07	tetr. col., 1.525, 1.479
15	*hypo*phosphate	$(NH_4)_2H_2P_2O_6$	196.13	....
16	*ortho*phosphite, di-H.	$NH_4H_2PO_3$	99.07	monocl. prisms, col
17	*hypo*phosphite	$NH_4H_2PO_2$	83.07	rhomb. tabl
18	phosphomolybdate	$(NH_4)_3PO_4.12MoO_3.3H_2O$(?)	1931.18	yel. powder
19	platinocyanide	$(NH_4)_2Pt(CN)_4.H_2O$	353.36	yel. cr
20	selenate	$(NH_4)_2SeO_4$	179.28	monocl. col., 1.561, 1.563, 1.585
21	selenide	$(NH_4)_2Se$	115.28	br
22	sulfate (mascagnite)	$(NH_4)_2SO_4$	132.14	rhomb. col., 1.521, 1.523, 1.533
23	sulfate, acid (bisulfate)	NH_4HSO_4	115.11	rhomb.
24	*per*sulfate	$(NH_4)_2S_2O_8$	228.20	monocl. col., 1.498, 1.502, 1.587
25	sulfide, mono-	$(NH_4)_2S$	68.14	col.-yel. cr., hyg
26	sulfite	$(NH_4)_2SO_3.H_2O$	134.15	monocl. col
27	sulfite, acid (bisulfite)	NH_4HSO_3	99.11	hex. pr
28	tellurate	$(NH_4)_2TeO_4$	227.58	wh. powd
29	thioantimonate	$(NH_4)_3SbS_4.4H_2O$	376.18	yel. pr
30	thiocarbonate, tri-	$(NH_4)_2CS_3$	144.26	yel. cr
31	thiocyanate	NH_4CNS	76.11	monocl. col., deliq
32	*di*thionate	$(NH_4)_2S_2O_6.\frac{1}{2}H_2O$	205.21	monocl.
33	thiosulfate	$(NH_4)_2S_2O_3$	148.20	monocl. col
34	tungstate, poly-	$x(NH_4)_2O.y(WO_3).zH_2O$	....	wh. crystals
35	vanadate, meta-	NH_4VO_3	116.99	col. cr., wh.-yelsh
36	**Antimonic acid** ortho-	H_3SbO_4	188.78	white powd
37	" " meta-	$HSbO_3$	170.77	wh. powd
38	" " pyro-	$H_4Sb_2O_7$	359.55	powd
	Anti-			
39	**monous acid**, ortho-	H_3SbO_3	172.78	wh. amor
40	" " meta-	$HSbO_2$	154.77	....
41	**Antimony**	Sb	121.76	hex. silv. wh. met
42	ammonium fluoride	$Sb(NH_4)_2F_5$	252.84	rhomb. col
43	bromide	$SbBr_3$	361.51	rhomb. col
44	chloride, tri- (butter of Sb)	$SbCl_3$	228.13	rhomb. col., deliq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	2.01	subl.	....	18.6^{17}	55.5^{100}	sl. s. al.; i. acet.
2	....	d.	....	s.	s.	i. al., eth.
3	....	120d.	subl.	128.1^{0}	d.	s. al.
4	....	−77	....	s.	....	....
5	3.309^{21}	d 150	....	2.6^{15}	14.5^{100}	....
6	3.056^{18}	exp.	....	2.7^{16}	....	....
7	2.563	subl. 551	220 vac.	154.2^{0}	250.3^{100}	v. s. al., acet., NH_3; sl. s. eth.
8	2.208	exp.	....	7.9^{15}	d.	....
9	2.27	d.	....	s. (d.)	d.	s. a.; i. al., NH_3, SO_2, acet.
10	2.498	d.	....	40	d.	s. a., alk.
11	1.725^{25}	169.6	d. 210	118.3^{0}	871^{100}	3.8^{20} al., 17.1^{20} meth. al.; s. acet., NH_3
12	1.69	d.	....	v. s.	d.	s. al.; i. eth.
13	1 619	d.	d.	42.9^{0}; 57.5^{10}	106.0^{70}	i. al., acet.
14	1.803^{19}	....	....	22.7^{0}	173.2^{100}	i. acet.
15	....	170	....	....	....	....
16	....	123	d. 145	171^{0}	v. s.	i. al.
17	2.515	200	d. 240	s.	s.	s. al., NH_3; i. acet.
18	....	d.	....	sl. s.	sl. s.	s. alk.; i. al., HNO_3
19	....	....	....	s.	....	....
20	2.194	d.	....	117^{7}	197^{100}	i. al., NH_3, acet.
21	....	....	d.	s.	....	....
22	1.769	d. 100	....	70.6^{0}	103.8^{100}	i. al., NH_3, acet.
23	1.78	146.9	....	100	v. s.	sl. s. al.; i. acet.
24	1.982	d. 120	....	58.2^{0}	v. s.	
25	....	d.	....	v. s.	d.	v. s. NH_3; s. al.
26	1.41^{25}	d.	subl. 150	32.4^{0}	60.4^{100} d.	sl. s. al.; i. acet.
27	....	d.	....	267^{0}	620^{60}	....
28	3.01^{25}	d.	....	s.	v. s.	i. al.; s. dil. a.
29	....	d.	....	71.2^{0}	d.	i al.
30	....	subl.	....	v. s.	d.	sl. s. al., eth.
31	1.305	149.6	d. 170	128^{0}	v. s.	s. al., NH_3, acet.
32	1.704	d. 130	....	135^{0}	v. s.	i. al.
33	....	d. 150	....	v. s.	....	sl. s. acet.; i. al.
34	....	d.	....	s.	v. s.	i. al., eth.
35	2 326	d.	....	0.52^{15}	6.95^{96} d.	i. al., eth., NH_4Cl
36	6.6	d. 100	....	sl. s.	sl s.	s. KOH
37	6.6	d.	....	sl s.	sl. s.	s. a. KOH; i. acet.
38	....	$-H_2O$, 200	....	sl. s.	sl s.	s. alk.
39	....	d.	....	i.	i.	i al.
40	....	d.	....	i.	i.	i. al.
41	6.684^{25}	630	1380	i.	i.	s. h. conc. H_2SO_4, aq. reg.
42	....	subl., d.	....	108	....	....
43	4.148^{23}	96.6	280	d.	d.	s. HCl, HBr, CS_2, NH_3, al., acet.
44	3.140^{25}	73	223	601.6^{0}	∞^{80}	s. al., HCl, tart. a., CS_2

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Antimony			
1	chloride, penta-	$SbCl_5$	299.05	liq. or monocl. wh., 1.601[14]
2	fluoride, tri-	SbF_3	178.76	oct.
3	" penta-	SbF_5	216.76	oily, col. liq
4	hydride (stibine)	SbH_3	124.78	col. gas
5	iodide, tri-	SbI_3	502.52	trig.; monocl. red; rhomb. yel.
6	" penta-	SbI_5	756.36	br.
7	oxide (senarmontite)	Sb_2O_3	291.52	cubic wh., 2.087
8	" (valentinite)	Sb_2O_3	291.52	rhomb. col., 2.18, 2.35, 2.35
9	" tetra-	Sb_2O_4	307.52	white powd.
10	" penta-	Sb_2O_5	323.52	yel. powd
11	oxychloride (ous)	$SbOCl$	173.22	monocl. wh.
12	" (ic)	$SbOCl_3$	244.13	yel
13	"	$Sb_4O_5Cl_2$	637.95	col
14	selenide	Sb_2Se_3	481.12	gray
15	sulfate	$Sb_2(SO_4)_3$	531.70	wh. powd., deliq
16	sulfide, tri-(stibnite)	Sb_2S_3	339.70	rhomb. blk.-or. red, 3.194, 4.046, 4.303
17	" penta-	Sb_2S_5 (exist. quest.)	403.82	or.-yel. powd
18	telluride	Sb_2Te_3	626.02	gray
19	**Antimonyl** sulfate, normal	$(SbO)_2SO_4$	371.58	wh.
20	" " basic	$(SbO)_2SO_4.Sb_2(OH)_4$	683.13	wh.
21	**Argon**	A	39.94	col. inert gas
22	**Arsenic acid**, ortho-	$H_3AsO_4.\frac{1}{2}H_2O$	150.96	wh. translu. cr.; hyg
23	" " meta-	$HAsO_3$	123.94	wh. cr
24	" " pyro-	$H_4As_2O_7$	265.89	col. cr
25	**Arsenic** (black cryst.)	As_4	299.72	hex. silv. gray-blk. met
26	" (black amor.)	As_4	299.72	amor. blk
27	" (yellow)	As_4	299.72	cubic yellow
28	bromide (ous)	$AsBr_3$	314.68	pr., col.-yelsh.; hyg
29	chloride, (ic)	$AsCl_5$	252.22	col
30	" (ous)	$AsCl_3$	181.30	oily liq. or need
31	fluoride (ic)	AsF_5	169.93	gas, col
32	" (ous)	AsF_3	131.93	oily liq
33	hydride (solid)	As_2H_2	151.88	brown masses
34	" (ous) (arsine)	AsH_3	77.95	gas, col
35	iodide, di-	AsI_2	328.77	red prisms
36	" (ic)	AsI_5	709.53	
37	" (ous)	AsI_3	455.69	hex., red
38	oxide (ous) (arsenolite)	As_2O_3	197.86	col., cubic or fibrous, 1.755
39	oxide (ous) (claudetite)	As_2O_3	197.86	monocl. col., 1.871, 1.92, 2.01
40	oxide (ous) (amor. or vitreous)	As_2O_3	197.86	amor. or vitreous
41	oxide, penta-	As_2O_5	229.86	amor. wh.
42	oxychloride (ous)	$AsOCl$	126.39	brownish
43	phosphide (ous)	AsP	105.95	br. red powd
44	selenide (ous)	As_2Se_3	387.46	br. cryst
45	sulfide, di- (realgar)	As_2S_2	213.98	monocl. red-br., 2.46, 2.59, 2.61

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	liq. 2.336	2.8	140	d.	d.	s. HCl, tart. a.
2	$4.379^{20.9}$	292	subl.	384.7^{0}	563.6^{30}	i. NH_3
3	liq. 2.99^{63}	7.0	149.5	s.	....	s. KF
4	liq 2.26^{-25} 5.30⁰ g/l	−88	−17	20 cm³	4 cm³	1500 cm³ al., 2500 cm³ CS_2
5	mon. 4.768^{22}	167	401	d.	d.	s. HI, HCl, KI, al., acet., CS_2
6	....	....	79	....	....	....
7	5.2	656	1550, subl.	v. sl. s.	sl. s.	s. HCl, KOH, tart. a., ac. a.
8	5.67	656	1550	v. sl. s.	sl. s.	s. HCl, KOH, tart. a., ac. a.
9	3.8-4.0	−O, 930	....	i.	i.	s. HCl, HI, KOH
10	3.78	−O, 380	−2O, 930	i.	i.	s. HCl, HI, KOH
11	....	170 d.	....	i.	d.	s. HCl, acet., NH_3, CS_2, chl.
12	....	d.	....	i.	d.	s. al.
13	5.01	....	....	v. sl. s.	....	....
14	....	611	....	v. sl. s.	....	....
15	3.625^{4}	d.	....	i.	d.	s. a.
16	4.64	550	....	0.000175^{18}	d.	s. alk., NH_4HS, K_2S, HCl; i. ac. a.
17	4.120	d.	....	i.	i.	s. alk., NH_4HS, HCl; i. al.
18	....	629	....	....	....	....
19	4.89	....	....	d.	d.	....
20	....	....	....	i.	d.	5.15^{15} glyc.
21	1.784⁰ g/l; liq. 1.40^{-186}; cr. 1.65^{-233}	−189.2	−185.7	5.6⁰ cm³	3.4^{50} cm³	....
22	2.0-2.5	35.5	$-H_2O$, 160	16.7	50	s. alk., al., glyc.
23	....	d.	....	Forms ort	hoarsenic	acid
24	....	d. 206	....	Forms ort	hoarsenic	acid
25	5.727^{14}	$814^{36atm.}$	subl. 615	i.	i.	s. HNO_3
26	4.7	....	....	i.	i.	s. HNO_3, aq. Cl_2, aq. reg., hot alk.
27	2.0^{20}	....	....	i.	....	s. CS_2
28	3.54^{25}	32.8	221	d.	d.	s. HCl, HBr, CS_2
29	....	−40	....	hydr.	....	....
30	liq. 2.163	−18	130.2	d.	d.	s. HBr, HCl, PCl_3, al., eth
31	7.71 g/l	−80	−53	s.	....	s. alk., al., eth., bz.
32	liq. 2.666	−8.5	63^{752}	d.	d.	s. al., eth., bz., NH_4OH
33	....	d. 200	....	i.	i.	s. KOH; i. al., eth., CS_2
34	3.484 g/l	−113.5	−55; d. 230	20 cm³	sl. s.	sl. s., al., alk.
35	....	d. 136	....	d.	....	s. al., eth., chl., CS_2
36	3.93	67	....	....	....	....
37	4.39^{13}	146	403	sl. s. d.	30 d.	s. al., eth., chl., bz., CS_2
38	3.865^{25}	subl. 193	....	1.2^{2}; 2.04^{25}	11.46^{100}	s. al., alk., HCl
39	3.86	subl. 193	....	1.2^{2}; 2.04^{25}	11.46^{100}	s. al., alk., HCl
40	4.15	....	....	3.7^{20}	10.14^{100}	s. alk., alk. carb., HCl
41	4.086	d. 315	....	150^{16}	v. s.	s. al., a., alk.
42	....	....	d.	d.	d.	....
43	....	d.	....	d.	d.	sl. s. CS_2; i. al., eth., chl.
44	4.75	360	....	i.	d.	s. alk.
45	α 3.506^{19} β 3.254^{19}	tr. 267 β 307	565	i.	i.	s. K_2S, $NaHCO_3$

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Arsenic			
1	sulfide, penta-	As_2S_5	310.16	yellow
2	" (ous) (orpiment)	As_2S_3	246.04	monocl., yel or red. β 2.72 (Li)
3	**Auric or Aurous**	See *gold*		
4	**Barium**	Ba	137.36	yelsh.-silv. met
5	arsenate	$Ba_3(AsO_4)_2$	689.94	blk
6	" acid	$BaHAsO_4.H_2O$	295.31	rhomb. or monocl. col
7	boride	BaB_6	202.28	cub. blk
8	bromate	$Ba(BrO_3)_2.H_2O$	411.21	monocl. col
9	bromide	$BaBr_2$	297.19	
10	"	$BaBr_2.2H_2O$	333.22	monocl. col., 1.713, 1.727, 1.744
11	carbide	BaC_2	161.36	tetr. gray
12	carbonate (witherite)	$BaCO_3$	197.36	rhomb. wh., 1.529, 1.676, 1.677
13	" (α)	$BaCO_3$	197.36	hex. wh
14	" (β)	$BaCO_3$	197.36	white
15	chlorate	$Ba(ClO_3)_2.H_2O$	322.29	monocl. col., 1.562, 1.577, 1.635
16	*per*chlorate	$Ba(ClO_4)_2$	336.27	hex. col
17	chloride	$BaCl_2$	208.27	monocl. col
18	"	$BaCl_2$	208.27	cubic col
19	"	$BaCl_2.2H_2O$	244.31	rhomb. col., 1.635, 1.646, 1.660
20	chloroplatinate	$BaPtCl_6.6H_2O$	653.43	rhomb. orange-yel
21	chloroplatinite	$BaPtCl_4.3H_2O$	528.46	
22	chromate	$BaCrO_4$	253.37	rhomb. yel
23	*di*chromate	$BaCr_2O_7$	353.38	monocl. red
24	*di*chromate	$BaCr_2O_7.2H_2O$	389.41	br. red-yel. need
25	cyanide	$Ba(CN)_2$	189.38	wh. cr. powd
26	ferrocyanide	$Ba_2Fe(CN)_6.6H_2O$	594.70	monocl. yel
27	fluobromide	$BaBr_2.BaF_2$	472.55	pl
28	fluochloride	$BaCl_2.BaF_2$	383.63	tetr
29	fluoiodide	$BaI_2.BaF_2$	566.56	plates
30	fluoride	BaF_2	175.36	cub. col
31	fluosilicate	$BaSiF_6$	279.42	rhomb. need
32	hydride	BaH_2	139.38	gray cryst
33	hydrosulfide	$Ba(SH)_2.4H_2O$	275.56	rhomb. yel
34	hydroxide	$Ba(OH)_2.8H_2O$	315.50	monocl. col., 1.471, 1.502, 1.50
35	iodate	$Ba(IO_3)_2$	487.20	monocl
36	"	$Ba(IO_3)_2.H_2O$	505.22	monocl. col
37	iodide	$BaI_2.2H_2O$	427.23	rhomb. col., deliq
38	manganate	$BaMnO_4$	256.29	hex. gray-grn
39	*per*manganate	$Ba(MnO_4)_2$	375.22	br.-vlt. cr
40	molybdate	$BaMoO_4$	297.36	wh. powd
41	nitrate (nitrobarite)	$Ba(NO_3)_2$	261.38	cub. col., 1.572
42	nitride, hexa-	$BaN_6.H_2O$	239.42	cryst
43	nitrite	$Ba(NO_2)_2.H_2O$	247.39	hex. col.-yelsh
44	oxide	BaO	153.36	cub. or hex. col.; wh.-yelsh. powd
45	" per-	BaO_2	169.36	wh.-gray powd
46	" "	$BaO_2.8H_2O$	313.48	hex. col
47	*ortho*phosphate, mono-	$BaH_4(PO_4)_2$	331.43	tricl
48	" di-	$BaHPO_4$	233.39	rhomb. wh
49	" tri-	$Ba_3(PO_4)_2$	602.12	cub. wh
50	*hypo*phosphate	$BaPO_3$	216.38	need
51	*pyro*phosphate	$Ba_2P_2O_7$	448.76	rhomb. wh

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	subl.	i.	i.	s. alk., HNO_3, alk. sulf.
2	3.43	300	707	0.00005^{18}	sl. s.	s. al., alk., alk. carb.
3	....	....	....	....	....	....
4	3.5^{20}	850	1140	d. ev. H_2	d.	s. al., a.; i. bz.
5	....	....	....	0.055	....	s. a., NH_4Cl
6	3.93^{15}	$-H_2O$, 150	....	sl. s.	d.	....
7	4.36^{15}	....	....	i.	i.	s. HNO_3
8	3.99^{18}	d. 260	....	0.8	5.67^{100}	i. al., acet.
9	4.781^{24}	847	....	98^0	149^{100}	v. s. meth. al.
10	3.58^{24}	$-H_2O$, 75	$-2H_2O$, 120	151^{20}	204^{100}	v. s. meth. al.; s. al.
11	3.75	....	....	d. to C_2H_2	....	d. a.
12	4.43	tr. 811 to α	d. 1450	0.0022^{18}	0.0065^{100}	s. a., NH_4Cl; i. al.
13	4.43	tr. 982 to β	d.	0.002^{20}	0.006^{100}	s. a., NH_4Cl; i. al.
14	....	$1740^{90 atm.}$	d.	0.0022^{18}	0.0065^{100}	s. a., NH_4Cl; i. al.
15	3.18	anh. 414	$-H_2O$, 120	27.4^{25}	111.2^{100}	sl. s. al.; acet., HCl
16	($3H_2O$) 2.74	505	....	198.5^{25}	v. s.	v. s. al.
17	3.856^{24}	tr. 925 to cub.	1560	31^0	59^{100}	sl. s. HCl, HNO_3; i. al.
18	....	962	1560	....	....	....
19	3.097^{24}	$-2H_2O$, 113	....	35.7^{20}	58.7^{100}	sl. s. HCl, HNO_3; i. al.
20	2.868	$-5H_2O$, 70	....	s.	....	d. a.; i. eth., meth. al.
21	2.868	....	....	s.	....	v. s. al.
22	4.498^{15}	....	....	$.00034^{16}$	$.00044^{23}$	s. min. a.
23	....	....	....	sl. s.	....	s. h. conc. H_2SO_4
24	....	....	....	d.	....	s. conc. soln. CrO_3
25	....	....	....	80^{14}	....	18^{14} 70% al.
26	....	....	....	0.17^{15}	0.9^{100}	....
27	4.96^{18}	....	....	d.	d.	i. al.; s. conc. HCl, HNO_3
28	4.51^{18}	....	....	d.	d.	i. al.; s. conc. HCl, HNO_3
29	5.21^{18}	....	....	d.	d.	i. al.; s. conc. HCl, HNO_3
30	4.83	1280	2137	0.17^{10}	sl. s.	s. a., NH_4Cl
31	4.29^{21}	....	....	0.026^{17}	0.09^{100}	sl. s. a., NH_4Cl; i. al.
32	4.21^0	d. 675	1400	d. to $Ba(OH)_2 + H_2$		d. a.
33	....	d. 50	....	s.	....	i. al.
34	2.18^{16}; anh. 4.50	78; $-8H_2O$, 780	103	3.48^{20}	94.7^{78}	sl. s. al.
35	4.998	d.	....	0.022	0.197	s. HNO_3, HCl
36	5.23	$-H_2O$, 130	....	v. sl. s.	sl. s.	s. HCl, HNO_3; i. al., acet., H_2SO_4
37	5.15; anh. 4.917	740 d.	$-2H_2O$, 539	200^{15}	269^{100}	1.07^{15} al.; s. acet.
38	4.85	....	....	v. sl. s.	....	s. a.
39	....	....	....	62.5^{11}	75.4^{25}	....
40	....	....	....	0.0058^{23}	....	sl. s. a.
41	3.24^{23}	592	d.	8.7^{20}	34.2^{100}	sl. s. a.; i. al.
42	....	exp.	....	v. s.	v. s.	sl. s. al.; i. eth.
43	3.173^{29}	d. 115	....	63^{20}	109.6^{50}	v. s. HCl; 1.6 al.; i. acet.
44	5.72; hex. 5.32	1923	*ca.* 2000	1.5^0 d.	90.8^{30}	s. dil. a., al.; i. NH_3, acet.
45	4.96	450	$-O$, 800	v. sl. s.	d.	s. dil. a.; i. acet.
46	....	$-8H_2O$, 100	....	0.168	d.	s. dil. a.; i. al., eth., acet.
47	2.9^4	....	....	d.	d.	s. a.
48	4.165^{15}	....	....	0.01–.02	....	s. a., NH_4Cl
49	4.1^{16}	....	....	i.	i.	s. a.
50	....	....	....	sl. s.	....	s. al.; v. sl. s. ac. a.
51	3.9^{20}	....	....	0.01	sl. s.	s. a., NH_4 salts

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Barium			
1	*hypo*phosphite	$Ba(H_2PO_2)_2.H_2O$	285.45	monocl. wh.
2	platinocyanide	$BaPt(CN)_4.4H_2O$	508.68	(a) monocl. yel., α 1.6704 (b) rhomb. grn.
3	selenate	$BaSeO_4$	280.56	rhomb.
4	silicate	$BaSiO_3$	213.42	rhomb. col., 1.673, 1.674, 1.678
5	"	$BaSiO_3.6H_2O$	321.51	rhomb., 1.542, 1.548, 1.548
6	sulfate (barite)	$BaSO_4$	233.42	rhomb. wh. (monocl.), 1.637, 1.638, 1.649
7	*per*sulfate	$BaS_2O_8.4H_2O$	401.54	monocl. wh.
8	sulfide, mono-	BaS	169.42	cub. col.
9	" tri-	BaS_3	233.54	yel.-grn.
10	" tetra-	$BaS_4.2H_2O$	301.63	rhomb.
11	sulfite	$BaSO_3$	217.42	cub. (hex.) col.
12	thiocyanate	$Ba(CNS)_2.2H_2O$	289.53	need.
13	thionate, di-	$BaS_2O_6.2H_2O$	333.51	rhomb., or monocl. col., 1.586, 1.595, 1.607
14	thiosulfate	BaS_2O_3	249.48	rhomb. wh.
15	"	$BaS_2O_3.H_2O$	267.50	wh. cr. powd.
16	tungstate	$BaWO_4$	385.36	tetr. col.
17	*meta*tungstate	$BaW_4O_{13}.9H_2O$	1243.50	rhomb.
18	**Beryllium** (glucinium)	Be (Gl)	9.02	hex. gray met.
19	aluminate	$Be(AlO_2)_2$	126.96	rhomb., 1.744, 1.747, 1.753
20	" (chrysoberyll)	$Be(AlO_2)_2$	126.96	rhomb., 1.747, 1.748, 1.757
21	aluminum silicate (euclase)	$2BeO.Al_2O_3.2SiO_2.H_2O$	290.12	monocl., 1.652, 1.655, 1.671
22	" " (beryl)	$3BeO.Al_2O_3.6SiO_2$	537.36	hex. col., transp., 1.580, 1.574
23	*ortho*borate, basic (hambergite)	$Be_2(OH)BO_3$	93.87	rhomb., 1.560, 1.591, 1.631
24	bromide	$BeBr_2$	168.85	wh. need., deliq.
25	carbide	Be_2C	30.04	hex. yel.
26	carbonate	$BeCO_3.4H_2O$	141.08	col.
27	" basic	$(BeO)_5CO_2.5H_2O$	259.18	wh. powd.
28	chloride	$BeCl_2$	79.93	col. need., deliq.
29	"	$BeCl_2.4H_2O$	152.00	monocl. wh., deliq.
30	fluoride	BeF_2	47.02	amor. col.
31	" basic	$2BeO.5BeF_2$	285.14	
32	hydroxide	$Be(OH)_2$	43.04	wh. amor. powd. or cr.
33	iodide	BeI_2	262.86	col. need.
34	nitrate	$Be(NO_3)_2.3H_2O$	187.08	wh.-yelsh. cr., deliq.
35	nitride	Be_3N_2	55.08	col. cr.
36	oxide (bromellite)	BeO	25.02	hex. wh. or amor. powd., 1.719, 1.733
37	oxychloride	Be_2OCl_2	104.95	
38	*ortho*phosphate	$Be_3(PO_4)_2.3H_2O$	271.15	
39	potassium fluoride	$BeF_2.2KF$	163.22	rhomb. col.
40	selenate	$BeSeO_4.4H_2O$	224.28	rhomb., 1.466, 1.501, 1.503
41	silicate (phenacite)	Be_2SiO_4	110.10	tricl., 1.654, 1.670
42	" (bertrandite)	$2Be_2(SiO_4).H_2O$	238.22	rhomb., 1.591, 1.605, 1.614
43	sodium fluoride	$BeF_2.2NaF$	131.01	rhomb. or monocl. wh.
44	sulfate	$BeSO_4$	105.08	
45	"	$BeSO_4.4H_2O$	177.14	tetr. col., 1.472, 1.440

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	2.90^{17}	d.	....	30^{15}	33^{100}	i. al.
2	(a) 2.076 (b) 2.085	$-2H_2O$, 100	....	sl. s.	s.	i. al.
3	4.75	d.	....	0.0118	0.0138^{100}	s. HCl; i. HNO_3
4	4.399	1604	....	s.	d.	s. HCl
5	2.59	....	....	....	....	....
6	4.50^{15}	1580	tr. 1149-monocl.	$.00023^{18}$	$.00039^{100}$	.006 3% HCl; sl. s. H_2SO_4
7	....	d.	....	52.2^{0}	d.	i. al.
8	4.25^{15}	....	....	d.	d.	i. al.
9	....	....	....	s.	s.	....
10	2.988	d. 300	....	41^{15}	v. s.	i. al., CS_2
11	....	....	d.	0.02^{20}	0.002^{80}	v. s. HCl
12	....	....	....	43^{20}	s.	35^{20} al.
13	$4.536^{13.5}$	d.	....	24.75^{18}	90.9^{100}	sl. s. al.
14	....	d.	....	0.2	....	....
15	3.5	....	....	v. sl. s.	....	....
16	5.04	....	....	sl. s.	sl. s.	d. a.
17	4.30	....	....	d.	v. s.	....
18	1.85	1350	1530^{5}	i.	sl. s. d.	s. dil. a., alk.; i. Hg
19	....	....	....	....	....	....
20	3.76	....	....	....	....	i. a.
21	3.1	....	....	....	....	....
22	2.66	1410 ± 100	....	....	....	i. a.
23	2.35	....	....	....	....	....
24	3.465^{25}	490 ± 10 subl.	520	s.	v. s.	s. al., eth.; i. bz.
25	1.90^{15}	>2100 d.	....	d.	d.	s. a.
26	....	$-4H_2O$, 100	....	0.36^{0}	....	i. NH_3
27	....	....	....	i.	d.	s. a., alk.
28	1.899^{25}	440 ± 10	520	v. s.	v. s. d.	v. s. al., eth., bz., pyr.; sl. s. chl., CS_2; i. acet., NH_3
29	....	600	subl.	v. s.	v. s.	s. al.
30	1.986^{25}	800	....	∞	∞	s. al., H_2SO_4
31	2.01^{15}	....	....	....	....	....
32	1.909 (cr.)	d.	....	i.	i.	s. a., alk. $(NH_4)_2CO_3$
33	4.325^{25}	510 ± 10	590	d.	d.	s. al. eth., CS_2
34	....	60	d. 100-200	v. s.	v. s.	v. s. al.
35	....	2200 ± 100	d. 2240	d.	d.	d. a., conc. alk.; i. al.
36	3.025	2570	*ca.* 3900	$.0002^{20}$	....	s. conc. H_2SO_4, fus. KOH; i. dil. a., alk.
37	....	....	....	i.	....	....
38	....	$-H_2O$, 100	....	s.	s.	s. ac. a.
39	....	red ht.	....	2^{20}	5.26^{100}	....
40	2.03	$-2H_2O$, 100	....	....	....	....
41	3.0	....	....	....	....	....
42	2.6	....	....	....	....	....
43	....	d.	....	1.47^{18}	2.94^{100}	....
44	2.443	d. 540	....	i.	d. to BeS	$O_4.4H_2O$
45	$1.713^{10.5}$	$-2H_2O$, 100	$-4H_2O$, 250	42.5^{25}	100^{100}	i. al. acet.; sl. s. conc. H_2SO_4

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Beryllium			
1	sulfide	BeS	41.08	
2	**Bismuth**	Bi	209.00	hex. silv. wh. or redsh. met
3	*ortho*arsenate	$BiAsO_4$	347.93	monocl., 2.14, 2.15, 2.18
4	bromide, mono-	BiBr	288.92	
5	" tri-	$BiBr_3$	448.75	yel. cr. powd., deliq
6	carbonate, sub-	$Bi_2O_3.CO_2.H_2O$	528.02	wh. powd
7	chloride, di-	$BiCl_2$ (exist. quest.)	279.91	blk. need
8	" tri-	$BiCl_3$	315.37	wh. cr., deliq
9	" tetra-	$BiCl_4$	350.83	col
10	*di*chromate, basic	$(BiO)_2Cr_2O_7$	666.02	yel.-or. red
11	fluoride	BiF_3	266.00	
12	hydride (bismuthine)	BiH_3	212.02	liq
13	hydroxide	$Bi(OH)_3$	260.02	wh. amor. powd
14	iodate	$Bi(IO_3)_3$	733.76	wh.
15	iodide	BiI_3	589.76	hex. redsh. br.-gray bl
16	nitrate	$Bi(NO_3)_3.5H_2O$	485.10	tricl. col., sl. hyg
17	"	$Bi(NO_3)_3.6H_2O$	503.12	
18	" sub-	$BiONO_3.H_2O$	305.02	hex. pl. or wh. powd
19	oxide, di-	BiO_2	241.00	
20	" "	$BiO_2.2H_2O$	277.03	br.-yel
21	" tri-	Bi_2O_3	466.00	rhomb. yel
22	" "	Bi_2O_3	466.00	cub. gray-blk
23	" "	Bi_2O_3	466.00	rhomb., 1.91, av., wh. lt
24	" " (bismite)	$Bi_2O_3.3H_2O$	520.05	rhomb., 2.01, 1.82
25	" pent-	Bi_2O_5	498.00	br. or dk. red
26	" " (metabismuthic acid)	$Bi_2O_5.H_2O$ or $HBiO_3$	516.02 (258.01)	red
27	oxybromide	BiOBr	304.92	col. cr. or wh. powd
28	oxychloride	BiOCl	260.46	cr. or wh. powd
29	oxyfluoride	BiOF	244.00	wh. cr. or powd
30	oxyiodide	BiOI	351.92	rhomb. red cr
31	*ortho*phosphate	$BiPO_4$	304.02	monocl. wh
32	selenide (guanajuatite)	Bi_2Se_3	655.60	rhomb. blk
33	sulfate	$Bi_2(SO_4)_3$	706.18	wh. need
34	sulfide, mono-	BiS	241.06	gray
35	" (bismuthinite)	Bi_2S_3	514.18	rhomb. br.-blk., 1.315, 1.900, 1.670.
36	tellurate (montanite)	$Bi_2TeO_6.2H_2O$	677.53	biaxial, β 2.09
37	telluride	Bi_2Te_3	800.50	
38	**Boric acid**, ortho- (boracic acid)	H_3BO_3	61.84	tricl. col
39	" " (sassolite)	$B_2O_3.3H_2O$	123.69	tricl., 1.340, 1.456, 1.459
40	" " pyro-	$B_4O_5(OH)_2$	157.30	vitr. or wh. powd
41	" " fluo- (hydrofluoboric-)	HBF_4	87.83	col. liq
42	**Boron**	B	10.82	monocl. yel. or br. amor. powd., 2.5 lq. (λ.579μ)
43	ammonium fluoride	$B(NH_4)F_4$	104.86	col. hex
44	bromide	BBr_3	250.57	col. fum. liq., $1.553^{6.3}$(F)

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	2.36	....	....	d.	d.	....
2	9.80	271	1470 (1420–1560)	i.	i.	s. HNO_3, h. H_2SO_4, aq. reg.; sl. s. h. HCl
3	7.14	....	....	....	....	....
4	....	287	....	....	....	....
5	5.7	218	453	d. to BiOBr	d.	s. HCl, HBr, eth.; i. al.
6	6.86	d.	....	i.	i.	s. a.
7	4.86	163	d. 300	d.	....	....
8	4.75	230–2	447	d. to BiOCl	d.	s. a., al., eth. acet.
9	....	225	....	d.	....	....
10	....	....	....	i.	i.	s. a.; i. alk.
11	5.32	....	....	....	....	....
12	....	....	22	....	....	....
13	4.36	$-H_2O$, 100 d. 415	$-1\frac{1}{2}H_2O$, 400	0.00014	d.	s. a.,; i. or sl. s., conc. alk.
14	....	....	....	i.	d.	sl. s. HNO_3; s. HI, KI, 3.5 abs. al.
15	5.7	439(408)	d. 500	i.	d.	s. HCl, HI, KI, 3.5 abs. al.
16	2.83	d. 30	$-5H_2O$, 80	d.	d.	v. s. HNO_3; s. a., 42^{19} acet.
17	2.76	....	....	....	....	s. dil. HNO_3
18	4.928^{15}	d. 260	....	i.	i.	s. a.; i. al.
19	5.6	....	....	....	....	....
20	5.6	$-H_2O$, 110	$-2H_2O$, 180; $-O$, 305	i.	....	s. a.
21	8.9	820	1890(?)	i.	i.	s. a.
22	8.20	tr. 704	....	i.	i.	s. a.
23	8.5	860	....	....	....	less s. a.
24	4.36	d. 415	....	....	....	....
25	5.10	$-O$, 150	$-2O$, 357	i.	i.	s. a., KOH
26	5.75	$-H_2O$, 120	$-2O$, 300(357)	i.	i.	s. a., KOH
27	8.08	....	....	i.	....	s. a.; i. al.
28	7.72	red ht.	....	i.	i.	s. a.; i. acet., tart. a., NH_3
29	7.5	....	....	i.	....	s. a.
30	7.92	....	....	i.	....	s. a.; i. al., chl. KI
31	6.323^{15}	d.	....	i.	i.	s. HCl; i. dil. HNO_3, al.
32	6.82	710	d.	i.	....	i. alk.
33	5.08^{15}	d.	....	d.	d.	s. a.
34	7.7	685	....	v. sl. s.	....	....
35	7.39	685 d.	....	0.000018^{18}	....	s. HNO_3; i. dil. a.
36	3.79	....	....	....	....	....
37	7.7	573	....	....	....	....
38	1.435^{15}	185 d.	$-1\frac{1}{2}H_2O$, 300	1.95^0; 5.15^{21}	39.1^{100}	28^{20} glyc., .0078 eth. 5.56 al.; sl. s. acet.
39	1.49	d.	....	....	....	....
40	....	....	....	s.	s.	s. al.
41	....	....	d. 130	∞	s.	∞ al.
42	2.3; 1.73 (am.)	2300	2550	i.	i.	s. HNO_3, H_2SO_4; i. al., eth., alk.
43	1.85	....	....	25^{16}	*ca.* 96^{100}	s. al.
44	2.650^0	−46	90.1^{740}	d.	....	s. al., CCl_4

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Boron			
1	bromohydride	B_2H_5Br	106.60	col. gas
2	bromodiiodide	$BBrI_2$	344.58	col. liq
3	bromoiodide, di-	BBr_2I	297.57	col. liq
4	carbide	B_6C	76.92	blk. cr
5	chloride	BCl_3	117.19	col. fum. liq., $1.428^{5.7}$(F)
6	fluoride	BF_3	67.82	col. gas
7	hydride (boroethane)	B_2H_6	27.69	col. gas
8	" (borobutane)	B_4H_{10}	53.36	col. poi. gas, disg. odor
9	"	$B_{10}H_{14}$	122.31	col. need
10	iodide	BI_3	391.58	col. pl., hyg
11	nitride	BN	24.83	amor. wh
12	"	BN_2	38.84	
13	oxide (boric anhydride)	B_2O_3	69.64	vitr. col., 1.464
14	phosphide	BP	41.84	maroon powd
15	potassium fluoride	BKF_4	125.92	col. cub. or rhomb
16	sulfide, tri-	B_2S_3	117.82	wh. cr. or vitr
17	" penta-	B_2S_5 (exist. quest.)	181.94	wh. cr
18	**Borotungstic acid**	$B_2O_3(WO_3)_9.24H_2O$	2590.01	yelsh. liq
19	**Bromic acid**	$HBrO_3$	128.92	known in soln. only, col. or yelsh
20	**Bromine**	Br_2	159.83	rhomb. or dk. red liq., 1.661
21	azide (bromoazide)	BrN_3	121.94	or. red liq
22	chloride	$BrCl$ (exist. quest.)	115.37	red-yel. liq. or gas
23	fluoride, tri-	BrF_3	136.92	col.-gray yel. liq
24	" penta-	BrF_5	174.92	col. liq
25	hydrate	$Br_2.10H_2O$	339.99	oct. red
26	iodide	BrI	206.84	dk. gray cryst
27	sulfide	Br_2S_2	223.95	red
28	**Bromous acid**, hypo-	$HBrO$	96.92	col
29	**Cadmium**	Cd	112.41	hex. silv.-wh. metal., 1.13
30	borotungstate	$Cd_2B_2W_9O_{32}.18H_2O$	2738.74	yel. cr
31	bromate	$Cd(BrO_3)_2.H_2O$	386.26	rhomb. wh
32	bromide	$CdBr_2$	272.24	yel. cr
33	"	$CdBr_2.4H_2O$	344.30	sm. wh. need., effl
34	carbonate	$CdCO_3$	172.41	trig. wh
35	chlorate	$Cd(ClO_3)_2.2H_2O$	315.36	col. pr., deliq
36	chloride	$CdCl_2$	183.32	hex. col
37	"	$CdCl_2.2\frac{1}{2}H_2O$	228.36	monocl. col., 1.6513
38	cobaltinitrite	$Cd_3Co(NO_2)_6$	672.22	yellow
39	cyanide	$Cd(CN)_2$	164.43	cr
40	ferrocyanide	$Cd_2Fe(CN)_6$	436.71	
41	fluoride	CdF_2	150.41	cub. wh
42	fluosilicate	$CdSiF_6$	254.47	hex. col
43	hydroxide	$Cd(OH)_2$	146.43	trig. or amor. wh
44	iodate	$Cd(IO_3)_2$	462.25	wh. cr
45	"	$Cd(IO_3)_2.H_2O$	480.27	monocl., small cr
46	iodide (α)	CdI_2	366.25	hex. brnsh

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm^3 of Cold water	Hot water	Alcohol, acids, etc.
1	...	−104	*ca.* 10	d. to B_2O_3 H_2	+HBr +	...
2	...	...	180	d.	d.	...
3	...	...	125	d.	d.	...
4	2.6	2350	>3500	i.	i.	s. fus. alk.; i. a.
5	1.434^{0}	−107	12.5	d. to HCl	$+H_3BO_3$	d. al.
6	2.99 g/l	−127	−101	106 cm^3	d.	d. al.; s. conc. H_2SO_4
7	lq. 0.45	−169	−92.5	sl. s. d. to H_2	H_3BO_3 +	s. NH_4OH
8	liq. 0.59^{-70}	−120(−112)	17.6	sl. s. d.	...	d. al.; s. bz.
9	0.94	99.5	$156^{162.4}$; d. 200	sl. s.	...	s. al., eth.; bz., CS_2
10	3.35^{50}	43	210	d.	d.	v. s. CS_2, CCl_4, bz.; d. al.
11	2.25	*ca.* 2730	subl.	i.	i.	d. HCl, HF, H_2SO_4
12	...	...	$1230^{9.4}$	...	...	...
13	1.844	*ca.* 577	...	d. 1.1^{0}	15.7^{100}	s. a., al.
14	...	ign. 200	...	i.	i.	i. all solv.
15	2.56	530	...	0.45^{20}	6.3^{100}	s. al.
16	1.55	310	...	d.	...	sl. s. PCl_3, SCl_2; d. al.
17	1.85	390	...	d.	d.	d. al.
18	3.0	...	...	s.	...	...
19	...	d. 100	...	v. s.	s. d.	...
20	2.928^{59}	−7.3	58.78	4.17^{0} 3.58^{20}	3.52^{50}	v. s. al., chl., eth., CS_2
21	...	*ca.* 45	exp.	...	...	s. eth., KI; sl. s. bz., lgr.
22	...	...	d. 10	s. d.	...	s CS_2, eth.
23	2.49^{135}	(−2)8.8	135	d. viol. to HF, HB	O_2HOBr, rO_3	d. alk.
24	2.466^{25}	−61.3	40.5	d.	d.	...
25	...	d. 6.8	...	s.	...	...
26	4.416^{0}	subl. 50 (±42)	...	d.	d.	s. chl. eth. al., CS_2
27	2.629	liq.	190–200	d.	...	...
28	...	40 (vac.)	...	s.	s.	...
29	8.642	320.9	767	i.	i.	s. a., NH_4NO_3, h. H_2SO_4
30	...	...	...	1250^{19}	v. s.	...
31	3.758	d.	...	125^{17}	...	i. al.
32	5.192^{25}	567	963	57^{10}	162^{104}	26.6^{15} al.; 0.4^{15} eth.; s. HCl
33	...	tr. 36	...	121^{10}	...	25 al.; s. acet.; sl. s. eth.
34	4.258^{4}	d. <500	...	i.	i.	s. a., KCN, NH_4 salts; i. NH_3
35	2.28^{18}	80	...	298^{0}	487^{65}	s. a., acet., al.
36	4.047^{25}	568	960	140^{20}	150^{100}	1.52^{15} al.; i. acet., eth.
37	3.327	tr. 34	...	168^{20}	180^{100}	2.05^{15} meth. al.; sl. s. al.
38	...	d. 175	...	sl. s.	v. s.	d. a., alk., org. solv.
39	...	d. >200	...	1.7^{15}	...	s. a., KCN, NH_4OH
40	...	...	...	i.	i.	s. HCl
41	6.64	1100	1758	4.35^{25}	...	s. a., HF; i. al., NH_3
42	...	...	...	s.	s.	s., 50% al.
43	4.79^{15}	d. 300	...	0.00026^{25}	...	s. a., NH_4 salts; i. alk.
44	6.48	d.	...	sl. s.	sl. s.	s. HNO_3, NH_4OH
45	...	d.	...	sl. s.	sl. s.	s. HNO_3, NH_4OH
46	5.670^{10}	388	713	79.8^{0}; 85.2^{18}	127.6^{100}	s. a., eth., al., NH_4OH; sl. s. NH_3, acet.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cadmium			
1	iodide (β)	CdI_2	366.25	
2	*per*manganate	$Cd(MnO_4)_2.6H_2O$	458.36	
3	nitrate	$Cd(NO_3)_2.4H_2O$	308.49	prism. need. wh., hyg
4	oxide	CdO	128.41	amor., brown
5	"	CdO	128.41	cubic br
6	" sub-	Cd_2O	240.82	grn. amor
7	*ortho*phosphate	$Cd_3(PO_4)_2$	527.27	amor. col
8	potassium cyanide	$Cd(CN)_2.2KCN$	294.64	cub. col
9	" iodide	$CdI_2.2KI.2H_2O$	734.32	wh.-yelsh. cr. powd., deliq
10	selenate	$CdSeO_4.2H_2O$	291.64	rhomb
11	silicate	$CdSiO_3$	188.47	col
12	sulfate	$CdSO_4$	208.47	rhomb. wh
13	"	$3CdSO_4.8H_2O$	769.53	monocl. wh., effl., 1.565
14	"	$CdSO_4.4H_2O$	280.53	
15	sulfide (greenockite)	CdS	144.47	hex. yel.-orange, 2.506, 2.529
16	sulfite	$CdSO_3$	192.47	cryst
17	tungstate	$CdWO_4$	360.41	yel. cryst
18	**Calcium**	Ca	40.08	cub. silv. wh. soft met
19	aluminate	$CaAl_2O_4$	158.02	rhomb. or monocl. col., 1.643, 1.655, 1.663
20	"	$Ca_3Al_2O_6$	270.18	cub
21	ammonium arsenate	$CaNH_4AsO_4.6H_2O$	305.14	monocl. col
22	" phosphate	$CaNH_4PO_4.7H_2O$	279.25	monocl. col
23	*ortho*arsenate	$Ca_3(AsO_4)_2$	398.10	wh. amor. powd
24	"	$Ca_3(AsO_4)_2.3H_2O$	452.15	col. or wh. powd
25	arsenide	Ca_3As_2	270.10	red cr
26	*meta*borate	$Ca(BO_2)_2$	125.72	col. rhomb., 1.540, 1.656, 1.682
27	"	$Ca(BO_2)_2.2H_2O$	161.75	cub
28	"	$Ca(BO_2)_2.6H_2O$	233.81	col. hex
29	boride	CaB_6	105.00	cub. blk
30	bromate	$Ca(BrO_3)_2.H_2O$	313.93	monocl
31	bromide	$CaBr_2$	199.91	need., deliq
32	"	$CaBr_2.3H_2O$	253.96	rhomb
33	"	$CaBr_2.6H_2O$	308.01	hex. col
34	carbide	CaC_2	64.08	rhomb. gray
35	carbonate (aragonite)	$CaCO_3$	100.08	rhomb. col., 1.530, 1.681, 1.685
36	" (calcite)	$CaCO_3$	100.08	hex. col., 1.658, 1.486
37	"	$CaCO_3.6H_2O$	208.17	monocl., 1.460, 1.535, 1.545
38	chlorate	$Ca(ClO_3)_2.2H_2O$	243.03	monocl. wh.-yelsh., deliq
39	*per*chlorate	$Ca(ClO_4)_2$	238.99	
40	chloride (hydrophilite)	$CaCl_2$	110.99	cub. col., deliq., 1.52
41	"	$CaCl_2.H_2O$	129.01	col., deliq
42	"	$CaCl_2.2H_2O$	147.03	col
43	"	$CaCl_2.6H_2O$	219.09	trig. col., deliq., 1.417, 1.393

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	5.305^{30}	....	....	....	....	....
2	....	d.	....	v. s.	v. s.	....
3	2.455^{17}	100(60)	132	109.7^{0}; 140.4^{30}	$326^{59.5}$	s. al., NH_3; i. HNO_3
4	6.95	>1426	d. 900-1000	i.	i.	s. a., NH_4 salts; i. alk.
5	8.15	d. 900	....	i.	i.	s. a., NH_4 salts; i. alk.
6	8.192^{18}	d.	....	....	....	d. a., alk.
7	....	1500	....	i.	....	s. a., NH_4 salts
8	1.85	....	....	33	100^{100}	sl. s. al.
9	3.359	....	....	137^{15}	....	s. a., al., eth.
10	3.632	d. 100	....	v. s.	....	....
11	4.93	1242	....	v. sl. s.	....	....
12	4.691	1000	....	75.5^{0}	60.8^{100}	i. al., acet., NH_3
13	3.09	tr. 41.5	....	114.2^{0}	87^{100}	50 al.
14	3.05	....	....	140^{0}	135.5^{100}	i. al.
15	4.82	$1750^{100\ atm.}$	subl. in N_2 980	0.00013^{18}	colloidal	v. s. NH_4OH; s. a.
16	....	d.	....	sl. s.	....	s. a., NH_4OH; i. al.
17	....	....	....	0.05	....	s. NH_4OH
18	1.55	810	(1170) 1439 ± 5	d. to $Ca(OH)_2 + H_2$		s. a.; sl. s. al.; i. bz.
19	3.67	1600	....	d.	....	s. HCl; i. HNO_3, H_2SO_4
20	....	1535 d.	....	i.	....	s. a.; not d. by KOH soln.
21	1.905^{15}	d.	....	0.02	s.	s. NH_4Cl; i. NH_4OH
22	1.561^{15}	d.	....	i.	d.	s. a.
23	....	....	....	0.0048	....	....
24	....	....	....	i.	i.	s. a.
25	2.5^{15}	d.	....	d.	d.	d. a.
26	....	1100	....	sl. s.	....	s. a., NH_4 salts; sl. s. ac. a.
27	....	....	....	0.40^{30}	0.40^{90}	s. a., NH_4 salts
28	....	....	....	0.25^{30}	....	....
29	2.33^{15}	....	....	i.	i.	s. HNO_3
30	3.329	d.	....	v. s.	v. s.	....
31	3.353^{25}	765	806–812	125^{0}	312^{105}	s. a., al., acet.; sl. s. NH_3
32	....	80.5	....	240^{0}	1850^{80}	s. a., al., acet.
33	....	38.2	149–50	594^{0}	1360^{25}	s. a., al. acet.
34	2.22	2300	....	d. to $Ca(OH)_2 + C_2H_2$		i. c. HCl, not d. H_2SO_4
35	2.93	d. 825	....	$.00153^{25}$ $(.146^{9})$*	$.00190^{75}$ $(.088^{35})$*	s. a., NH_4Cl
36	$2.711^{25.2}$	$1339^{1025\ atm.}$	subl. 898.6	$.0014^{25}$ $(.13^{9})$*	$.0018^{75}$ $(.077^{35})$*	s. a., NH_4Cl
37	....	....	....	....	....	....
38	2.711	$-H_2O$, >100	....	177.7^{8}	v. s.	s. al., acet.
39	....	....	....	188.6^{25}	....	s. al.
40	2.152^{25}	772	>1600	59.5^{0}	159^{100}	s. al., ac. a.
41	....	....	....	76.8^{0}	249^{100}	s. al.; i. acet.
42	....	....	....	97.7^{0}	326^{60}	s. al.
43	1.68^{17}	29.92	$-4H_2O$, 30; $-6H_2O$, 200	279^{0}	536^{20}	s. al.

* Solubility in water containing CO_2 (?)

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Calcium			
1	*hypo*chlorite	$Ca(ClO)_2.4H_2O$	215.06	col. cr., deliq
2	chlorohypochlorite (bleaching powder)	$CaOCl_2$	126.99	wh. powd.; strong Cl odor
3	chromate	$CaCrO_4.2H_2O$	192.12	monocl. pr., yel
4	cyanamide	$CaCN_2$	80.10	hex. rhbdr. col
5	cyanide	$Ca(CN)_2$	92.10	cubic
6	ferricyanide	$Ca_3[Fe(CN)_6]_2.12H_2O$	760.20	red, need., deliq
7	ferrocyanide	$Ca_2Fe(CN)_6.12H_2O$	508.24	tricl. yel., 1.570, 1.582, 1.596
8	fluoride (fluorite)	CaF_2	78.08	cub. col., lum. with heat., 1.434
9	fluosilicate	$CaSiF_6$	182.14	wh. cr. powd
10	"	$CaSiF_6.2H_2O$	218.17	hex. col
11	hydride	CaH_2	42.10	gray-wh. cr. powd
12	hydrosulfide	$Ca(SH)_2.6H_2O$	214.31	prism. col
13	hydroxide	$Ca(OH)_2$	74.10	rhomb. trig. col., 1.574, 1.547
14	iodate (lautarite)	$Ca(IO_3)_2$	389.92	tricl.
15	"	$Ca(IO_3)_2.6H_2O$	498.01	rhomb.
16	iodide	CaI_2	293.92	yelsh.-wh. plates, deliq
17	"	$CaI_2.6H_2O$	402.01	
18	*per*manganate	$Ca(MnO_4)_2.4H_2O$	350.00	purp., pr.
19	molybdate (powellite)	$CaMoO_4$	200.08	tetr. col., 1.967, 1.978
20	nitrate (nitrocalcite)	$Ca(NO_3)_2$	164.10	cub. col., hyg
21	"	$Ca(NO_3)_2.3H_2O$	218.14	
22	" (α)	$Ca(NO_3)_2.4H_2O$	236.16	monocl. col., deliq., 1.465, 1.498, 1.504
23	nitride	Ca_3N_2	148.26	br. cr.
24	nitrite	$Ca(NO_2)_2.H_2O$	150.11	hex. col.-yelsh., deliq
25	"	$Ca(NO_2)_2.4H_2O$	204.16	col
26	oxide (lime)	CaO	56.08	cub. col., 1.83
27	oxide, per-	CaO_2	72.08	wh.
28	" "	$CaO_2.8H_2O$	216.20	tetr., pearly
29	phosphate, mono-	$Ca(H_2PO_4)_2.H_2O$	252.17	tricl. col., deliq
30	" di-	$CaHPO_4.2H_2O$	172.14	monocl. wh
31	" tri-	$Ca_3(PO_4)_2$	310.28	amor. wh. powd
32	*meta*phosphate	$Ca(PO_3)_2$	198.12	col
33	*hypo*phosphate	$Ca_2P_2O_6.2H_2O$	274.23	gel
34	*pyro*phosphate	$Ca_2P_2O_7$	254.20	biaxial, col
35	" (brushite)	$Ca_2P_2O_7.5H_2O$	344.28	monocl., 1.539, 1.545, 1.551
36	*ortho*phosphate-fluochloride (apatite)	$3Ca_3(PO_4)_2.CaFCl$	1025.38	col., 1.634, 1.631
37	phosphide	Ca_3P_2	182.28	red cr.
38	*ortho*phosphite	$2CaHPO_3.3H_2O$	294.26	
39	*hypo*phosphite	$Ca(H_2PO_2)_2$	170.15	monocl. wh.-gray
40	platinocyanide	$CaPt(CN)_4.5H_2O$	429.42	grn.-yel. cr., bluish fluores
41	plumbate	Ca_2PbO_4	351.38	red-br. cr.
42	plumbite	$CaPbO_2$	279.30	cryst
43	potassium sulfate (syngenite)	$CaK_2(SO_4)_2.H_2O$	328.42	monocl., 1.500, 1.517, 1.518
44	selenate	$CaSeO_4$	183.28	col., ($2H_2O$, monocl.)

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	...	i.	...	v. s.	d.	d. a.
2	...	i.	...	i. evln. Cl	...	d. a.
3	...	$-2H_2O$, 200	...	[illegible] [illegible]	15.2[illegible]	s. a., al.
4	...	1190 [illegible]	...	d. evln. NH_3	d.	...
5	...	...	...	s. [illegible]	d.	...
6	...	...	...	v. s.	v. s.	...
7	1.68	i.	...	$83.8^{24.9}$	$115^{48.7}$	...
8	3.180	1330	...	0.0016[illegible]	0.0017[illegible]	sl. s. a.; s. soln. NH_4 salts
9	$2.662^{27.5}$	...	...	sl. s.	...	s. HF, HCl, al.
10	2.254	...	...	sl. s. d.	...	i. al.; s. HF, HCl
11	1.7	d. 675	...	d. to $Ca(OH)_2$ — H_2		d. a., no known solv.
12	...	d. 15–18	...	v. s.	...	s. al.
13	[illegible]; anh. [illegible]	$-H_2O$, 580	...	0.185^0	0.077^{100}	s. NH_4Cl soln., a.; i. al.
14	4.59[illegible]	i.	...	0.10^0	0.95^{100}	s. HNO_3
15	...	d. [illegible]	...	0.13^0	1.22^{100}	s. HNO_3
16	[illegible]	575	715	182^0	426^{100}	s. a., al. acet.
17	...	42	160	757^0	1680^{60}	s. a., acet., al.
18	2.4	d. [illegible]	...	331^{14}	388^{25}	s. NH_4OH
19	4.35	...	...	i.	...	s. a.; i. al., eth.
20	2.35	561	...	102.0^0	376[illegible]	s. al., acet.
21	...	51.1	...	...	...	...
22	1.82	α 42.7; β 39.7	132	266[illegible]	666[illegible]	s. al., acet.
23	2.63[illegible]	900	...	75.5 d.	247 d.	s. dil. a.; i. abs. al.
24	2.23^{34}; anh. 2.53[illegible]	$-H_2O$, 100	...	45.9^0	89.6[illegible]	sl. s. al.
25	1.674[illegible]	$-2H_2O$, 44	...	74.9^0	106[illegible]	s. al.
26	3.40	2572	2850	.12 d.	.07[illegible] d.	s. a., al.
27	...	d.	...	sl. s.	...	s. a.
28	...	$-8H_2O$, 100	d. 275, exp.	sl. s. ev. O	d.	s. a., NH_4 salts; i. al., eth.
29	[illegible]	$-H_2O$, 100	d. 200	d.	d.	s. a.
30	[illegible]	d. 25	...	0.02^{25}	d.	s. a.; i. al.
31	3.14	1670	...	0.002–3	d.	s. a.; i. al.
32	2.52	975	...	i.	i.	i. a.
33	...	...	...	i.	...	s. HCl, $H_4P_2O_6$
34	3.09	1230	...	i.	...	s. a.
35	2.25	...	...	sl. s.	...	s. a.; i. NH_4Cl
36	3.14	1270	...	v. sl. s.	...	...
37	2.51^{15}	>1600	...	d. ev. PH_3	...	s. a.; i. al., eth.
38	...	...	...	sl. s.	d.	s. NH_4Cl
39	...	d. [illegible]	...	15.4^{25}	12.5^{100}	i. al.
40	...	...	...	s.	...	...
41	5.71	d.		i.	d.	s. a.
42	...	d.		sl. s.	...	...
43	2.60	1004	...	0.25	d.	s. a.; i. al.
44	2.93; ($2H_2O$) 2.6[illegible]	...	...	7.9^0	54[illegible]	...

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Calcium			
1	silicate (α) (pseudo-wollastonite)	$CaSiO_3$	116.14	monocl. col., 1.610, 1.611, 1.654
2	" (β), (wollastonite)	$CaSiO_3$	116.14	monocl. col., 1.616, 1.629, 1.631
3	silicide	$CaSi_2$	96.20	....
4	sodium sulfate	$CaNa_2(SO_4)_2.2H_2O$	314.23	monocl. need
5	sulfate (anhydrite)	$CaSO_4$	136.14	rhomb. or monocl. col., 1.569, 1.575 1.613
6	" (gypsum)	$CaSO_4.2H_2O$	172.17	monocl. col., 1.521, 1.523, 1.530
7	sulfide (oldhamite)	CaS	72.14	cubic col
8	sulfite	$CaSO_3.2H_2O$	156.17	hex. col
9	" bi-	$Ca(HSO_3)_2$	202.22	yelsh. liq., strong SO_2 odor
10	thiocarbonate	$CaCS_3$	148.26	yel
11	thiocyanate	$Ca(CNS)_2.3H_2O$	210.26	wh. cr., deliq
12	thionate, di-	$CaS_2O_6.4H_2O$	272.26	trig. col
13	thiosulfate	$CaS_2O_3.6H_2O$	260.29	tricl
14	titanate (perovskite)	$CaTiO_3$	135.98	rhomb., β 2.38
15	tungstate (scheelite)	$CaWO_4$	288.08	tetr. col. or wh. sc., 1.918, 1.934
16	" meta-	$CaW_4O_{13}.10H_2O$	1164.24	col. tricl
17	**Carbonic acid**	H_2CO_3	62.02	exists only in solution
18	**Carbon** amorphous	C	12.00	amor. blk
19	" graphite	C	12.00	cub. blk
20	" diamond	C	12.00	cub. col., 2.4173
21	bromide, di- (tetrabromoethylene)	C_2Br_4	343.66	....
22	" tri- (hexabromoethane)	C_2Br_6	503.50	1.740, 1.847, 1.863
23	" tetra- (tetrabromomethane)	CBr_4	331.66	wh. tabl
24	chloride, di- (tetrachloroethylene)	C_2Cl_4	165.83	col. liq., eth. odor, 1.5055
25	" tri- (hexachloroethane)	C_2Cl_6	236.74	rhomb., tricl. or cub., col
26	" tetra- (tetrachloromethane)	CCl_4	153.83	col. liq., 1.4607
27	fluoride, tetra-	CF_4	88.00	col
28	iodide, tetra-	CI_4	519.68	octahdr. red
29	nitride	C_2N_2	52.02	col
30	oxide, mon-	CO	28.00	col. odorl. **poisonous gas**
31	" di-	CO_2	44.00	col. odorl. gas or col. liq
32	" sub-	C_3O_2	68.00	col. gas or liq., 1.4538^0
33	oxybromide (carbonyl bromide)	$COBr_2$	187.83	....
34	oxychloride (phosgene, carbonyl chloride)	$COCl_2$	98.91	col. pois. gas or col. volat. liq
35	oxysulfide (carbonyl sulfide)	COS	60.06	gas
36	selenosulfide	CSSe	123.26	liq
37	silicide	CSi_2	68.12	gray cryst

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	2.905	1540	....	0.0095^{17}	....	s. HCl
2	2.915	tr. 1200	....	....	....	....
3	2.5	....	....	i.	d.	d. a., bases
4	2.64	$-2H_2O$, 80	....	d.	d.	....
5	2.96	monocl. 1450	tr. to rhomb. 1193	0.298	0.1619^{100}	s. a., $Na_2S_2O_3$, NH_4 salts, glyc.
6	2.32	$-1\frac{1}{2}H_2O$, 128	$-2H_2O$, 163	0.241^0	0.222^{100}	s. a., $Na_2S_2O_3$, NH_4 salts, glyc.
7	2.8^{15}	....	d.	$.0121^{15}$ d.	$.4614^{100}$ d.	d. a.
8	....	$-2H_2O$, 100	....	0.0043^{18}	0.0011^{100}	s. H_2SO_3
9	....	....	....	s.	....	s. a.
10	....	....	....	s.	....	s. al.
11	....	....	....	v. s.	v. s.	v. s. al.
12	2.176	....	....	19.75^0	34.59^{30}	....
13	1.872	d.	....	100^3	d.	i. al.
14	4.10	....	....	....	....	....
15	6.06	....	....	0.2	....	s. NH_4Cl; i. a., al.
16	....	d.	....	....	....	d. a.
17	....	....	....	s.	....	....
18	1.8–2.1	subl. 3537	4200(?)	i.	i.	i. a. alk.
19	2.25	3527	4200(?)	i.	i.	i. a., alk.; s. liq. Fe
20	3.51	>3500	4200(?)	i.	i.	i. a., alk.
21	....	57.5	227	....	....	....
22	3.823	....	210	....	....	s. CS_2; i. al., eth.
23	3.42	α 48.4; β 90.1	189.5	i.	....	s. al., eth., chl.
24	1.623	−22.4	120.8	....	....	s. al., eth.
25	2.091	185	185	i.	....	s. al., eth., oils
26	1.595	−23.0	76.8	v. sl. s.	....	s. al., bz., chl., eth.
27	....	−80	−15	sl. s.	....	....
28	4.32	d.	d.	i.	d.	s. al., CS_2, eth.
29	0.87	−34.4	−20.5	sl. s.; $(C_2N_2)_n$ more sol		....
30	1.250^0 g/l; lq. 0.793	−207	−192	3.5^0 cm³	$.0018^{50}$ cm³	s. al., Cu_2Cl_2, bz., ac. a.
31	1.977^0 g/l; lq 1.101^{-37}; s. 1.56^{-79}	$-56.6^{5.2 atm}$	−78.5 subl.	179.7^0 cm³; $.355^0$ g; $.145^{25}$ g	90.1^{20} cm³; $.097^{40}$ g; $.058^{60}$ g	31^{15} al. cm³; s. acet.
32	liq. 1.114^0	−107	6.3	d.	....	....
33	2.44	....	64.5	....	....	....
34	1.392	−104	8.3	d.	....	v. s. bz., tol.; s. ac. a.; a. a., al.
35	2.72 g/l; lq. 1.24^{-87}	−138	−48	133^0 cm³	40.3^{30} cm³	v. s. al., alk.
36	....	−85	84.5	i.	i.	s. CS_2; sl. s. al.
37	2.5	....	....	d.	d.	s. HNO_3, H_2SO_4; i. al., eth.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Carbon			
1	sulfide, mono-	CS	44.06	red powd
2	" di-	CS_2	76.12	col. liq., 1.629[18]
3	tellurosulfide	CSTe	171.56	yel.-red
4	thionyl chloride (thiophosgene)	$CSCl_2$	114.97	red-yel. liq., 1.5442
5	" perchloride	$CSCl_4$	185.89	yel
6	**Cerium**	Ce	140.13	cub. or hex. steel gray met
7	ammonium nitrate (ic)	$Ce(NH_4)_2(NO_3)_6$	548.26	monocl. yel.-red
8	" " (ous)	$Ce(NO_3)_3.2NH_4NO_3.4H_2O$	558.31	monocl
9	" sulfate "	$Ce_2(SO_4)_3(NH_4)_2SO_4.8H_2O$	844.70	monocl
10	bromate (ous)	$Ce(BrO_3)_3.9H_2O$	686.02	hex. redsh. wh
11	bromide (ous)	$CeBr_3$	379.88	wh. cr. powd., deliq
12	" "	$CeBr_3.H_2O$	397.89	need., deliq
13	carbide	CeC_2	164.13	hex. red
14	carbonate (ous)	$Ce_2(CO_3)_3.5H_2O$	550.34	micr. pr. wh
15	chloride (ous)	$CeCl_3$	246.50	col. cr., deliq
16	fluoride (ic)	$CeF_4.H_2O$	234.15	wh. amor. powd
17	" (ous), (fluocerite)	CeF_3	197.13	hex. wh
18	hydride (ous)	CeH_3	143.15	amor. powd., dk. bl
19	hydroxide (ic)	$Ce(OH)_4$	208.16	yelsh. gelat. ppt
20	" (ous)	$Ce(OH)_3$	191.15	wh. gelat. ppt
21	iodate	$Ce(IO_3)_4$	839.81	col
22	iodide (ous)	$CeI_3.9H_2O$	683.03	redsh.-wh. cr
23	nitrate (ic)	$Ce(NO_3)_4$	388.16	redsh. yel., deliq
24	" " basic	$Ce(NO_3)_3OH.3H_2O$	397.21	long red need
25	" (ous)	$Ce(NO_3)_3.6H_2O$	434.25	col. or redsh. (trac. La, Di) cr., deliq.
26	oxide (ic)	CeO_2	172.13	cub. wh.-yel. or amor
27	" (ous)	Ce_2O_3	328.26	gray-grn. powd
28	oxychloride (ous)	CeOCl	191.59	purp. leaf
29	*ortho*phosphate (ous) (monazite)	$CePO_4$	235.15	monocl. red or rhomb. yel
30	*meta*phosphate (ous)	$Ce(PO_3)_3$	377.19	micr. need
31	platinocyanide (ous)	$Ce_2Pt_3(CN)_{12}.18H_2O$	1502.33	monocl. yel. bl. lust
32	silicide (ic)	$CeSi_2$	196.25	
33	sulfate (ic)	$Ce(SO_4)_2$	332.25	deep yel. cryst
34	" "	$Ce(SO_4)_2.4H_2O$	404.31	rhomb. sulf. yel
35	" (ous)	$Ce_2(SO_4)_3$	568.44	monocl. or rhomb. col.; grn. powd., hyg.
36	" "	$Ce_2(SO_4)_3.4H_2O$	640.50	rhomb. asbestos like need. ($5H_2O$ monocl.)
37	" "	$Ce_2(SO_4)_3.8H_2O$	712.56	tricl. or monocl. sm. pink cr
38	" "	$Ce_2(SO_4)_3.9H_2O$	730.58	asbestos like need., hex. cr
39	sulfide "	Ce_2S_3	376.44	red cr.; br.-dk. purp. powd
40	**Cesium**	Cs	132.81	hex. sil.-wh. duct. met
41	bromate	$CsBrO_3$	260.73	
42	bromide	CsBr	212.73	cub. col., 1.6984
43	" tri-	$CsBr_3$	372.56	rhomb
44	" chlorodi-	$CsBr_2Cl$	328.10	yellow
45	" dichloro-	$CsBrCl_2$	283.64	
46	" diiodo-	$CsBrI_2$	466.57	

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.66	d.	200	i.	....	s. CS_2, eth.; i. al.
2	1.261^{22}_{20}	−111.6	46.3	0.2^{0}	$.014^{50}$	s. al., eth.
3	....	−54	d.	....	....	s. CS_2, bz.
4	1.509^{15}	....	73.5	....	....	....
5	1.712^{13}	....	146–7	....	d.	....
6	cub. 6.90; hex. 6.7	640	1400	i.	i.	s. dil. a.; i. al.
7	....	....	....	141^{25}	226.8^{86}	sl. s. HNO_3; s. al.
8	....	74	....	s.	....	....
9	2.523	$-6H_2O$, 100; $-8H_2O$, 150	....	anh. 5.33^{22}	....	....
10	....	49	....	s.	....	....
11	....	....	....	s.	....	....
12	....	d.	....	s.	....	s. al.
13	5.23	....	....	d.	d.	s. a.
14	....	....	....	v. sl. s.	....	s. dil. a., $(NH_4)_2CO_3$
15	3.92^{0}	848(794–812)	d.	100	d.	30 al.; s. acet.
16	....	d.	....	i.	....	s. a.
17	6.16	1324	....	i.	....	....
18	....	ign.	....	d.	....	....
19	....	....	....	....	....	s. a.; sl. s. alk. carb.; i. alk.
20	....	....	....	....	....	s. a., $(NH_4)_2CO_3$; i. alk.
21	....	....	....	0.015^{20}	....	....
22	....	....	d. ev. I_2	v. s.	....	v. s. al.
23	....	....	....	s.	d.	s. al.
24	....	....	....	s.	....	....
25	....	$-3H_2O$, 150	d. 200	v. s.	v. s.	50 al.; s. acet.
26	7.3	1950	....	i.	i.	s. H_2SO_4, HNO_3; i. dil. a.
27	6.9–7.0	ign. 200	....	i.	i.	s. H_2SO_4; i. HCl
28	....	....	....	i.	....	s. dil. a.
29	5.22	....	....	i.	i.	s. a.; i. al.
30	3.723	....	....	....	....	i. a.
31	2.657	....	....	....	....	....
32	5.67^{17}	....	....	i.	....	....
33	3.91^{18}	....	d. 195	sly. d. to	form basic	salt
34	....	....	....	v. s., d.	....	s. dil. H_2SO_4
35	3.912	....	....	10.1^{0}	4.06^{60}; 2.25^{100}	....
36	$3.22(5H_2O)$	....	....	8.5^{35}	0.43^{100}	....
37	2.886^{17}	$-8H_2O$, 630	....	23.8^{0}	6^{50}	....
38	2.831	....	....	11.87^{15}	....	....
39	5.020^{11}	d.	....	i.	d.	s. dil. a.
40	1.90	28.5	670	d.	d.	s. a., al.
41	....	....	....	4.53^{30}	....	....
42	4.44; lq. 3.04^{700}	636	1300	124.3^{25}	....	d. al.
43	....	180	....	....	....	....
44	....	191	....	....	....	....
45	....	205	....	....	....	....
46	....	195.5	....	260.5^{15} d.	....	s. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cesium			
1	carbonate	Cs_2CO_3	325.62	col. cr., deliq
2	" acid	$CsHCO_3$	193.82	rhomb.
3	chlorate	$CsClO_3$	216.27	
4	*per*chlorate	$CsClO_4$	232.27	rhomb. col
5	chloride	$CsCl$	168.27	cub. col. deliq., 1.6418
6	chloroaurate	$CsAuCl_4$	471.84	
7	chloroplatinate	Cs_2PtCl_6	673.59	cub. yel
8	chlorostannate	Cs_2SnCl_6	597.06	cub. wh.
9	chromate	Cs_2CrO_4	381.63	
10	cyanide	$CsCN$	158.82	col. cr
11	fluoride	CsF	151.81	cub. col
12	"	$CsF.3/2H_2O$	178.83	
13	fluosilicate	Cs_2SiF_6	407.68	cub. wh.
14	hydride	CsH	133.82	wh. cr
15	hydroxide	$CsOH$	149.82	col.-yelsh., v. deliq
16	iodate	$CsIO_3$	307.73	monocl. wh.
17	*per*iodate	$CsIO_4$	323.73	rhomb. wh. pl
18	iodide	CsI	259.73	cub. col., 1.7876
19	" tri-	CsI_3	513.57	rhomb. blk
20	" penta-	CsI_5	767.41	tricl. blk
21	" chlorobromo-	$CsIBrCl$	375.10	rhomb. yel.-red
22	" dibromo-	$CsIBr_2$	419.56	rhomb.
23	" dichloro-	$CsICl_2$	330.64	rhomb. pa. or
24	*per*manganate	$CsMnO_4$	251.74	
25	mercuric bromide	$CsBr.2HgBr_2$	933.61	
26	" chloride	$CsCl.HgCl_2$	439.79	cub. or rhomb. col., 1.792
27	nitrate	$CsNO_3$	194.82	col. hex. or cub., glit
28	" hydro-	$CsNO_3.HNO_3$	257.83	oct
29	" dihydro-	$CsNO_3.2HNO_3$	320.85	col. plates
30	nitrite	$CsNO_2$	178.82	yel. cryst
31	oxide, mon-	Cs_2O	281.62	or.-red cr
32	" di-	Cs_2O_2	297.62	pa. yel. need
33	" tri-	Cs_2O_3	313.62	choc. br. cr
34	" tetr-	Cs_2O_4	329.62	yel. cryst
35	silicotungstate	$Cs_8SiW_{12}O_{42}$	3970.54	wh. cr
36	sulfate	Cs_2SO_4	361.68	rhomb. or hex. col., 1.560, 1.564, 1.566
37	" acid	$CsHSO_4$	229.88	rhomb. col. pr
38	sulfide	$Cs_2S.4H_2O$	369.74	wh. cr., deliq
39	" di-	Cs_2S_2	329.74	amor., dk. red
40	" "	$Cs_2S_2.H_2O$	347.76	tetr
41	" tri-	Cs_2S_3	361.80	yel. leaf
42	" tetra-	Cs_2S_4	393.86	yel.
43	" penta-	Cs_2S_5	425.92	?
44	" hexa-	Cs_2S_6	457.98	brown-red
45	**Chloric acid**	$HClO_3.7H_2O$ (?)	210.57	known only as col. soln
46	" " per-	$HClO_4$	100.46	col. unst. liq
47	" " "	$HClO_4.H_2O$	118.48	need., fairly stable
48	" " "	$HClO_4.2H_2O$	136.50	stable, liq.
49	**Chlorine**	Cl_2	70.91	grnsh.-yel. gas or lq. or rhomb. cr, gas 1.000768, lq. 1.367

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	......	d. 610	......	260.5^{15}	v. s.	11^{19} al.; s. eth.
2	......	$-\frac{1}{2}CO_2$, 175	......	209.3^{15}	v. s.	s. al.
3	3.57	......	......	......	37.9^{100}	s. al.
4	3.327	d.	......	0.8^{0}	30^{100}	i. abs. al.
5	3.97	646	1290 subl.	161.7^{0}; 185.7^{20}	270.5^{100}	v. s. al.
6	......	......	......	0.5^{20}	27.5^{100}	s. al.
7	......	d.	......	$.024^{0}$; $.135^{20}$	0.377^{100}	i. al.
8	3.33	......	......	......	......	......
9	4.237	......	......	71.4^{13}	95.5^{30}	......
10	......	......	......	s.	......	i. al.
11	3.586	684	1250	v. s.	......	i. al.
12	......	......	......	366.5^{15}	......	......
13	3.372^{17}	......	......	60^{17}	less s. h.	i. al.
14	2.7	d.	......	d.	d.	d. a.
15	3.675	272.3	......	395.5^{15}	......	s. al.
16	4.85	......	......	2.6^{24}	......	......
17	4.259	......	......	2.15^{15}	......	......
18	4.510	621	1280	44^{0}	160^{62}	s. al.
19	......	207.5	......	v. sl. s.	......	......
20	......	73	......	......	......	......
21	......	235	d. 290	......	......	......
22	......	248	d. 320	......	......	......
23	3.86	230	d. 290	......	......	......
24	3.597	d.	......	0.097^{25}	1.27^{59}	......
25	......	......	......	0.807^{17}	......	sl. s. al.
26	......	......	......	1.44^{17}	......	i. abs. al.
27	3.685; lq. 2.71^{500}	414	d.	9.16^{0}; 14.9^{20}	196.8^{100}	s. acet.; sl. s. al.
28	......	100	......	......	......	......
29	......	32–36	......	......	......	......
30	......	......	......	v. s.	v. s.	......
31	4.36	d. 360–400	......	v. s.	d.	s. abs. al.
32	4.25	400	$-O_2$, 650	s.	d.	s. a.
33	4.25^{0}	400	......	d.	......	s. a.
34	3.77^{19}	600	d.	d. to CsOH	d.	s. a.
35	......			0.005^{20}	0.5^{100}	sl. s. NH_4OH; i. HCl, al.
36	4.243	1010	tr. hex. 660	167^{0}	220^{100}	i. al., acet.
37	3.352^{16}	d.	......	s.	......	......
38	......	......	......	v. s.	v. s.	......
39	......	460	>800	hyg.	......	......
40	......	......	......	s.	......	......
41	......	217	780	......	......	......
42	......	160 d.	......	......	......	......
43	2.806^{16}	210	......	......	......	......
44	......	186	......	......	......	......
45	$1.282^{14.2}$	< −20	d. 40	v. s.	......	......
46	1.764^{22}	−112	39^{56}	∞	......	......
47	1.88; lq. 1.776^{50}	50	exp. 110	v. s.	v. s.	......
48	1.65	−17.8	200	v. s.	v. s.	s. al.
49	3.214^{0} g/l; lq. 1.557^{-34}; s. 1.9	−102	−33.7 (−34.6)	310^{10} cm³; 1.46^{0} g	177^{30} cm³; 0.57^{30} g	s. alk.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Chlorine			
1	azide (chloroazide)	ClN_3	77.48	gas
2	fluoride	ClF	54.46	nearly col. gas
3	" tri-	ClF_3	92.46	col. gas
4	hydrate	$Cl.5H_2O$	125.54	cub. oct. yel
5	"	$Cl_2.8H_2O$	215.04	rhomb. lt. yel
6	oxide, mon-	Cl_2O	86.91	yel.-red gas or red-br. lq
7	" di-	ClO_2	67.46	red-yel. gas or or.-red cr
8	" hept-	Cl_2O_7	182.91	col. oil
9	**Chlorosulfonic acid**	SO_3HCl	116.52	col. fum. liq., 1.437^{14}
10	**Chromium**	Cr	52.01	cub. steel gray. v. hard met
11	ammonium sulfate (ic)	$Cr(NH_4)(SO_4)_2.12H_2O$	478.36	cub. grn. or vlt., 1.4842
12	arsenide (ic)	$CrAs$	126.94	gray
13	boride (ic)	CrB	62.83	silv. cr
14	bromide (ic)	$CrBr_3$	291.76	hex. olv. grn
15	" "	$CrBr_3.6H_2O$	399.85	hex. pl., grn., deliq
16	carbide (ic)	Cr_3C_2	180.03	gray cr
17	carbonate (ous)	$CrCO_3$	112.01	amor. gray bl
18	chloride (ic)	$CrCl_3$	158.38	i. vlt. pl. (or deliq. s. cr.)
19	" "	$[Cr(H_2O)_6]Cl_3$	266.47	monocl. vlt
20	" "	$[CrCl_2(H_2O)_4].Cl.2H_2O$	266.47	rhomb. grn
21	" "	$CrCl_3.10H_2O$	338.54	grn. cr. powd
22	" (ous)	$CrCl_2$	122.92	wh. need., deliq
23	fluoride (ic)	CrF_3	109.01	rhomb. grn
24	" "	$CrF_3.4H_2O$	181.07	cub. oct. grn
25	" "	$CrF_3.9H_2O$	271.15	vlt. bl. gelat
26	" (ous)	CrF_2	90.01	grn. cryst
27	hydroxide (ic)	$Cr(OH)_3$	103.03	bl.-gray grn. gel. or vlt. amor
28	" "	$Cr(OH)_3.2H_2O$	139.06	grn
29	" (ous)	$Cr(OH)_2$	86.03	yel. br
30	iodide (ous)	CrI_2	305.85	
31	nitrate (ic)	$Cr(NO_3)_3.7\frac{1}{2}H_2O$	373.15	monocl. purp
32	" "	$Cr(NO_3)_3.9H_2O$	400.17	monocl. purp
33	nitride (ic)	CrN	66.02	amor
34	oxide (ic)	Cr_2O_3	152.02	hex., grn
35	" (ous)	CrO	68.01	black
36	" di-	CrO_2	84.01	br.-blk. powd
37	" tri-	CrO_3	100.01	rhomb. red., deliq
38	oxychloride	CrO_2Cl_2	154.92	dk. red liq
39	*ortho*phosphate (ic)	$Cr(PO_4).3H_2O$	201.08	violet cr
40	" "	$Cr(PO_4).4H_2O$	219.09	grn. cr
41	" "	$Cr(PO_4).6H_2O$	255.12	tricl. vlt
42	phosphide (ic)	CrP	83.03	gray blk. cr
43	potassium cyanide (ic)	$CrK_3(CN)_6$	325.36	yel. monocl

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	......	......	......	sl. s.	......	d. alk.
2	1.62^{-100}	−154 ± 0.5	−100.8	d.	d.	......
3	1.77^{13}	−83	11.3	d.	d.	......
4	......	−50	d. 35	......	......	s. HCl
5	1.23	d. 9.6	......	v. s.	......	......
6	3.89^{0} g/l	−20	3.8^{766}; exp.	200 cm³	d. to HOCl	s. alk.; H_2SO_4; exp. C comp.
7	3.09^{11} g/l	−59	9.9^{731}; exp. 100	2000^{4} cm³	d. $HClO_3$, Cl_2, O_2	s. alk., H_2SO_4; exp. C comp.
8	......	−91.5	82	s. d.	......	s. bz.
9	1.766^{18}	−80	158	d. to H_2SO_4 + HCl		d. al., a.; i. CS_2
10	6.92	1615	2200	i.	i.	s. HCl, dil. H_2SO_4; i. HNO_3
11	1.72	94; $-9H_2O$, 100	......	21.2^{25}	32.8^{40}; grn. at 70	s. al., dil. a.
12	6.35^{16}	......	......	i.	i.	i. a.
13	5.4^{17}	......	......	i.	i.	s. fus. Na_2O_2
14	4.250	......	subl.	(1) 200* (2) i.	...... i.	v. s. al.; d. alk.
15	5.4^{17}	......	......	200	......	v. s. al.; s. fus. Na_2O_2; i. eth.
16	6.68	1890	3800	i.	i.	s. dil. HCl
17	......	......	......	v. sl. s.	......	i. eth., al.; s. min. a.
18	2.76^{15}	......	1300 subl.	i. (233^{25})	i. (s.)	i. a., CS_2, acet., al.
19	2.76	95	......	58.7^{25}	s.	s. al.; i. eth.
20	2.76	83	1200–1500	58.5^{35}	s.	s. al.; i. eth.
21	......	......	......	v. s.	......	v. s. al.
22	2.75	......	......	v. s.	v. s.	sl. s. al.; i. eth.
23	3.8	>1000	subl.	i.	......	sl. s. a.; i. al., NH_3
24	3.78	......	......	s.	s.	s. a.; i. al., NH_3
25	......	......	......	v. s.	......	s. a., HCl, KOH; i. al.
26	4.11	1100	>1300	sl. s.	......	s. h. HCl; i. al.
27	......	......	......	i.	i.	s. a., alk.; sl. s. NH_4OH
28	......	$-2H_2O$, 100	......	i.	i.	s. a., alk., $NaHSO_3$
29	......	......	......	d.	......	s. a.
30	5.196	......	......	v. s.	......	......
31	......	100	......	s.	s.	......
32	......	37	125.5	s.	s.	s. a., al., alk., acet.
33	......	d. 1500	......	i.	......	i. a., alk.
34	5.21	1990	......	i.	i.	i. a., al., alk.
35	......	......	......	i.	i.	i. dil. HNO_3
36	......	−O, 300	......	i.	......	s. HNO_3
37	2.70	196	d.	166^{15}	206.7^{100}	s, eth., al., H_2SO_4
38	1.911	−96.5	117	d.	d.	s., eth., ac. a.; d. al.
39	......	......	......	sl. s.	......	s. a., alk.; i. ac. a.
40	......	......	......	sl. s.	......	s. a.
41	2.121	$-3\frac{1}{2}H_2O$, 100	......	sl. s.	......	s. a., alk.; i. ac. a.
42	5.7^{15}	......	......	i.	......	s. HNO_3, HF; i. a.
43	1.71	......	......	30.9^{20}	......	i. al.

* Several chromic salts exist in two forms, a soluble and an insoluble modification.

PHYSICAL CONSTANTS O

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Chromium			
1	potassium sulfate (ic)	$CrK(SO_4)_2.12H_2O$	499.42	cub. oct., red or grn., 1.4814
2	rubidium sulfate	$Cr_2(SO_4)_3.Rb_2SO_4.24H_2O$	1091.51	cub., 1.482
3	silicide (ic)	Cr_3Si_2	212.15	tetr. pr
4	sulfate (ic)	$Cr_2(SO_4)_3$	392.20	vlt. or red powd
5	" "	$Cr_2(SO_4)_3.5H_2O$	482.28	green amor
6	" "	$Cr_2(SO_4)_3.15H_2O$	662.43	dk. grn. amor. sc
7	" "	$Cr_2(SO_4)_3.18H_2O$	716.48	cub. oct., bl.-vlt
8	" (ous)	$CrSO_4.7H_2O$	274.18	blue
9	sulfide (ic)	Cr_2S_3	200.20	br. blk. powd
10	" (ous), (daubrelite)	CrS	84.07	blk. powd
11	" tetra-	Cr_3S_4	284.27	gray-blk. powd
12	**Cobalt**	Co	58.94	cub. silv. gray metal
13	aluminate (Thenard's blue)	$Co(AlO_2)_2$	176.88	cub. blue
14	ammonium chloride (ous)	$CoCl_2.NH_4Cl.6H_2O$	291.44	red, deliq
15	" phosphate (ous)	$CoNH_4PO_4.H_2O$	190.01	vlt. cr. powd
16	" sulfate (ous)	$CoSO_4(NH_4)_2SO_4.6H_2O$	395.23	monocl. ruby-red, 1.490, 1.495, 1.50
17	arsenate (ous), (erythrite)	$Co_3(AsO_4)_2.8H_2O$	598.80	monocl. vlt.-red, 1.626, 1.661, 1.699
18	arsenite (ous)	$Co_3H_6(AsO_3)_4.H_2O$	692.60	rose red
19	boride (ic)	CoB	69.76	pr
20	bromate (ous)	$Co(BrO_3)_2.6H_2O$	422.87	oct. red
21	bromide (ous)	$CoBr_2$	218.77	grn. cr., deliq
22	" "	$CoBr_2.6H_2O$	326.87	pr. red-vlt., deliq
23	carbonate (ous), (spherocobaltite)	$CoCO_3$	118.94	trig., red, 1.855, 1.60
24	" basic (ous)	$2CoCO_3.3Co(OH)_2$	516.75	vlt.-red prisms
25	carbonyl, tri-	$Co(CO)_3$	142.94	blk. cr
26	" tetra-	$Co(CO)_4$	170.94	or. cr
27	chlorate (ous)	$Co(ClO_3)_2.6H_2O$	333.95	cub. red, deliq
28	perchlorate (ous)	$Co(ClO_4)_2$	257.85	red need
29	" "	$Co(ClO_4)_2.6H_2O$	365.95	hex., 1.55
30	chloride (ic)	$CoCl_3$	165.31	ruby-red cr
31	" (ous)	$CoCl_2$	129.85	bl. cr
32	" "	$CoCl_2.2H_2O$	165.89	
33	" "	$CoCl_2.6H_2O$	237.95	monocl. red
34	chromate (ous)	$CoCrO_4$	174.95	yel.-br. powd
35	cyanide (ous)	$Co(CN)_2.2H_2O$	146.99	buff
36	" "	$Co(CN)_2.3H_2O$	165.00	amor. red-gray powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.83	89	$-12H_2O$, 400	24.39^{25}	50	s. dil. a.; i. al.
2	1.946	107	....	....	....	....
3	5.5	....	....	i.	i.	s. HCl, HF; i. HNO_3, H_2SO_4
4	3.012	....	....	i.; s.*	....	i. a.; s. al.
5	....	....	....	s.	....	v. s. al.; s. al., H_2SO_4
6	1.867^{17}	100	$-10H_2O$, 100	s.	s., $d.^{57}$	i. al.
7	1.86	$-12H_2O$, 100	....	120^{20}	i.	s. al.
8	....	....	....	12.35^{0}	....	sl. s. al.
9	3.77^{19}	....	....	i. d.	i.	s. HNO_3; d. al.
10	4.1	....	....	i.	....	v. s. a.
11	....	....	....	i.	....	s. HNO_3; i. HCl, dil. H_2SO_4
12	8.9	1480	2900	i.	i.	s. a.
13	....	....	....	i.	i.	i. a.
14	....	....	....	v. s.	v. s.	....
15	....	....	....	i.	....	s. a.
16	1.902	....	....	20.5^{20}	45.4^{80}	i. al.
17	2.948	d.	....	i.	i.	s. dil. a., NH_4OH
18	....	$-H_2O$, 100	....	i.	....	s. a., NH_4OH
19	7.25^{13}	....	....	d.	d.	s. HNO_3
20	....	....	....	45.5^{17}	....	s. NH_4OH
21	4.909^{25}	d.	....	66.7^{39}	68.1^{37}	77.1^{20} al.; s. eth.
22	2.46	47–8; $-4H_2O$, 100	$-6H_2O$, 130	s. red color	153.2^{97}	s. a., eth.; s. al., bl. color
23	4.13	d.	....	i.	i.	s. a.; i. NH_3
24	....	....	....	i.	d.	s. a., $(NH_4)_2CO_3$
25	....	....	....	sl. s.	....	d. with Br.
26	1.73^{18}	51	d. 52	i.	i.	s. al., CS_2, eth.
27	1.92	61	d. 100	558.3^{0}	v. s.	s. al.
28	3.327	....	....	100^{0}	115^{45}	s. al., acet.
29	....	143	....	....	....	....
30	2.94	subl.	....	s.	s.	s. al.
31	3.356	subl.	1049	45^{7}	105^{36}	54.4 al.; 8.6 acet.; 38.5 meth. al.
32	2.477^{25}_{5}	....	....	....	....	....
33	1.924^{25}_{5}	86	$-6H_2O$, 110	76.7^{0} (red); 49.9^{20}	190.7[illegible]	v. s. al. bl. color; 0.29 eth.; s. acet.
34	....	d.	....	i.	....	s. a., NH_4OH
35	anh. 1.872^{25}	$-2H_2O$, 280	....	i.	....	s. KCN, HCl, NH_4OH
36	....	$-3H_2O$, 250	....	i.	....	s. KCN soln.

* Several chromic salts exist in two forms, a soluble and an insoluble modification.

PHYSICAL CONSTANTS O

No	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cobalt			
1	ferricyanide (ous)	$Co_3[Fe(CN)_6]_2$	600.60	red
2	ferrocyanide (ous)	$Co_2Fe(CN)_6.7H_2O$	455.88	gray-grn
3	fluoride (ic)	CoF_3	115.94	grn. powd
4	" (ous)	$CoF_2.2H_2O$	132.97	monocl. rose red
5	" "	$CoF_2.5HF.6H_2O$	305.07	trig., orange red
6	fluosilicate (ous)	$CoSiF_6.6H_2O$	309.09	trig. pink, 1.382, 1.387
7	hydroxide (ic)	$Co(OH)_3$	109.96	blk.-br. powd
8	" (ous)	$Co(OH)_2$	92.96	rhomb. rose red
9	iodate (ous)	$Co(IO_3)_2$	408.78	bl. vlt. need
10	" "	$Co(IO_3)_2.6H_2O$	516.87	
11	iodide "	CoI_2	312.78	br. red, deliq
12	" "	$CoI_2.2H_2O$	348.81	grn., deliq
13	" "	$CoI_2.6H_2O$	420.87	hex. br.-red
14	magnesium aluminate (spinel blue)	$CoMg(AlO_2)_2$	201.20	
15	nitrate (ous)	$Co(NO_3)_2.6H_2O$	291.05	monocl. red, deliq
16	oxide (ic)	Co_2O_3	165.88	blk.-gray powd
17	" (ous)	CoO	74.94	cub. grn.-br
18	" (ous, ic)	Co_3O_4	240.82	cub. blk
19	*ortho*phosphate (ous)	$Co_3(PO_4)_2$	366.86	redsh
20	" "	$Co_3(PO_4)_2.2H_2O$	402.89	pink powd
21	" "	$Co_3(PO_4)_2.3H_2O$	420.91	red
22	" "	$Co_3(PO_4)_2.8H_2O$	510.98	redsh. powd
23	phosphide	Co_2P	148.90	sm. need
24	*ortho*phosphite (ous)	$CoHPO_3.2H_2O$	175.00	redsh
25	potassium carbonate (ous)	$CoCO_3.KHCO_3.4H_2O$	291.11	rose cryst
26	potassium nitrite (ic)	$CoK_3(NO_2)_6$	452.29	yel. pr
27	" " "	$CoK_3(NO_2)_6.H_2O$	470.30	yel. cr. powd
28	" " "	$2Co(NO_2)_3.6KNO_2.3H_2O$	958.62	tetr. yel
29	" sulfate (ous)	$CoK_2(SO_4)_2.6H_2O$	437.35	monocl. pr. red, 1.481, 1.487, 1.500
30	*per*rhenate (ous)	$Co(ReO_4)_2.5H_2O$	649.64	dk. pink
31	selenate (ous)	$CoSeO_4.5H_2O$	292.22	tricl. ruby red
32	selenide (ous)	$CoSe$	138.14	hex. yel
33	silicate (ous)	Co_2SiO_4	209.94	dk. vlt. cr
34	sulfate (ic)	$Co_2(SO_4)_3$	406.06	bl. cr. powd
35	" (ous)	$CoSO_4$	155.00	red powd
36	" " (bieberite)	$CoSO_4.7H_2O$	281.11	monocl. red-pink, 1.477, 1.483, 1.48
37	sulfide (ic)	Co_2S_3	214.06	blk. cryst
38	" (ous), (syeporite)	CoS	91.00	hex. br
39	" di-	CoS_2	123.06	cub. blk
40	sulfite (ous)	$CoSO_3.5H_2O$	229.08	red
41	thiocyanate (ous)	$Co(SCN)_2.4H_2O$	247.14	dk. bl. hyg. cr
42	tungstate (ous)	$CoWO_4$	306.94	red-br. powd
	Cobalt complexes:			
43	aquapentammine cobaltichloride	$[Co(NH_3)_5H_2O]Cl_3$	268.48	brick red cr
44	chloropentammine cobaltichloride	$[CoCl(NH_3)_5]Cl_2$	250.47	rhomb. dk. red-violet

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	i.	....	s. NH_4OH; i. HCl
2	....	....	....	i.	....	s. KCN; i. HCl
3	....	....	....	d. to $Co(OH)_3$		....
4	anh. 4.43	....	....	s.	d.	s. HF
5	2.045	....	....	....	....	....
6	2.113^{19}	....	....	118.1[illegible]	s.	....
7	....	d.	$-1\frac{1}{2}H_2O$, 100	0.00032	....	s. a.; i. al.
8	3.597^{15}	d.	....	.00032	....	s. a., NH_4 salts; i. alk.
9	5.008^{15}	....	....	0.4^{15}	1.33^{100}	s. HCl, HNO_3
10	3.889^{21}	....	....	....	....	....
11	5.68	....	....	150^{0}	420^{100}	v. s. al., acet.
12	....	....	....	376.2^{25}	s.	....
13	2.90	$-6H_2O$, 130	....	s.	s.	s. al., eth., chl.
14	....	....	....	i.	i.	i. a.
15	1.87	<100	$-3H_2O$, 55	133.8^{0}	v. s.	$100^{12.5}$ al.; s. acet.; sl. s. NH_3
16	5.18	d. 895	....	i.	i.	s. a.; i. al.
17	5.68	d. 890	....	i.	i.	s. a., NH_4OH; i. al.
18	6.07	....	....	i.	i.	s. H_2SO_4; i. HCl, HNO_3, aq. reg.
19	....	....	....	i.	i.	s. H_3PO_4, NH_4OH
20	....	....	....	i.	....	s. H_3PO_4
21	....	....	....	v. sl. s.	....	s. H_3PO_4
22	....	$-8H_2O$, 250	....	sl. s.	....	s. min. a., H_3PO_4; i. al.
23	6.4^{15}	....	....	i.	i.	s. HNO_3
24	....	bl. at 250	....	sl. s.	....	....
25	....	....	....	d.	....	....
26	....	....	....	sl. s.	sl. s.	i. al.
27	....	....	....	i.	s. d.	s. min. a.; sl. s. ac. a.; i. al., eth.
28	....	d. 200	....	0.089^{17}	sl. s.	i. al. eth.
29	2.218	....	....	25.5^{0}	108.4^{49}	....
30	....	d.	....	d.	....	....
31	2.512	d.	....	v. s.	....	....
32	7.65	red ht.	....	....	....	....
33	4.63	....	....	i.	....	s. dil. HCl
34	....	....	....	s. d.	....	s. H_2SO_4
35	3.71^{25}_{25}	989	....	36.2^{20}	83^{100}	1.04^{18} meth. al.; i. NH_3
36	1.948^{25}_{25}	96.8	$-7H_2O$, 420	60.4^{3}	67^{0}	2.5^{3} al.; s. meth. al.
37	4.8	....	....	i.	....	d. a.
38	5.45	>1100	....	0.00038^{15}	....	s. a., al.
39	4.269	....	....	i.	....	s. HNO_3, aq. reg.
40	....	....	....	i.	....	s. H_2SO_4
41	....	....	....	s.	....	....
42	....	....	....	i.	....	....
43	....	d. 100	....	16.12^{0}	24.87^{15}	sl. s. HCl; i. al.
44	1.819^{25}_{25}	d.	....	0.232^{0}	$1.031^{88.4}$	s. conc. H_2SO_4; i. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cobalt complexes:			
1	hexammine cobaltichloride	$Co(NH_3)_6Cl_3$	267.50	monocl. or
2	tetrammine cobaltichloride	$[Co(NH_3)_4H_2OCl]Cl_2$	251.45	rhomb. grn
3	**Columbic acid**	$3Cb_2O_5.7H_2O$	925.91	
4	**Columbium** (niobium)	Cb(Nb)	93.30	rhomb. steel gray lust. met., 1.80
5	bromide	$CbBr_5$	492.88	purp. red
6	chloride	$CbCl_5$	270.59	yel.-wh., deliq
7	fluoride	CbF_5	188.30	monocl. pr., col.
8	hydride	CbH	94.31	gray powd
9	hydroxide	$Cb(OH)_5$	178.34	wh. amor
10	nitride	CbN	107.31	black
11	oxide, mon-	CbO	109.30	cubic
12	" di-	CbO_2	125.30	black
13	" pent-	Cb_2O_5	266.60	rhomb. wh
14	oxybromide	$CbOBr_3$	349.05	yel. cryst
15	oxychloride	$CbOCl_3$	215.67	need. col
16	oxysulfide	Cb_2OS_3	298.78	black
17	potassium fluoride	$CbOF_3.2KF.H_2O$	300.52	monocl. leaf. col
18	**Copper**	Cu	63.57	cub. redsh. metal
19	ammonio sulfate (ic)	$Cu(NH_3)_4SO_4.H_2O$	245.77	rhomb. bl
20	ammonium chloride (ic)	$CuCl_2.2NH_4Cl.2H_2O$	277.51	tetr. blue, 1.744, 1.724
21	" iodide (ous)	$CuI.NH_4I.H_2O$	353.46	rhomb. pl
22	*ortho*arsenate (ic)	$Cu_3(AsO_4)_2.4H_2O$	540.63	bluish grn
23	" acid (ic)	$Cu_5H_2(AsO_4)_4.2H_2O$	911.62	blue
24	arsenide (ic)	Cu_5As_2	467.71	oct. bl
25	*ortho*arsenite, acid (ic) (Scheele's green or Paris green)	$CuHAsO_3$	187.51	green powd
26	borate (ic)	$CuBO_4$	138.39	bluish-grn. cr. powd
27	boride	Cu_3B_2	212.35	yellow
28	bromate (ic)	$Cu(BrO_3)_2.6H_2O$	427.50	cub. bl. grn
29	bromide (ic)	$CuBr_2$	223.40	monocl. blk., deliq
30	" (ous)	Cu_2Br_2	286.97	cub., tetrah. wh
31	carbonate (ic), (azurite)	$2CuCO_3.Cu(OH)_2$	344.73	monocl. bl., 1.730, 1.758, 1.838
32	carbonate, basic (ic) (malachite)	$CuCO_3.Cu(OH)_2$	221.16	monocl. dk. grn., 1.655, 1.875, 1.909
33	carbonate (ous)	Cu_2CO_3	187.14	yellow
34	chlorate (ic)	$Cu(ClO_3)_2.6H_2O$	338.58	cub. green, deliq
35	chloride (ic), (eriochalcite)	$CuCl_2$	134.48	br. yel. powd
36	" (ic)	$CuCl_2.2H_2O$	170.52	rhomb. grn., deliq., β 1.685
37	" (ous), (nantokite)	Cu_2Cl_2	198.05	cub. wh., 1.93
38	chromate, basic (ic)	$CuCrO_4.2CuO.2H_2O$	374.75	yel.-br
39	*di*chromate (ic)	$CuCr_2O_7.2H_2O$	315.62	blk. cryst., deliq
40	cyanide (ic)	$Cu(CN)_2$	115.59	yel.-grn. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.702	....	....	4.26^{0}	$12.74^{46.5}$	s. conc. HCl; i. al., NH_4OH
2	1.847	d.	....	v. s.	....	s. a.; i. al.
3	....	....	....	i.	....	s. KOH, HF, H_2SO_4; i. NH_3
4	8.4	1950	2900	i.	i.	s. h. H_2SO_4; sl. s. HCl, HNO_3 aq. reg.
5	....	....	....	....	....	....
6	2.75	194	240.5	d.	....	s. HCl, CCl_4, al.
7	3.293^{18}	75.5	236	s. d.	....	s. al.; sl. s. CS_2, chl., H_2SO_4
8	6.6	ign.	....	....	....	s. HF, H_2SO_4
9	....	....	....	i.	....	s. alk.; i. a.
10	....	....	....	....	....	s. HF + HNO_3; i. HNO_3
11	6.3–.7	....	....	i.	....	s. HCl, H_2SO_4; i. HNO_3, KOH
12	....	....	....	i.	....	s. H_2SO_4; i. HNO_3
13	4.47	1520	....	i.	i.	s. H_2SO_4, HF, alk.
14	....	subl.	....	d.	....	s. a.
15	10.19^{400} g/l	subl. 400	....	s. d.	d.	s. H_2SO_4, al.; i. HCl
16	....	....	....	i.	....	s. H_2SO_4; sl. s. HF; i. HCl
17	....	....	....	7.69	....	....
18	8.92	1083	2310	i.	i.	s. HNO_3, h. H_2SO_4; v. sl. s. HCl, NH_4OH
19	....	d. 150	....	$18.5^{21.5}$	d.	i. al.
20	1.98	d. 110	....	33.8^{0}	99.3^{80}	s. a., al.
21	....	....	....	d.	d.	s. NH_4I
22	....	....	....	i.	i.	s. a., NH_4OH
23	....	....	....	i.	....	s. a., NH_4OH
24	7.56	d.	....	i.	i.	s. a., NH_4OH
25	....	d.	....	i.	i.	s. a., al., NH_4OH
26	....	....	....	s.	....	....
27	8.116	....	....	....	....	....
28	2.583	d. 180	$-6H_2O$, 200	v. s.	....	s. NH_4OH
29	....	498	....	v. s.	....	s. al., acet., NH_3; i. bz.
30	4.72^{12}	504	1345	v. sl. s.	d.	s. HBr, HCl, HNO_3, NH_4OH; i. acet.
31	3.88	d. 220	....	i.	d.	s. NH_4OH, h. aq. $NaHCO_3$
32	4.0	d. 200	....	i.	d.	0.026 aq. CO_2; s. a., NH_4OH, KCN; i. al.
33	4.40	d.	....	i.	i.	s. a., NH_4OH
34	....	65	d. 100	207^{0}	v. s.	s. al., acet.
35	3.054	498	d. to CuCl, 993	70.6^{0}	107.9^{100}	53^{15} al.; 68^{15} meth. al.
36	$2.39^{22.4}$	$-2H_2O$, 110	d.	110.4^{0}	192.4^{100}	s. al., eth., NH_4Cl
37	3.53	422	1366	0.0062	....	s. HCl, NH_4OH
38	....	$-2H_2O$, 260	....	i.	....	s. HNO_3, dil. a., NH_4OH; i. al.
39	2.286^{18}	....	....	v. s.	d.	s. a., al., NH_4OH
40	....	d.	....	i.	....	s. a., alk., KCN, C_5H_5N

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Copper			
1	cyanide (ous)	$Cu_2(CN)_2$	179.16	monocl. wh
2	ferricyanide (ic)	$Cu_3[Fe(CN)_6]_2$	614.49	yel.-grn
3	" (ous)	$Cu_3Fe(CN)_6$	402.60	br-red
4	ferrocyanide (ic)	$Cu_2Fe(CN)_6.7H_2O$	465.14	red br
5	" (ous)	$Cu_4Fe(CN)_6$	466.17	br-red
6	fluoride (ic)	$CuF_2.2H_2O$	137.60	monocl. bl
7	" (ous)	Cu_2F_2	165.14	red cryst
8	fluosilicate (ic)	$CuSiF_6.4H_2O$	277.69	monocl. pr
9	" "	$CuSiF_6.6H_2O$	313.72	rhomb. bl., deliq., 1.409, 1.408
10	" (ous)	Cu_2SiF_6	269.20	red powd
11	hydride	Cu_2H_2	129.16	red-br
12	hydroxide (ic)	$Cu(OH)_2$	97.59	bl. gel. or amor. bl. powd
13	" (ous)	$CuOH$	80.58	yellow
14	iodate (ic)	$Cu(IO_3)_2$	413.41	monocl. grn
15	" "	$Cu(IO_3)_2.H_2O$	431.43	tricl. blue
16	" basic (ic)	$CuOHIO_3$	255.50	rhomb. grn
17	*per*iodate (ic)	Cu_2HIO_6	351.07	grn. powd
18	iodide (ous,) (marshite)	Cu_2I_2	380.98	cub. wh., 2.346
19	nitrate (ic)	$Cu(NO_3)_2.3H_2O$	241.63	blue, deliq
20	" "	$Cu(NO_3)_2.6H_2O$	295.68	bl. cr
21	nitrite, basic (ic)	$Cu(NO_2)_2.3Cu(OH)_2$	448.34	grn. powd
22	nitride	Cu_3N	204.72	
23	nitroprusside (ic)	$CuFe(CN)_5NO.2H_2O$	315.49	grnsh. powd
24	oxide (ic), (paramelaconite)	CuO	79.57	cub. blk
25	" " (tenorite)	CuO	79.57	tricl. black, β 2.63
26	" (ous), (cuprite)	Cu_2O	143.14	cub. red
27	" per-	$CuO_2.H_2O$	113.59	olive grn.-br
28	" sub-	Cu_4O	270.28	olive grn
29	oxychloride (ic)	$CuCl_2.2CuO.4H_2O$	365.69	bl.-grn
30	*ortho*phosphate (ic)	$Cu_3(PO_4)_2.3H_2O$	434.80	rhomb. bl
31	phosphide (ic)	Cu_3P_2	252.75	gray-blk. met. powd
32	" (ous)	Cu_3P	221.73	gray blk
33	*ortho*phosphite (ic)	$CuHPO_3.2H_2O$	179.63	
34	potassium cyanide (ous)	$CuK_3(CN)_4$	284.90	rhbdr. col
35	rubidium sulfate	$CuRb_2(SO_4)_2.6H_2O$	534.66	monocl., 1.489, 1.491, 1.504
36	selenate (ic)	$CuSeO_4.5H_2O$	296.85	tricl. bl
37	sulfate (ic), (hydrocyanite)	$CuSO_4$	159.63	grn.-wh. rhomb
38	" " (bluevitriol or chalcanthite)	$CuSO_4.5H_2O$	249.71	tricl. blue, 1.514, 1.537, 1.543
39	sulfate (ous)	Cu_2SO_4	223.20	gray powd
40	sulfide (ic), (covellite)	CuS	95.63	hex. or monocl. blk
41	" (ous), (chalcocite)	Cu_2S	159.20	rhomb. blk

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	2.92	474.5	d.	i.	i.	s. HCl, NH_4OH, KCN; sl. s. NH_3
2	....	....	....	i.	....	s. NH_4OH; i. HCl
3	....	....	....	i.	....	s. NH_4OH; i. HCl
4	....	....	....	i.	i.	s. NH_4OH; i. a., NH_3
5	....	....	....	i.	....	s. NH_4OH; i. NH_4Cl
6	2.93	....	....	sl. s.	d.	s. al., HCl, HNO_3, HF; i. acet., NH_3
7	....	908	subl. 1100	i.	....	s. HCl, HF, HNO_3; i. al.
8	2.158	....	....	42.8	....	....
9	2.207	....	....	232^{17}	....	0.16^{20}, 92% al.
10	....	....	....	....	d., 100	....
11	....	d. 60	....	d.	....	s. HCl d.
12	3.368	d. $-H_2O$	....	i.	d.	s. a., al., NH_4OH, KCN
13	3.37	$-\frac{1}{2}H_2O$, 360	....	i.	i.	s. a., NH_4OH
14	5.24^{15}	d.	....	0.1364^{25}	i.	s. dil. H_2SO_4; i. dil. HNO_3
15	4.876^{15}	$-H_2O$, 240	d. 290	0.33^{15}	0.65^{100}	s. NH_4OH, dil. H_2SO_4; i. al., dil. HNO_3
16	4.878^{15}	d. 290	....	i.	i.	s. dil. H_2SO_4
17	....	d. 110	100–120	i.	i.	s. dil. HNO_3
18	$5.63^{15.5}$	605	1290	0.0008^{15}	....	s. KI, KCN, NH_4OH; i. a. al.
19	$2.047^{3.9}$	114.5	$-HNO_3$, 170	137.8^{0}	1270^{100}	$100^{12.5}$ al.
20	2.074	$-3H_2O$, 26.4	....	243.7^{0}	∞	s. al.
21	....	....	....	sl. s.	....	s. NH_4OH; sl. s. al.; d. dil. a.
22	....	d. 300	....	d.	....	d. a.
23	....	....	....	i.	....	s. alk.; i. al.
24	6.40	d. 1026	....	i.	i.	s. a., NH_4Cl, KCN
25	6.45	d. 1026	....	i.	i.	s. a., NH_4Cl, KCN
26	6.0	1235	$-O$, 1800	i.	i.	s. HCl, NH_4Cl, NH_4OH; sl. s. HNO_3; i. al.
27	....	....	....	i.	....	s. a. d.; i. al.
28	....	d.	....	i.	....	d. a.
29	....	$-3H_2O$, 140	....	i.	....	s. a.
30	....	....	....	i.	sl. s.	s. a., NH_4OH, H_3PO_4; i. NH_3
31	6.67	d.	....	i.	....	s. HNO; i. HCl
32	6.4–6.8	....	....	i.	....	s. HNO_3 i. HCl
33	....	d.	....	i.	i.	....
34	....	d.	....	v. s.	....	....
35	....	2.57	....	....	....	....
36	2.559	....	....	25.7^{15}	d.	s. a., NH_4OH; i. al.
37	3.606^{15}	200	d. 650 to CuO	14.3^{0}	75.4^{100}	i. al.; 1.04^{18} meth. al.
38	$2.286^{15.6}$	$-4H_2O$, 110	$-5H_2O$, 150	31.6^{0}	203.3^{100}	i. al.; 15.6^{18} meth. al
39	....	+O, 200	....	d.	....	....
40	4.6	tr. 103	d. 220	0.000033^{18}	....	s. HNO_3, KCN, h. conc. HCl, H_2SO_4; i. al., alk.
41	5.6	1100	....	0.0005^{18}	....	s. HNO_3, NH_4OH; i. acet.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Copper			
1	sulfide (ous)	Cu_2S	159.20	cub. blk
2	sulfite (ous)	$Cu_2SO_3.H_2O$	225.22	hex. red or wh
3	tartrate (ic)	$CuC_4H_4O_6.3H_2O$	265.65	lt. gray bl. powd
4	thiocyanate (ic)	$Cu(SCN)_2$	179.71	black
5	" (ous)	$CuCNS$	121.64	wh
6	tungstate (ic)	$CuWO_4.2H_2O$	347.60	oct. lt. grn
7	**Cyanic acid**	$CNOH$	43.02	
8	" " thio-	$HCNS$	59.08	col. gas
9	" " cobalti-	$[H_3Co(CN)_6]_2.H_2O$	454.04	col. need., deliq
10	**Cyanogen**	C_2N_2	52.02	col. gas. pungent odor, v. pois
11	**Cyanogen compounds**	See *organic tables*		
12	**Dysprosium**	Dy	162.46	
13	bromate	$Dy(BrO_3)_3.9H_2O$	708.35	yel. hex. need
14	carbonate	$Dy_2(CO_3)_3.4H_2O$	576.98	
15	chloride	$DyCl_3$	268.83	shining yel. pl
16	chromate	$Dy_2(CrO_4)_3.10H_2O$	853.11	yel. cr
17	nitrate	$Dy(NO_3)_3.5H_2O$	438.56	yel. cryst
18	oxide	Dy_2O_3	372.92	wh. powd
19	*ortho*phosphate	$DyPO_4.5H_2O$	347.56	yellow
20	selenate	$Dy_2(SeO_4)_3.8H_2O$	898.64	yel. need
21	sulfate	$Dy_2(SO_4)_3.8H_2O$	757.22	brill. yel. cr
22	**Erbium**	Er	167.64	dk. gray powd
23	chloride	$ErCl_3.6H_2O$	382.10	deliq
24	nitrate	$Er(NO_3)_3.6H_2O$	461.76	redsh. cr
25	oxide	Er_2O_3	383.28	rose red powd
26	sulfate	$Er_2(SO_4)_3$	623.46	
27	"	$Er_2(SO_4)_3.8H_2O$	767.58	monocl. rose red
28	**Europium**	Eu	152.00	
29	chloride	$EuCl_3$	258.37	fine yel. need
30	oxide	Eu_2O_3	352.00	pa. rose powd
31	sulfate	$Eu_2(SO_4)_3.8H_2O$	736.30	pa. rose cr
32	**Fluorine**	F_2	38.00	grn. yel. gas, pois., 1.000195
33	oxide	F_2O	54.00	col. gas. unst
34	**Fluosilicic acid**	H_2SiF_6	144.08	col. liq. fum. corros
35	**Gadolinium**	Gd	157.3	
36	bromide	$GdBr_3.6H_2O$	505.14	rhomb. pl
37	chloride	$GdCl_3$	263.67	monocl. pr. col
38	"	$GdCl_3.6H_2O$	371.76	wh. pr., deliq
39	fluoride	GdF_3	214.30	wh. gelat
40	nitrate	$Gd(NO_3)_3.5H_2O$	433.40	prisms
41	nitrate	$Gd(NO_3)_3.6H_2O$	451.42	tricl
42	oxide	Gd_2O_3	362.60	wh. amor. powd., hyg
43	platinum cyanide	$Gd_2Pt_3(CN)_{12}.21H_2O$	1395.48	rhomb
44	potassium sulfate	$Gd_2(SO_4)_3.K_2SO_4.2H_2O$	813.07	cryst
45	selenate	$Gd_2(SeO_4)_3.8H_2O$	888.32	monocl. pearly
46	sulfate	$Gd_2(SO_4)_3$	602.78	col
47	"	$Gd_2(SO_4)_3.8H_2O$	746.90	monocl

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	5.78	1130	...	0.0005^{18}	...	s. HNO_3, NH_4OH; i. acet.
2	3.83^{15}	d.	...	sl. s.	...	s. NH_4OH, HCl; i. al., eth.
3	...	d.	...	0.02^{15}	0.14^{85}	s. a., alk.
4	...	d. 100	...	d.	d.	s. a., NH_4OH
5	2.846_{15}^{15}	1084	...	0.0005^{18}	...	s. NH_4OH, conc. a., eth.; i. al.
6	...	...	...	0.1^{15}	...	s. NH_4OH; sl. s. ac. a.; i. al.; d. min. a.
7	1.140_0^0	...	...	d.	...	...
8	...	>-10 d.	...	v. s.	...	v. s. al., eth., bz.
9	...	d. <100	...	...	...	s. al.
10	2.335 g/l	−34.4	−20.7	450^{20} cm³	...	230 cm³ al.; 500 cm³ eth.
11	...	...	...	...	...	...
12	...	...	...	...	...	...
13	...	78	$-6H_2O$, 110	v. s.	...	sl. s. al.
14	...	$-3H_2O$, 150	...	i.	...	...
15	3.67^0	680	...	...	...	...
16	...	$-3\frac{1}{2}H_2O$, 150	d.	1.002^{25}	...	...
17	...	88.6	...	s.	...	...
18	7.81^{27}	...	...	...	...	s. a. grn. soln.
19	...	$-5H_2O$, 200	...	i.	...	s. dil. a., ac. a.
20	...	$-8H_2O$, 200	...	v. s.	...	i. al.
21	...	stab. 110	$-8H_2O$, 360	s.	...	...
22	4.77^{15}(?)	...	...	...	...	...
23	...	...	...	s.	s.	s. al.
24	...	...	...	s.	...	s. al., eth., acet.
25	8.640	infus.	...	0.00049^{29}	...	sly. s. min. a.
26	3.678	d. 630	...	43^0	...	...
27	3.180	...	...	16^{20}	6.53^{40}	...
28	...	...	...	...	...	...
29	...	623 ± 2	...	...	...	...
30	7.42 fr. oxal. 6.55 fr. nit.	...	...	...	...	...
31	...	$-8H_2O$, 375	...	2.563^{20}	1.93^{40}	...
32	1.69^{15} g/l; lq. 1.108^{-187}	−223	−187	d. to O_3 + HF	d.	...
33	lq. $1.90^{-223.8}$	−223.8	−144.8	sl. s., d.	i.	sl. s. a., alk.
34	$1.29\text{–}31^{15}$	...	d.	s.	s.	sl. s. alk.
35	...	...	...	d. ev. H_2	...	...
36	2.844^{15}	...	...	s.	s.	s. HBr
37	4.52^0	628	...	s.	s.	...
38	2.424^0	...	...	s.	s.	...
39	...	...	...	i.	...	sl. s. hot HF
40	2.406^{15}	92	...	v. s.	v. s.	v. sl. s. conc. HNO_3
41	2.332	91	...	v. s.	v. s.	...
42	7.407^{15}	...	...	v. sl. s.	...	s. a.
43	2.563	...	...	...	...	...
44	3.503^{16}	...	...	s.	s.	s. K_2SO_4
45	3.309	$-8H_2O$, 130	...	s.	s.	...
46	$4.139^{14.6}$	...	...	3.98^0	$2.26^{34.4}$	...
47	$3.010^{14.6}$	...	...	2.886^{20}	2.19^{40}	...

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Gadolinium			
1	sulfide	Gd_2S_3	410.78	yel. hyg. mass
2	**Gallium**	Ga	69.72	rhomb. pseudotetr. gray-bl
3	ammonium sulfate	$Ga_2(SO_4)_3.(NH_4)_2SO_4.24H_2O$	992.13	cub. oct. col., 1.4684
4	bromide, tri-	$GaBr_3$	309.47	col. cr., deliq
5	" monammine	$GaBr_3.NH_3$	326.50	wh. powd
6	" hexammine	$GaBr_3.6NH_3$	411.66	wh. powd
7	cesium selenate	$Ga_2(SO_4)_3.Cs_2SeO_4.24H_2O$	1268.81	col. cr
8	" sulfate	$Ga_2(SO_4)_3.Cs_2SO_4.24H_2O$	1221.67	cub. col., 1.46495
9	chloride, di-	$GaCl_2$	140.63	col. cr., deliq
10	" tri-	$GaCl_3$	176.09	col. cryst, deliq
11	" monammine	$GaCl_3.NH_3$	193.12	wh. powd
12	" hexammine	$GaCl_3.6NH_3$	278.28	wh. powd
13	ferrocyanide	$Ga_4[Fe(CN)_6]_3$	914.54	gel. wh. ppt
14	fluoride (ic)	$GaF_3.3H_2O$	180.77	wh. powd
15	hydroxide	$Ga(OH)_3$	120.74	amor. wh
16	" (hydrous gallium oxide)	$Ga_2O_3.xH_2O$	....	gel. ppt., indef. comp
17	iodide, tri-	GaI_3	450.48	col.-lem. yel. (need.), hyg
18	" monammine	$GaI_3.NH_3$	467.51	wh. powd
19	" hexammine	$GaI_3.6NH_3$	552.67	wh. powd
20	nitrate	$Ga(NO_3)_3.xH_2O$	255.74 $+xH_2O$	wh. cr., deliq
21	nitride	GaN	83.73	dk. gray powd
22	oxide, sub-	Ga_2O	155.44	br.-blk. powd
23	" sesqui-	Ga_2O_3	187.44	wh. powd
24	oxychloride	$6GaOCl.14H_2O$	979.28	oct
25	potassium sulfate	$Ga_2(SO_4)_3.K_2SO_4.24H_2O$	1034.25	col. cr., 1.46528
26	rubidium sulfate	$Ga_2(SO_4)_3.Rb_2SO_4.24H_2O$	1126.93	col. cr., 1.46579
27	selenate	$Ga_2(SeO_4)_3.16H_2O$	857.29	col. cr
28	"	$Ga_2(SeO_4)_3.22H_2O$	965.38	cr. monocl. or tricl., col
29	sulfate	$Ga_2(SO_4)_3$	427.62	wh. powd
30	"	$Ga_2(SO_4)_3.18H_2O$	751.90	col. cr
31	"	$Ga_2(SO_4)_3.22H_2O$	823.96	wh. leaf
32	sulfide, mono-	GaS	101.78	sublimate, lt. yel
33	" sub-	Ga_2S	171.50	grn. cr. or blk. powd
34	" sesqui-	Ga_2S_3	235.62	yel. cr. or wh. amor
35	zincate	Ga_2ZnO_4	268.82	1.74
36	**Germanium**	Ge	72.60	cub. gray-wh. met
37	bromide, di-	$GeBr_2$	232.43	col. need. or pl
38	" tetra-	$GeBr_4$	392.26	gray-wh. oct
39	bromoform	$GeHBr_3$	313.36	col. liq
40	bromomonogermane, mono-	GeH_3Br	155.54	col. liq
41	" di-	GeH_2Br_2	234.45	col. liq
42	chloride, di-	$GeCl_2$	143.51	wh. powd
43	" tetra-	$GeCl_4$	214.43	col. liq., 1.464

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	3.8	....	....	d.	....	d. a.
2	lq. 6.09^{30}; 5.903^{20}	29.78	2000 ± 150	i.	i.	s. a. alk.; sl. s. Hg
3	1.777	....	....	30.9^{25}	....	.00864 70% al.
4	3.69^{25}	124.5 ± .5	284 ± 1	s.	s.	sl. s. NH_3
5	3.112^{25}	124	....	d.	d.	sl. s. NH_3
6	....	....	....	d.	d.	sl. s. NH_3
7	....	....	....	4.14^{25}	....	....
8	2.113	....	....	1.51^{25}	....	$.0035^{25}$ 70% al.
9	....	164(175)	535	v. s.	d.	....
10	2.47^{25}; lq. 2.36^{80}_{80}	76.65	199.6	v. s.	v. s.	s. NH_3; sl. s. pet. eth.
11	2.189^{25}	124	....	d.	d.	s. NH_3
12	....	....	....	d.	d.	s. NH_3
13	....	....	d.	s.	s.	i. conc. HCl
14	....	>140	d.	i.	sl. s.	s. dil. HCl; sl. s. 50% HF
15	....	d. to Ga_2O_3	−H_2O	i.	i.	s. a., alk.
16	....	....	....	.00010	....	.0032 4.6% NH_4OH; s. a.. NaOH
17	4.15^{25}	213.5	337 ± 5, subl.	....	d.	....
18	3.635^{25}	140	....	d.	d.	....
19	....	....	....	d.	d.	....
20	....	d. 110	−Ga_2O_3, 200	v. s.	v. s.	....
21	....	....	subl. >800	i.	i.	d. h. a., alk.
22	....	>660	sl. volt. >660	i.	i.	s. a., alk.
23	6.44	1900	....	i.	i.	s. h. a., alk.
24	....	....	....	sl. s.	....	s. KOH
25	1.895	....	....	s.	....	....
26	1.962	....	....	s.	....	....
27	....	....	....	v. s.	v. s.	....
28	....	....	....	57.4^{25}	v. s.	....
29	....	d. >600	....	v. s.	v. s.	s. al.; i. eth.
30	....	....	....	v. s.	v. s.	i. al.
31	....	....	....	v. s.	v. s., sl. d.	s. al.; i. eth.
32	3.75 ± .03	965 ± 10	....	i.	d.	s. a., alk.
33	4.22 ± .03	d. >800	....	d.	d.	s. a., alk.
34	3.48 ± .02	1255 ± 10	....	d.	d.	s. a., alk.
35	6.15 calc.	<800	....	....	....	....
36	5.35^{20}_{20}	958.5	(2700)	i.	i.	s. h. H_2SO_4, aq. reg.; i. alk.
37	....	122.0	d.	d.	d.	s. a., $GeBr_4$, al.; i. bz.
38	3.132^{20}_{20}	26.1	186.5	d.	d.	s. abs. al., eth., bz.; i. conc. H_2SO_4
39	....	−24.0	d.	d.	d.	d. alk.
40	$2.34^{29.5}$	−32.0	52.0	d.	d.	reacts like GeH_2Br_2 d. alk.; i. al.
41	2.80^{0}	−15.0	89.0	d.	d.	d. alk.; i. al.
42	....	d. to Ge + $GeCl_4$		d.	d.	s. $GeCl_4$; i. al., chl.
43	1.879^{20}_{20}	−49.5	83.0	d.	d.	v. s. dil. HCl; s. al., eth.; i. conc. H_2SO_4, conc. HCl

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Germanium			
1	chloroform	$GeHCl_3$	179.98	col. liq
2	chloromonogermane, mono-	GeH_3Cl	111.08	col. liq
3	" di-	GeH_2Cl_2	145.53	col. liq
4	fluoride, di-	GeF_2	110.60	wh. cr., hyg
5	"	GeF_4	148.60	col. gas or solid., not liq. at atm. press.
6	"	$GeF_4.3H_2O$	202.65	wh. cr., deliq
7	hydride, mono-	GeH	73.61	br. powd
8	" tetra- (monogermane)	GeH_4	76.63	col. gas
9	" (digermane)	Ge_2H_6	151.25	liq
10	" (trigermane)	Ge_3H_8	225.86	col. liq
11	imide	$Ge(NH)_2$	102.63	wh. amor. powd
12	iodide, di-	GeI_2	326.44	yel. hex
13	" tetra-	GeI_4	580.28	cub. yel
14	nitride, di-	Ge_3N_2	245.82	blk. cr
15	" tetra-	Ge_3N_4	273.83	wh.-lt. br. powd
16	oxide, mono-	GeO	88.60	blk. cr. powd
17	" di- (soluble)	GeO_2	104.60	col. polymorph
18	" di- (insoluble)	GeO_2	104.60	tetr
19	oxychloride	$GeOCl_2$	159.51	col. liq
20	sulfide, mono-	GeS	104.66	yel.-red amor. or rhomb. blk
21	" di-	GeS_2	136.72	wh. powd
22	**Glucinum**	See *beryllium*		
23	**Gold**	Au	197.2	cub. yel. duct. met., coll. bl. vlt
24	Auric acid, bromo-	$HAuBr_4.5H_2O$	607.95	red-br. cr
25	" " chloro-	$HAuCl_4.4H_2O$	412.10	brt. yel. need, deliq
26	Auricyanhydric acid	$HAu(CN)_4.3H_2O$	356.29	tab
27	**Gold** bromide (ic)	$AuBr_3$	436.95	gray powd
28	" " (ous)	AuBr	277.12	yelsh.-gray mass
29	" " (ous, ic)	Au_2Br_4	714.06	blk
30	chloride (ic)	$AuCl_3$	303.57	yel.-red, deliq. leaf
31	" "	$AuCl_3.2H_2O$	339.60	orange cr
32	" (ous)	AuCl	232.66	yel. cr
33	" (ous, ic)	Au_2Cl_4	536.23	dk. red
34	cyanide (ic)	$Au(CN)_3.6H_2O$	383.32	col. hyg. pl
35	" (ous)	AuCN	223.21	lt. yel. cr. powd
36	hydrogen nitrate (ic)	$AuH(NO_3)_4.3H_2O$	500.29	tricl. oct. yel
37	hydroxide (ic)	$Au(OH)_3$	248.22	yel.-br. powd
38	" (ous)	AuOH	214.21	dk. vlt
39	iodide (ic)	AuI_3	577.96	dk. grn
40	" (ous)	AuI	324.12	grnsh.-yel. powd
41	oxide (ic)	Au_2O_3	442.40	br.-blk. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.93^{0}	−71.0	75.2	d.	d.	d. alk.
2	1.75^{-52}	−52.0	28.0	d.	d.	d. alk.; i. al.
3	1.90^{-68}	−68.0	69.5	d.	d.	d. alk.; i. al.
4	....	d. >350	subl.	s.	v. s.	....
5	6.65 g/l	subl.	....	s. d. to H_2GeF_6	GeO_2 +	....
6	....	d.	....	s.	s.	....
7	....	d. 165	sl. exp.	i.	i.	s. HNO_3, H_2O_2; i. NaOH
8	3.43 g/l; lq. 1.532^{-142}	−165.0	−90.0 (−126)	i.	i.	s. NaOCl; sl. s. h. HCl
9	g. 6.74^{20} g/l; lq. 1.98^{-109}	−109	29	d	....	....
10	2.2	−105.6	110.5	i.	....	s. CCl_4
11	....	d. 150	....	d. to NH_3	+ GeO_2	....
12	....	subl., d.	....	s.	d.	s. dil. a., conc. HI; sl. s chl., CCl_4
13	4.322^{26}_{26}	144.0	d.	s., with slow hydrolysis	d.	s. CS_2, CCl_4, bz.; sl. s conc. HCl, KOH
14	....	....	subl. >650	....	....	....
15	....	d. 450	....	i.	i.	i. a., alk.
16	....	subl. 710	....	i.	i.	s. Cl_2 water or H_2O_2 with NH_4OH; i. a., alk.
17	4.703^{18}	1115.0	....	0.447^{25}	1.0^{100}	s. a., alk.: one form i. H_2O, HCl, HF, NaOH, NH_4OH
18	6.239	1086 ± 5	....	i.	....	sl. s. NaOH; i. HF, HCl
19	....	−56.0	d. >20	d.	d.	i. all solv.
20	(am.) 3.31; rhomb. 4.01^{14}_{4}	530	subl. >430	i.	i.	s. HCl, alk. or alk. sulfd.; sl. s. NH_4OH
21	2.94^{14}	*ca.* 800.0	subl. >600	sl. s.; slw. d.	d. to GeO_2 + H_2S	s. alk., alk. sulfd.; i. a., al., eth., etc.
22	....	....	....	....	....	....
23	19.3; lq. 17.0^{1063}	1063	2600	i.	i.	s. KCN, aq. reg., h. H_2SeO_4; i. a.
24	....	27	....	v. s.	....	s. al.
25	....	d.	....	s.	v. s.	s. al., eth.
26	....	50	d.	s.	....	s. al., eth.
27	....	160 d.	....	slowly s	....	s. eth.
28	7.9	d. 115	....	v. sl. s.	....	d. a.
29	....	d. 115	....	d.	....	....
30	3.9	254 d.	subl. 265	68	v. s.	s. al., eth.; sl. s. NH_3; i. CS_2
31	....	d.	....	s.	s.	s. HCl, al., eth; sl. s. NH_3
32	7.4	d. to $AuCl_3$, 170	d. 289.5	d. v. sl. s.	d.	s. HCl, HBr
33	5.1	d. 250	....	d.	....	....
34	....	d. 50	....	v. s.	d. v. s.	s. al., eth.
35	7.12	d.	....	v. sl. s.	....	s. KCN, NH_4OH; i. al., eth.
36	2.84	72 d.	....	s. d.	....	s. HNO_3
37	....	−1½H_2O, 250	....	i.	i.	s. HCl, NaCN, conc. HNO_3
38	....	−H_2O, 200	....	s.	....	s. d. alk.
39	....	....	....	i.	d.	s. iodides
40	8.25	d. 120	....	v. sl. s.	sl. s. d.	s. KI
41	....	−O, 160	−3O, 250	i.	i.	s. HCl

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Gold			
1	oxide (ous)	Au_2O	410.40	gray-violet
2	" (ous, ic)	Au_2O_2	426.40	
3	phosphide	Au_2P_3	487.46	gray
4	potassium bromide	$AuBr_3.KBr.2H_2O$	592.00	violet cr
5	" chloride	$AuCl_3.KCl.2H_2O$	414.16	rhomb. pl., yel
6	" cyanide	$AuK(CN)_2$	288.32	col. rhomb
7	" iodide	$AuI_3.KI$	743.98	lust. blk. cr
8	selenide	Au_2Se_3	632.00	
9	sodium bromide	$AuBr_3.NaBr.2H_2O$	575.89	br.-blk. cr
10	" chloride	$AuNaCl_4.2H_2O$	398.06	rhomb. yel
11	" cyanide	$AuNa(CN)_2$	272.21	wh. cr. powd
12	" thiosulfate	$AuNa_3(S_2O_3)_2.2H_2O$	526.46	wh. odorl. cr
13	sulfate (ic)	$Au_2O_3.2SO_3.H_2O$	620.54	yel. deliq
14	sulfide, (ic)	Au_2S_3	490.58	br
15	" (ous)	Au_2S	426.46	br.-blk. powd
16	" (ous, ic)	AuS	229.26	blk
17	telluride (calaverite)	$AuTe$	324.70	tricl
18	"	Au_2Te_4	904.40	
19	**Hafnium**	Hf	178.6	gray
20	oxide	HfO_2	210.60	wh. monocl
21	oxychloride	$HfOCl_2.8H_2O$	409.64	col
22	**Helium**	He	4.00	col. gas, inert, odorl
23	**Holmium**	Ho	163.5	salts yellow
24	**Hydrazine**	$NH_2.NH_2$	32.05	col. liq. or wh. cr., 1.470^{22}
25	azoimide	$N_2H_4.HN_3$	75.08	deliq
26	chloride, mono-	$N_2H_4.HCl$	68.51	wh. need
27	" di-	$N_2H_4.2HCl$	104.98	cub. col
28	fluosilicate	$N_2H_4H_2SiF_6$	176.12	cryst
29	hydrate	$N_2H_4.H_2O$	50.06	col. fum. liq. or cub. cr
30	nitrate, mono-	$N_2H_4.HNO_3$	95.06	col. dimorph need
31	" di-	$N_2H_4.2HNO_3$	158.08	col. cr
32	*ortho*phosphate	$N_2H_4.H_3PO_4$	130.09	
33	*hypo*phosphate	$(N_2H_4)H_4P_2O_6$	194.12	
34	*ortho*phosphite, mono-	$N_2H_4.H_3PO_3$	114.09	
35	" di-	$N_2H_4.(H_3PO_3)_2$	196.13	
36	sulfate	$N_2H_4.H_2SO_4$	130.12	rhomb. col
37	" prim-	$2N_2H_4.H_2SO_4$	162.17	col. cr
38	**Hydrazoic acid,** (azoimide)	HN_3	43.03	col. liq
39	**Hydroferricyanic acid**	$H_3Fe(CN)_6$	214.91	grn.-br. need., deliq
40	**Hydroferrocyanic acid**	$H_4Fe(CN)_6$	215.92	wh. need., bl. in moist air
41	**Hydrogen**	H_2	2.0156	col. gas, cub. solid
42	bromide (hydrobromic a.)	HBr	80.92	col. gas or pa. yel. liq., 1.325 lq
43	"	$HBr.H_2O$	98.94	col. liq
44	"	$HBr.H_2O(47.8\%)$	98.94	col. liq
45	chloride (hydrochloric a.)	HCl	36.46	col. gas or col. pois. fum. liq.; 1.256 lq.
46	"	$HCl.H_2O(45.2\%)$	54.48	col. liq
47	"	$HCl.2H_2O$	72.50	col. liq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm^3 of: Cold water	Hot water	Alcohol, acids, etc.
1	3.6	−0, 205	...	i.	i.	s. HCl; sl. s. KOH; i. H_2SO_4, HNO_3, al.
2	...	d. 180	...	...	...	...
3	6.67	d.	...	...	...	i. HCl, d. HNO_3
4	...	...	...	s.	...	s. al.
5	...	...	...	s.	s.	s. al., eth.
6	3.45	...	...	*ca.* 20	...	sl. s. al.; i. eth.
7	...	...	...	s., d.	...	s. dil. soln. KI
8	4.65^{22}	...	...	...	...	...
9	...	...	...	s.	...	...
10	...	d.	...	v. s.	...	s. al., eth.
11	...	...	...	s.	...	...
12	...	...	...	50	...	i. al.
13	...	...	...	s.	d.	s. HCl, H_2SO_4
14	8.754	d. 197	...	i.	...	s. Na_2S; i. a., eth.
15	...	d. 240	...	i.; fresh soln.	ppt. coll.	i. a.; s. KCN, aq. reg.
16	...	d. 140	...	i.	i.	s. $(NH_4)_2S$; i. a.
17	9.04	...	...	...	...	...
18	...	472	...	...	...	...
19	13.3	2207 (1700?)	>3200	i.	...	...
20	9.68	2812	...	i.	...	...
21	...	...	...	s.	...	...
22	0.1785^{0} g/l; lq. $0.147^{-270.8}$	-272.2^{26atm}	−268.9	$1.49^{0.5}$ cm^3	1.37^{25} cm^3	abs. by Pt.; i. al.
23	...	...	...	...	...	...
24	lq. 1.011^{15}	1.4	113.5	v. s.	...	s. al.
25	...	75.4	...	v. s.	v. s.	v. s. al.
26	...	89	...	v. s.	...	sl. s. al.
27	1.42	198	...	270.4^{23}	v. s.	sl. s. al.
28	...	d. 186	...	v. s.	...	sl. s. al.
29	1.03^{21}	<−40	118.5^{740}	∞	∞	s. al.; i. eth., chl.,
30	...	70.7	subl. 140	v. s.	...	sl. s. al.
31	...	104 d.	...	v. s.	...	...
32	...	82	...	...	...	...
33	...	152	...	...	...	...
34	...	36	...	...	...	...
35	...	82	...	...	...	...
36	1.37	254	...	3.05^{32}	v. s.	i. al.
37	...	85	...	v. s.	...	i. al.
38	...	−80	37	∞	∞	s. al., alk.
39	...	d.	...	s.	s.	s. al.
40	...	d.	...	s.	s.	s. al.; i. eth.
41	.0899 g/l; lq. .070	−259.18	−252.8	1.93^{0} cm^3	0.85^{80} cm^3	6.925^{0} cm^3 al.
42	3.50^{0} g/l; lq. 2.77^{-67}	−88.5	−67.0	221^{0}	130^{100}	s. al.
43	1.78	Stable −15.5	to -11.3^{0} an	d 1 to 2.5	atm.	...
44	1.49	−11	126	∞	∞	s. al.
45	1.639^{0} g/l; lq. 1.194^{-86}	−112	−83.7	82.3^{0} g	56.1^{60} g	327 cm^3 al.; s. eth.
46	1.48	−15.35	...	∞	∞	s. al.
47	lq. $1.46^{18.3}$	−17.7	d.	∞	...	s. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Hydrogen			
1	chloride	$HCl.3H_2O$	90.51	col. liq.
2	cyanide (hydrocyanic a.)	HCN	27.02	col. liq. or gas, pois., 1.2675^{10} lq
3	fluoride	HF	20.01	col. fum. corros. liq. or gas
4	"	$HF.H_2O$(35.35%)	38.02	col. liq.
5	iodide (hydriodic a.)	HI	127.93	col. gas. or pa. yel liq., 1.466 lq
6	"	$HI.H_2O$	145.94	col. or pa. yel. fum. liq.
7	"	$HI.2H_2O$	163.96	col. liq.
8	"	$HI.3H_2O$	181.97	col. liq.
9	"	$HI.4H_2O$	199.99	col. liq.
10	oxide	H_2O	18.02	col. liq. or hex. col. cr., lq. 1.333, sld. 1.309, 1.313
11	oxide, per-	H_2O_2	34.02	col. liq., 1.414^{22} lq
12	phosphide, (phosphine)	H_3P	34.04	col. pois. spon. infl. gas or col. liq., 1.317 lq
13	"	H_4P_2	66.07	col. liq.
14	"	$(H_2P_4)_3$	378.29	yel. solid
15	selenide	H_2Se	81.22	col. gas
16	sulfide	H_2S	34.08	col. infl. gas, offen. odor 1.374 lq
17	" di-	H_2S_2	66.14	yel. oil, 1.885
18	" tri-	H_2S_3	98.20	bright yel. liq.
19	telluride	H_2Te	129.52	col. gas
20	**Hydroxylamine**	NH_2OH	33.03	wh. need. or col. liq., $1.440^{23.5}$ (lq.) deliq.
21	fluosilicate	$(NH_2OH)_2.H_2SiF_6.2H_2O$	246.17	scales
22	hydrochloride	$NH_2OH.HCl$	69.50	monocl. col
23	nitrate	$NH_2OH.HNO_3$	96.05	wh.
24	sulfate	$(NH_2OH)_2.H_2SO_4$	164.14	monocl. col
25	**Illinium**	Il	146?	
26	**Indium**	In	114.76	tetr. silv. wh. soft metal
27	bromide, mono-	$InBr$	194.68	red-br. solid
28	" di-	$InBr_2$	274.59	pa. yel. solid
29	" tri-	$InBr_3$	354.51	v. sl. yel. need., deliq.
30	*perchlorate*	$In(ClO_4)_3.8H_2O$	557.26	deliq. cr
31	chloride, mono-	$InCl$	150.22	dk. red solid, deliq.
32	" di-	$InCl_2$	185.67	pa. yel. to wh. cr., deliq.
33	" tri-	$InCl_3$	221.13	wh. pl., deliq.
34	cyanide	$In(CN)_3$	192.78	wh. ppt
35	fluoride	$InF_3.3H_2O$	225.81	
36	"	$In_2F_6.18H_2O$	667.80	need.
37	hydroxide	$In(OH)_3$	165.78	wh. ppt
38	iodate	$In(IO_3)_3$	639.52	cryst
39	iodide, mono-	InI	241.68	br.-red solid
40	" di-	InI_2	368.60	
41	" tri-	InI_3	495.52	yel. cr. deliq.
42	nitrate	$In(NO_3)_3.3H_2O$	354.83	deliq. plates
43	"	$In(NO_3)_3.4\frac{1}{2}H_2O$	381.85	need., deliq.
44	oxide, mon-	InO	130.76	black

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	−24.4	d.	∞	....	s. al.
2	.901 g/l; $.699^{20}$	−14	26	∞	∞	∞ al., s. eth.
3	.921 g/l; lq. .987	−92.3	19.4	∞	v. s.	....
4	1.15	−35	120	v. s.	v. s.	....
5	5.66^{0} g/l; lq. $2.85^{-4.7}$	−50.8	−35.38	$42{,}500^{10}$ cm³	v. s.	s. al.
6	1.70^{15}	....	127^{774}	∞	∞	∞ al.
7	....	−43	....	∞	....	....
8	....	−48	....	∞	....	....
9	....	−36.5	....	∞	....	....
10	1.000^{4}_{4}; s. $.9168^{0}$	0	100	....	....	∞ al.
11	1.4631^{0}	−1.7	152.1	∞	....	s. al. eth.; i. pet. eth.
12	1.529^{0} g/l; lq. $.746^{-90}$	−133.5	−87.4	26^{17} cm³	i.	s. al., eth., Cu_2Cl_2
13	1.012	<−10	57.5^{735}	i.	i.	s. al., turp.
14	1.83^{19}	ign. 160	d.	i.	i.	i. al.; s. P, P_2H_4
15	3.614 g/l; lq. 2.12^{-42}	−64	−42	377^{4} cm³	$270^{22.5}$ cm³	s. CS_2, $COCl_2$
16	1.539^{0} g/l; lq. .96	−82.9	−61.80	437^{0} cm³	186^{40} cm³	9.54^{20} cm³ al.; s. CS_2
17	1.376	−88	74.5	d.	....	s. bz., CS_2; i. al.
18	1.496^{15}	−52	d. 90	....	....	....
19	5.81 g/l; lq. 2.57^{-20}	−48	−1.8	s. (unst.)	....	s. al., alk.
20	1.204	33.05	56.5	s.	d.	s. a. al., meth. al.; v. sl. s. eth., chl., bz., CS_2
21	....	....	....	v. s.	....	i. al.
22	1.67^{17}	151	d.	83^{17}	v. s.	s. al., meth. al. glyc.; i. eth.
23	....	48	d. <100	v. s.	d.	v. s. al.
24	....	170	d.	32.9^{0}	68.5^{90}	sl. s. al.; s. eth.
25	....	....	....	....	....	....
26	7.31	155	1450	i.	i.	s. a.; v. sl. s. NaOH
27	....	....	subl.	d.	....	s. a.
28	....	....	subl.	d.	....	s. a.
29	....	....	subl. easily	v. s.	....	....
30	....	80	d. 200	v. s.	d.	s. abs. al.; sl. s. eth.
31	....	....	....	d.	d.	s. a.
32	....	....	subl. 1300–1400	d.	d.	....
33	4. (3.46)	586; subl. <400	volat. 600	v. s.	v. s.	sl. s. al., eth.
34	....	....	....	unst.	....	s. HCN; v. sl. s. NaOH; i. dil. a.
35	....	$-3H_2O$, 100	....	8.4^{25}	....	s. a.; i. al., eth.
36	....	d.	....	sl. s.	d.	s. HCl, HNO_3; i. al., eth
37	....	$-H_2O$, <150	....	i.	....	s. a.; v. sl. s. NaOH; i NH_4OH
38	....	....	d.	0.067^{20}	....	s. dil. H_2SO_4, HNO_3
39	....	351	700	....	slowly d.	s. dil. a.; i. al., eth., chl.
40	....	212	....	....	....	....
41	....	199	....	s. unst.	s.	s. a., chl., bz., xylene
42	....	$-2H_2O$, 100	d.	v. s.	....	s. al.
43	....	$-4\frac{1}{2}H_2O$, 100	d.	v. s.	s.	s. al.
44	....	....	....	i.	....	s. a.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Indium			
1	oxide, tri-	In_2O_3	277.52	red-br., hot; pa. yel., cold; amor. and trig.
2	selenate	$In_2(SeO_4)_3.10H_2O$	839.28	deliq. cr.
3	sulfate	$In_2(SO_4)_3$	517.70	wh.-gray powd., hyg.
4	"	$In_2(SO_4)_3.9H_2O$	679.84	
5	" hydro-	$In_2(SO_4)_3.H_2SO_4.8H_2O$	759.90	cr.
6	sulfide, tri-	In_2S_3	325.70	red cr. or yel. ppt.
7	sulfite	$2In_2O_3.3SO_2.8H_2O$	891.34	cr.
8	**Iodic acid**	HIO_3	175.93	rhomb. col. or pa. yel cr. powd.
9	" " per-	HIO_4	191.93	col.
10	" " "	$HIO_4.2H_2O$	227.96	monocl. wh., deliq.
11	**Iodine**	I_2	253.84	rhomb. vlt.-blk., met. lust., 3.34
12	azide (iodoazide)	IN_3	168.94	yellow
13	bromide mono-	IBr	206.84	dk. gray cr.
14	" tri-	IBr_3	366.67	dk. br. liq.
15	chloride, mono-α	ICl	162.38	cub. need. dk. red; oily red-br. liq.
16	" mono-β	ICl	162.38	rhomb., 6 sided pl., brn.-red.
17	" tri-	ICl_3	233.29	rhomb. yel-br. red, deliq.
18	fluoride, penta-	IF_5	221.92	col. liq.
19	" hepta-	IF_7	259.92	col. cr. or liq.
20	oxide, di-	IO_2	158.92	lem. yel. cr.
21	" penta-	I_2O_5	333.84	trim. wh.
22	sulfide, di-	I_2S_2	317.96	brittle gray-blk., met. lust.
23	**Iridium**	Ir	193.10	cub., silv. wh. met.
24	ammonium chloride	$IrCl_4.2NH_4Cl$	441.92	dk. red
25	" "	$IrCl_3.3NH_4Cl$	459.96	grn.-br.
26	" sulfate	$Ir_2(SO_4)_3(NH_4)_2SO_4.24H_2O$	1238.89	yel. red
27	bromide, tri-	$IrBr_3.4H_2O$	504.91	olv. grn. cryst.
28	" tetra-	$IrBr_4$	512.76	bl., deliq.
29	chloride, di-	$IrCl_2$ (exist. doubt.)	264.01	blk.-grn. cryst.
30	" tri-	$IrCl_3$	299.47	olive grn.
31	fluoride, hexa-	IrF_6	307.10	yel. glass or tetr.
32	hydrosulfide	$Ir(SH)_3.2H_2O$	328.33	choc. br.
33	hydroxide, tetra-	$Ir(OH)_4$	261.13	indigo bl.
34	" sesqui-	$Ir_2O_3.5H_2O$	524.28	olive grn.
35	iodide, tri-	IrI_3	573.86	grn.
36	" tetra-	IrI_4	700.78	blk.
37	oxide, di-	IrO_2	225.10	tetr. blk.
38	" sesqui-	Ir_2O_3 (exist quest.)	434.20	bl.-blk.
39	sulfate, sesqui-	$Ir_2(SO_4)_3.xH_2O$	674.38 $+xH_2O$	yel. pr.
40	sulfide, mono-	IrS (exist. quest.)	225.16	bl. blk.
41	" di-	IrS_2	257.22	br.
42	" sesqui-	Ir_2S_3	482.38	br. blk.
43	**Iron** pure	Fe (*See under alloys*)	55.84	cub. silv. metal
44	ammonium sulfate (ic)	$Fe(NH_4)(SO_4)_2.12H_2O$	482.19	cub. oct., vlt.; effl., 1.4854

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	7.179	d. 900-1100	volat.	i.	....	amor. s. a.; cr. i. a.
2	....	....	....	v. s.	....	....
3	3.438	....	....	s.	v. s.	....
4	....	....	d. 250	v. s.	....	....
5	....	$-H_2O$	$-H_2SO_4$	s.	....	....
6	4.90	1050	....	i.	....	s. a.; sl. s. Na_2S
7	....	$-3H_2O$, 100	$-8H_2O$, 260	i.	....	s. a.
8	4.629^{0}	110	....	286^{0}	472^{80}	v. s. 87% al.; sl. s. HNO_3; i. abs. al., eth. chl.
9	....	....	subl. 110	v. s.	....	....
10	....	d. 140	....	v. s.	v. s.	s. al., eth.
11	4.93	114	183	0.029^{20}	0.078^{50}	20.5^{15} al., 20.6^{17} eth.; s. chl., glyc.; KI, CS_2
12	....	....	....	s. d.	....	s. $Na_2S_2O_3$
13	4.4157^{0}	(42); subl. 50	116	s. d.	....	s. al., eth., chl.
14	....	....	....	s.	....	s. al.
15	3.1822^{0}	27.2	97.4	d. to HIO_3 + Cl		s. HCl, al., eth., CS_2
16	lq. 3.24^{34}	13.92	97.4	d.	....	s. HCl, al., eth.
17	3.117^{15}	$101^{16\ atm}$	77 d.	s. d.	....	s. bz., CCl_4, al., eth., ac. a.
18	3.5	-8	97	d.	d.	d. a., alk.
19	liq. 2.8^{6}	5.5	4.5 subl.	v. s., d.	d.	d. a., alk.
20	4.2^{18}_{18}	d. slw. 75; rap. 130	....	d. to $HIO_3 + I_2$		s. H_2SO_4; sl. s. acet.; i. al., eth.
21	4.799^{25}	d. 300-50	....	187.4^{13}	....	i. abs. al., eth., chl.; CS_2; sl. s. dil. al.
22	....	....	....	....	....	s. CS_2; sl. s. glyc.
23	22.421	2440 ± 15	4400	i.	i.	i. a., aq. reg.; amor. s. aq. reg.
24	2.86	d.	....	0.9^{27}	....	....
25	....	....	....	s.	....	....
26	....	106	....	s.	....	....
27	....	$-3H_2O$, 100	....	v. s.	....	i. al.
28	....	d.	....	s. d.	....	s. al.
29	....	d. 773	....	s.	....	i. a., alk.
30	5.30	d. 763	....	i.	....	i. a., alk.
31	6.0	44.4	53	d.	d.	....
32	....	d.	....	i.	....	s. HNO_3
33	....	$-2H_2O$, 350	....	i.	i.	s. HCl
34	....	d.	....	i.	....	s. a., alk.
35	....	....	....	sl. s.	s.	sl. s. al.
36	....	d. 100	....	i.	i.	s. KI; i. al.
37	....	d.	....	i.	i.	i. a., alk.
38	....	$-O$, 400	....	i.	....	s. H_2SO_4, h. HCl; i. alk.
39	....	d.	....	s.	....	....
40	....	d.	....	i.	....	s. K_2S; i. a.
41	....	d. 300	....	i.	....	s. aq. reg., i. a.
42	....	d.	....	sl. s.	....	s. HNO_3, K_2S
43	7.86	1535	3000	i.	i.	s. a.; i. al., alk., eth.
44	1.71	230	$-12H_2O$, 230	124^{25}	400^{100}	s. dil. a.; i. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Iron			
1	ammonium sulfate (ous). (odite)	$Fe(NH_4)_2(SO_4)_2.6H_2O$	392.13	monocl. grn., 1.487, 1.492, 1.499
2	*ortho*arsenate (ic), (scor-	$FeAsO_4.4H_2O$	266.83	rhomb. wh., 1.765, 1.774, 1.797
3	" (ous)	$Fe_3(AsO_4)_2.6H_2O$	553.47	grn. amor. powd
4	arsenide	$FeAs$	130.77	wh
5	" di- (arseno-ferrite)	$FeAs_2$	205.70	cub. silv. gray
6	arsenite, basic (ic)	$2FeAsO_3.Fe_2O_3.5H_2O$	607.30	br.-yel. powd
7	*pyro*arsenite (ous)	$Fe_2As_2O_5$	341.54	grn.-wh
8	boride	FeB	66.66	gray cryst
9	bromide (ic)	$FeBr_3$	295.59	dk. red-br., deliq
10	" "	$FeBr_3.6H_2O$	403.68	red
11	" (ous)	$FeBr_2$	215.67	hex. grn.-yel
12	carbide	Fe_3C	179.52	cub. gray
13	carbonate (ous), (siderite)	$FeCO_3$	115.84	trig. gray, 1.875, 1.633
14	" (ous)	$FeCO_3.H_2O$	133.86	amor
15	carbonyl, tetra-	$Fe(CO)_4$	167.84	dk. grn. lust. cr
16	" penta-	$Fe(CO)_5$	195.84	visc. yel. liq
17	*per*chlorate (ous)	$Fe(ClO_4)_2.6H_2O$	362.85	grn
18	chloride (ic), (molysite)	$FeCl_3$	162.21	hex. blk.-br
19	" "	$FeCl_3.6H_2O$	270.30	br.-yel. v. deliq., cr. mass
20	" (ous), (lawrencite)	$FeCl_2$	126.75	hex. grn. to yel., deliq
21	" "	$FeCl_2.4H_2O$	198.82	monocl. bl.-grn., deliq
22	" (ous, ic)	$FeCl_2.2FeCl_3.18H_2O$	775.46	yel., deliq
23	chloroplatinate (ous)	$FePtCl_6.6H_2O$	571.91	yel. hex
24	dichromate (ic)	$Fe_2(Cr_2O_7)_3$	759.74	red-br. gran
25	ferricyanide (ous) (Turnbull's blue)	$Fe_3[Fe(CN)_6]_2$	591.30	deep bl
26	ferricyanide (ous, ic) (Prussian green)	$Fe'''_4Fe''_3[Fe(CN)_6]_6$	1662.21	grn
27	ferrocyanide (ic), (Prussian blue)	$Fe_4[Fe(CN)_6]_3$	859.02	dk. bl. cryst,
28	ferrocyanide (ous)	$Fe_2Fe(CN)_6$	323.57	amor. bl.-wh
29	fluoride (ic)	FeF_3	112.84	rhomb. grn
30	" "	$FeF_3.4\frac{1}{2}H_2O$	193.91	yel. cryst
31	" (ous)	$FeF_2.8H_2O$	237.96	grn.-bl
32	fluosilicate (ic)	$Fe_2(SiF_6)_3$	537.86	gel., flesh color
33	" (ous)	$FeSiF_6.6H_2O$	305.99	trig. col., 1.364, 1.385
34	hydroxide (ic)	$Fe(OH)_3$	106.86	red-br
35	" (ous)	$Fe(OH)_2$	89.86	hex. pa. grn. or wh. amor
36	iodide (ous)	FeI_2	309.68	hex. gray
37	" "	$FeI_2.4H_2O$	381.74	gray-blk. cr., deliq
38	nitrate (ic)	$Fe(NO_3)_3.6H_2O$	349.96	cub
39	" "	$Fe(NO_3)_3.9H_2O$	404.00	monocl. col.-pa. vlt., deliq
40	" (ous)	$Fe(NO_3)_2.6H_2O$	287.95	rhomb. grn
41	nitride	Fe_2N	125.69	gray
42	oxide (ic), (hematite)	Fe_2O_3	159.68	hex. red br. to blk., 3.01, 2.94 (Li)
43	" (ous)	FeO	71.84	blk

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.864	d.	...	26.9^{20}	73.0^{80}	i. al.
2	3.18	d.	...	i.	i.	s. HCl; i. HNO_3
3	...	d.	...	i.	i.	s. dil. HCl; sl. s. NH_4OH
4	7.83	1020	...	v. sl. s.	...	...
5	7.4	990	...	i.	...	sl. s. HNO_3; i. HCl
6	...	d.	...	sl. s.	...	s. a., alk.
7	...	...	...	i.	...	s. NH_4OH
8	7.15^{18}	...	...	i.	...	s HNO_3, h. conc. H_2SO_4
9	...	subl. d.	...	s.	s.	s. al., eth.; sl. s. NH_3
10	...	27	...	v. s.	v. s.	...
11	4.636^{25}	d.	...	109^{10}	170^{95}	s. al.
12	7.4	1837	...	i.	i.	s. a.
13	3.8	d.	...	0.0067^{25}	...	s. CO_2 soln.
14	...	d.	...	sl. s.	...	s. a. CO_2 soln.
15	1.996^{18}	d. 140–50	...	i.	...	s. org. solv.
16	lq. 1.457	−21	102.8^{749}	i.	...	s. conc. H_2SO_4, alk., al., eth. bz.
17	...	d. >100	...	s.	...	s. al.
18	2.804^{11}	282	315	74.4^{0}	535.7^{100}	v. s. al., eth., 63^{18} acet
19	...	37	280–5	91.9^{20}	∞	s. al., eth.
20	2.98	...	...	64.4^{10}	105.7^{100}	100 al.; s. acet.; i. eth.
21	1.93	...	...	160.1^{10}	415.5^{100}	s. al.
22	...	d. 50	...	...	...	...
23	2.714	d.	...	v. s.	v. s.	...
24	...	...	...	s.	...	s. a.
25	...	d.	...	i.	...	i. al., dil. a.
26	...	d. 180	...	i.	...	s. h. HCl
27	...	d.	...	i.	i.	s. HCl, H_2SO_4; i. al., eth.
28	...	...	...	i.	...	...
29	3.18	...	...	sl. s.	s.	s. a.; i. al., eth.
30	...	$-3H_2O$, 100	d.	sl. s.	s.	i. al.
31	4.09 anh.	$-8H_2O$, 100	...	sl. s.	s.	s. [illegible]., HF; i. al., eth.
32	...	...	...	s.	s. d.	...
33	1.961	...	...	128.2	...	...
34	3.4–3.9	$-1\frac{1}{2}H_2O$, 500	...	i.	i.	s. a.; i. al., eth.
35	3.4	d.	...	0.00067	...	s. a., NH_4Cl; i. alk.
36	...	177	...	s.	...	...
37	2.87	177 anh.	...	v. s.	d.	s. al., eth.
38	...	35	...	s.	...	...
39	1.684	47.2	d.	s.	s.	s. al., acet.; sl. s. HNO_3
40	...	60.5 d.	...	70.9^{0}; 83.5^{20}	166.7^{61}	...
41	6.35	d. 200	...	i.	...	s. HCl, H_2SO_4
42	5.24	1565	...	i.	...	s. HCl
43	5.7	1420	...	i.	i.	s a.; i. al., alk.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Iron			
1	oxide (ous, ic), (magnetite)	Fe_3O_4	231.52	cub. blk.; red-blk. powd
2	" (ous, ic)	$Fe_3O_4.4H_2O$	303.58	blk
3	*ortho*phosphate (ic)	$FePO_4.2H_2O$	186.89	yel.-wh., dimorph
4	phosphate (ous), (vivianite)	$Fe_3(PO_4)_2.8H_2O$	501.68	monocl. wh.-bl., 1.579, 1.603, 1.633
5	*pyro*phosphate (ic)	$Fe_4(P_2O_7)_3.9H_2O$	907.62	yel.-wh. powd
6	phosphide (ic)	Fe_3P	198.54	gray
7	" (ous)	Fe_2P	142.70	bl.-gray cr. or powd
8	*hypo*phosphite (ic)	$Fe(H_2PO_2)_3$	250.95	wh. or gray-wh. powd
9	potassium sulfate (ic)	$FeK(SO_4)_2.12H_2O$	503.25	cub. oct. col. or vlt., 1.482
10	rubidium selenate (ic)	$Fe_2(SeO_4)_3.Rb_2SeO_4.24H_2O$	1287.73	cub., 1.507[18]
11	sulfate (ic)	$Fe_2(SO_4)_3$	399.86	rhomb. yel
12	" " (coquimbite)	$Fe_2(SO_4)_3.9H_2O$	562.00	rhomb., deliq., 1.552, 1.558
13	sulfate (ous), (melanterite)	$FeSO_4.7H_2O$	278.01	monocl. bl.-grn., 1.471, 1.478, 1.486.
14	sulfide (ic)	Fe_2S_3	207.86	yel., grn
15	" (ous), (triolite)	FeS	87.90	hex. blk.-br
16	" (ous, ic)	Fe_3S_4	295.76	hex
17	" di- marcasite	FeS_2	119.96	rhomb. yel
	" " pyrite	FeS_2	119.96	cub. yel
18	sulfite (ous)	$FeSO_3.2\frac{1}{2}H_2O$	180.94	
19	tantalate (ic)	$Fe_2(TaO_4)_3$	847.88	gray-br. powd
20	thiocyanate (ic)	$Fe(CNS)_3.3H_2O$	284.09	cub. blk.-red, deliq
21	" (ous)	$Fe(CNS)_2.3H_2O$	226.02	rhomb. grn
22	thiosulfate (ous)	$FeS_2O_3.5H_2O$	258.04	grn. cr. deliq
23	vanadate (ic)	$FeVO_3$	154.79	grayish-br. powd
24	**Krypton**	Kr	83.70	col. inert gas
25	**Lanthanum**	La	138.92	lead gray met
26	bromate	$La(BrO_3)_3.9H_2O$	684.81	
27	bromide	$LaBr_3.7H_2O$	504.78	col. cr
28	carbide	LaC_2	162.92	yel. cryst
29	carbonate	$La_2(CO_3)_3.3H_2O$	511.89	trimet. wh
30	chloride	$LaCl_3$	245.29	wh. deliq. cryst
31	"	$LaCl_3.7H_2O$	371.40	tricl. wh., hyg
32	hydroxide	$La(OH)_3$	189.94	wh. powd
33	iodate	$La(IO_3)_3$	663.68	col
34	iodide	LaI_3	519.68	
35	molybdate	$La_2(MoO_4)_3$	757.84	tetr
36	nitrate	$La(NO_3)_3.6H_2O$	433.04	col. deliq
37	oxide, sesqui-	La_2O_3	325.84	amor. or rhomb. wh
38	sulfate	$La_2(SO_4)_3$	566.02	wh. powd., hyg
39	"	$La_2(SO_4)_3.9H_2O$	728.16	hex. col
40	sulfide	La_2S_3	374.02	red-yel. cr
41	tungstate	$La_2(WO_4)_3$	1021.84	
42	**Lead**	Pb	207.22	cub. silv. bl.-wh. soft met
43	antimonate	$Pb_3(SbO_4)_2$	993.18	or.-yel powd., v. pois
44	*ortho*arsenate, mono-	$PbH_4(AsO_4)_2$	489.11	tricl., 1.74, 1.82

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm^3 of: Cold water	Hot water	Alcohol, acids, etc.
1	5.18	1538 d.	....	i.	i.	sl. s. a.; i. al., eth.
2	....	d.	....	i.	i.	s. a.
3	2.87	d.	....	v. sl. s.	0.67^{100}	s. HCl, H_2SO_4
4	2.58	....	....	i.	i.	s. a.; i. ac. a.
5	....	....	....	i.	....	s. a., alk. citrates
6	6.74	1100	....	i.	....	....
7	6.56	1290	....	i.	i.	s. aq. reg., $HNO_3 + HF$; i. dil. a.
8	....	d.	....	0.043^{25}	0.083^{100}	s. alk. citrate
9	1.83	33	....	$20^{12.5}$	v. s.	i. al.
10	2.131^{15}	45	....	....	....	....
11	3.097^{18}	d. 480	....	sl. s.	d.	i. H_2SO_4, NH_3
12	2.1	d.	....	440	d.	s. abs. al.
13	1.898	64; $-6H_2O$, 100	$-7H_2O$, 300	15.65	48.6^{50}	i. al.
14	4.3	d.	....	v. sl. s., d.	to FeS + S	d. a.
15	4.84	1193	d.	$.00062^{18}$	....	s. a., ev. H_2S; i. NH_3
16	4.55	....	....	i.	....	s. a.
17	4.87 5.00	tr. 450 1171	} d.	0.00049	....	s. HNO_3; i. dil. a.
18	....	d. 250	....	v. sl. s.	....	s. SO_2 soln.; i. al.
19	....	....	....	i.	....	....
20	....	d.	....	s.	v. s.	s. al., eth.
21	....	d.	....	v. s.	....	s. al., eth., acet.
22	....	....	....	v. s.	d.	v. s. al.
23	....	....	....	i.	....	s. a.; i. al.
24	3.708^0 g/l; lq. $2.155^{-152.9}$	-157	-152.9	6^{20}	....	....
25	6.15	826	1800	d. to $La(OH)_3$	d.	s. a.
26	....	37.5	$-7H_2O$, 100	28.5^{15}	....	i. al.
27	....	....	....	v. s.	....	v. s. al.; i. eth.
28	5.02	....	....	d.	d.	s. H_2SO_4; i. conc. HNO_3
29	....	....	....	i.	....	s. dil. a.; sl. s. aq. CO_2; i. acet.
30	3.842^{25}	872(860)	....	v. s.	d.	v. s. al.; i. acet.
31	....	d. 91	....	v. s.	v. s.	v. s. al.
32	....	d.	....	i.	....	s. a.
33	....	....	....	1.7^{25}	....	....
34	5.057^{25}	761 ± 2	....	....	....	....
35	4.77^{16}	1181	....	sl. s.	....	....
36	....	40	126	151.1^{25}	v. s.	v. s. al.; s. acet.
37	6.51	>2000	4200	0.0001^{29}	d.	s. a.; NH_4Cl, al.; i. acet.
38	3.60^{15}	d. 1150	....	3.0	0.69^{100}	sl. s. al.; i. acet.
39	2.821	d.	....	3.8^0	0.87^{100}	sl. s. HCl., al.
40	4.911^{11}	2100 vac.	....	d.	d.	s. a.
41	....	....	....	sl. s.	....	....
42	11.3437^{16} 11.288^{20}_{20} Ra 11.2960^{16} Ur	327.43 dio Pb. an. Pb.	1613	i.	i.	s. HNO_3, h. conc. H_2SO_4
43	....	....	....	i.	....	....
44	4.46^{15}	d. 140	....	d.	....	s. HNO_3

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Lead			
1	*ortho*arsenate, di-	$PbHAsO_4$	347.16	monocl. leaf., α1.90, γ1.97
2	"	$Pb_3(AsO_4)_2$	899.52	wh. cr.; v. pois
3	*meta*arsenate	$Pb(AsO_3)_2$	453.08	hex. tabl
4	*pyro*arsenate	$Pb_2As_2O_7$	676.30	rhomb., β2.03
5	*meta*arsenite	$Pb(AsO_2)_2$	421.08	wh. powd
6	azoimide	PbN_6	291.27	cryst
7	*meta*borate	$Pb(BO_2)_2.H_2O$	310.88	cr. wh. powd
8	bromate	$Pb(BrO_3)_2.H_2O$	481.07	monocl. col
9	bromide	$PbBr_2$	367.05	rhomb. wh
10	carbonate (cerussite)	$PbCO_3$	267.22	rhomb. col., 1.804, 2.076, 2.078
11	" basic, (white lead, hydrocerussite)	$2PbCO_3.Pb(OH)_2$	775.68	hex. wh. amor. powd., 2.09, 1.94
12	chlorate	$Pb(ClO_3)_2$	374.13	monocl. wh
13	"	$Pb(ClO_3)_2.H_2O$	392.15	monocl. wh., deliq
14	*per*chlorate	$Pb(ClO_4)_2.3H_2O$	460.18	rhomb
15	chloride (cotunnite)	$PbCl_2$	278.13	rhomb. wh., 2.199, 2.217, 2.260
16	" tetra-	$PbCl_4$	349.05	yel. oily liq
17	chlorite	$Pb(ClO_2)_2$	342.13	monocl. yel
18	chromate (crocoite)	$PbCrO_4$	323.23	monocl. yel., 2.31, 2.37 (Li), 2.66
19	" basic, (chrome red)	$PbCrO_4.PbO$	546.45	red cr. powd
20	*di*chromate	$PbCr_2O_7$	423.24	red cr
21	cyanate	$Pb(CNO)_2$	291.24	wh. need
22	cyanide	$Pb(CN)_2$	259.24	yelsh.-wh. pois. powd
23	ferricyanide	$Pb_3[Fe(CN)_6]_2$ $6H_2O$	1153.53	red cr
24	ferrocyanide	$Pb_2Fe(CN)_6.3H_2O$	680.37	yelsh.-wh. powd
25	fluoride	PbF_2	245.22	col
26	fluosilicate	$PbSiF_6.2H_2O$	385.31	monocl. col
27	hydroxide	$Pb(OH)_2$	241.24	wh. amor
28	"	$2PbO.H_2O$	464.46	cub. or wh. amor. powd
29	iodate	$Pb(IO_3)_2$	557.06	wh
30	*per*iodate	$PbHIO_5$	415.15	cryst
31	"	$PbHIO_5.H_2O$	433.16	amor
32	iodide	PbI_2	461.06	hex yel. powd
33	molybdate	$PbMoO_4$	367.22	yel. powd
34	nitrate	$Pb(NO_3)_2$	331.24	cub. or monocl. col., 1.782
35	" basic	$2PbO.N_2O_5.H_2O$	572.47	rhomb. cr
36	oxide, mono- (litharge)	PbO	223.22	tetr. yel., 2.665 (Li), 2.535 (Li)
37	" " (massicotite)	PbO	223.22	rhomb. yel., 2.51, 2.61(Li), 2.71
38	oxide, di- (plattnerite)	PbO_2	239.22	tetr. br., ω 2.3 (Li)
39	" sesqui-	Pb_2O_3	462.44	amor. or. powd
40	" red (minium)	Pb_3O_4	685.66	cr. sc. or red amor. powd
41	" sub-	Pb_2O	430.44	amor. blk
42	oxychloride (matlockite)	$PbCl_2.PbO$	501.35	tetr. wh., 2.04, 2.15, 2.15
43	" (mendipite)	$PbCl_2.2PbO$	724.57	rhomb. yel., 2.24, 2.27, 2.31
44	"	$PbCl_2.3PbO$	947.79	yel
45	" (cassel yellow)	$PbCl_2.7PbO$	1840.67	yel. cr., or powd
46	*ortho*phosphate	$Pb_3(PO_4)_2$	811.70	hex. col. or wh. powd., 1.970, 1.936
47	*meta*phosphate	$Pb(PO_3)_2$	365.26	col

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	5.79	d. >200	$-H_2O$, 280	i.	sl. s.	s. HNO_3, caust. alk.
2	7.30	1042	...	v. sl. s.	...	s. HNO_3
3	6.42^{15}	...	...	d.	d.	s. HNO_3
4	6.85	802	...	i.	d.	s. HCl, HNO_3; i. ac. a.
5	...	...	...	i.	...	s. HNO_3
6	...	exp. 350	...	0.05	sl. s.	v. s. ac. a.; i. NH_4OH
7	5.598 anh.	...	$-H_2O$, 160	i.	i.	s. a.; i. alk.
8	5.53	d. 180	...	1.38^{20}	...	...
9	6.66	373	916	0.4554^{0}	4.75^{100}	s. a., KBr; sl. s. NH_3; i. al.
10	6.6	d. 315	...	0.00011^{20}	d.	s. a. alk.; i. al., NH_3
11	6.14	d. 400	...	i.	i.	sl. s. aq. CO_2
12	3.89	d.	...	v. s.	...	s. al.
13	4.037	d. 110	...	151.3^{18}	171^{80}	s. al.
14	2.6	d. 100	...	s.	...	s. al.
15	5.85	501	950	0.673^{0}	3.34^{100}	sl. s. dil. HCl, NH_3; i. al.
16	3.18^{0}	−15	exp. 105	d. ev. Cl_2	d.	s. conc. HCl
17	...	exp. 126	...	v. sl. s.	sl. s.	s. KOH
18	6.3(6.12^{15})	844	d.	0.000007^{20}	i.	s. a. alk.; i. ac. a., NH_3
19	...	...	...	i.	i.	s. a., alk.
20	...	...	...	d.	...	s. a., alk.
21	...	d.	...	i.	sl. s.	...
22	...	...	...	sl. s.	s.	s. KCN
23	...	d.	...	sl. s.	s.	s. HNO_3, alk.
24	...	d.	...	i.	...	sl. s. H_2SO_4
25	8.24	855	1290	0.064^{20}	...	s. HNO_3; i. acet., NH_3
26	...	...	...	s.	v. s.	...
27	...	d. 145	...	0.016^{20}	sl. s.	s. a., alk.; i. acet.
28	7.592	d. 145	...	.014	sl. s.	s. HNO_3, alk., ac. a.
29	...	d. 300	...	0.0012^{2}	0.003^{25}	sl. s. HNO_3; i. NH_3
30	...	d. 130	...	i.	i.	s. dil. HNO_3
31	...	$-H_2O$, 110	...	i.	i.	sl. s. dil. HNO_3
32	6.16	402(393)	954(900)	$.044^{0}$; $.069^{20}$	0.436^{100}	s. alk., KI; i. al.
33	...	...	...	i.	...	s. a.; i. al.
34	4.53^{24}	d. 357	...	37.65^{0}	126.1^{100}	8.77^{22} 43% al.; s. NH_3, alk.
35	5.93	180 d.	...	v. s.	...	s. a.
36	9.53	888	...	0.0017^{20}	...	s. HNO_3, alk., lead acet., NH_4Cl, $CaCl_2$, $SrCl_2$
37	8.0	...	...	i.	i.	s. alk.
38	9.375	d. 290	...	i.	i.	s. dil. HCl; sl. s. ac. a.; i. al.
39	...	d. 370	...	i.	d.	d. a. to Pb + PbO_2
40	9.1	d. 500	...	i.	i.	s. ac. a., h. HCl; i. al.
41	8.342	d.	...	i.	i.	s. a., alk.
42	7.21	d. 524	...	i.	i.	s. alk.
43	7.08	693	...	i.	i.	s. alk.
44	...	...	...	0.0056^{18}	0.07^{74}	...
45	...	...	...	i.	...	...
46	6.9–7.3	1014	...	0.000014^{20}	i.	s. HNO_3, alk.; i. ac. a.
47	...	800	...	v. sl. s.	...	...

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Lead			
1	*pyro*phosphate	$Pb_2P_2O_7$	588.48	rhomb. wh
2	"	$Pb_2P_2O_7.H_2O$	606.50	rhomb
3	phosphite	$PbHPO_3$	287.25	wh. powd
4	selenide (clausthalite)	$PbSe$	286.42	cub
5	silicate	$PbSiO_3$	283.28	wh. cr. powd
6	sulfate (anglesite)	$PbSO_4$	303.28	monocl. or rhomb. wh., 1.877, 1.882, 1.894
7	" acid	$Pb(HSO_4)_2.H_2O$	419.37	cryst
8	" basic (lanarkite)	$PbSO_4.PbO$	526.50	monocl. wh., 1.93, 1.99, 2.02
9	*per*sulfate	$PbS_2O_8.3H_2O$	453.39	deliq
10	sulfide (galena)	PbS	239.28	cub. bl. metallic, 3.912
11	sulfite	$PbSO_3$	287.28	wh
12	sulfochloride	$3PbS.PbCl_2$	995.97	red
13	thiocyanate	$Pb(CNS)_2$	323.36	monocl. wh
14	thionate, di-	$PbS_2O_6.4H_2O$	439.40	trig., 1.635, 1.653
15	thiosulfate	PbS_2O_3	319.34	wh. cr
16	tungstate (raspite)	$PbWO_4$	455.22	monocl. col., 2.27, 2.27, 2.30
17	" (stolzite)	$PbWO_4$	455.22	tetr., 2.269, 2.182
18	*meta*vanadate	$Pb(VO_3)_2$	405.12	yel. powd
19	**Lithium**	Li	6.94	cub. silv. wh. soft met., μc 3.16
20	amide	$LiNH_2$	22.96	cub. col
21	*ortho*arsenate	$Li_3AsO_4.H_2O$	177.77	wh. powd
22	*tetra*borate	$Li_2B_4O_7.5H_2O$	259.24	
23	*meta*borate	$LiBO_2$	49.76	wh. powd
24	bromide	$LiBr$	86.86	cub. wh., deliq
25	carbide	Li_2C_2	37.88	cr. or wh. powd
26	carbonate	Li_2CO_3	73.88	monocl. col., 1.428, 1.567, 1.572
27	" acid, (bicarbonate)	$LiHCO_3$	67.95	wh
28	chlorate	$LiClO_3.\frac{1}{2}H_2O$	99.40	tetr., deliq
29	*per*chlorate	$LiClO_4$	106.40	col., deliq
30	"	$LiClO_4.3H_2O$	160.44	hex. col
31	chloride	$LiCl$	42.40	cub. wh., deliq
32	chloroplatinate	$Li_2PtCl_6.6H_2O$	529.95	hex. or. red, deliq
33	chromate	$Li_2CrO_4.2H_2O$	165.92	rhomb. or.-yel., deliq
34	dichromate	$Li_2Cr_2O_7.2H_2O$	265.93	blk.-br., deliq
35	fluoride	LiF	25.94	cub. col
36	fluosilicate	$Li_2SiF_6.2H_2O$	191.97	monocl. wh., 1.300, 1.296
37	*meta*germanate	Li_2GeO_3	134.48	monocl., 1.7
38	hydride	LiH	7.95	col
39	hydroxide	$LiOH$	23.95	wh. cr. or powd
40	"	$LiOH.H_2O$	41.96	monocl. col
41	iodide	LiI	133.86	cub. wh., deliq
42	"	$LiI.3H_2O$	187.91	monocl. col.-yelsh
43	nitrate	$LiNO_3$	68.95	trig. col. deliq., 1.735, 1.435
44	"	$LiNO_3.3H_2O$	122.99	col
45	nitrite	$LiNO_2.H_2O$	70.96	flat need

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	5.8	824	....	i.	i.	s. HNO_3, KOH
2	....	806 anh.	....	i.	d.	s. HNO_3, KOH, $Na_4P_2O_7$
3	....	d.	....	i.	i.	s. HNO_3
4	8.10^{15}	1065	....	i.	....	s. HNO_3
5	6.49	766	....	i.	....	d. a.
6	6.2	d. 1000	....	0.0028^{0}	0.0056^{40}	sl. s. conc. H_2SO_4: s. NH_4 salts; i. al.
7	....	d.	....	0.0001^{18} d.	....	sl. s. H_2SO_4
8	6.92	977	....	0.0044^{0}	v. sl. s.	sl. s. H_2SO_4
9	....	....	....	v. s.	....	....
10	7.5	1114	....	$.000086^{18}$	i.	s. a., i. KOH, al.
11	....	....	....	i.	i.	s. HNO_3
12	....	....	....	i.	d.	i. dil. a.
13	3.82	....	....	0.05^{20}	d.	s. KCNS, HNO_3
14	3.22	d.	....	s.	....	....
15	5.18	d.	....	0.03	....	s. a., $Na_2S_2O_3$
16	....	1123	....	0.03	....	d. a.; i. al.
17	8.23	....	....	i.	....	s. KOH; i. HNO_3
18	....	....	....	i.	....	....
19	0.534	186	1336	d. to LiO	$H + H_2$	s. a.; d. al.
20	1.178	390	430	d.	d.	....
21	....	....	....	v. sl. s.	....	....
22	....	....	....	v. s.	....	i. al.
23	....	....	....	sl. s.	....	....
24	3.464^{25}	547	1265	142.7^{0}	243.6^{82}	s. al. eth.
25	1.65^{18}	....	....	d.	d.	s. conc. a.
26	$2.111^{17.5}$	618	d.	1.54^{0}; 1.33^{20}	0.72^{100}	s. a.; i. acet., NH_3, al.
27	....	....	....	5.5^{13}	....	....
28	....	(50)65	$-\frac{1}{2}H_2O$, 90; d. 290	313.5^{18}	∞	v. s. al.
29	2.429	236	d. 380	59.7^{25}	....	s. al.
30	1.841	95	$-2H_2O$, 100; $-3H_2O$, 150	s.	s.	v. s. al.
31	2.068^{25}	613	1353	67^{0}; 81.8^{25}	127.5^{100}	2.48^{25} al., 5.2^{1} meth. al.; 3.94^{25} acet.; s. eth.
32	....	....	$-6H_2O$, 180	s.	s.	s. al.; i. eth.
33	....	....	$-2H_2O$, 150	110.9^{18}	99.94^{30}	....
34	....	$-2H_2O$, 130	d.	130.4^{30}	....	....
35	$2.295^{21.5}$	870	1676	0.27^{18}	....	s. a., HF; i. al., acet.
36	2.33^{12}	$-2H_2O$, 100	d.	52.6^{17}	....	s. al.; i. eth., acet.
37	3.53^{21}	1239	....	0.85^{25}	....	s. a.
38	0.82	680	....	d. to LiO	$H + H_2$	....
39	2.54	450	d.	12.7^{0}	17.5^{100}	sl. s. al.
40	....	....	....	11.28^{10}	$11.68^{45.5}$; 14.9^{100}	sl. s. al.
41	4.061^{25}	446	1190	s.	s.	251^{25} al.; v. s. NH_3
42	3.48	73; $-H_2O$, 73	$-2H_2O$, 80 $-3H_2O$, 300	151^{0}	201.2^{60}	s. abs. al., acet.
43	2.38	255	....	52.2	$66.1^{70.9}$	s. al., acet.
44	....	29.88 $-2\frac{1}{2}H_2O$, 29.9	$-3H_2O$, 61.1	$34.8^{0.1}$	$57.48^{29.6}$	....
45	1.615^{0}	<100	d.	125^{0}	459^{50}	v. s. abs. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Lithium			
1	oxide	Li_2O	29.88	wh. cr
2	phosphate	Li_3PO_4	115.84	rhomb. col
3	*ortho*phosphate	$2Li_3PO_4.H_2O$	249.70	wh. cr. powd
4	silicate	Li_2SiO_3	89.94	rhomb. col., lq. 1.548^{25}, α 1.584, γ 1.604
5	"	Li_4SiO_4	119.82	rhomb. col., α1.594, γ1.614
6	silicide	Li_6Si_2	97.76	bl. cr
7	sulfate	Li_2SO_4	109.94	monocl. col., β 1.465
8	"	$Li_2SO_4.H_2O$	127.96	monocl. col., 1.460, 1.477, 1.488
9	" acid	$LiHSO_4$	104.01	pr
10	sulfide	Li_2S	45.94	cub. wh.-yel
11	sulfite	$Li_2SO_3.H_2O$	111.96	need
12	thiocyanate	$LiSCN$	65.01	deliq., wh. cr
13	tungstate	Li_2WO_4	261.88	trig. col
14	*meta*vanadate	$LiVO_3.2H_2O$	141.92	yelsh. powd
15	**Lutecium**	Lu	175.0	
16	**Magnesium**	Mg	24.32	hex. silv. wh. met
17	aluminate (spinel)	$MgO.Al_2O_3$	142.26	cub. col., 1.723
18	ammonium arsenate	$MgNH_4AsO_4.6H_2O$	289.38	tetr. col., 1.608
19	" carbonate	$MgCO_3(NH_4)_2CO_3.4H_2O$	252.46	wh.
20	" chloride	$MgCl_2.NH_4Cl.6H_2O$	256.82	rhomb., deliq
21	" chromate	$MgCrO_4.(NH_4)_2CrO_4.6H_2O$	400.51	monocl. yel., 1.636, 1.637, 1.653
22	" phosphate (struvite)	$MgNH_4PO_4.6H_2O$	245.47	rhomb. col., 1.495, 1.496, 1.504
23	" sulfate, (boussingaultite)	$MgSO_4.(NH_4)_2SO_4.6H_2O$	360.61	monocl. col., 1.472, 1.473, 1.479
24	arsenate	$Mg_3(AsO_4)_2.22H_2O$	747.16	
25	*ortho*arsenate, mon-H	$2MgHAsO_4.13H_2O$	562.72	
26	*ortho*arsenite	$Mg_3(AsO_3)_2$	318.82	
27	*ortho*borate	$Mg_3(BO_3)_2$	190.60	rhomb. col
28	*meta*borate	$Mg(BO_2)_2.8H_2O$	254.08	tetr., 1.565, 1.575
29	bromate	$Mg(BrO_3)_2.6H_2O$	388.25	cub. col., 1.514
30	bromide	$MgBr_2$	184.15	col. cr., deliq
31	"	$MgBr_2.6H_2O$	292.25	hex. col
32	carbonate (magnesite)	$MgCO_3$	84.32	trig. wh., 1.700, 1.509
33	" (nesquehonite)	$MgCO_3.3H_2O$	138.37	rhomb. col. need., 1.495, 1.501, 1.526
34	" basic, (hydromagnesite)	$3MgCO_3.Mg(OH)_2.3H_2O$	365.34	rhomb. wh., 1.527, 1.530, 1.540
35	chlorate	$Mg(ClO_3)_2.6H_2O$	299.33	wh. cr. or powd., deliq
36	*per*chlorate	$Mg(ClO_4)_2$	223.23	
37	"	$Mg(ClO_4)_2.6H_2O$	331.33	
38	chloride (chloromagnesite)	$MgCl_2$	95.23	hex col., 1.675, 1.59
39	" (bischofite)	$MgCl_2.6H_2O$	203.33	monocl. col. deliq., 1.495, 1.507, 1.528
40	chromate	$MgCrO_4.7H_2O$	266.44	rhomb. yel., 1.521, 1.550, 1.568
41	ferrocyanide	$Mg_2Fe(CN)_6.12H_2O$	476.72	pa. yel. cr
42	fluoride (sellaite)	MgF_2	62.32	tetr. col., 1.378, 1.390

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	$2.013^{25.2}$	>1700	....	6.67^{0} d.	10.02^{100}	....
2	$2.537^{17.5}$	837	....	0.039^{18}	....	s. a. NH_4OH; i. acet.
3	2.41	....	....	0.04	....	s. a.
4	2.52^{25}	1201	....	i.	s. d.	s. dil. HCl
5	2.28	1256	....	i.	d.	....
6	1.12	d.	....	d.	d.	d. a.; i. NH_3, turp.
7	2.221	860	....	26.1^{0}	23^{100}	i. abs. al., acet.
8	2.06	$-H_2O$, 130	....	34.6^{20}	29.5^{100}	i. abs. al.
9	2.123^{13}	120	....	d.	....	....
10	1.66	....	....	v. s.	v. s.	v. s. al.
11	....	455 sl. d.	$-H_2O$, 180–200	s.	s.	i. al.
12	....	....	....	v. s.	....	....
13	....	742	....	v. s.	v. s.	d. a.; i. al.
14	....	....	....	s.	....	....
15	....	....	....	....	....	....
16	1.74	651	1110	i.	sl. s. d. to $Mg(OH)_2$	s. a., NH_4 salts
17	3.6	2135	....	....	....	v. sl. s. dil. HCl; i. dil. HNO_3
18	1.932^{15}	d.	....	0.038^{20}	0.024^{80}	s. a.; i. al.
19	....	....	....	s.	v. s.	s. a.; i. al.
20	1.456	d.	....	16.7	....	....
21	1.84	d.	....	v. s.	v. s.	....
22	1.72	d.	....	0.0231^{0}	0.0195^{80}	s. a.; i. al.
23	1.70	>120	....	17.68^{0}	130.53^{100}	....
24	1.788	....	....	i.	i.	s. a., NH_4Cl
25	3.155^{15}	....	....	i.	0.15^{100}	s. HNO_3; i. NH_4Cl
26	....	....	....	s.	v. s	s. a. NH_4Cl; i. NH_4OH
27	2.99^{21}	....	....	s.	s.	s. min. a.; i. ac. a.
28	2.30	....	....	i.	i. (v. sl. s.)	s. a.
29	2.29	$-6H_2O$, 200	d.	72.6^{18}	v. s.	i. al.
30	3.72	700(695)	....	91^{0}	120.2^{100}	6.9^{0} al.; 21.8^{20} meth. al.
31	....	165 d.	....	316^{0}	v. s.	s. al., acet.; sl. s. NH_3
32	3.037	d. 350	$-CO_2$, 900	0.0106	....	s. a., aq. CO_2; i. acet., NH_3
33	1.850	165	....	0.152^{19}	d.	s. a.; 1.4 aq. CO_2
34	2.16	d.	....	0.04	0.011	s. a., NH_4 salts
35	1.80^{25}	35	d. 120	56.5^{18}	73.7^{91}	s. al.
36	2.60^{25}	251 d.	....	49.90^{25}	v. s.	....
37	1.970^{25}	147	....	....	....	....
38	2.325	712	1412	52.8^{0}; 56.7^{20}	73 [illegible]	50 al
39	1.56	118 d.	d.	167	367	50 al.
40	1.695	....	....	211.5^{18}	v. s.	....
41	....	....	....	33	....	....
42	3.0	1396	2239	0.0087^{15}	i.	s. HNO_3; sl. s. a.; i. al

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Magnesium			
1	fluosilicate	$MgSiF_6$	166.38	wh. cr. or powd
2	"	$MgSiF_6.6H_2O$	274.47	trig. wh.
3	hydroxide (brucite)	$Mg(OH)_2$	58.34	trig. col., 1.559, 1.580
4	iodate	$Mg(IO_3)_2.4H_2O$	446.22	monocl.
5	iodide	MgI_2	278.16	wh. cr., deliq.
6	"	$MgI_2.8H_2O$	422.28	wh. deliq. powd
7	nitrate	$Mg(NO_3)_2.6H_2O$	256.43	monocl. col. deliq.
8	nitride	Mg_3N_2	100.98	grn. yel. cr.
9	*per*manganate	$Mg(MnO_4)_2.6H_2O$	370.27	dk. purp. need. deliq.
10	oxide (periclase)	MgO	40.32	cub. col., 1.736
11	*ortho*phosphate	$Mg_3(PO_4)_2.4H_2O$	335.06	monocl.
12	" (bobierite)	$Mg_3(PO_4)_2.8H_2O$	407.12	monocl. pl., 1.510, 1.520, 1.543
13	*ortho*phosphate, acid, (newberyite)	$MgHPO_4.3H_2O$	174.39	rhomb. wh., 1.514, 1.518, 1.533
14	*ortho*phosphate, acid	$MgHPO_4.7H_2O$	246.46	hex
15	*pyro*phosphate	$Mg_2P_2O_7$	222.68	monocl. col., 1.602, 1.604, 1.615
16	"	$Mg_2P_2O_7.3H_2O$	276.73	wh. amor
17	*ortho*phosphite	$MgHPO_3.3H_2O$	158.39	
18	*hypo*phosphite	$Mg(H_2PO_2)_2.6H_2O$	262.48	wh. cr
19	potassium carbonate	$MgKH(CO_3)_2.4H_2O$	256.49	tricl. col.
20	" chloride, (carnallite)	$MgCl_2.KCl.6H_2O$	277.88	rhomb. col., deliq., 1.466, 1.475, 1.494
21	" chlorosulfate	$MgK(SO_4)Cl.3H_2O$	248.98	col. monocl.
22	" sulfate (picromerite, schönite)	$MgSO_4.K_2SO_4.6H_2O$	402.73	monocl. col., 1.461, 1.463, 1.476
23	selenate	$MgSeO_4.6H_2O$	275.61	monocl. 1.486, 1.489, 1.491
24	silicate (clinoenstatite)	$MgSiO_3$	100.38	monocl
25	silicide	Mg_2Si	76.70	oct
26	sodium chloride	$MgCl_2.NaCl.H_2O$	171.70	
27	" sulfate, (bloedite)	$MgNa_2(SO_4)_2.4H_2O$	334.50	monocl. col., 1.486, 1.488, 1.489
28	sulfate	$MgSO_4$	120.38	col. cr.
29	" (kieserite)	$MgSO_4.H_2O$	138.40	monocl. col., 1.523, 1.535, 1.586
30	" (epsom salt epsomite)	$MgSO_4.7H_2O$	246.49	rhomb. (monocl.) col., 1.433, 1.455, 1.461
31	sulfide	MgS	56.38	cub. col.
32	sulfite	$MgSO_3.6H_2O$	212.47	wh. cr. powd.
33	thiosulfate	$MgS_2O_3.6H_2O$	244.53	col. pr
34	tungstate	$MgWO_4$	272.32	[illegible]
35	**Manganese**	Mn	[illegible]	cub. or tetr. gray-pink met.
36	ammonium phosphate	$MnNH_4PO_4.H_2O$	[illegible]	wh. cr
37	" sulfate	$MnSO_4.(NH_4)_2SO_4.6H_2O$	391.22	monocl. pa. red. 1.480, 1.484, 1.491
38	arsenide (kaneite)	$MnAs$	[illegible]	blk
39	"	[illegible]	184.79	
40	"	Mn_3As	[illegible]	magnetic
41	arsenite	$Mn_3H_6(AsO_3)_4.2H_2O$	[illegible]	rose red
42	boride	MnB_2	[illegible]	gray-vi. cr
43	bromide	$MnBr_2$	214.76	rose red

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	...	...	...	65	...	...
2	1.788	...	...	...	...	...
3	2.4	d.	...	0.0009[illegible]	0.004^{100}	s. a., NH_4 salts
4	$3.3^{13.5}$	$-4H_2O$, 210	d.	10^{15}	33^{100}	...
5	4.25	d.	...	100^{0}; 148^{3}	164.9^{110}	s. al., eth., NH_3
6	...	d.	...	148.1[illegible]	...	s. al., eth.
7	1.464	95	$-5H_2O$, 330	200	∞	s. al.
8	...	d. 1500	...	i.	d.	s. a.; i. al.
9	...	d.	...	v. s.	d.	s. ac. a., meth. al.
10	3.65	2800	...	0.00062	$.00086^{29}$ sl. d.	s. a., NH_4 salts, i. al.
11	1.64^{15}	...	...	0.0205	...	s. a.; i. NH_4 salts, NH_3
12	2.41	...	...	...	...	s. NH_4 citrate
13	2.10	...	...	sl. s.	...	s. a.
14	...	$-4H_2O$, 100	...	0.3	0.2	s. a.; i. al.
15	2.598^{22}	1383	...	i.	i.	s. a.; i. al.
16	2.56	d. 150	...	i.	sl. s.	s. a.; i. al.
17	...	...	...	0.25	...	s. a.
18	...	...	...	20	...	i. al., eth.
19	2.98	...	...	s. d. gives $MgCO_2.3H_2O$		...
20	1.60	167	...	64.5[illegible] d.	d.	d. al.
21	2.12-15	...	...	s.	...	...
22	2.15	d. 72	...	19.26^{0}	81.70^{75}	...
23	1.928	...	...	v. s.	v. s.	...
24	3.28	1557 d.	...	...	...	...
25	...	1102	...	i.	d.	s. a., NH_4Cl, HCl
26	...	...	...	s.	...	...
27	2.23	...	...	s.	...	...
28	2.66	1185	...	26^{0}	73.8^{100}	s. al. glyc., 1.16^{13} eth.; i. acet.
29	2.57	...	...	...	$68.4^{99.4}$	...
30	1.68	$-6H_2O$, 150	$-7H_2O$, 200	71^{20}	91^{40}	s. al., glyc.
31	2.80	d.	...	d.	d.	s. a. PCl_3
32	...	$-6H_2O$, 200	d.	1.25	0.83	i. al., NH_3
33	1.818^{24}	$-3H_2O$, 170	d.	v. s.	v. s.	s. al.
34	5.66	...	...	i.	...	d. a.; i. al.
35	7.20	1260	1900	d.	d.	s. dil. a.
36	...	...	...	0.0031	0.05	i. al., NH_4 salts
37	1.83	...	...	51.3^{25}	v. s.	...
38	5.55	d. 400	...	i.	i.	s. HCl, aq. reg.
39	...	1400	...	i.	i.	s. aq. reg.
40	...	...	...	i.	i.	s. aq. reg.
41	...	...	...	i.	...	s. a.
42	6.9	...	...	d.	d.	s. a.
43	4.385^{25}	d.	...	127.3^{0}	228^{100}	i. NH_3

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Manganese			
1	bromide	$MnBr_2.4H_2O$	286.82	monocl. rose-red, deliq
2	carbide	Mn_3C	176.79	tetrahedral
3	carbonate (rhodochrosite)	$MnCO_3$	114.93	trig. rose pink or amor. lt. br. powd., 1.817, 1.597
4	chloride (scacchite)	$MnCl_2$	125.84	cub. pink, deliq
5	"	$MnCl_2.4H_2O$	197.91	monocl. rose, deliq
6	" per-	$MnCl_4$	196.76	green
7	chromite	$Mn(CrO_2)_2$	222.95	oct. gray
8	ferrocyanide	$Mn_2Fe(CN)_6.7H_2O$	447.86	grnsh.-wh. powd
9	fluoride (ous)	MnF_2	92.93	red. quad. pr. or redsh. powd
10	" sesqui-	MnF_3	111.93	red cr
11	fluosilicate	$MnSiF_6.6H_2O$	305.08	hex. pr., rose red, 1.357, 1.374
12	hydroxide	$MnO(OH)_2$	104.95	blk.-br. amor
13	" (ic), (manganite)	$Mn_2O_3.H_2O$	175.88	rhomb. br.-blk., 2.24, 2.24 (Li), 2.53
14	" (ous), (pyrochroite)	$Mn(OH)_2$	88.95	trig. wh.-pink, 1.723, 1.681
15	iodide	MnI_2	308.77	yelsh.-br., deliq., cr. mass
16	"	$MnI_2.4H_2O$	380.83	monocl. rose red, deliq
17	nitrate	$Mn(NO_3)_2.6H_2O$	287.04	monocl. rose-wh
18	oxide (ic) (braunite)	Mn_2O_3	157.86	cub. (tetr.) blk
19	" "	$Mn_2O_3.H_2O$	175.88	br
20	" (ous), (manganosite)	MnO	70.93	cub. grn., 2.16
21	" di-, (polianite, pyrolusite)	MnO_2	86.93	rhomb. blk. or br.-blk. powd
22	" tri-	MnO_3	102.93	redsh., deliq
23	" hept-	Mn_2O_7	221.86	dk. red oil
24	" (ous, ic), (hausmannite)	Mn_3O_4	228.79	tetr. (rhomb.) blk., 2.46 (Li), 2.15 (Li)
25	*ortho*phosphate (ous)	$Mn_3(PO_4)_2.7H_2O$	480.94	wh.-redsh. amor. powd
26	" acid, (ous)	$MnHPO_4.3H_2O$	205.00	rhomb. red. or pink powd
27	*meta*phosphate	$Mn_2(PO_3)_6.2H_2O$	620.01	pink
28	*pyro*phosphate	$Mn_2P_2O_7$	283.90	monocl. br.-pink, 1.695, 1.704, 1.710
29	"	$Mn_2P_2O_7.3H_2O$	337.95	amor. wh. powd
30	phosphide	MnP	85.95	dk. gray
31	"	Mn_3P_2	226.83	dk. gray
32	phosphite	$MnHPO_3.H_2O$	152.97	redsh
33	*hypo*phosphite	$Mn(H_2PO_2)_2.H_2O$	203.02	rose red cr. or powd
34	potassium sulfate (ic)	$MnK(SO_4)_2.12H_2O$	502.34	cub. (oct.) vlt
35	selenate	$MnSeO_4.2H_2O$	234.16	
36	"	$MnSeO_4.5H_2O$	288.21	
37	selenite	$MnSeO_3.2H_2O$	218.16	
38	*pyro*selenite	$MnSe_2O_5.H_2O$	311.35	
39	silicate (rhodonite, hermannite)	$MnSiO_3$	130.99	tricl. red.; 1.733, 1.740, 1.744
40	silicide	$MnSi$	82.99	tetrah
41	" di-	$MnSi_2$	111.05	gray oct
42	" (ous)	Mn_2Si	137.92	quad. pr
43	sulfate (ic)	$Mn_2(SO_4)_3$	398.04	grn. cr., deliq
44	" (ous)	$MnSO_4$	150.99	reddish

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	64.3 d.	d.	296.7^{0}	....	....
2	6.89^{17}	....	....	d.	d.	s. a.
3	3.125	d.	....	$.0065^{25}$	....	s. dil. a., .026 aq. CO_2; i. NH_3, al.
4	2.977^{25}	650	1190	62.2^{10}	123.8^{100}	s. al.; i. eth., NH_3
5	2.01	58; $-4H_2O$, 198	106	151^{8}	656^{100}	s. al.; i. eth.
6	....	....	....	s.	s.	s. al., eth.
7	4.87	....	....	....	....	....
8	....	....	....	i.	....	s. HCl; i. NH_4 salts
9	3.98	856	....	i.	d.	s. a.; i. al., eth.
10	3.54	d.	....	d.	d.	s. a.
11	1.903	d.	....	140^{18}	v. s.	s. al.
12	2.58	....	....	v. sl. s.	....	v. sl. s. al.
13	3.258	d.	....	i.	i.	s. h. H_2SO_4, HCl
14	3.258^{18}	d.	....	$.0002^{18}$	....	s. a., NH_4 salts; i. alk.
15	....	d.	....	s. d.	....	....
16	....	d.	....	s.	v. s.	....
17	1.82	25.8	129.4	426.4^{0}	∞	v. s. al.
18	4.50	−O, 1080	....	i.	i.	s. a.; i. ac. a.
19	3.26	d.	....	v. sl. s.	....	....
20	5.18	1650	....	i.	i.	s. a., NH_4Cl
21	5.026	−O, 535	....	i.	i.	s. HCl; i. HNO_3, acet.
22	....	d.	....	s.	d.	s. H_2SO_4, alk.
23	>1.84	<−20	exp. 70	v. s.	d.	s. H_2SO_4
24	4.70	1705	....	i.	i.	s. HCl
25	....	....	....	v. sl. s.	....	s. a., ac. a.; i. al.
26	....	....	....	sl. s.	d.	s. a.; i. al.
27	....	....	....	sl. s.	s.	....
28	3.707^{25}	(1196)	....	i.	....	s. a.
29	....	....	....	i.	....	s. aq. $K_4P_2O_7$, H_2SO_3; i. acet.
30	5.39^{21}	....	....	i.	i.	sl. s. HNO_3
31	5.12	1095	....	i.	i.	sl. s. dil. HNO_3
32	....	$-H_2O$, 200	....	sl. s.	....	s. $MnCl_2$, $MnSO_4$
33	....	....	....	12.5	16.7	i. al.
34	....	....	....	d.	....	....
35	2.95-3.01	....	....	....	....	....
36	2.33-.39	....	....	....	....	....
37	....	....	....	v. sl. s.	v. sl. s.	....
38	....	....	....	v. sl. s.	v. sl. s.	....
39	3.72^{25}	1323	....	i.	i.	i. HCl
40	5.90^{15}	1280	....	i.	i.	s. HF; v. sl. s. a.
41	5.24^{15}	....	....	i.	i.	s. HF, alk.; i. $HNO_3.H_2SO_4$
42	6.20^{15}	1316	....	i.	i.	s. HCl, NaOH; i. HNO_3
43	....	d. 160	....	d.	d.	s. HCl, dil. H_2SO_4; i. conc. H_2SO_4, HNO_3
44	3.25	700	d. 850	52^{5}	70^{70}	s. al., i. eth.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Manganese			
1	sulfate (ous) (szmikite)	$MnSO_4.H_2O$	169.01	monocl. pa. pink, 1.562, 1.595, 1.632
2	" "	$MnSO_4.2H_2O$	187.02	
3	" "	$MnSO_4.3H_2O$	205.04	
4	" " (common form)	$MnSO_4.4H_2O$	223.05	monocl. or rhomb. pink effl.
5	" "	$MnSO_4.5H_2O$	241.07	tricl. rose
6	" "	$MnSO_4.6H_2O$	259.08	
7	" "	$MnSO_4.7H_2O$	277.10	rhomb. or monocl. red
8	sulfide (ic), (hauerite)	MnS_2	119.05	cub. blk., 2.69 (Li)
9	" (ous), (alabandite)	MnS	86.99	cub. grn. or amor. pink, 2.70 (Li)
10	" "	$3MnS.H_2O$	278.99	gray-pink
11	thiocyanate	$Mn(CNS)_2.3H_2O$	225.11	deliq
12	thionate, di-	MnS_2O_6	215.05	tricl.
13	**Manganic acid**, per-	$HMnO_4$	119.94	in soln. only
14	**Manganocyanhydric acid**	$H_4Mn(CN)_6$	215.01	
15	**Masurium**	Ma		
16	**Mercury**	Hg	200.61	silv. liq., hex. met
	Mercury-ammonium compounds:			
17	Mercuriammonium bromide	$NH_2HgBr.NH_4Br$	394.50	rhbdr
18	" chloride	$NHg_2Cl.3NH_4Cl$	611.17	red cryst. (fus. wh. ppt.)
19	" "	$NHg_2Cl.NH_4Cl$	504.18	cryst. (infus. wh. ppt.)
20	" nitrate	$NHg_2NO_3.NH_4NO_3.H_2O$	575.30	
21	" iodide	$NHg_2I.3NH_4I$	977.03	
22	" sulfate	$(NH_3)_2HgSO_4.H_2O$	348.75	orthorhombic
23	" "	$(NHg_2)_2SO_4.3(NH_4)_2.SO_4.4H_2O$	1394.99	
24	Mercuri bromide	NHg_2Br	495.14	yel
25	" chloride	NHg_2Cl	450.69	yel
26	" hydroxide	NHg_2OH	432.24	brown
27	" iodide	NHg_2I	542.15	
28	" mercuric chloride	$2NHg_2Cl.HgCl_2$	1172.89	red cr
29	" nitrate	NHg_2NO_3	477.24	
30	" sulfate	$(NHg_2)_2SO_4.2H_2O$	962.55	
31	Mercuroammonium chloride	NH_3HgCl	253.10	blk
32	Mercuroxyammonium hydroxide	NH_2Hg_2OOH	450.25	yel. br. rhomb
33	" iodide	NH_2Hg_2OI	560.16	br
34	" nitrate	$NH_2Hg_2ONO_3$	495.25	
35	" sulfate	$(NH_2Hg_2O)_2SO_4$	962.55	wh. and yel
36	" chloride	NH_2Hg_2OCl	468.70	yel
	Mercury			
37	*ortho*arsenate (ic)	$Hg_3(AsO_4)_2$	879.69	yel
38	" (ous)	Hg_3AsO_4	740.76	dk. red

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	2.95	stab. 57–117	....	98.47^{48}	79.8^{100}	....
2	2.526^{15}	stab. 40–57	....	85.27^{35}	106.8^{55}	....
3	2.356^{15}	stab. 30–40	....	74.22^{5}	99.31^{57}	....
4	2.107	stab. 18–30	....	105.3^{0}	111.2^{54}	i. al.
5	2.103	stab. 8–18	....	124^{0}	142^{54}	....
6	....	stab. −5 to +8	....	147.4^{0}	134.5^{38}	....
7	2.092	$-7H_2O$, 280	stab. −10 to −5	172^{0}	118^{13}	i. al.
8	3.463	d.	....	i.	i.	d. HCl
9	3.99	d.	....	$.00047^{18}$	....	s. dil. a., al.; i. $(NH_4)_2S$
10	....	d.	....	0.0006	i.	s. dil. a.; i. $(NH_4)_2S$
11	....	$-3H_2O$, 160–70	....	s.	v. s.	v. s. al.
12	1.757	....	....	s.	v. s.	....
13	....	....	....	v. s.	d.	....
14	....	d.	....	i.	....	v. s. al.; i. eth.
15	....	2300	....	....	....	....
16	13.546	−38.89	356.9	i.	i.	s. HNO_3; i. dil. HCl, HBr, HI
17	....	d. 180	....	i.	....	s. HCl, H_2SO_4
18	....	300	....	i.	d.	s. a., KI
19	5.70	volat.	....	0.14	d.	s. a.; i. al.
20	....	....	....	i.	....	s. HNO_3; i. KOH
21	....	....	....	d.	....	s. al., eth.
22	....	$-H_2O$, 115	d.	d.	d.	s. a., NH_4 salts
23	....	....	....	d.	....	s. dil. a., NH_4 salts
24	....	d.	....	i.	....	s. HCl, KI
25	....	d. 300	....	i.	i.	s. a., KI
26	....	exp.	....	d.	....	s. h. HCl, HNO_3
27	....	....	....	i.	....	s. HCl; d. KI
28	....	d. 360	....	i.	i.	s. h. HCl
29	....	....	....	i.	....	s. KI
30	....	....	....	i.	....	s. HCl, KI
31	....	d.	....	i.	....	....
32	....	d. 130	....	0.007^{17}	0.06^{80}	....
33	....	>128	exp.	i.	....	s. d. HCl, KI soln.
34	....	....	....	i.	....	....
35	....	d.	....	sl. s.	....	s. HCl, HNO_3
36	....	d. 200	....	sl. s.	....	s. HCl, HNO_3
37	....	....	....	v. sl. s.	....	s. HCl, HNO_3
38	....	d.	....	i.	....	s. HNO_3; i. ac a.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Mercury			
1	*ortho*arsenate, acid, (ous)	Hg_2HAsO_4	541.16	yel.-red
2	bromate (ic)	$Hg(BrO_3)_2.2H_2O$	492.47	cr
3	" (ous)	$HgBrO_3$	328.53	cr
4	bromide (ic)	$HgBr_2$	360.44	rhomb. col
5	" (ous)	HgBr	280.53	tetr. wh.-yel
6	carbonate (ous)	Hg_2CO_3	461.22	yel.-br
7	" basic, (ic)	$2HgO.HgCO_3$	693.83	br.-red
8	chloramide (ic)	$HgNH_2Cl$	252.09	wh. powd. or sm. pr
9	chlorate (ic)	$Hg(ClO_3)_2$	367.52	need
10	" (ous)	$HgClO_3$	284.07	rhomb. wh
11	chloride (ic), (corrosive sublimate)	$HgCl_2$	271.52	rhomb. col. or wh. powd., pois
12	" (ous), (calomel)	HgCl	236.07	tetr. wh., 1.973, 2.656
13	chromate (ic)	$HgCrO_4$	316.62	rhomb. red
14	" (ous)	Hg_2CrO_4	517.23	red. need. or powd
15	cyanide (ic)	$Hg(CN)_2$	252.63	tetr. col. or wh. powd., pois
16	fluoride (ic)	HgF_2	238.61	cub
17	" (ous)	HgF	219.61	cub. yel
18	fluosilicate (ic)	$HgSiF_6.6H_2O$	450.76	rhbdr. col
19	" basic (ic)	$HgSiF_6.HgO.3H_2O$	613.83	yel. need
20	" (ous)	$Hg_2SiF_6.2H_2O$	579.31	col. pr
21	hydroxide (ic)	$Hg(OH)_2$	234.63	
22	iodate (ic)	$Hg(IO_3)_2$	550.45	wh. amor. powd
23	" (ous)	$HgIO_3$	375.53	yelsh
24	iodide (ic), red	HgI_2	454.45	tetr. red., cr. or powd
25	" " yellow	HgI_2	454.45	rhomb. yel., cr. or powd
26	" (ous)	HgI	327.53	tetr. or amor. powd., yel
27	iodobromide (ic)	HgIBr	407.45	rhomb. yel
28	iodochloride (ic)	HgICl	362.99	rhomb. red
29	nitrate (ic)	$Hg(NO_3)_2$	324.63	wh.-yel deliq. powd
30	" "	$Hg(NO_3)_2.2H_2O$	360.66	col. cr. or wh. deliq. powd., pois
31	" (ous)	$HgNO_3.H_2O$	280.63	monocl. col. effl
32	nitride (ic)	Hg_3N_2	629.85	br. powd
33	" , tri- (ous)	HgN_3	242.63	wh. cr
34	oxide (ic), (montroydite)	HgO	216.61	rhomb yel. or red, 2.37, 2.5, 2.65
35	" (ous)	Hg_2O	417.22	blk-brnsh. powd
36	oxybromide (ic)	$HgBr_2.3HgO$	1010.27	yel. cr
37	oxychloride (ic), (kleinite)	$HgCl_2.3HgO$	921.35	hex. yel
38	oxycyanide (ic)	$Hg(CN)_2.HgO$	469.24	need. or wh. cr. powd
39	oxyfluoride (ic)	$HgF_2.HgO.H_2O$	473.24	yel. cr
40	oxyiodide (ic)	$HgI_2.3HgO$	1104.28	yel. br
41	*ortho*phosphate (ic)	$Hg_3(PO_4)_2$	791.87	wh.-yelsh. powd
42	" (ous)	Hg_3PO_4	696.85	col

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	d.	....	i.	....	s. HNO_3; i. NH_4OH, ac. a.
2	....	d. 130–40	....	0.15	1.6	s. HNO_3, HCl, $Hg(NO_3)_2$
3	....	d.	....	d.	....	sl. s. HNO_3
4	5.73	236	325	0.5^{20}	25^{100}	15^0 al.; s. meth. al.; v. sl. s. eth.
5	7.307	subl. 345	....	$.000004^{25}$	....	s. a.; i. al., acet.
6	5.07^{218} g/l	d. 130	....	i.	d.	s. NH_4Cl; i. al.
7	....	....	....	i.	....	s. aq. CO_2, NH_4Cl
8	....	infus.	....	i.	$d.^{100}$	d. a.
9	4.998	d.	....	25	....	....
10	6.409	d. 250	....	s.	d.	s. al., ac. a.
11	5.42	275	301	3.6^0; 6.9^{20}	61.3^{100}	33^{25} al., 25 eth.; s. ac. a., pyr.
12	7.150	302	383.7	$.0002^{18}$	$.001^{43}$	s. $Hg(NO_3)_2$, aq. reg.; sl. s. h. HNO_3, HCl; i. al. eth.
13	....	d.	....	sl. s. d.	d.	d. a.; s. NH_4Cl; i. acet.
14	....	d.	....	v. sl. s.	sl. s.	s. HNO_3, KCN; i. al., acet.
15	4.00	d.	....	9.3^{14}	53^{100}	10^{20} al., $44.1^{19.5}$ meth. al.; s. NH_3, glyc.; i. bz.
16	8.95^{15}	645 d.	650	d.	....	s. dil. HNO_3, HF
17	8.73	570	....	s. d. to Hg_2O	....	....
18	....	....	....	d. easily	....	....
19	....	....	....	d.	....	s. a.
20	....	....	....	sl. s.	....	i. HCl
21	....	$-H_2O$, 175	....	i.	i.	s. a.
22	....	....	....	i.	....	s. HCl, NH_4Cl, NaCl, KI; i. HNO_3
23	....	d.	....	i.	i.	s. dil. HCl; i. cold HNO_3
24	6.283	tr. 130	....	$.00610^{25}$	sl. s.	1.8^{25} abs. al.; s. eth., acet., $Na_2S_2O_3$, alk. salts
25	6.271	259	354	v. sl. s.	sl. s.	v. sl. s. al.; s. eth., $Na_2S_2O_3$, KI
26	7.70	subl. 140; 290 d.	310 d.	v. sl. s.	....	s. KI, NH_4OH; i. al. eth.
27	....	229	360	....	....	s. al. eth.
28	....	153	315	i.	sl. s.	s. al.
29	4.39	79	d.	v. s.	d.	s. HNO_3, NH_3, acet.; i. al.
30	....	....	....	s.	....	s. HNO_3; i. al.
31	4.79^4	70	....	d.	s. d.	s. dil. HNO_3; i. NH_4OH
32	....	exp.	....	d.	....	d. a.; s. NH_4OH, NH_4 salts
33	....	exp. d. by light		0.025	....	....
34	11.14	d. 100	....	$.0052^{25}$	$.0395^{100}$	s. a.; i. al., eth.
35	9.8	d. 100	....	.0007	....	s. H_2SO_4, HNO_3, h. ac. a.; i. dil. HCl, alk. NH_3
36	....	....	....	i.	sl. s.	v. s. al.
37	7.93	d. 260	....	i.	d.	....
38	4.437^{19}	exp.	....	1.25	s.	....
39	....	d. 100	....	d.	....	s. dil. HNO_3
40	....	....	....	d.	....	s. HI
41	....	....	....	i.	sl. s.	s. a., NH_4Cl; i. al.
42	....	....	....	i.	d.	s. HNO_3, aq. $HgNO_3$; i. H_3PO_4

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Mercury			
1	potassium cyanide (ic)	$Hg(CN)_2.2KCN$	382.84	col. cr. pois
2	" iodide (ic)	$2HgI_2.2KI.3H_2O$	1294.99	yel., deliq
3	selenide (ic), (tilmannite)	$HgSe$	279.81	gray plates
4	silver iodide (ic)	$HgI_2.2AgI$	924.05	deep-yel. powd
5	sulfate (ic)	$HgSO_4$	296.67	rhomb. col. or wh. powd
6	" basic, (ic)	$HgSO_4.2HgO$	729.89	lem. yel. powd
7	" (ous)	Hg_2SO_4	497.28	monocl. col., wh.-yelsh. powd
8	sulfide (ic) (α) (cinnabarite)	HgS	232.67	hex. red cr. or powd., 2.854, 3.201
9	" " (β)	HgS	232.67	cub. blk. or amor. powd
10	" (ous)	Hg_2S	433.28	blk
11	thiocyanate (ic)	$Hg(CNS)_2$	316.74	wh. powd. pois
12	" (ous)	$HgCNS$	258.68	
13	tungstate (ic)	$HgWO_4$	448.61	yel
14	" (ous)	Hg_2WO_4	649.22	yel. amor
15	**Molybdenum**	Mo	96.0	cub. silv. wh. met. or gray-blk. powd.
16	ammonium oxychloride	$Mo(NH_4)_2OCl_5$	325.36	rhomb. grn
17	bromide, di-	$MoBr_2$	255.83	yel
18	" tri-	$MoBr_3$	335.75	dk. grn. need
19	" tetra-	$MoBr_4$	415.66	blk. need., deliq
20	bromohydroxide	$Mo_3Br_4(OH)_2$	641.68	red powd
21	carbide	MoC	108.00	dk. gray cr. powd
22	" di-	MoC_2	120.00	wh. pr
23	chloride, di-	$MoCl_2$	166.91	amor. yel
24	" tri-	$MoCl_3$	202.37	dk. red need
25	" tetra-	$MoCl_4$	237.83	br. cr., deliq
26	" penta-	$MoCl_5$	273.29	blk. cr., deliq
27	chlorohydroxide	$Mo_3Cl_4(OH)_2.2H_2O$	499.87	amor. yel
28	fluoride, hexa-	MoF_6	210.00	col. cr
29	hydroxide	$MoO(OH)_3$	163.02	light br. amor
30	iodide, di-	MoI_2	349.84	amor. br
31	oxide, di-	MoO_2	128.00	tetr. vlt.-red
32	" sesqui-	Mo_2O_3	240.00	blk
33	" tri- (molybdite)	MoO_3	144.00	rhomb. wh.-yelsh
34	" "	$MoO_3.2H_2O$	180.03	yel
35	" ("molyb. blue")	$Mo_2O_5.xMoO_3$		dk. blue
36	oxydibromide, di-	MoO_2Br_2	287.83	tabl. yel.-red, deliq
37	oxychloride	$MoOCl_4$	253.83	grn. cr., deliq
38	oxydichloride, di-	MoO_2Cl_2	198.91	yelsh. wh
39	oxypentachloride, tri-	$Mo_2O_3Cl_5$	417.29	dk. br. cr., deliq
40	oxyhexachloride, tri-	$Mo_2O_3Cl_6$	452.74	ruby-red cr
41	oxyfluoride	$MoOF_4$	188.00	col
42	oxythiocyanate, basic (thiocyanate)	$Mo(OH)_2(SCN)_3$	304.22	red in aq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	s.	....	s. al.
2	....	....	....	d.	....	s. al., eth., KI, ac. a.
3	7.1-8.9	subl.	....	i.	....	s. aq. reg.
4	....	....	....	i.	....	s. KI, KCN; i. dil. a.
5	6.47	d.	....	d.	....	s. a. NaCl; i. al., acet., NH_3
6	6.44	....	volat.	$.003^{16}$	sl. s.	s. a.; i. al.
7	7.56	d.	d.	$.06^{25}$	$.09^{00}$	s. H_2SO_4, HNO_3
8	8.09	subl. 580	....	$.000001^{18}$	....	s. Na_2S, aq. reg.; i. HNO_3, al.
9	7.67	subl. 580	....	i.	....	s. Na_2S, aq. reg., alk.; i. HNO_3, al.
10	....	d. 0	....	i.	....	i. a., $(NH_4)_2S$
11	....	d.	....	$.07^{25}$	s.	s. NH_4 salts, NH_3, HCl, KCN; sl. s. al., eth.
12	....	d.	....	i.	....	s. HCl, KCNS
13	....	d.	....	i.	d.	d. a.; i. al.
14	....	d.	....	i.	i.	d. a.; i. al.
15	10.2	2620 ± 10	3700	i.	i.	s. h. conc. H_2SO_4; i. HCl, HF, dil. H_2SO_4, NH_3
16	....	....	....	s. d.	....	....
17	....	....	....	i.	i.	s. alk.; i. a., aq. reg.
18	....	d.	....	i.	i.	i. a.; d. alk., NH_3
19	....	d.	volat.	v. s.	....	d. alk.
20	....	....	....	....	....	s. alk.
21	8.40	2570	....	i.	i.	sl. s. HNO_3, HF, h. H_2SO_4; i. alk. hyd.
22	8.9	....	4500	....	....	....
23	3.714^{25}	d.	....	i.	i.	s. HCl, H_2SO_4, NH_4OH, al., eth.
24	3.578^{25}	d.	....	i.	d.	d. alk.; s. conc. H_2SO_4, HNO_3; v. sl. s. al., eth.; i. HCl
25	....	d.	....	d.	d.	s. HNO_3, H_2SO_4; sl. s. al., eth.
26	2.93	194	268	d.	d.	v. s. a., al., eth., NH_4OH; s. chl., CCl_4, CS_2
27	....	....	....	i.	....	s. a.; i. al.
28	lq. 2.55	17	35	sl. s. d.	d.	....
29	....	....	....	0.2 (coll.)	....	v. s. HCl; s. alk. carb.
30	4.3	d.	....	s. d.	d.	i. al.
31	$4.516^{19.5}$	....	....	i.	i.	sl. s. h. conc. H_2SO_4; i. $KHC_4H_4O_6$; i. alk., HCl
32	....	....	....	i.	i.	i. a., alk., NH_4OH
33	$4.50^{19.5}$	795	subl.	0.1066^{18}	2.055	s. a., NH_4OH
34	3.12	....	....	....	....	....
35	....	....	....	....	....	s. a.
36	....	....	....	s.	....	....
37	....	subl.	....	s.	....	....
38	....	subl.	....	s.	....	s. al.; sl. s. eth.
39	....	subl.	....	s.	s.	....
40	....	....	....	d.	....	s. eth.
41	3.0	98	180	s.	....	....
42	....	....	....	v. s.	v. s.	s. eth.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Molybdenum			
1	phosphide	$MoP(Mo_2P_2)$	127.02 (254.04)	gray cr
2	sulfide, di- (molybdenite)	MoS_2	160.12	hex. blk
3	" tri-	MoS_3	192.18	red-br
4	" tetra-	MoS_4	224.24	brown powd
5	" sesqui-	Mo_2S_3	288.18	steel gray need
6	**Molybdic acid**	H_2MoO_4	162.02	hex. yelsh.-wh
7	" "	$H_2MoO_4.H_2O$	180.03	monocl. yel
8	**Neodymium**	Nd	144.27	yelsh. met
9	bromate	$Nd(BrO_3)_3.9H_2O$	690.16	hex. red
10	bromide	$NdBr_3$	384.02	grn. cr
11	carbide	NdC_2	168.27	hex. leaf. yel
12	chloride	$NdCl_3$	250.64	rose-vlt. pr
13	"	$NdCl_3.6H_2O$	358.73	rhomb. red
14	iodide	NdI_3	525.03	blk. cr. powd
15	molybdate	$Nd_2(MoO_4)_3$	768.54	tetr., 2.005
16	nitride	NdN	158.28	blk. powd
17	oxide	Nd_2O_3	336.54	lt. bl. powd. red fluores
18	rubidium nitrate	$Nd(NO_3)_3.2RbNO_3.4H_2O$	697.25	redsh. vlt. pl
19	sulfate	$Nd_2(SO_4)_3.8H_2O$	720.84	monocl. red, 1.541, 1.551, 1.562
20	sulfide	Nd_2S_3	384.72	olive grn. powd
21	**Neon**	Ne	20.18	col., wholly inert gas
22	**Nickel**	Ni	58.69	cub. silvery metal
23	ammonium chloride	$NiCl_2.NH_4Cl.6H_2O$	291.19	monocl. grn., deliq
24	" nitrate	$Ni(NO_3)_2.4NH_3.2H_2O$	286.86	grn. cr
25	" sulfate	$NiSO_4.(NH_4)_2SO_4.6H_2O$	394.98	monocl. dk. bl.-grn., 1.495, 1.501, 1.508
26	*ortho*arsenate	$Ni_3(AsO_4)_2$	453.93	yelsh.-grn. powd
27	arsenide (niccolite)	NiAs	133.62	hex
28	*ortho*arsenite, hydrogen	$Ni_3H_6(AsO_3)_4.H_2O$	691.85	grn.-wh
29	boride	NiB	69.51	prisms
30	bromate	$Ni(BrO_3)_2.6H_2O$	422.62	monocl
31	bromide	$NiBr_2$	218.52	yel.-br., deliq
32	"	$NiBr_2.3H_2O$	272.57	yelsh.-grn. need., deliq
33	" ammonia	$NiBr_2.6NH_3$	320.71	violet powd
34	carbonate	$NiCO_3$	118.69	rhomb. lt. grn
35	" basic	$2NiCO_3.3Ni(OH)_2.4H_2O$	587.59	lt. grn. cr. or br. powd
36	carbonyl	$Ni(CO)_4$	170.69	col. volat. inflam. liq. or need
37	chlorate	$Ni(ClO_3)_2.6H_2O$	333.70	dk. red
38	" ammonia	$Ni(ClO_3)_2.6NH_3$	327.79	
39	*per*chlorate	$Ni(ClO_4)_2.6H_2O$	365.70	hex. need. grn., 1.55 av
40	chloride	$NiCl_2$	129.60	yel. sc., deliq
41	"	$NiCl_2.6H_2O$	237.70	monocl. grn., deliq
42	" ammonia	$NiCl_2.6NH_3$	231.79	
43	cyanide	$Ni(CN)_2$	110.71	
44	"	$Ni(CN)_2.4H_2O$	182.77	lt. grn. pl. or powd., pois

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	6.167	....	....	....	....	s. h. HNO_3
2	4.80^{14}	1185	....	i.	i.	s. H_2SO_4, aq. reg., HNO_3; i. dil. a.
3	....	d.	....	sl. s.	s.	s. alk. sulfd.
4	....	d.	....	i.	i.	s. alk. sulfd., h. H_2SO_4
5	5.91^{15}	d. 1100	volat.	....	....	i. conc. HCl
6	3.112	d. 115	....	v. sl. s.	sl. s.	s. NH_4OH, H_2SO_4; i. NH_3
7	3.124^{15}	$-H_2O$, 70	....	0.133^{18}	2.568^{70}	s. a., NH_4OH, NH_4 salts, alk.
8	6.9	840	....	d.	....	....
9	....	66.7	$-9H_2O$, 150	146^{25}	....	....
10	....	....	....	sl. s.	....	....
11	5.15	d.	....	d.	d.	s. dil. a., H_2SO_4; i. conc. HNO_3
12	4.134^{25}	784	....	96.7^{13}	140^{100}	44.5 al.; i. eth. chl.
13	$2.282^{16.5}$	124	$-6H_2O$, 160	246^{13}	511^{100}	v. s. al.
14	....	775 ± 3	....	....	....	....
15	5.14^{18}	1176	....	....	....	....
16	....	....	....	d.	....	....
17	7.24	....	....	$.00019^{25}$	....	s. a.
18	....	47	$-4H_2O$	....	....	....
19	2.85	....	....	$7.^{20}$	4.51^{40}	....
20	5.179^{11}	d.	....	i.	d.	s. dil. a.
21	$.9002^{0}$ g/l; lq. $1.204^{-245.9}$	−248.67	−245.9	1.5 cm³	....	s. liq. O_2
22	8.90	1452	2900	i.	i.	s. dil. HNO_3; sl. s. HCl, H_2SO_4; i. NH_3
23	1.645	....	....	v. s.	v. s.	....
24	....	....	....	s.	....	i. al.
25	1.923	....	....	10.4^{20}	30^{80}	s. $(NH_4)_2SO_4$; i. al.
26	4.98	....	....	i.	....	s. a.
27	7.57^{0}	968	....	i.	i.	s. aq. reg.
28	....	d.	....	i.	....	s. a., alk.
29	7.39^{18}	....	....	d.	d.	s. HNO_3, aq. reg.
30	2.575	d.	....	28	....	....
31	4.64^{28}	d.	....	112.8^{0}	155.1^{100}	s. al., eth. NH_4OH
32	....	$-3H_2O$, 200	....	199^{0}	315.7^{100}	s. al., eth., NH_4OH
33	1.837	....	....	v. s.	d.	....
34	....	d.	....	0.0093^{25}	i.	s. a.
35	....	d.	....	i.	d.	s. a., NH_4 salts
36	1.32^{17}	−25	43	$.018^{9.8}$	....	s. HNO_3, aq. reg., al., eth., chl., bz.; i. dil. a. alk.
37	2.07	d. 80	....	0.9^{27}	....	....
38	1.52	180	....	giv. $Ni(NH_3)_4$		....
39	....	149	....	222.5^{0}	273.7^{15}	s. al. acet.; i. chl.
40	3.55	subl.	973	64.2^{20}	87.6^{100}	s. al., NH_4OH; i. NH_3
41	....	....	....	254^{20}	599^{100}	v. s. al.
42	....	....	....	s.	d.	s. NH_4OH; i. al.
43	....	....	....	i.	i.	s. KCN
44	....	$-4H_2O$, 200	d.	i.	i.	s. KCN, NH_4OH, alk.; sl. s. dil. a.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Nickel			
1	ferrocyanide	$Ni_2Fe(CN)_6.11H_2O$	527.44	grn.-wh
2	fluoride	NiF_2	96.69	grn. quad
3	" acid	$NiF_2.5HF.6H_2O$	304.82	trig. blue-grn
4	fluosilicate	$NiSiF_6.6H_2O$	308.84	trig. grn., 1.391, 1.407
5	hydroxide (ic)	$Ni(OH)_3$	109.71	blk. amor. powd
6	" (ous)	$Ni(OH)_2$	92.71	grn. amor. or cr
7	" "	$4Ni(OH)_2.H_2O$	388.84	lt. grn. powd
8	iodide	NiI_2	312.53	blk., deliq
9	" ammonia	$NiI_2.6NH_3$	414.72	
10	nitrate	$Ni(NO_3)_2.6H_2O$	290.80	monocl. grn., deliq
11	" ammonia	$Ni(NO_3)_2.4NH_3.2H_2O$	286.86	
12	oxide, mono- (bunsenite)	NiO	74.69	cub. grn.-blk., 2.18 (red)
13	" sesqui-	Ni_2O_3	165.38	gray-blk. powd
14	" (ous, ic)	Ni_3O_4	240.07	cub. or amor. gray-blk
15	oxyiodide	$NiI_2.9NiO.15H_2O$	1254.97	
16	*ortho*phosphate	$Ni_3(PO_4)_2.7H_2O$	492.22	grn. powd
17	*pyro*phosphate	$Ni_2P_2O_7.6H_2O$	399.51	grn
18	phosphide	Ni_3P_2	238.11	dk. grn.-blk
19	"	Ni_2P	148.40	gray cr
20	*hypo*phosphite	$Ni(H_2PO_2)_2.7H_2O$	314.87	grn
21	potassium cyanide	$Ni(CN)_2.2KCN.H_2O$	258.94	monocl. cr. or powd., red-yel
22	" sulfate	$K_2SO_4.NiSO_4.6H_2O$	437.10	monocl. bl., 1.484, 1.492, 1.505
23	selenide	$NiSe$	137.89	cryst
24	sulfate	$NiSO_4$	154.75	cub. yel
25	"	$NiSO_4.6H_2O$	262.84	tetr. blk. or monocl. grn., 1.511, 1.487
26	" (morenosite)	$NiSO_4.7H_2O$	280.86	rhomb. grn., 1.467, 1.489, 1.492
27	sulfide, mono- (millerite)	NiS	90.75	trig. or amor. blk
28	" sub-	Ni_2S	149.44	yel. cr
29	" (ous, ic) (polydymite)	Ni_3S_4	304.31	cub. gray-blk
30	sulfite	$NiSO_3.6H_2O$	246.84	tetrah. grn
31	**Niobium**	See *columbium*		
32	**Nitric acid**	HNO_3	63.02	col. corros. pois. liq., $1.397^{16.4}$
33	**Nitrogen**	N_2	28.02	col. gas; col. liq. or cub. cr. at low temp.
34	chloride, tri-	NCl_3	120.38	yel. oil or rhomb. cr
35	fluoride, tri-	NF_3	71.01	col. gas
36	iodide, tri-	NI_3	394.77	blk
37	" tri- (monoammonate)	$NI_3.NH_3$	411.80	rhomb. dk. red
38	oxide (ic)	NO (or N_2O_2)	30.01	col. gas; blue liq. and solid, liq. 1.330^{-90}
39	" mon-	N_2O	44.02	col. gas or liq. or cub. cr., 1.193^{16} liq.
40	" tri-	N_2O_3	76.02	red. br. gas; bl. solid or liq
41	" pent-	N_2O_5	108.02	hex. (rhomb.) wh

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	i.	....	s. NH_4OH, KCN; i. HCl
2	4.63	....	....	0.02	....	i. a., al., eth., NH_3
3	2.132	....	....	s.	....	s. dil. a.
4	2.134	d.	....	v. s.	....	....
5	....	d.	....	i.	i.	s. a., NH_4OH, NH_4Cl
6	4.1	....	....	0.0013	....	s. a., NH_4OH
7	4.36	d.	....	i.	i.	s. a., NH_4OH; i. alk.
8	5.834	subl.	....	124.2^{0}	188.2^{100}	s. al.
9	2.101	d.	....	d.	....	s. NH_4OH
10	2.05	56.7	136.7	238.5^{0}	∞	s. al., NH_4OH
11	....	....	....	v. s.	....	i. al.
12	7.45	to Ni_2O_3 400	$-O_2$, 600	i.	i.	s. a., NH_4OH
13	4.83	$-O_2$, 600	....	i.	i.	s. a., NH_4OH, KCN
14	....	....	....	i.	i.	s. a
15	....	....	....	i.	....	s. HNO_3; i. NH_4OH
16	....	....	....	i.	i.	s. a., NH_4 salts
17	anh. 3.93^{25}	....	....	i.	....	s. a., NH_4OH
18	5.99	....	....	i.	i.	s. HNO_3; i. HCl
19	6.31^{15}	1112	....	i.	....	s. HNO_3 + HF; i. a.
20	1.82	d.	....	s.	....	....
21	1.875^{11}	$-H_2O$, 100	....	s.	....	d. a.
22	2.124	d. <100	....	7^{0}	60.8^{75}	....
23	8.46	....	....	i.	....	s. HNO_3, aq. reg.; i. HCl
24	3.68	$-SO_3$, 840	....	29.3^{0}	83.7^{100}	i. al., eth., acet.
25	2.07	tr. 53.3	$-6H_2O$, 280	62.52^{0}	340.7^{100}	v. s. al., NH_4OH; 12.5 meth. al.
26	1.948	$-H_2O$, 31.5; 99	$-6H_2O$, 103	$75.6^{15.5}$	475.8^{100}	s. al.
27	4.60	797	....	$.00036^{18}$	d.	s. HNO_3, KHS, aq. reg.; sl. s. a.
28	5.52	....	....	i.	....	s. HNO_3
29	4.7	....	....	i.	....	s. HNO_3
30	....	....	....	i.	....	s. HCl, H_2SO_4
31	....	....	....	....	....	....
32	1.502	−42	86	∞	∞	d. al. viol.; s. eth.
33	1.2506^{0} g/l; lq. $0.808^{-195.8}$ s. $1.026^{-252.5}$	−209.86	−195.8	2.33^{0} cm³	1.02^{45} cm³	sl. s. al.
34	1.653	<−40	<71 exp. 95	i.	d.	s. chl. bz., CCl_4, CS_2, PCl_3
35	liq. 1.537^{-129}	−216.6	−120	v. sl. s.	....	....
36	....	exp.	subl. vacuum	i.	d.	s. $Na_2S_2O_3$, KCNS
37	3.5	d. >20	exp.	i.	d.	s. HCl, KCN, $Na_2S_2O_3$; i. abs. al.
38	1.3402 g/l; lq. $1.269^{-150.2}$	−163.6	−151.8	7.34^{0} cm³	2.37^{60} cm³	3.5 cm³ H_2SO_4, 26.6 cm³ al; s. $FeSO_4$, CS_2
39	1.977 g/l; lq. 1.226^{-89}	−102.4	−89.5	106.7^{5} cm³	59.92^{25} cm³	s. al. eth., H_2SO_4
40	1.447^{2}	−102	3.5 d.	s.	d.	s. alk., a., eth.
41	1.642^{18}	30	47 d.	s.	d. to HNO_3	s. chl.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Nitrogen			
1	oxide, per- (dioxide, tetroxide)	NO_2 or (N_2O_4)	46.01 (92.02)	col. solid (N_2O_4), yel. liq. or red-br. gas
2	sulfide, penta-	N_2S_5	188.32	red liq. gray solid
3	**Nitrosyl** bromide	NOBr	109.92	br. gas or dk. br. liq
4	chloride	NOCl	65.47	yel. gas or yel.-red liq. or cr
5	fluoride	NOF	49.01	col. gas
6	sulfuric acid (chamber crystals)	SO_2OHONO	127.08	rhomb. col
7	" anhydride	$(SO_2.NO_2)_2O$	236.14	tetr
8	**Nitroxyl** chloride (nitryl chloride)	NO_2Cl	81.47	pa. yel. br. gas
9	fluoride (nitryl fluoride)	NO_2F	65.01	col. gas and solid
10	**Osmium**	Os	190.8	hex. gray-bl. met
11	ammonium aquopentachloride, (III)	$(NH_4)_2Os(H_2O)Cl_5.\frac{1}{2}H_2O$	431.19	red-br. cr
12	chloride, di-	$OsCl_2$	261.71	dk. br., deliq
13	" tri-	$OsCl_3$	297.17	cub. br
14	" "	$OsCl_3.3H_2O$	351.22	dk. grn. cr
15	" tetra-	$OsCl_4$	332.63	red br. need
16	fluoride, tetra-	OsF_4	266.80	br. powd
17	" hexa-	OsF_6	304.80	grn. cr
18	" octo-	OsF_8	342.80	citron yel. cr
19	oxide, mon-	OsO	206.80	blk
20	" di-	OsO_2	222.80	cub. or hex. red-br
21	" sesqui-	Os_2O_3	429.60	dk. br
22	" tetr-	OsO_4	254.80	(a) monocl. col (b) yel. mass
23	potassium hexachloride (IV)	K_2OsCl_6	481.74	cub. red
24	" hexachloride (III)	$K_3OsCl_6.3H_2O$	574.89	cr. dk. red
25	sulfide, di-	OsS_2	254.92	cub. blk
26	" tetra-	OsS_4	319.04	br. blk
27	sulfite (ous)	$OsSO_3$	270.86	bl. blk
28	**Oxygen**	O_2	32.00	col. gas or liq. or hex
29	**Ozone**	O_3	48.00	col. gas or dk. bl. liq
30	**Palladium**	Pd	106.7	cub. silv.-wh. met
31	bromide	$PdBr_2$	266.53	red-br
32	chloride	$PdCl_2$	177.61	cub. need., dk. red, deliq
33	"	$PdCl_2.2H_2O$	213.65	br. prisms, deliq
34	cyanide	$Pd(CN)_2$	158.72	yelsh. wh
35	fluoride	PdF_2	144.70	br
36	" tri-	PdF_3	163.70	rhomb. blk
37	hydride	Pd_2H, (Pd_4H_2)	214.41	silv. metallic
38	hydroxide (ic)	$PdO_2.xH_2O$	......	dull red
39	" (ous)	$PdO.xH_2O$	......	yel. to br
40	iodide	PdI_2	360.54	blk. powd
41	nitrate	$Pd(NO_3)_2$	230.72	rhomb. br.-yel., deliq
42	oxide, mon-	PdO	122.70	blk

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.491^{0}	−9.3	21.3 d.	s. d.	....	s alk , CS_2, chl.
2	1.901^{18}	11	d.	i.	....	s. eth.; sl. s. al., CS_2
3	>1.0	−55.5	−2	i. d.	d.	s. alk.
4	2.99 g/l; lq. 1.417^{-12}	−64.5	−5.5	d.	d.	s. fuming H_2SO_4
5	2.176 g/l	−134	−56	s. d. to H	$NO_2 + HF$	....
6	....	73	....	d.	....	s. H_2SO_4
7	....	217	360	d.	....	s. H_2SO_4
8	2.57 g/l; lq. 1.32^{14}	<−31	5	d.	....	....
9	2.90 g/l	−139	−63.5	d.	....	d. al., eth., chl.
10	22.48	2700	>5300	i.	i.	sl. s. HNO_3, aq. reg.; i. NH_3
11	....	d.	....	v. s.	d.	s. al.; i. eth.
12	....	d.	....	i.	sl. d.	s. al. eth. HNO_3; sl. s. alk.
13	....	d. 560–600	....	v. s.	....	s. a. alk. al.; sl. s. eth.
14	....	d.	....	v. s.	....	s. al.
15	....	subl.	....	sl. s. d.	....	i. al.
16	....	....	....	d.	d.	....
17	....	>50	205	d.	d.	....
18	....	34.4	47.3	s. d.	s. d.	s. KF aq.
19	....	....	....	i.	i.	i. a.
20	7.91^{22}	d. 650	....	i.	i.	i. a.
21	....	d.	....	i.	i.	i. a.
22	4.906^{22}	(a) 39.5 (b) 41	130	5.07^{0}	6.23^{25}	s. al., eth., NH_4OH, $POCl_3$; v. s. CCl_4
23	....	d.	....	sl. s.	s.	s. dil. HCl.; i. al.
24	....	$-3H_2O$, 150	....	v. s.	....	s. al., i. eth.
25	....	d.	....	i.	i.	i. alk.
26	....	d.	....	i.	....	s. dil. HNO_3; i. $(NH_4)_2S$
27	....	d.	....	i.	....	s. dil. HCl, alk.
28	1.429^{0} g/l; lq. 1.14^{-183}; s. $1.426^{-252.5}$	−218.4	−183.0	4.89^{0} cm³	1.7^{100} cm³	2.78^{25} cm³ al.; s. fus. Ag.
29	2.144 g/l; lq. 1.71^{-183}	−251	−112	49^{0} cm³	....	s. alk. solns., oils
30	11.97^{0}; $11.40^{22.5}$	1555	>2200	i.	i.	s. aq. reg., h. HNO_3. H_2SO_4; HCl if finely divided
31	....	d.	....	i.	i.	s. HBr
32	....	500 d.	....	sl. s.	s.	s. HCl, acet.
33	....	d.	....	v. s.	v. s.	s. HCl, acet.
34	....	d.	....	i.	i.	s. KCN, NH_4OH; i. dil. a.
35	....	volat.	d. red heat	sl. s.	....	s. HF
36	5.06	d.	d.	d.	d.	s. HF
37	10.76	d.	....	....	....	....
38	....	d. $-H_2O$, $-O$	....	i.	i.	s. a., alk.
39	....	d.	....	i.	i.	s. a., NH_3, NH_4Cl
40	....	d. 350	....	i.	i.	s. KI; i. al. eth., dil. HCl
41	....	d.	....	s. d.	....	s. HNO_3
42	8.31	d. 750	....	i.	i.	sl. s. h. a.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Palladium			
1	oxide, di-	PdO_2	138.70	blk
2	" sub-	Pd_2O	229.40	blk
3	sulfate	$PdSO_4.2H_2O$	238.79	red-br. cr., deliq
4	sulfide, mono-	PdS	138.76	br.-blk
5	" di-	PdS_2	170.82	dk. br
6	" sub-	Pd_2S	245.46	grn.-gray
7	**Palladodiammine** dichloride	$PdCl_2(NH_3)_2$	211.68	tetr. yel
8	dihydroxide	$Pd(OH)_2(NH_3)_2$	174.78	micr.-cr. yel
9	**Phospham**	PHN_2	60.04	wh. amor
10	**Phosphamic acid**	$PONH_2.(OH)_2$	97.06	
11	**Phosphomolybdic acid**	$H_3PO_4.12MoO_3$	1826.04	yelsh. cr
12	" "	$H_3PO_4.12MoO_3.12H_2O$	2042.23	monocl. yel
13	**Phosphonium** bromide	PH_4Br	114.97	cub. col
14	chloride	PH_4Cl	70.51	cub. col
15	iodide	PH_4I	161.97	tetr. col
16	sulfate	$(PH_4)_2SO_4$	166.16	cr
17	**Phosphoric acid,** ortho-	H_3PO_4	98.04	col. liq. or rhomb cr., deliq
18	" " ortho-	$(H_3PO_4)_2.H_2O$	214.10	hex. pointed pr. col., deliq
19	" " meta-	HPO_3	80.03	vitreous col., deliq
20	" " pyro-	$H_4P_2O_7$	178.07	col. need. or liq., hyg
21	" " hypo-	H_2PO_3	81.04	cryst
22	" " thio-	$PS(OH)_3$	114.10	
23	**Phosphorous acid,** ortho-	H_3PO_3	82.04	col.-yel., deliq. cr
24	" " meta-	HPO_2	64.03	feather like cr
25	" " pyro-	$H_4P_2O_5$	146.07	need
26	" " hypo-	$H(H_2PO_2)$	66.04	col. oily liq. or deliq. cr
27	**Phosphorus,** yellow	P_4	124.08	cub. yelsh. wax-like solid, 2.144
28	" red	P_4	124.08	cub. redsh.-br. or amor. red br. powd.
29	" violet	P_4	124.08	monocl. vlt
30	" black	P_4	124.08	blk. incombust
31	arsenide	PAs	105.95	
32	bromide, tri-	PBr_3	270.77	col. fum. liq., $1.697^{26.5}$
33	" penta-	PBr_5	430.60	rhomb. yel
34	bromodichloride, hepta-	PBr_7Cl_2	661.35	prisms
35	bromotrichloride, di-	PBr_2Cl_3	297.22	or. cr
36	" tetra-	PBr_4Cl_3	457.06	dk. red cr
37	" octa-	PBr_8Cl_3	776.72	br. need
38	bromotetrachloride, mono-	$PBrCl_4$	252.76	yel. cr
39	bromotrifluoride, di-	PBr_2F_3	247.85	pa. yel
40	bromonitride, di-	$PNBr_2$	204.86	rhomb
41	chloride	P_2Cl_4	203.87	col

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	...	−O, 200	...	v. sl. s.	...	sl. s. a.
2	...	d.	...	i.	...	i. a.
3	...	d.	...	v. s.	d.	...
4	...	950 d.	...	i.	i.	s. HNO_3, aq. reg.; i. HCl, $(NH_4)_2S$
5	...	d.	...	i.	i.	s. aq. reg., $(NH_4)_2S$
6	7.303^{15}	d. 800	...	i.	i.	sl. s. a., aq. reg.
7	2.5	d.	...	0.304^{16}	s. d.	s. a. (dec.), NH_4OH
8	...	>105	...	v. s.	d.	...
9	...	infus.	...	i.	i.	s. conc. H_2SO_4; i. a., alk.
10	...	d.	...	v. s.	...	...
11	...	...	...	s.	...	s. al., eth.
12	...	$-H_2O$, 104	...	s.	...	...
13	g. 2.464 g/l	...	38.8^{794}	d.	d.	...
14	...	28^{46} atm.	subl.	d.	...	...
15	2.86	subl. 61.8	80	d.	...	s. d. a., alk.
16	...	...	...	d.	...	...
17	1.834^{18}	42.35	$-\frac{1}{2}H_2O$, 213	514^{24}	v. s.	s. al.
18	...	...	...	v. s.	...	...
19	2.2–.5	subl.	...	d. to H_3PO_4	d.	s. al.; i. liq. CO_2
20	...	61	...	709^{23}	d. to H_3PO_4	v. s. al., eth.
21	...	55	d. 70	s.	...	...
22	...	...	...	s.	d.	s. al.
23	$1.651^{21.2}$	73.6	d. 200	∞	∞	s. al.
24	...	...	...	...	...	...
25	...	38	d. 130	d.	...	...
26	1.493^{19}	26.5	d.	s.	v. s.	v. s. al., eth.
27	1.82	44.1; ign. 34	280	$.0003^{15}$	sl. s.	0.3 al., 880^{10} CS_2, s. bz., NH_3, alk. eth. chl.
28	2.20	590^{43} atm.	ign. >200; 280	i. (v. sl. s.)	i.	s. abs. al.; i. CS_2, eth., NH_3
29	2.36	593	...	i.	...	i. a., org. solv.
30	2.70	...	...	...	...	...
31	...	...	subl. d.	d.	...	s. CS_2; i. al., eth.
32	2.852^{15}	−40	172.9	d.	...	s. eth., chl., CS_2, CCl_4; d. al.
33	...	<100	106 d.	d.	...	...
34	...	...	...	d.	...	s. PCl_3
35	...	35	...	d.	...	...
36	...	...	...	d.	...	...
37	...	25	...	d.	...	...
38	...	...	...	d.	...	...
39	...	−20	...	d.	...	...
40	...	190	subl. 150^{vac}	i.	...	s. eth.; sl. s. CS_2, chl.
41	...	−28	180	hydr.	...	...

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Phosphorus			
1	chloride tri-	PCl_3	137.39	col. fum. liq., 1.516[14]
2	" penta-	PCl_5	208.31	tetr. yelsh., fum
3	chlorotrifluoride, di-	PCl_2F_3	158.93	
4	chloronitride, di-	$P_3N_3Cl_6$	347.83	rhomb
5	"	$P_4N_4Cl_8$	463.77	
6	"	$P_5N_5Cl_{10}$	579.71	
7	"	$P_6N_6Cl_{12}$	695.65	
8	"	$P_6N_7Cl_9$	603.29	
9	fluoride, tri-	PF_3	88.02	col. gas
10	" penta-	PF_5	126.02	col. gas
11	imidoamide	$PO(NH)(NH_2)$	78.06	amor. wh
12	iodide, di-	P_2I_4	569.72	tricl. orange
13	" tri-	PI_3	411.78	hex. red., deliq
14	iodochloride	PI_2Cl_3	391.23	hex. red
15	nitride	P_3N_5	163.10	amor
16	oxide, tri-	P_4O_6	220.08	monocl. col. or wh. powd., deliq
17	" tetr-	P_2O_4	126.04	rhomb. col., deliq
18	" pent- (phosphoric anhydride)	P_2O_5 (or P_4O_{10})	142.04	monocl. or wh. powd., v. deliq
19	oxybromide	$POBr_3$	286.77	col. pl
20	oxybromodichloride	$POBrCl_2$	197.85	tabl. or liq
21	oxychloride	$POCl_3$	153.39	col. fum. liq., 1.460[25.1]
22	oxychlorodibromide	$POClBr_2$	242.31	
23	*tri*oxytetrachloride	$P_2O_3Cl_4$	251.87	
24	oxyfluoride	POF_3	104.02	col. gas
25	oxyiodide	$P_3O_8I_6$	982.58	red cr
26	oxynitride	PON	61.03	amor. wh
27	selenide, mono-	P_2Se	141.24	red
28	" tri-	P_2Se_3	299.64	dk. red
29	" penta-	P_2Se_5	458.04	dk. red-blk. need
30	" sub-	P_4Se	203.28	dk. yel. liq
31	sulfide, di-	P_3S_6 (or PS_2)	285.42	yel. need
32	" tri-	P_4S_6 (or P_2S_3)	316.44	gray.-yel. cr
33	" " (sesquisulfide)	P_4S_3	220.26	rhomb. yel
34	" penta-	P_2S_5	222.34	gray-yel. cr., deliq
35	" hepta-	P_4S_7	348.50	lt. yel. cr
36	"	P_4S_{10}	444.68	lt. yel. cr
37	sulfoxide	$P_4S_4O_6$	348.32	tetr., deliq
38	thioamide	$PS(NH_2)_3$	111.15	amor. yel.-wh
39	thiobromide	$P_2S_3Br_4$	477.88	yel. oil
40	"	$PSBr_3$	302.83	cub. yel
41	"	$PSBr_3.H_2O$	320.84	yel. cr
42	thiobromochloride	$PSBrCl_2$	213.91	yel. liq
43	thiochloride	$PSCl_3$	169.45	col. liq., 1.563 (C)
44	thiochlorobromide	$PSClBr_2$	258.37	
45	thiocyanate	$P(CNS)_3$	205.22	liq
46	thiofluoride	PSF_3	120.08	gas
47	thioiodide	P_2SI_2	347.94	
48	triamide	$PO(NH_2)_3$	95.09	amor., wh

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.574^{21}	−111.8	73.5	d.	d.	s. eth., bz., chl., CS_2, CCl_4
2	g. 4.65^{296} g/l	148 (press.)	subl. 162	d.	....	d. a.; s. CCl_4, CS_2
3	....	−8	1412	d.	....	s. al. d.
4	1.98	114	256.5	i.	d.	s. al., eth., chl., CS_2, bz., ac. a.
5	2.18^{24}_{24}	123.5	....	....	....	....
6	....	41	....	....	....	....
7	....	91	....	....	....	....
8	....	237.5	....	....	....	....
9	3.907 g/l	−160	−95	d.	....	s. al., d. alk.
10	5.805 g/l	−83	−75	d.	....	....
11	....	d.	....	i.	d.	....
12	....	124.5	d.	d.	....	s. CS_2
13	....	61	d.	d.	d.	v. s. CS_2
14	....	....	....	d.	....	s. CS_2
15	2.51^{18}	d.	....	i.	v. sl. s. d.	i. any solv.
16	2.135^{21}	22.5	173	d. to H_3PO_3	d.	s. CS_2, eth., chl., bz.
17	2.54^{23}	>100, subl.	180	v. s. to H_3PO_3	d.	....
18	2.39	563	subl. 347	d. to H_3PO_4	d.	s. H_2SO_4; i. acet., NH_3
19	2.822	56	193	d.	....	s. H_2SO_4, CS_2, eth., bz., chl.
20	lq. 2.104^{14}	13	137.6	d.	....	....
21	1.675	1.25	107.23	d.	d.	d. al., a.
22	lq. 2.45^{50}	30	....	....	....	....
23	lq. 1.58^{7}	<−50	212	d.	....	....
24	4.69 g/l	−68	−40	d.	....	d. al.
25	....	140	d.	s.	....	s. al. eth.
26	....	red heat	....	i.	i.	i. a., alk.
27	....	....	....	d.	....	v. s. CS_2; sl. s. eth.; i. al.
28	....	....	....	....	d.	s. KOH; i. CS_2
29	....	d.	....	d.	....	s. CCl_4; i. CS_2
30	....	−12	ign.	d.	....	s. CS_2; i. al., eth.
31	....	298	$337^{10.5}$	....	....	v. sl. s. CS_2
32	....	290	490	d.	....	s. al., eth. alk.; v. sl. s. CS_2
33	2.03	172.5	407.5	i.	d.	60 CS_2; s. bz. CS_2, PCl_3, HNO_3; i. HCl, H_2SO_4
34	2.03	276	514	d.	....	0.22 CS_2; s. alk.
35	2.19^{17}	310	523	....	....	i. most solv.
36	2.09	290	515	d.	....	s. CS_2; d. alk.
37	....	102	295	d.	....	50 CS_2
38	1.7^{13}	d. 200	....	sl. s.	d.	....
39	lq. 2.262^{17}	....	d.	d.	....	s. CS_2, eth.
40	2.85^{17}	38	d. 175	d.	....	s. CS_2, eth. PCl_3
41	2.794^{18}	35	....	....	....	....
42	lq. 2.12^{0}	−30	150 d.	d.	....	....
43	lq. 1.635	−35	125	d.	....	s. CS_2, CCl_4, bz.
44	lq. 2.48^{0}	−60	....	....	....	....
45	1.625^{18}	<−20	265	d.	....	s. al., eth., CS_2, bz.
46	....	$3.8^{7.6}$ atm.	....	d.	....	sl. s. eth.; i. CS_2, bz.
47	....	75	....	....	....	....
48	....	d.	....	i.	i.	s. al.; i. a.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Phosphotungstic acid**	$P_2O_5.12WO_3.42H_2O$	3682.70	yel.-grn. cr.
2	**Platinic acid,** bromo-	$H_2PtBr_6.9H_2O$	838.88	monocl. red, deliq.
3	" " chloro-	$H_2PtCl_6.6H_2O$	518.08	red-br. pr., deliq.
4	" " iodo-	$H_2PtI_6.9H_2O$	1120.91	monocl. blk., deliq.
5	**Platinum**	Pt	195.23	cub. silv. metal
6	arsenide (sperrylite)	$PtAs_2$	345.09	cub. tin wh.
7	bromide, di- (ous)	$PtBr_2$	355.06	br.
8	" tetra- (ic)	$PtBr_4$	514.89	dk. br.
9	chloride, di- (ous)	$PtCl_2$	266.14	olive grn.
10	" tetra- (ic)	$PtCl_4$	337.06	br.-red cr.
11	" " " (salt of Norton)	$PtCl_4.5H_2O$	427.14	monocl. red.
12	cyanide	$Pt(CN)_2$	247.25	yel. br. cr.
13	fluoride, di-	PtF_2	233.23	yelsh. grn.
14	" tetra-	PtF_4	271.23	yel.-lt. br. cr., deliq.
15	hydroxide (ic)	$Pt(OH)_4$	263.26	yel.-br.
16	" "	$Pt(OH)_4.2H_2O$	299.29	white
17	" (ous)	$Pt(OH)_2$	229.25	blk.
18	" "	$Pt(OH)_2.2H_2O$	265.28	blk.
19	iodide, di- (ous)	PtI_2	449.07	blk.
20	" tetra- (ic)	PtI_4	702.91	amor. br.
21	oxide, mon- (ous)	PtO	211.23	vlt.-blk.
22	" di- (ic)	PtO_2	227.23	blk.
23	" " "	$PtO_2.H_2O$	245.25	blk.
24	" " "	$PtO_2.2H_2O$	263.26	yel. br.
25	" " "	$PtO_2.3H_2O$	281.28	ochre
26	" " "	$PtO_2.4H_2O$	299.29	yel. need.
27	" (ous, ic)	Pt_3O_4	649.69	blk.
28	*pyro*phosphate	PtP_2O_7	369.27	grn.-yel.
29	sulfate	$Pt(SO_4)_2.4H_2O$	459.41	yel. pl.
30	" sesqui-	$Pt(H_2O)(SO_4)_2H.4H_2O$	478.44	tricl. or. pr.
31	sulfide, mono- (ous)	PtS	227.29	blk.
32	" di- (ic)	PtS_2	259.35	blk.
33	" sesqui-	Pt_2S_3	486.64	gray
34	**Potassium**	K	39.10	cub. silv. metal
35	aluminate	$K_2Al_2O_4.3H_2O$	250.19	col. cr.
36	amide	KNH_2	55.12	yel. grn.
37	*meta*antimonate	$KSbO_3$	208.86	wh. powd.
38	*pyro*antimonate, acid	$K_2H_2Sb_2O_7.4H_2O$	507.80	gran., wh. cr. powd.
39	*ortho*arsenate (tribas.)	K_3AsO_4	256.23	col. deliq. need.
40	" (dibas)	K_2HAsO_4	218.14	col. cr.
41	" (monbas.)	KH_2AsO_4	180.05	tetr. col., 1.567, 1.518.
42	*ortho*arsenite	K_3AsO_3	240.23	col. need.
43	*meta*arsenite	$KAsO_2$	146.03	wh. powd., hyg.
44	*meta*arsenite, acid	$KH(AsO_2)_2.H_2O$	271.98	
45	aurate	$KAuO_2.3H_2O$	322.35	lt. yel. need.
46	auricyanide	$KAu(CN)_4.1\frac{1}{2}H_2O$	367.36	col. tabl.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	s.	....	s. al., eth.
2	....	<100 d.	....	v. s.	v. s.	s. al., eth., chl.
3	2.431	60	....	v. s.	v. s.	s. al., eth.
4	....	<100	....	v. s. d.	....	....
5	21.45	1773.5	4300	i.	i.	s. aq. reg., fus. alk.
6	10.602	>800 d.	....	i.	....	i.
7	6.65	d. 250	....	i. (v. sl. s.)	i.	s. HBr, KBr, Br aq.
8	5.69	d. 180	....	0.41^{20}	sl. s.	v. s. al., eth., HBr
9	5.87^{11} (6.05)	d. 581	....	i. (v. sl. s.)	i.	s. HCl, NH_4OH; sl. s. NH_3 i. al., eth.
10	....	d. 370	....	v. s.	v. s.	s. acet.; sl. s. al., NH_3 i. eth.
11	2.43 ($8H_2O$)	$-H_2O$, 100	....	v. s.	v. s.	s. al., eth.
12	....	....	....	i.	i.	i. a., alk., al.; s. KCN
13	....	....	....	i.	i.	....
14	....	d.	....	s. d.	v. s.	s. a., alk.
15	....	$-H_2O$, 120	....	i.	i.	s. HCl, aq. reg., KOH
16	....	d. <100	....	i.	i.	s. dil. a., alk.
17	....	d.	....	i.	i.	s. HCl, HBr, alk.; i. H_2SO_4; dil. HNO_3
18	....	$-2H_2O$, 100	....	i.	i.	s. conc. a.
19	6.4	d. 300-350	....	i.	i.	s. HI, sl. s. Na_2SO_3; i. a.
20	....	d. 370	....	s. d.	....	s. al., alk., acet., HI, KI, NH_3
21	....	d. 550	....	i.	i.	s. HCl, H_2SO_3; i. a., aq. reg.
22	....	430	....	i.	i.	i. a., aq. reg.
23	....	$-H_2O$, 100	....	i.	i.	sl. s. HCl, NaOH; i. ac. a.
24	....	$-H_2O$, 100	....	i.	i.	....
25	....	d.	....	i.	i.	i. HCl, aq. reg.
26	....	d.	....	i.	i.	s. a.
27	....	d.	....	i.	....	i. a., aq. reg.
28	4.85	d. 600	....	v. sl. s.	....	....
29	....	....	....	s.	d.	s. a., al., eth.
30	....	d.	....	s.	....	....
31	8.847	d.	....	i.	i.	i. a., alk.; s. $(NH_4)_2S$
32	7.22	d.	....	i.	i.	s. HCl, HNO_3; i. $(NH_4)_2S$
33	5.52	d.	....	i.	i.	i. a.; slowly s. aq. reg.
34	0.86^{20}; 0.83^{62}	62.3	760	d. to KOH + H_2	d.	s. a., al., Hg
35	....	....	....	v. s., d.	v. s., d.	s. alk.; i. al.
36	....	335	subl. 400	d.	d.	d. al.
37	....	....	....	i.	sl. s.	s. h. KOH; i. al., CS_2
38	....	....	....	2.82^{20}	s.	....
39	....	....	....	18.87	v. s.	4 al.
40	....	....	....	18.86^{6}	s.	i. al.
41	2.867	288	....	19^{6}	v. s.	i. al.
42	....	....	....	v. s	....	s. al.
43	....	....	....	s.	s.	sl. s. al.
44	....	....	....	s.	....	sl. s. al.
45	....	d.	....	s.	d.	s. al.
46	....	d. 200	....	s.	v. s.	s. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	aurocyanide (cyanoaurate)	$KAu(CN)_2$	288.32	rhomb. col
2	*meta*borate	$K_2B_2O_4$	163.84	monocl. col
3	*tetra*borate	$K_2B_4O_7.5H_2O$	323.56	monocl. or hex. pr
4	borotartrate	$KC_4H_4BO_7$	213.95	wh. cr. powd
5	bromate	$KBrO_3$	167.02	trig. col
6	bromide	KBr	119.02	cub. col. sl. hyg., 1.559
7	bromoaurate	$KAuBr_4$	555.96	rhomb. red.-br
8	"	$KAuBr_4.2H_2O$	592.00	monocl
9	bromoplatinate	K_2PtBr_6	752.93	cub. dk. red-br
10	bromoplatinite	K_2PtBr_4	593.09	rhomb. br
11	"	$K_2PtBr_4.2H_2O$	629.13	rhomb. blk
12	carbonate	K_2CO_3	138.20	monocl. col., deliq
13	"	$K_2CO_3.2H_2O$	174.23	rhomb
14	" (trihydrate)	$2K_2CO_3.3H_2O$	330.45	monocl. col
15	" acid	$KHCO_3$	100.11	monocl. col
16	carbonyl	$K_6C_6O_6$	402.60	gray-red
17	chlorate	$KClO_3$	122.56	monocl. col., 1.409, 1.517, 1.524
18	*per*chlorate	$KClO_4$	138.56	rhomb. col
19	chloride (sylvite)	KCl	74.56	cub. col., 1.490
20	*hypo*chlorite	$KClO$	90.56	in soln. only
21	chloroaurate	$KAuCl_4$	378.13	monocl. yel
22	chlorochromate	$KOClCrO_2$	174.57	monocl. red
23	chloroiridate	K_2IrCl_6	484.04	cubic. blk
24	chloropalladate	K_2PdCl_6	397.64	cub. red
25	chloropalladite	K_2PdCl_4	326.73	tetr. red-br. (cub. yel.)
26	chloroplatinate	K_2PtCl_6	486.17	cub. yel
27	chloroplatinite	K_2PtCl_4	415.26	tetr. red-br
28	chlororhodite	$K_3RhCl_6.3H_2O$	487.00	tricl. red
29	" penta-	K_2RhCl_5	358.40	rhomb. red
30	chlorostannate	K_2SnCl_6	409.64	cub. col., 1.657
31	chromate (tarapacaite)	K_2CrO_4	194.21	rhomb yel., β 1.74
32	*di*chromate	$K_2Cr_2O_7$	294.22	monocl. or tricl. red
33	*per*chromate	K_3CrO_8	297.31	cub. br
34	chromicyanide	$K_3Cr(CN)_6$	325.36	monocl. yel
35	cobalticyanide	$K_3Co(CN)_6$	332.29	monocl. yel
36	cobaltocyanide	$K_4Co(CN)_6$	371.39	violet need
37	cyanate	$KCNO$	81.11	need. col
38	cyanide	KCN	65.11	cub. col., wh. gran., deliq., extr. pois.
39	ferricyanide	$K_3Fe(CN)_6$	329.19	monocl. red., 1.566, 1.569, 1.583
40	ferrocyanide	$K_4Fe(CN)_6.3H_2O$	422.33	monocl. lem. yel., β 1.577
41	fluoborate	KBF_4	125.92	rhomb. or cub. col
42	fluogermanate	K_2GeF_6	264.80	hex. wh
43	fluomanganite	K_2MnF_6	247.13	hex. tab., yel
44	fluoride	KF	58.10	cub. col., deliq
45	"	$KF.2H_2O$	94.13	monocl. pr., deliq
46	" acid	KHF_2	78.11	cub. col
47	fluosilicate	K_2SiF_6	220.26	hex. or cub. col
48	fluostannate	$K_2SnF_6.H_2O$	328.92	monocl. pr
49	fluosulfonate	$KFSO_3$	138.16	short, thick pr
50	fluotitanate	$K_2TiF_6.H_2O$	258.12	sm. lust. leaf., wh
51	fluozirconate	K_2ZrF_6	283.42	monocl. col., 1.466, 1.455

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	14.3	200	sl. s. al.; i. eth.
2	....	947	....	71^{30}	v. s.	....
3	(anh.) 1.74	d.	....	26.7^{30}	v. s.	....
4	1.832	....	....	sl. s.	....	....
5	$3.27^{17.5}$	370 d.	....	3.1^{0}; 13.3^{40}	49.75^{100}	sl. s. al.; i. acet.
6	2.75^{25}	730	1380	53.48^{0}	102^{100}	0.5 al.; s. glyc.; sl. s. eth.
7	....	d.	....	sl. s.	....	s. al.
8	....	....	....	19.5^{15}	204^{67}	s. KBr; d. eth.
9	4.66^{24}	d. >400	....	2.02^{20}	10^{100}	i. al.
10	....	....	....	v. s.	v. s.	....
11	....	$-H_2O$ vac.	....	v. s.	v. s.	....
12	2.29	891	d.	112^{20}	156^{100}	i. al., acet.
13	....	....	....	146.9	331^{100}	....
14	2.043	....	....	129.4	268.3^{100}	i. conc. NH_4OH, al.
15	2.17	d. 100–200	....	22.4	60^{60}	i. al.
16	....	exp.	....	exp.	....	d. al.
17	2.32	368.4	d. 400	7.1^{20}	57^{100}	0.83 al.; s. alk.
18	2.52^{10}	d. 400	....	0.75^{0}	21.8^{100}	i. al., eth.
19	1.984	776	subl. 1500	34.7^{20}	56.7^{100}	s. al., alk. eth., glyc.
20	....	d.	....	v. s.	v. s.	....
21	....	d. 357	....	61.8^{20}	80.2^{60}	s. a.; 25 al.
22	2.497	d.	....	s. d.	....	s. a.
23	3.546	d.	....	1.25^{19}	6.67	i. al., KCl, NH_4OH
24	2.738	d.	....	sl. s. d.	d.	i. al., sl. s. HCl
25	2.67	d. 105	....	s.	v. s.	s. KCl, NH_4OH; i. al.
26	3.499^{24}	d. 250	....	0.481^{2}	5.22^{100}	i. al., eth.
27	3.30	d.	....	0.93^{16}	5.3^{100}	i. al.
28	3.291	d.	....	d.	....	sl. s. al., KCl
29	....	d.	....	sl. s.	d.	i. al.
30	2.71	....	....	s.	s.	....
31	2.732^{18}	971	....	62.9^{20}	79.2^{100}	i. al.
32	2.69	tr. 236; 398	d. 500	4.9^{0}	102^{100}	i. al.
33	....	d. 170	....	sl. s.	....	i. al., eth.
34	1.71	....	....	30.9^{20}	....	i. al.
35	1.906	d.	....	s.	s.	i. al.
36	....	....	....	s.	s.	i. al. eth.
37	2.048	....	....	s.	s.	i. al.
38	1.52^{16}	634.5	....	v. s.	v. s.	sl. s. al.; s. glyc., meth. al.
39	1.894^{17}	d.	....	33^{4}	77.5^{100}	s. acet.; i. al.
40	1.85^{17}	$-3H_2O$, 70	d.	27.8^{12}	$90.6^{96.3}$	s. acet.; i. al., NH_3
41	2.50	d. 500	....	$.44^{20}$	6.27^{100}	s. al.; sl. s. eth.
42	....	730	*ca.* 835	$.542^{18}$	2.58^{100}	....
43	....	d.	....	d.	d.	s. c. HCl
44	2.48	880	1500	92.3^{18}	v. s.	s. HF, NH_3; i. al.
45	2.454	41	....	349.3^{18}	v. s.	s. HF, i. al.
46	....	d.	....	$41.^{21}$	v. s.	s. $KC_2H_3O_2$; i. al.
47	hex. 3.08; cub. 2.665^{17}	d.	....	$.12^{17.5}$	$.954^{100}$	s. HCl; i. NH_3, al.
48	3.053	....	....	3.7^{18}	33.3^{100}	i. al., NH_3
49	....	311	....	6.9^{19}	....	....
50	....	$-H_2O$, 32; 780	d.	$.556^{0}$	1.27^{21}	s. min. a.; i. NH_3
51	3.48	....	....	$.781^{2}$	25^{100}	i. NH_3

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	germanate, di-	$K_2Ge_2O_5$	303.40	wh. cryst
2	“ meta-	K_2GeO_3	198.80	wh. cryst
3	“ tetra-	$K_2Ge_4O_9$	512.60	wh. cryst
4	hydride	KH	40.11	wh. need
5	hydrosulfide	KHS	72.17	rhomb. yel. deliq
6	hydroxide	KOH	56.11	rhomb. deliq., wh
7	iodate	KIO_3	214.02	monocl. col
8	“ acid	$KH(IO_3)_2$	389.95	monocl
9	*per*iodate	KIO_4	230.02	tetr. col
10	iodide	KI	166.02	cub. col. or wh. gran., 1.677
11	“ tri-	KI_3	419.86	monocl. dk. bl., deliq
12	iodobromide	KBr.IBr	325.85	rhomb
13	iodochloride	$KCl.ICl_3$	307.85	rhomb. yel
14	iodoiridite	K_3IrI_6	1071.92	grn. cr
15	iodoplatinite	K_2PtI_6	1034.95	cub. blk
16	manganate	K_2MnO_4	197.13	rhomb. grn
17	*per*manganate	$KMnO_4$	158.03	rhomb. purple, ω 1.59
18	manganicyanide	$K_3Mn(CN)_6$	328.28	monocl. red, 1.553, 1.555 (Li), 1.571
19	manganocyanide	$K_4Mn(CN)_6.3H_2O$	421.42	tetr. bl
20	molybdate	K_2MoO_4	238.20	wh. deliq. powd
21	“	$K_2MoO_4.5H_2O$	328.28	wh. deliq. powd
22	nitrate (saltpeter)	KNO_3	101.11	rhomb. or trig. col., 1.335, 1.506, 1.506
23	nitride	K_3N	131.31	grnsh. blk
24	nitrite	KNO_2	85.11	col. prism, deliq
25	nitroprusside	$K_2Fe(CN)_5.NO.2H_2O$	330.12	monocl. red
26	osmate	$K_2OsO_4.2H_2O$	369.03	cub. vlt., hyg
27	osmocyanide	$K_4Os(CN)_6.3H_2O$	557.29	monocl. col., β 1.607
28	oxide	K_2O	94.20	cub. col.-gray
29	“ per-	K_2O_4	142.20	yel. leaf
30	*ortho*phosphate	K_3PO_4	212.32	rhomb col., deliq
31	“ mon-H.	K_2HPO_4	174.23	amor. wh., deliq
32	“ di-H.	KH_2PO_4	136.14	tetr. col., deliq., 1.510, 1.4684
33	*meta*phosphate	$K_4(PO_3)_4.2H_2O$	508.51	amor. col
34	*pyro*phosphate	$K_4P_2O_7.3H_2O$	384.49	col. deliq
35	*ortho*phosphite, mon-H.	K_2HPO_3	158.23	wh. powd., deliq
36	*ortho*phosphite, di-H.	KH_2PO_3	120.14	deliq. wh
37	*hypo*phosphite	KH_2PO_2	104.14	hex. wh., deliq
38	platinate	$K_2PtO_3.3H_2O$	375.48	rhomb. yel
39	platinocyanide	$K_2Pt(CN)_4.3H_2O$	431.51	rhomb. col. yel., blue fluores., deliq.
40	platinonitrite	$K_2Pt(NO_2)_4$	457.46	monocl. col
41	plumbate	$K_2PbO_3.3H_2O$	387.47	rhomb. col
42	ruthenate	$K_2RuO_4.H_2O$	261.92	tetr. blk
43	“ hexachloro-	K_2RuCl_6	392.64	cub. blk
44	“ hydroxypenta-chloro-	$K_2RuOHCl_5$	374.19	brn. cr
45	“ nitrosopenta-chloro-	$K_2RuNOCl_5$	387.19	rhomb. dk. red
46	*per*ruthenate	$KRuO_4$	204.80	tetr. blk
47	ruthenite, aquopenta-chloro-	$K_2Ru(H_2O)Cl_5$	375.20	rose prisms
48	selenate	K_2SeO_4	221.40	rhomb. col., 1.535, 1.539, 1.545

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	$4.31^{21.5}$	>83	....	s.	....	s. a.
2	$3.40^{21.5}$	823	....	s.	....	s. a.
3	$4.12^{21.5}$	1033	....	s.	....	s. a.
4	0.80	d.	....	d.	d.	i. CS_2, eth., bz.
5	2.0	455	....	d.	d.	s. al.
6	2.044	380	1320	97^0; 107^{15}	178^{100}	v. s. al., eth.; i. NH_3
7	3.89	560	d. >100	4.74^0	32.3^{100}	s. KI; i. al., NH_3
8	....	....	....	1.33^{15}	....	....
9	3.618^{13}	582	−O, 300	0.66^{13}	s.	v. sl. s. KOH
10	3.13	773	1330	127.5^0	208^{100}	14.3 al.; s. NH_3; sl. s. eth.
11	3.498	45	d. 225	v. s.	....	s. al., KI
12	....	60	d. 180	d.	....	....
13	1.76^{45}	d.	....	d.	....	d. eth.
14	....	d.	....	v. s. (i)	....	i. al.
15	....	d.	....	s.	s. d.	sl. s. al.
16	....	d. 190	....	d.	d.	s. KOH
17	2.703	d. <240	....	2.83^0; 6.38^{20}	25^{65}	d. al.; s. H_2SO_4; v. s. meth. al., acet.
18	....	....	....	s.	....	....
19	....	....	....	s.	d.	....
20	lq. 2.342^{964}	919	....	184.6^{25}	v. s.	i. al.
21	....	....	....	s.	....	....
22	2.109^{16}	tr.-trig. 129 m.p. 334	d. 400	13.3^0; 31.6^{20}	247^{100}	i. al., eth.
23	....	d.	....	d.	....	....
24	1.915	297	d. 350	281^0; 313^{25}	413^{100}	v. s. NH_3; sl. s. al.; i. c. 94% al.
25	....	....	....	100^{16}	....	s. al.
26	....	−H_2O, >100	....	sl. s.	s. d.	i. al., eth.
27	....	d.	....	sl. s.	s.	i. al., eth.
28	2.32^0	....	....	v. s.	v. s.	s. al., eth.
29	....	ca. 400	d.	v. s. d.	....	d. al.
30	....	1340	....	sl. s.	s.	i. al.
31	....	d.	....	v. s.	v. s.	v. s. al.
32	2.338	96	....	33^{25}	s.	i. al.
33	2.26^{145}	−$2H_2O$, 100	....	sl. s.	sl. s.	s. al.
34	2.33	−$2H_2O$, 180	−$3H_2O$, 300	s.	v. s.	i. al.
35	....	d.	....	v. s.	v. s.	i. al.
36	....	d.	....	v. s.	v. s.	i. al.
37	....	d.	....	v. s.	v. s.	11.1^{25} chl.; v. sl. s. abs. al., NH_3; i. eth.
38	....	d.	....	s.	....	i. al.
39	2.455^{16}	d. 400–600	....	sl. s.	v. s.	s. al., eth., H_2SO_4
40	....	d.	....	3.8^{15}	s.	....
41	....	....	....	d.	d.	s. KOH
42	....	−H_2O, 200	d. 400 vac.	v. s.	d.	d. a., al.
43	....	d.	....	s. d.	....	i. al.
44	....	d.	....	s. d.	d.	i. al.
45	....	d.	....	12^{25}	80^{60}	i. al.
46	....	d. 440	....	sl. s.	s. d.	....
47	....	−H_2O, 200	....	s.	s.	sl. s. al.
48	3.066	....	....	110.5^0	122.2^{100}	....

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	selenocyanide	$KSeCN$	144.31	need., deliq
2	silicate	K_2SiO_3	154.26	amor. col
3	*tetra*silicate	$K_2Si_4O_9.H_2O$	352.46	rhomb., α 1.495, β 1.535
4	silicododecatungstate	$K_4[SiW_{12}O_{40}].18H_2O$	3356.74	col. hex
5	sodium carbonate	$KNaCO_3.6H_2O$	230.19	monocl
6	" cobaltinitrite	$K_2NaCo(NO_2)_6.H_2O$	454.20	yel. cr
7	stannate	$K_2SnO_3.3H_2O$	298.95	trig. col
8	stannosulfate	$K_2Sn(SO_4)_2$	389.02	wh. cr
9	sulfate (arcanite)	K_2SO_4	174.26	rhomb. or hex. col., 1.494, 1.495, 1.497
10	" acid, (misenite)	$KHSO_4$	136.17	monocl. or rhomb. col., deliq
11	*per*sulfate	$K_2S_2O_8$	270.32	tricl. col., 1.461, 1.467, 1.566
12	*pyro*sulfate	$K_2S_2O_7$	254.32	col. need
13	sulfide, mono-	K_2S	110.26	yel.-br., deliq
14	" "	$K_2S.5H_2O$	200.34	rhomb
15	" di-	K_2S_2	142.32	red. yel. cr
16	" tri-	K_2S_3	174.38	br. yel. cr
17	" tetra-	K_2S_4	206.44	red-br. cr
18	" penta-	K_2S_5	238.50	orange cryst
19	sulfite	$K_2SO_3.2H_2O$	194.29	monocl. wh.-yelsh
20	" acid	$KHSO_3$	120.17	col. cr
21	*pyro*sulfite (metabisulfite)	$K_2S_2O_5$	222.32	monocl. pl
22	tellurate	$K_2TeO_4.5H_2O$	359.78	rhomb. col., deliq
23	tellurite	K_2TeO_3	253.70	wh. deliq. cr
24	thioantimonate	$2K_3SbS_4.9H_2O$	896.74	yel. cr
25	thioarsenate	K_3AsS_4	320.47	deliq. cr
26	thioarsenite	K_3AsS_3	288.41	
27	thiocarbonate	K_2CS_3	186.38	red, br. cr., deliq
28	thiocyanate	$KCNS$	97.17	col. prisms, deliq
29	thionate, di-	$K_2S_2O_6$	238.32	trig. col., 1.455, 1.515
30	" tri-	$K_2S_3O_6$	270.38	rhomb., 1.475, 1.480, 1.487
31	" tetra-	$K_2S_4O_6$	302.44	monocl
32	" penta-	$2K_2S_5O_6.3H_2O$	723.05	rhomb
33	thioplatinate	$K_2Pt_4S_6$	1051.48	bl. gray cr
34	thiostannate	$K_2SnS_3.3H_2O$	347.13	dk. br. oil
35	thiosulfate	$3K_2S_2O_3.H_2O$	588.98	monocl. deliq
36	"	$3K_2S_2O_3.5H_2O$	661.04	col. rhomb
37	*ortho*tungstate	$K_2WO_4.2H_2O$	362.23	monocl. col., deliq
38	*meta*tungstate	$K_2W_4O_{13}.8H_2O$	1166.32	cubic
39	*para*tungstate	$K_6W_7O_{24}.6H_2O$	2014.69	rhomb
40	uranate	K_2UO_4	380.34	or.-yel., rhomb
41	*per*uranate	$K_2UO_5.3H_2O$	450.39	orange-yel
42	vanadate; meta-	KVO_3	138.05	col. cr
43	xanthogenate	$KS_2COC_2H_5$	160.26	col.-lt. yel. pr
44	**Praseodymium**	Pr	140.92	pa. yel. met
45	ammonium sulfate	$Pr_2(SO_4)_3.(NH_4)_2SO_4.8H_2O$	846.28	cryst
46	bromate	$Pr(BrO_3)_3.9H_2O$	686.81	hex. grn
47	bromide	$PrBr_3$	380.67	grn. cr. powd
48	carbide	PrC_2	164.92	yel. cr

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	d. 100	....	s.	s.	d. a.; s. al.
2	....	976	....	s.	s.	i. al.
3	2.417	d. 400	....	s.	s.	i. al.
4	....	$-17H_2O$, 100	....	33.3^{20}	v. s.	sl. s. al.
5	1.61	$-6H_2O$, 100	....	$133^{12.5}$	185^{15}	....
6	1.633	135	....	0.07^{25}	....	i. al.
7	3.197	....	....	85^{10}	110.5^{20}	sl. s. KOH; i. al., acet.
8	....	....	....	....	....	s. HCl, dil. NaOH, KOH
9	2.662	tr. 588; 1076	....	6.85^{0}; $12.^{25}$	24.1^{100}	i. al., acet., CS_2
10	2.24–2.61	210	d.	36.3^{0}	121.6^{100}	i. al., acet.
11	....	d. <100	....	1.75^{0}	5.3^{20}	i. al.
12	2.27	>300	d.	s.	d.	....
13	1.805	471	....	s.	v. s.	s. al. glyc.; i. eth.
14	....	60	$-3H_2O$, 150	s.	....	s. al. glyc.; i. eth.
15	....	....	....	s.	d.	s. al.
16	....	252	....	s.	d.	s. al.
17	....	145	d. 850	s.	....	s. al.
18	....	206	....	v. s.	v. s.	v. s. al.
19	....	d.	....	100	<100	sl. s. al.; i. NH_3
20	....	d. 190	....	s.	s.	i. al.
21	....	d.	....	sl. s.	....	sl. s. al., i. eth.
22	....	....	....	sl. s.	s.	i. al., sl. s. KOH
23	....	....	....	sl. s.	s.	....
24	....	....	....	s.	....	i. al.
25	....	d.	....	v. s.	....	i. al.
26	....	d.	....	s.	....	i. al.
27	....	d.	....	v. s.	s.	sl. s. al.
28	1.886	173.2	d. 500	177.2^{0}	217^{20}	s. al., 20.75^{22} acet.; 0.18^{13} amyl. al.
29	2.278	d.	....	6	66^{100}	i. al.
30	2.304	....	....	v. s.	d.	i. al.
31	2.296	....	....	v. s.	....	i. al.
32	2.112	d.	....	50	d.	i. al.
33	6.44^{15}	d. ign.	....	i.	....	d. HCl
34	1.847^{18}	$-3H_2O$, 100	....	s.	....	i. al.
35	2.23; (anh.) 2.590	$-H_2O$, 180	d.	96.1^{0}	312^{90}	i. al.
36	....	d.	....	$150.2^{17.2}$	....	....
37	3.113	tr. 388; 921	....	51.5	151.5	d. a.; i. al.
38	....	....	....	s.	v. s.	d. a.
39	....	d.	....	2.15	6.6	d. a.; i. al.
40	....	....	....	i.	i.	v. s. a.
41	....	d. 100	....	d.	d.	d. HCl
42	....	....	....	s.	....	sl. s. KOH; i. al.
43	$1.558^{21.5}$	d. >200	....	v. s.	....	20 al., i. eth.
44	6.5	940	....	d.	....	s. a.
45	$2.531^{16.5}$	$-8H_2O$, 170	....	sl. s.	....	....
46	....	56.5	$-7H_2O$, 100	190^{25}	....	....
47	....	....	....	sl. s. d.	....	....
48	5.10	d.	....	d.	d.	s. dil. a.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Praseodymium			
1	carbonate	$Pr_2(CO_3)_3.8H_2O$	605.96	grn. silky. pl
2	chloride	$PrCl_3$	247.29	bl. grn. need
3	"	$PrCl_3.7H_2O$	373.40	tricl. grn
4	oxide, di-	PrO_2	172.92	br.-bl. powd
5	" tri-	Pr_2O_3	329.84	yel.-grn. amor
6	" per-	Pr_2O_5	361.84	
7	" tetr-	Pr_2O_4	204.92	blk
8	potassium sulfate	$Pr_2(SO_4)_3.3K_2SO_4.H_2O$	1110.82	cryst
9	rubidium nitrate	$Pr(NO_3)_3.2RbNO_3.4H_2O$	693.90	grnsh. need., hyg
10	sulfate	$Pr_2(SO_4)_3$	570.02	lt. grn. powd
11	"	$Pr_2(SO_4)_3.5H_2O$	660.10	monocl. pr
12	"	$Pr_2(SO_4)_3.8H_2O$	714.14	monocl. grn., 1.540, 1.549, 1.561
13	sulfide	Pr_2S_3	378.02	br. powd
14	**Radium**	Ra	225.97	silv. wh. met
15	bromide	$RaBr_2$	385.80	monocl. col.-yelsh
16	carbonate	$RaCO_3$	285.97	wh. or sl. brnsh
17	chloride	$RaCl_2$	296.88	monocl. col.-yelsh
18	sulfate	$RaSO_4$	322.03	col
19	**Radon** (niton) (radium emanation)	Rn	222.00	col. gas, opaque cr
20	**Rhenium**	Re	186.31	hex. met. lust
21	chloride, tri-	$ReCl_3$	292.68	hex. dk. red
22	" tetra-	$ReCl_4$	328.14	blk
23	" hexa-	$ReCl_6$	399.05	yelsh. red
24	fluoride, hexa-	ReF_6	300.31	pa. yel
25	oxide, di-	ReO_2	218.31	blk
26	" hept-	Re_2O_7	484.62	br.-yel. pl. or powd
27	" per-	Re_2O_8	500.62	wh
28	**Rhodium**	Rh	102.91	cub. gray-wh
29	cesium sulfate	$Rh_2(SO_4)_3Cs_2SO_4.24H_2O$	1288.05	yel. oct
30	chloride	$RhCl_3$	209.28	br. red. powd. deliq
31	"	$RhCl_3.xH_2O$	.....	dk. red
32	fluoride, tri-	RhF_3	159.91	rhomb. red
33	hydrosulfide	$Rh(SH)_3$	202.11	blk
34	hydroxide, tri-	$Rh(OH)_3$	153.93	yel. gel
35	" tetra-	$Rh(OH)_4$	170.94	olive grn
36	nitrate	$Rh(NO_3)_3$	288.93	br.-yel
37	"	$Rh(NO_3)_3.2H_2O$	324.97	red, deliq
38	oxide, mon-	RhO	118.91	gray
39	" di-	RhO_2	134.91	br
40	" sesqui-	Rh_2O_3	253.82	gray cr. or amor
41	potassium sulfate	$RhK(SO_4)_2.12H_2O$	550.32	yel. cub
42	sulfate	$Rh_2(SO_4)_3.4H_2O$	566.06	red
43	"	$Rh_2(SO_4)_3.12H_2O$	710.19	lt. yel. cr
44	"	$Rh_2(SO_4)_3.15H_2O$	764.23	pa. yel. cr
45	sulfide, mono-	RhS	134.97	gray-blk. cr
46	" sesqui-	Rh_2S_3	302.00	blk
47	sulfite	$Rh_2(SO_3)_3.6H_2O$	554.09	yel. cr
48	**Rubidium**	Rb	85.44	soft, silv.-wh. met

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	$-6H_2O$, 100	......	i.	......	s. a.
2	4.02^{25}	818(769–82)	>1000	103.9^{13}	∞^{100}	v. s. al. 2.4 pyr.; i. eth., chl
3	2.25^{17}	115	......	334^{13}	∞^{100}	s. al., HCl
4	......	......	......	......	......	......
5	6.88	d	......	$.000020^{29}$	......	s. a.
6	......	......	......	......	......	......
7	5.978	......	......	......	......	......
8	3.275^{16}	......	......	sl. s.	......	s. HNO_3, HCl
9	......	63.5	......	......	......	......
10	3.72^{16}	......	......	17.7^{20}	1.02^{95}	......
11	3.176^{16}	......	......	......	1.60^{86}	......
12	$2.827^{13.3}$	......	......	12.7^{20}	sl. s.	......
13	5.042^{11}	d.	......	i.	d.	s. dil. a.
14	5?	960	1140	d. ev. H_2	......	d. a.
15	5.79	728	......	s.	s.	s. al.
16	......	......	......	i.	......	d. a.
17	4.91	1000	......	s.	s.	s. al.
18	......	......	......	$.000002^{25}$	$.000005^{45}$	i. a.
19	9.73 g/l; lq. 4.4^{-62}; sld. 4	−71	−61.8	s.	......	......
20	20.53	3440	......	......	......	s. conc. HNO_3, H_2O_2
21	......	......	>550	s.	s.	s. a., alk.
22	......	......	500	s. d.	s. d.	s. HCl
23	......	......	<40	s. d.	s. d.	s. HCl
24	......	25.6	......	s. d.	s. d.	......
25	......	......	......	i.	i.	s. conc. HCl, H_2O_2
26	8.2	*ca.* 220	450 subl.	v. s.	v. s.	v. s. al.; s. a., alk.
27	8.4	150	......	v. s.	......	......
28	12.5	1985 ± 15	>2500	i.	i.	sl. s. a., aq. reg.; s. H_2SO_4 + HCl
29	......	110–111	......	sl. s.	......	......
30	......	d. 450–500	subl. 800	i.	i.	i. a., aq. reg.
31	......	d.	......	v. s.	......	s. al., HCl; i. eth.
32	5.38	......	>600 subl.	i.	i.	i. a., alk.
33	......	d.	......	i.	d.	s. aq. reg., aq. Br.; i. a., Na_2S
34	......	d.	......	i.	......	s. a., alk.
35	......	d.	......	i.	......	s. HCl
36	......	d.	......	v. s.	s.	i. al.
37	......	......	......	s.	s	i. al.
38	......	......	......	i.	i.	i. a.
39	......	......	......	i.	i.	i. a., alk.
40	......	d. 1100–1150	......	i.	i.	i. a., aq. reg., KOH
41	2.23	......	......	s.	......	......
42	......	d.	......	s.	s.	......
43	......	......	......	v. s.	d.	i. al.
44	......	d.	......	v. s.	d.	i. al., eth.
45	......	d.	......	i.	i.	i. a., aq. reg.
46	......	d.	......	i.	i.	i. a., aq. reg., aq. Br.
47	......	d.	......	s.	......	i. al.
48	1.532; lq. $1.475^{33.5}$	38.5	700	d.	d.	s. a., al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Rubidium			
1	bromate	$RbBrO_3$	213.36	
2	bromide	$RbBr$	165.36	cub. col., 1.5530
3	" tri-	$RbBr_3$	325.19	rhomb.
4	" chlorodi-	$RbBr_2Cl$	280.73	rhomb.
5	" dichloro-	$RbBrCl_2$	236.27	rhomb.
6	carbonate	Rb_2CO_3	230.88	col. cr., deliq
7	" acid	$RbHCO_3$	146.45	rhomb.
8	chlorate	$RbClO_3$	168.90	trim.
9	*per*chlorate	$RbClO_4$	184.90	rhomb.
10	chloride	$RbCl$	120.90	cub. col., 1.493
11	chloroplatinate	Rb_2PtCl_6	578.85	cub. yel
12	chromate	Rb_2CrO_4	286.89	rhomb. yel
13	*di*chromate	$Rb_2Cr_2O_7$	386.90	tricl. or monocl
14	fluoride	RbF	104.44	col
15	fluosulfonate	$RbFSO_3$	184.50	need
16	fluosilicate	Rb_2SiF_6	312.94	cub. oct
17	hydride	RbH	86.45	col. need
18	hydroxide	$RbOH$	102.45	gray-wh., deliq
19	iodate	$RbIO_3$	260.36	monocl. or cub
20	*per*iodate	$RbIO_4$	276.36	tetr
21	iodide	RbI	212.36	cub. col., 1.6474
22	" tri-	RbI_3	466.20	rhomb. blk
23	" chlorobromo-	$RbIBrCl$	327.73	rhomb.
24	" dibromo-	$RbIBr_2$	372.19	rhomb.
25	" dichloro-	$RbICl_2$	283.27	rhomb.
26	" tetrasulfon-	$RbI.4SO_2$	468.60	lemon yel
27	*per*manganate	$RbMnO_4$	204.37	cryst
28	nitrate	$RbNO_3$	147.45	hex. cub. rhomb. or tricl. col., 1.51, 1.52, 1.524
29	" hydro-	$RbNO_3.HNO_3$	210.46	tetr
30	" dihydro-	$RbNO_3.2HNO_3$	273.48	col. need
31	oxide, mon-	Rb_2O	186.88	cub. col.-yel
32	" di- (per)	Rb_2O_2	202.88	cub. yel
33	" tri-	Rb_2O_3	218.88	blk
34	" tetr-	Rb_2O_4	234.88	yel
35	sulfate	Rb_2SO_4	266.94	rhomb. hex. col., 1.513, 1.513, 1.514
36	" acid	$RbHSO_4$	182.51	rhomb.
37	sulfide	Rb_2S	202.94	col
38	"	$Rb_2S.4H_2O$	275.00	cr., deliq
39	" di-	Rb_2S_2	235.00	dk. red
40	" tri-	Rb_2S_3	267.06	redsh. yel
41	" penta-	Rb_2S_5	331.18	rhomb. red, deliq
42	" hexa-	Rb_2S_6	363.24	brown-red
43	**Ruthenium**	Ru	101.70	blk. porous
44	"	Ru	101.70	hex. gray-wh. brittle met
45	chloride, di-	$(RuCl_2)_x$	$(172.61)_x$	blk. cr
46	" tri-	$RuCl_3$	208.07	cr. br., deliq
47	" tetra-	$RuCl_4$	243.53	
48	fluoride, penta-	RuF_5	196.70	dk. grn

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	3.68	430	....	2.93^{25}	5.08^{40}	....
2	3.35; lq. 2.79^{730}	682	1340	98^{5}	$205.2^{113.5}$	sl. s. acet.; i. al.
3	....	d. 140	....	....	....	....
4	....	76	....	....	....	....
5	....	d. 110	....	....	....	....
6	....	837	d. 740	450^{20}	s.	0.7 abs. al.
7	....	d. 175	....	v. s.	....	s. al.
8	3.19	....	....	5^{19}	62.8^{100}	....
9	2.9	fus.	d.	0.5^{0}	18^{100}	i. al.
10	2.76; lq. 2.088^{750}	715	1390	77^{0}; 91.2^{20}	138.9^{100}	0.08^{25} al.; v. sl. s. NH_3; i. al.
11	$3.94^{17.5}$	d.	....	$.184^{0}$; $.141^{20}$	$.634^{100}$	i. al.
12	3.518	....	....	62^{0}	95.7^{80}	....
13	....	....	tricl. monocl.	4.96^{18} 5.42^{18}	27.3^{60} 28.1^{50}	....
14	lq. 2.888^{20}	760	1410	130.6^{18}	....	s. dil. HF; i. al., eth., NH_3
15	....	304	....	....	....	....
16	3.332	....	....	0.16^{20}	1.35^{100}	s. a.; i. al.
17	2.0	d. 300	....	d.	d.	d. a.
18	3.203^{11}	300	....	180^{15}	v. s.	s. al.
19	$4.33^{19.5}$	d.	....	2.1^{23}	....	v. s. HCl
20	3.918^{16}	....	....	0.65^{13}	....	....
21	3.55; lq. 2.87^{825}	642	1300	$152.^{17}$	v. s.	0.674^{25} acet.
22	....	190	....	s.	....	....
23	....	205	d. begins 200	....	....	....
24	....	225	d. 265	....	....	....
25	....	180–200	d. 265	....	....	....
26	....	13.5	....	....	....	....
27	$3.235^{10.4}$	....	....	0.5^{0}	4.7^{60}	....
28	3.11; lq. 2.395^{400}	tr.-cub. 161.4, m.p. 310	tr.-rhomb. 219	34.8^{20}	452^{100}	v. s. HNO_3; s. acet.
29	....	62	....	....	....	....
30	....	15	....	....	....	....
31	3.72	d. 400	....	s. d.	s. d.	....
32	3.65^{0}	600	....	d. to RbO	H + H_2O_2	....
33	3.53	<500	....	s. d.	....	....
34	3.05^{0}	280	....	d. to H_2O_2 +	RbOH + O_2	....
35	3.613; lq. 2.53^{1100}	1060; tr. 653	....	42.4^{10}	81.8^{100}	....
36	2.892^{16}	<red heat	....	....	....	....
37	2.912	....	....	v. s.	v. s.	....
38	....	....	....	v. s.	v. s.	....
39	....	420	volat. >850	....	....	....
40	....	213	....	....	....	....
41	2.618^{15}	225	....	d.	....	s. 70% al.; i. eth., chl.
42	....	201	....	....	....	....
43	8.6	>1950	....	i.	i.	sl. s. a., aq. reg.; i. al., eth.
44	12.063	2450	4150	i.	i.	s. fus. alk.; sl. s. aq. reg.; i. a.
45	....	....	....	i.	....	s. dil. al. (bl.); i. a. alk.
46	....	d. >500	....	i.	d.	s. HCl; sl. s. al.; i. CS_2
47	....	....	....	s.	....	s. al.
48	$2.963^{16.5}$	101	270	d.	d.	....

PHYSICAL CONSTANTS OF

No	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Ruthenium			
1	hydroxide	$Ru(OH)_3$	152.72	blk. powd
2	" tri-	$Ru_2O_3.xH_2O$	......	yel
3	" tetra-	$RuO_2.xH_2O$	......	blk
4	oxide, di-	RuO_2	133.70	tetr. dk. bl
5	" tetr-	RuO_4	165.70	rhomb. yel
6	" sesqui-	Ru_2O_3	251.40	bl.-blk
7	" pent-	Ru_2O_5	283.40	blk. cr
8	" non-	Ru_4O_9	550.80	blk. cr
9	silicide	RuSi	129.76	met. pr
10	sulfide, (laurite)	RuS_2	165.82	cub. gray-blk
11	**Samarium**	Sm (or Sa)	150.43	hex. gray-wh. met.
12	bromate	$Sm(BrO_3)_3.9H_2O$	696.32	hex. yel
13	bromide	$SmBr_3.6H_2O$	498.27	yel. cr., deliq
14	carbide	SmC_2	174.43	hex. yel
15	chloride	$SmCl_3$	256.80	yelsh.-wh. cr., hyg
16	"	$SmCl_3.6H_2O$	364.89	tricl. grn.-yel., deliq
17	" (ous)	$SmCl_2$	221.34	red-br. cr
18	fluoride	$SmF_3.\frac{1}{2}H_2O$	216.44	....
19	hydroxide	$Sm(OH)_3$	201.45	pa. yel. powd
20	iodide	SmI_3	531.19	or.-yel. cr
21	nitrate	$Sm(NO_3)_3.6H_2O$	444.55	tricl. pa. yel
22	oxide	Sm_2O_3	348.86	wh.-yelsh. powd
23	" per-	Sm_4O_9 (exist. quest.)	745.72	....
24	sulfate	$Sm_2(SO_4)_3.8H_2O$	733.16	monocl. lt. yel., 1.543, 1.552, 1.563
25	" basic	$Sm_2O_3SO_3$	428.92	yel. powd
26	sulfide	Sm_2S_3	397.04	yel. mass
27	**Scandium**	Sc	45.10	silv
28	chloride	$ScCl_3$	151.47	col. cr
29	nitrate	$Sc(NO_3)_3$	231.12	col
30	"	$Sc(NO_3)_3.4H_2O$	303.19	prisms, deliq
31	oxide	Sc_2O_3	138.20	wh. powd
32	sulfate	$Sc_2(SO_4)_3$	378.38	col. cr
33	"	$Sc_2(SO_4)_3.5H_2O$	468.46	....
34	"	$Sc_2(SO_4)_3.6H_2O$	486.47	....
35	**Selenic acid**	H_2SeO_4	145.22	hex. pr., col
36	" "	$H_2SeO_4.H_2O$	163.23	col. liq. or need. or rect. pl
37	" "	$H_2SeO_4.4H_2O$	217.28	col. liq
38	**Selenious acid**	H_2SeO_3	129.22	hex. col
39	**Selenium**	Se_8	633.60	amor. red
40	"	$Se_8 < 500 (Se_2$ at 900)	633.60	trig. gray met
41	"	Se_8	633.60	vitreous, red to blk
42	"	Se_8	633.60	monocl. (hex.?) red, 2.9^{220} lq
43	boride	Se_3B_2	259.24	yel. gray powd
44	bromide, mono-	Se_2Br_2	318.23	dk. red liq
45	" tetra-	$SeBr_4$	398.86	or. red-br. cr
46	bromochloride, tri-	$SeBr_3Cl$	354.41	orange cr
47	bromodinitride	Se_2N_2Br	266.33	....
48	bromotrichloride	$SeBrCl_3$	265.49	yel. br. cr

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	v. sl. s.	....	s. a.; i. alk.
2	....	d.	....	i.	i.	s. a., alk.
3	....	d.	....	i.	i.	s. a., i. alk.
4	6.97	d.	....	i.	i.	i. a.; s. fus. alk.
5	3.29^{21}	25.5	*ca.* 100 d.	2.033^{20}	2.249^{75}	s. a., alk., al.
6	....	....	....	i.	i.	i. a. alk.
7	....	$-\frac{1}{2}$O, 360	....	i.	....	s. HCl
8	....	−O, 440	....	....	....	....
9	5.40^{4}	....	....	i.	i.	s. HNO_3 + HF
10	6.99	....	....	i.	i.	s. fus. alk., i. a.
11	7.7	1300–1400	....	....	....	....
12	....	75	$-9H_2O$, 150	114^{25}	....	v. sl. s. al.
13	2.971^{22}	....	....	....	....	....
14	5.86	....	....	d.	d.	s. a. d.
15	4.46^{18}	678 ± 2	....	92.4^{10}	99.9^{50}	v. s. al.; 6.4^{25} pyr.
16	2.383	$-5H_2O$, 110	....	....	....	....
17	3.687^{22}	....	....	s. d.	....	i. al., CS_2
18	....	....	....	i.	....	i. dil. a.
19	....	....	....	i.	....	s. a.; i. alk.
20	....	816–24	d. 800	....	....	....
21	2.375	78–9	....	v. s.	....	....
22	7.43	....	....	i.	....	v. s. a.
23	....	....	....	i.	....	....
24	2.96	$-8H_2O$, 450	....	2.67^{20}	1.99^{40}	....
25	....	....	d. 1100	i.	....	i. dil. H_2SO_4
26	3.7	....	....	....	....	....
27	2.5	1200	2400	d. ev. H_2	....	....
28	....	939	subl. 800–50	v. s.	v. s.	i. abs. al.
29	....	150	....	s.	....	....
30	....	$-4H_2O$, 100	....	v. s.	....	....
31	3.86	....	....	i.	i.	s. h. a.
32	2.579	d.	....	10.3^{25}	v. s.	....
33	....	....	....	39.9^{25}	....	....
34	....	$-4H_2O$, 100; $-6H_2O$, 250	....	v. s.	....	....
35	sld. 2.951^{15}; lq. 2.608^{15}	58; eas. undercools	260 d.	v. s.	v. s.	s. H_2SO_4; i. NH_3; d. al. & org. solv.
36	2.627^{15}; lq. 2.356^{15}	25–6; eas. undercools	205	v. s.	v. s.	v. s. al.; i. NH_3; d. org. solv.
37	....	−51.7; eas. undercools	172^{85}; $-H_2O$	∞	....	s. H_2SO_4; d. org. solv.
38	3.004^{15}	d.	$-H_2O$	167^{20}	v. s.	v. s. al.; i. NH_3
39	4.26	tr.-vit. 40–50; −met. 200	688	i.	i.	s. H_2SO_4, sl. s. CS_2; i. al.
40	4.79^{15}	217	688	i.	i.	s. H_2SO_4, HNO_3; i. CS_2
41	4.28(4.14^{22})	indef.	688	i.	i.	s. H_2SO_4, HNO_3, CS_2
42	4.46^{25}(4.50)	170–180	688	i.	i.	s. H_2SO_4, HNO_3, CS_2
43	....	....	....	d.	d.	....
44	3.604^{15}	....	227 d.	d.	d.	s. CS_2, chl., C_2H_5Br; d. ai
45	....	d. 75	....	d.	d.	s. CS_2, chl., C_2H_5Br, HCl
46	....	d.	....	....	....	v. sl. s. CS_2
47	....	....	....	i.	d.	....
48	....	190	....	....	....	i. CS_2

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Selenium			
1	chloride, mono-	Se_2Cl_2	229.31	br.-red liq., 1.596
2	" tetra-	$SeCl_4$	221.03	cub. wh.-yel., deliq., 1.807
3	fluoride, tetra-	SeF_4	155.20	col. liq. or wh. cr
4	" hexa-	SeF_6	193.20	gas, col., 1.895
5	iodide, mono-	Se_2I_2	412.24	steel gray cr
6	" tetra-	SeI_4	586.88	dk. gray cr
7	nitride	Se_4N_4	372.83	amor. or.-yel. to brk. red
8	oxide, di-	SeO_2	111.20	monocl. (tetr.) col
9	" tri-	SeO_3	127.20	amor. pa. yel
10	oxybromide	$SeOBr_2$	255.03	red-yel. cr
11	oxychloride	$SeOCl_2$	166.11	col-yel. liq., 1.651^{20}
12	oxyfluoride	$SeOF_2$	133.20	col. liq
13	sulfide, mono-	SeS	111.26	or. yel. tabl. or powd
14	" di-	SeS_2	143.32	br. red-yel
15	sulfotrioxide	$SeSO_3$	159.26	grn. pr. or yel. powd
16	sulfoxytetrachloride	$SeSO_3Cl_4$	301.09	hex. pr
17	**Silicane**, amine, tri-	$(SiH_3)_3N$	107.26	
18	" bromo-	SiH_3Br	111.00	
19	" chloro-	SiH_3Cl	66.54	
20	" dibromo-	SiH_2Br_2	189.91	
21	" dichloro-	SiH_2Cl_2	100.99	
22	" ether	$(SiH_3)_2O$	78.17	
23	" tribromo-	$SiHBr_3$	268.82	col. liq
24	" trichloro-	$SiHCl_3$	135.44	col. liq
25	" trifluoro-	$SiHF_3$	86.07	col. gas
26	" triiodo-	$SiHI_3$	409.83	red liq
27	**Silicic acid**, ortho-	H_4SiO_4	96.09	amor. col
28	" " meta-	H_2SiO_3	78.08	amor. col
29	**Silicon**	Si	28.06	cub. steel gray
30	amorphous	Si	28.06	amor. br
31	graphitic	Si	28.06	blk. pl
32	boride, tri-	SiB_3	60.52	rhomb. blk
33	" hexa-	SiB_6	92.98	blk. cr
34	bromide, tri-	Si_2Br_6	535.62	rhomb. wh
35	" tetra-	$SiBr_4$	347.72	col. fum liq., 1.579^{16} (F)
36	bromotrichloride	$SiBrCl_3$	214.35	col. liq
37	*di*bromodichloride	$SiBr_2Cl_2$	258.81	col. liq
38	*tri*bromochloride	$SiBr_3Cl$	303.27	col. liq
39	carbide (carborundum)	SiC	40.06	hex. col., 2.654, 2.697
40	chloride, tri-	Si_2Cl_6	268.86	col. liq
41	" tetra-	$SiCl_4$	169.89	col. fum. liq., 1.412 (C)
42	chlorohydrosulfide	$SiCl_3SH$	167.50	col. liq
43	fluoride, tetra-	SiF_4	104.06	col. gas
44	hydride (silicane)	SiH_4	32.09	col. gas
45	" (disilicane)	Si_2H_6	62.17	col. gas
46	" (trisilicane)	Si_3H_8	92.24	col. liq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	2.91^{17}; 2.77^{23}	−85	130 d.	d.	d.	s. CS_2, CCl_4, chl. bz.; d. al., eth.
2	$3.78–85^{360}$	305 subl. 170–196	d. 288	d.	d.	s. $POCl_3$; v. sl. s. CS_2; d. a., alk.
3	....	−80	>100(93)	d.	d.	....
4	3.25^{-28} g/l	−39; subl. −46.6	−34.5	s. d.	....	....
5	....	68–70	d. 100	d.	d.	....
6	....	75–80	−41, 100	d.	d.	....
7	....	exp. 160–200	d.	i.	i.	v. sl. s. bz., ac. a., CS_2; i. al., eth.
8	$3.95\frac{15}{18}$	340	subl. 315–7	38.4^{14}	82.5^{65}	6.67^{14} al., $4.35^{15.3}$ acet.; $1.11^{13.9}$ ac. a.; s. bz.
9	3.6	d. 120	....	v. s. d.	v. s. d.	s. al. conc. H_2SO_4; i. eth., bz., chl. CCl_4
10	lq. 3.38^{50}	41.6	217^{740} d.	d.	....	s. CS_2, CCl_4, chl., H_2SO_4, bz.
11	2.42^{22}	8.5(10.9)	176.4	d.	....	s. CS_2, CCl_4, chl., bz.
12	2.67	4.6	124	d.	....	s. al.; i. CCl_4
13	3.056^{0}	d. 118–9	....	i.	i.	s. CS_2; i. eth.
14	....	<100	d.	i.	....	s. $(NH_4)_2S$; d. aq. reg., HNO_3
15	....	−SO_2, 40	....	d.	....	s. H_2SO_4; i. SO_3
16	....	165	183	d.	....	....
17	0.895^{-106}	−105.6	52	....	....	....
18	1.72^{-80}	−94	1.9	....	....	....
19	1.145^{-113}	−118.1	−30.4	....	....	....
20	2.17^{0}	−70.1	66	....	....	....
21	1.42^{-122}	−122	8.3	....	....	....
22	0.881^{-80}	−143.6	−15.2	....	....	....
23	2.7^{17}	<−60	109	d.	d.	d. NH_3
24	1.35^{0}	−126.5	31.8	d.	d.	s. CS_2, CCl_4, chl., bz.
25	3.86^{0} g/l	*ca.* −110	−80.2	d.	d.	d. alk., al., eth. s. tol.
26	3.314	8	220	d.	d.	s. CS_2, bz.
27	1.57^{17}	....	....	sl. s.	sl. s.	s. alk.; i. NH_4Cl
28	2.1–.3	....	....	i.	i.	s. alk.; i. NH_4Cl
29	2.4	1420	2600	i.	i.	s. HF + HNO_3; i. a., HF
30	2.00	....	2600	i.	i.	s. HF, KOH
31	*ca.* 2.4	....	2600	i.	i.	s. HF + HNO_3; i. HF
32	2.52	....	....	i.	....	sl. s. HNO_3; d. H_2SO_4, KOH
33	2.47	....	....	i.	....	s. HNO_3; i. KOH; d. H_2SO_4
34	....	65	240	d.	d.	d. KOH; s. CS_2
35	2.812	5	153	d.	d.	d. H_2SO_4
36	....	<−60	80	d.	d.	....
37	....	<−60	104	d.	d.	....
38	2.432	−39	140.5	d.	d.	....
39	3.17	>2700	subl. >2000	i.	i.	i. a.; d. fused KOH
40	lq. 1.58^{0}	−1	139(145)	d.	d.	d. al.
41	1.483	−70	59.6	d.	d.	d. al.
42	1.45	....	*ca.* 95	d.	d.	d. al.
43	4.68 g/l	−77(−97)	-65^{181}	d.	d.	s. abs. al., eth., HF
44	lq. 0.68^{-185}; 1.44 g/l	−185	−111.8	i.	....	d. KOH
45	lq. 0.686^{-25}	−132.5	−14.5	slow d., sl. s.	....	s. bz., al., CS_2
46	0.743^{0}	−117.4	52.9	d.	....	d. CCl_4

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Silicon			
1	hydride (tetrasilicane)	Si_4H_{10}	122.32	col. liq
2	iodide, di-	SiI_2	281.90	
3	" tetra-	SiI_4	535.74	cub. col
4	" hexa-	Si_2I_6	817.64	hex. col
5	iodotrichloride	$SiICl_3$	261.35	col. liq
6	oxide, di- (cristobalite)	SiO_2	60.06	cub. or tetr. col., 1.487, 1.484
7	" " (lechatelierite)	SiO_2	60.06	col., 1.46
8	" " (quartz)	SiO_2	60.06	trig. col., 1.544, 1.553
9	" " (tridymite)	SiO_2	60.06	rhomb. col., 1.469, 1.470, 1.471
10	" " (amor., opal)	SiO_2 $(+xH_2O)$		col. amor., 1.41–1.46
11	oxychloride	Si_2OCl_6	284.86	col. liq
12	sulfide, mono-	SiS	60.12	yel. need
13	sulfobromide	$SiSBr_2$	219.95	col. pl
14	sulfochloride	$SiSCl_2$	131.03	col. pr
	Silicotungstic acid,			
15	dodeca-	$H_4[SiW_{12}O_{40}].24H_2O$	3312.47	trig. col
16	**Siloxane, di-**	Si_2H_6O	78.17	col. gas
17	**Silver**	Ag	107.88	cub. wh. met., 0.54
18	*ortho*arsenate	Ag_3AsO_4	462.57	cub. dk. red
19	*ortho*arsenite	Ag_3AsO_3	446.57	yel. powd
20	*tetra*borate	$Ag_2B_4O_7.2H_2O$	407.07	white
21	bromate	$AgBrO_3$	235.80	tetr. col., 1.847, 1.920
22	bromide (bromyrite)	$AgBr$	187.80	cub. pa. yel., 2.253
23	carbide	Ag_2C_2	239.76	wh. amor.
24	carbonate	Ag_2CO_3	275.76	yel. powd
25	chlorate	$AgClO_3$	191.34	tetr. wh
26	*per*chlorate	$AgClO_4$	207.34	wh. cr., deliq
27	chloride (cerargyrite)	$AgCl$	143.34	cub. wh., 2.071
28	chromate	Ag_2CrO_4	331.77	monocl. red
29	*di*chromate	$Ag_2Cr_2O_7$	431.78	tricl. red
30	cyanate	$AgCNO$	149.89	col
31	cyanide	$AgCN$	133.89	hex. wh
32	ferricyanide	$Ag_3Fe(CN)_6$	535.53	orange
33	ferrocyanide	$Ag_4Fe(CN)_6.H_2O$	661.42	yel
34	fluoride	AgF	126.88	cub. yel., deliq
35	" sub-	Ag_2F	234.76	hex. yel
36	fluosilicate	$Ag_2SiF_6.2H_2O$	393.85	col. cr. or wh. powd., deliq
37	iodate	$AgIO_3$	282.80	rhomb. col
38	iodide, (iodyrite)	AgI	234.80	hex. yel., 2.21, 2.22
39	*per*manganate	$AgMnO_4$	226.81	monocl. dk. vlt
40	nitrate	$AgNO_3$	169.89	rhomb. col., α 1.729, γ 1.788
41	nitride (azide)	AgN_3	149.90	wh. prisms
42	nitrite	$AgNO_2$	153.89	rhomb. wh
43	nitroprusside	$Ag_2Fe(CN)_5NO$	431.65	lt. pink
44	oxide	Ag_2O	231.76	cub. br.-blk

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	0.79^{0}	−93.5	80	d.	....	....
2	....	....	....	d.	....	i. CS_2, chl., bz.
3	....	120.5	290	d.	....	2.2^{27} CS_2
4	....	250	d.	d.	d.	19^{19} CS_2
5	....	<−60	113.5	d.	....	....
6	2.32	1713	2230(2590)	i.	i.	s. HF; v. sl. s. alk.
7	2.20	....	2230(2590)	i.	i.	s. HF; v. sl. s. alk.
8	2.651	<1470	2230(2590)	i.	i.	s. HF; v. sl. s. alk.
9	2.26	1670	2230(2590)	i.	i.	s. HF; v. sl. s. alk.
10	2.1–2.3	>1600	....	i.	i.	s. HF, hot alk.
11	....	−33	137	d.	d.	∞ CS_2, CCl_4, chl., eth.; d. al.
12	1.853^{15}	....	subl. 940^{20}	d.	d.	d. alk., al.
13	....	93	$150^{13.3}$	d.	d.	s. bz. CS_2
14	....	75	$92^{18.3}$	d.	d.	s. CCl_4, CS_2
15	....	$-18H_2O$, 100	....	v. s.	v. s.	v. s. al., eth.
16	0.881^{-80}	−144	−15.2	v. sl. s.	sl. d.	....
17	10.5	960.5	1950	i.	i.	s. HNO_3, h. H_2SO_4, KCN; i. alk.
18	6.657^{25}	....	....	0.00085^{20}	....	s. ac. a., NH_4OH
19	....	150 d.	....	0.00115^{20}	i.	s. ac. a., NH_4OH, HNO_3; i. al.
20	....	....	....	sl. s.	....	s. a.
21	5.206	d.	....	$0.81^{24.5}$	1.33^{90}	s. NH_4CH; sl. s. HNO_3
22	6.473^{25}	434	d. 700	8.4×10^{-6}	$.00037^{100}$	s. KCN, $Na_2S_2O_3$; sl. s. NH_4OH; i. al.
23	....	exp.	....	sl. s.	....	s. HCl; sl. s. al.
24	6.077	218 d.	....	0.0032^{20}	0.05^{100}	s. NH_4OH, $Na_2S_2O_3$; i. al.
25	4.430	230	d. 270	10^{15}	50^{80}	sl. s. al.
26	2.806^{25}	d. 486	....	525^{25}	s.	s. al.
27	5.56	455	1550	$.000089^{10}$	$.0021^{100}$	s. NH_4OH, $Na_2S_2O_3$, KCN
28	5.625	....	....	0.0014^{0}	0.008^{70}	s. a., NH_4OH, KCN
29	4.770	d.	....	0.0083^{16}	d.	s. a., NH_4OH, KCN
30	4.00	d.	....	sl. s.	s.	s. HNO_3, NH_4OH, KCN
31	3.95	320 d.	....	$.000022^{20}$	....	s. HNO_3, NH_4OH, KCN, $Na_2S_2O_3$
32	....	....	....	$.000066^{20}$	....	s. NH_4OH, h. $(NH_4)_2CO_3$; i. a.
33	....	....	....	i.	i.	s. NH_4OH, KCN; i. a.
34	$5.852^{15.5}$	435	....	$182^{15.5}$	205^{103}	sl. s. NH_4OH
35	8.57	90 d.	....	d.	....	....
36	....	<100	d.	v. s.	....	....
37	5.525	>200	d.	0.003^{10}	0.019^{60}	s. NH_4OH, HNO_3, KI
38	5.67	d. 552	....	3×10^{-7}	3×10^{-6}	s. KCN, $Na_2S_2O_3$; sl. s. NH_4OH
39	....	d.	....	0.55^{0}	$1.69^{28.5}$	d. al
40	4.352^{19}	212	444 d.	122^{0}	952^{100}	s. eth., glyc.; v. sl. s. abs. al.
41	....	exp. 252	....	i.	0.01^{100}	s. KCN, dil. HNO_3; sl. s. NH_4OH
42	4.453^{26}	d. 140	....	0.155^{0}	1.363^{60}	s. ac. a., NH_4OH; i. al.
43	....	....	....	i.	....	s. NH_4OH; i. al., HNO_3
44	$7.143^{16.6}$	d. 300	....	0.0013^{20}	0.0053^{80}	s. a., NH_4OH, KCN

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Silver			
1	oxide per-	Ag_2O_2	247.76	cub. blk
2	*ortho*phosphate	Ag_3PO_4	418.66	cub. yel
3	*meta*phosphate	$AgPO_3$	186.90	wh. amor
4	*pyro*phosphate	$Ag_4P_2O_7$	605.56	white
5	potassium carbonate	$AgKCO_3$	206.98	rect. pl
6	" cyanide	$AgK(CN)_2$	199.00	cub. col
7	" nitrate	$KNO_3.AgNO_3$	271.00	monocl
8	selenide (naumannite)	Ag_2Se	294.96	cub. thin gray pl
9	sodium thiosulfate	$Ag_2S_2O_3.2Na_2S_2O_3.2H_2O$	680.14	wh. to gray cr. powd
10	sulfate	Ag_2SO_4	311.82	rhomb. wh
11	sulfide (argentite)	Ag_2S	247.82	cub. blk
12	" (acanthite)	Ag_2S	247.82	rhomb. gray-blk
13	sulfite	Ag_2SO_3	295.82	wh. cr
14	telluride (hessite)	Ag_2Te	343.26	cub. gray
15	thallium nitrate	$AgNO_3.TlNO_3$	436.29	wh. cr. powd
16	thioantimonite (pyrargyrite)	$3Ag_2S.Sb_2S_3$	1083.16	trig., 3.084, 2.881 (Li)
17	thioarsenite (proustite)	$3Ag_2S.As_2S_3$	989.50	trig., 3.088, 2.792
18	thiocyanate	$AgCNS$	165.95	col. cr. or wh. curd
19	thiosulfate	$Ag_2S_2O_3$	327.88	wh
20	tungstate	Ag_2WO_4	463.76	pa. yel. cr
21	**Sodium**	Na	22.997	cub. silv. met., 4.22
22	aluminate	$NaAlO_2$	81.97	amor. wh. powd
23	amide	$NaNH_2$	39.02	olive grn
24	ammonium phosphate (microcosmic salt; stercorite)	$NaNH_4HPO_4.4H_2O$	209.13	monocl. col., 1.439, 1.441, 1.469
25	*meta*antimonate	$2NaSbO_3.7H_2O$	511.62	cub. col
26	*pyro*antimonate	$Na_2H_2Sb_2O_7.H_2O$	421.55	tetr. col
27	*ortho*arsenate	$Na_3AsO_4.12H_2O$	424.11	trig. col., 1.457, 1.466
28	" monbas	$NaH_2AsO_4.H_2O$	181.96	rhomb. or monocl. col
29	" dibas	$Na_2HAsO_4.7H_2O$	312.04	monocl. col., 1.462, 1.466, 1.478
30	" "	$Na_2HAsO_4.12H_2O$	402.12	monocl. col., 1.445, 1.450, 1.451
31	*ortho*arsenite, dibas	Na_2HAsO_3	169.93	col
32	aurosulfide	$NaAuS.4H_2O$	324.32	monocl
33	*meta*borate	$NaBO_2$	65.82	hex. pr., col
34	"	$NaBO_2.2H_2O$	101.85	monocl. col
35	*per*borate	$NaBO_3.H_2O$	99.83	
36	"	$NaBO_3.4H_2O$	153.88	monocl. col
37	*tetra*borate	$Na_2B_4O_7$	201.27	
38	"	$Na_2B_4O_7.5H_2O$	291.35	cub
39	" (borax)	$Na_2B_4O_7.10H_2O$	381.43	monocl. col., 1.447, 1.469, 1.472
40	bromate	$NaBrO_3$	150.91	cub. col., 1.594
41	bromide	$NaBr$	102.91	cub. col
42	"	$NaBr.2H_2O$	138.94	monocl. col
43	bromoplatinate	$Na_2PtBr_6.6H_2O$	828.81	tricl. dk. red
44	carbide	Na_2C_2	69.99	powd
45	carbonate	Na_2CO_3	105.99	wh. powd., hyg

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	7.44	d. >100	....	i.	....	s. H_2SO_4, HNO_3, NH_4OH
2	6.370^{25}	849	....	$.0006^{19.5}$	....	s. a., NH_4OH, KCN; i. NH_3
3	6.37	*ca.* 482	....	i.	....	s. HNO_3, NH_4OH
4	$5.306^{7.5}$	585	....	i.	i.	s. a., NH_4OH, KCN; i. ac. a.
5	3.769	d.	....	d.	d.	....
6	2.36	....	....	25^{20}	100	4, 85% al.; i. a.
7	3.219	125	....	v. s.	v. s.	....
8	8.0	880	d.	i.	....	s. h. HNO_3, NH_4OH
9	....	....	....	s.	....	....
10	$5.45^{29.2}$	652	d. 1085	0.57^{c}	1.41^{100}	s. a., NH_4OH; i. al.
11	7.317	tr. 175	d.	$.000014^{20}$	....	s. a., KCN
12	7.326	825	d.	.00002	....	s. HNO_3, KCN, conc. H_2SO_4
13	....	d. 100	....	v. sl. s.	....	s. a., NH_4OH, KCN; i. HNO_3
14	8.5	955	....	i.	....	s. HNO_3, KCN
15	....	75	....	s.	....	....
16	5.76	>175	....	i.	i	s. HNO_3
17	5.49	>175	....	i.	i.	s. HNO_3
18	....	d.	....	$.00002^{25}$	$.00064^{100}$	s NH_4OH; i. a.
19	....	d.	....	sl. s.	....	s. NH_4OH, $Na_2S_2O_3$
20	....	....	....	0.05^{15}	....	s. HNO_3, NH_4OH, KCN
21	0.97	97.5	880	d. to NaO	H + H_2	d. al.; i. bz., eth.
22	....	1650	....	s.	v. s.	i. al.
23	....	210	400	d.	d.	d. al.
24	1.574	79 d.	....	16.7	100	i. al.
25	....	$-2H_2O$, 200	....	$0.031^{12.3}$	....	sl. s. al., NH_4 salts; i. ac. a.
26	....	....	....	sl. s.	sl. s.	sl. s. al.
27	1.759	86.3	....	26.7^{17}	....	sl. s. al.
28	(monocl.) 2.53	....	....	v. s.	....	....
29	1.871	57	$-7H_2O$, 100	61^{15}	100^{100}	sl. s. al.
30	1.72	28	$-12H_2O$, 100	17.2^{0}	140.7^{30}	sl. s. al.
31	1.87	....	....	v. s.	v. s.	sl. s. al.
32	....	....	....	s.	....	s. al.
33	....	966	>1400	s.	v. s.	....
34	....	57	....	v. s.	v. s.	....
35	....	d. 40	....	2.55^{15}	3.78^{32}	s. glyc., alk.
36	....	....	....	sl. s.	d.	s. a.
37	2.367	741	....	1.49^{0}	8.79^{40}	i. al.
38	1.815	....	....	24.4^{70}	52.5^{100}	....
39	1.73	75	....	1.3^{0}; 1.6^{10}	14.2^{55}; 201^{100}	s. glyc.; v. sl. s. al.; i. a.
40	$3.339^{17.5}$	381	109	27.5^{0}	90.9^{100}	i. al.
41	3.205	755	1390	116^{52}	121^{100}	sl. s. al.
42	2.176	$-2H_2O$, 51	....	79.5^{0}	116^{50}	sl. s. al.
43	3.323	d.	....	v. s.	v. s.	v. s. al.
44	1.575^{15}	....	700	d.	d.	s. a.; d. al.
45	2.533	851	d.	7.1^{0}	45.5^{100}	i. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	carbonate (thermonatrite)	$Na_2CO_3.H_2O$	124.01	rhomb. col
2	" (washing soda)	$Na_2CO_3.10H_2O$	286.15	monocl. wh., 1.405, 1.425, 1.440
3	" acid, (baking soda)	$NaHCO_3$	84.00	monocl. wh
4	" sesqui-	$Na_4H_2(CO_3)_3.3H_2O$	328.05	monocl
5	chlorate	$NaClO_3$	106.45	cub. or trig. col., 1.513
6	*per*chlorate	$NaClO_4$	122.45	rhomb
7	"	$NaClO_4.H_2O$	140.47	rhbdr. col., deliq
8	chloride (common salt; halite)	$NaCl$	58.45	cub., col., 1.5442
9	*hypo*chlorite	$NaClO$	74.45	in solution only
10	"	$NaClO.2\frac{1}{2}H_2O$	119.49	col
11	chloroaurate	$NaAuCl_4.2H_2O$	398.06	yel. cr
12	chloroiridate	$Na_2IrCl_6.6H_2O$	559.93	tricl. dull red
13	chloropalladite	$Na_2PdCl_4.3H_2O$	348.57	br., deliq. salt
14	chloroplatinate	$Na_2PtCl_6.6H_2O$	562.06	tricl. yel.-red
15	chloroplatinite	$Na_2PtCl_4.4H_2O$	455.11	red
16	chlororhodate	Na_3RhCl_6	384.64	tricl. red
17	"	$Na_3RhCl_6.12H_2O$	600.83	oct. garnet-red
18	chromate	$Na_2CrO_4.10H_2O$	342.16	monocl. yel., deliq
19	*di*chromate	$Na_2Cr_2O_7.2H_2O$	298.05	monocl. red, deliq., 1.661, 1.699, 1.751
20	*per*chromate	Na_3CrO_8	249.00	or. pl
21	copper cyanide	$NaCu(CN)_2$	138.58	col
22	cyanide	$NaCN$	49.01	cub. col., deliq
23	ferricyanide	$Na_3Fe(CN)_6.H_2O$	298.89	red, deliq
24	ferrite	$Na_2Fe_2O_4$	221.67	
25	ferrocyanide	$Na_4Fe(CN)_6.10H_2O$	484.03	monocl. yel., 1.519, 1.530, 1.544
26	fluoride (villiaumite)	NaF	42.00	tetr. or cub. col., 1.336
27	" di-	$NaHF_2$	62.00	rhbdr. col. or wh. cr. powd
28	fluosilicate	Na_2SiF_6	188.05	hex. col., 1.300, 1.296
29	*meta*germanate	Na_2GeO_3	166.59	monocl., wh., deliq., 1.59
30	"	$Na_2GeO_3.7H_2O$	292.70	rhombic col
31	hydride	NaH	24.00	silv. need
32	hydrosulfide	$NaSH$	56.06	rhomb. col
33	"	$NaSH.2H_2O$	92.10	need., deliq
34	hydrosulfite	$NaHSO_2$	88.06	
35	hydroxide	$NaOH$	40.00	wh., deliq., 1.3576
36	iodate	$NaIO_3$	197.92	rhomb
37	iodide	NaI	149.92	cub. col
38	"	$NaI.2H_2O$	185.95	monocl. col
39	manganate	$Na_2MnO_4.10H_2O$	345.08	monocl. grn
40	*per*manganate	$NaMnO_4$	141.93	red
41	"	$NaMnO_4.3H_2O$	195.97	purp. deliq., cr
42	molybdate	Na_2MoO_4	205.99	purple
43	"	$Na_2MoO_4.2H_2O$	242.03	rhbdr. wh
44	"	$Na_2MoO_4.22H_2O$	602.34	wh. tetramorph
45	*di*molybdate	$Na_2Mo_2O_7$	349.99	need
46	*para*molybdate	$Na_6Mo_7O_{24}.22H_2O$	1590.33	monocl. col
47	*tri*molybdate	$Na_2Mo_3O_{10}.7H_2O$	620.10	need
48	*tetra*molybdate	$Na_2Mo_4O_{13}.6H_2O$	746.09	
49	*octo*molybdate	$Na_2Mo_8O_{25}.4H_2O$	1286.06	powd
50	*deka*molybdate	$Na_2Mo_{10}O_{31}.12H_2O$	1718.18	cryst
51	nitrate (soda niter)	$NaNO_3$	85.01	trig. col., 1.587, 1.336
52	nitride	Na_3N	83.00	dk. gray
53	" (azide)	NaN_3	65.02	col. hex

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.55	$-H_2O$, 100	....	33	56^{100}	14^{25} glyc.; i. al., eth.
2	1.46	$-5H_2O$, 34	....	21.5^{20}	421^{104}	i. al.
3	2.20	$-CO_2$, 270	....	6.9^{0}	16.4^{60}	i. al.
4	2.112	d.	....	13^{0}	42^{100}	....
5	2.490^{16}	248	d.	79^{0}	230^{100}	s. al., glyc.
6	....	482 d.	d.	s.	v. s.	s. al.
7	2.02	....	....	v. s.	....	s. al.
8	2.163	804	1413	35.7^{0}	39.8^{100}	s. glyc.; sl. s. al.; i. HCl
9	....	d.	....	s.	d.	....
10	....	57.5	....	v. s.	....	....
11	....	....	....	150^{10}	990^{60}	v. s. abs. al.
12	....	d.	....	v. s.	v. s.	sl. s. al.
13	....	....	....	s.	....	s. al.
14	2.50	$-6H_2O$, 100	....	66^{15}	v. s.	11.9 al.; s. aq. Cl.; i. eth.
15	....	d. 100	....	s.	....	....
16	....	....	....	v. s.	....	....
17	....	d. effl.	....	v. s.	....	i. al.
18	1.483	19.92	....	50^{10}	∞	sl. s. al.
19	2.52^{13}	$-2H_2O$, 100; anh. 320	d. 400	anh. 180^{20}	anh. 433^{98}	i. al.
20	....	d. 115	....	sl. s.	....	i. al. eth.
21	1.01	d. 100	....	s.	....	....
22	....	563.7	1496	s.	v. s.	sl. s. al.
23	....	....	....	18.9^{0}	67^{100}	i. al.
24	....	....	....	d.	....	v. s. dil. HCl
25	1.458	....	....	32^{20}	161^{98}	i. al.
26	2.79	980	1700	4^{15}	....	v. sl. s. al.
27	....	....	....	s.	s.	....
28	2.755	d.	....	0.652^{17}	2.46^{100}	i. al.
29	3.31^{22}	1078	....	....	d.	s. a.
30	....	83	....	24.6^{0}; 45.5^{25}	....	s. a.
31	0.92	d.	....	d.	d.	i. CS_2, CCl_4, bz., NH_3
32	....	....	....	v. s.	....	s. al.
33	....	d.	....	s.	s.	s. al.
34	....	....	....	v. s.	....	s. al.
35	2 130	318.4	1390	42^{0}	347^{100}	v. s. al.; eth., glyc.
36	4.277	d.	....	2.5^{0}	34^{100}	s. ac. a.; i. al.
37	3.667	651	1300	158.7^{0}	256.8^{60}	v. s. al.; s. glyc.
38	2.448	....	....	317.9^{0}	1550^{100}	....
39	....	17	....	s.	d.	....
40	....	d.	....	deliq.	v. s.	....
41	....	d.	....	v. s.	v. s.	s. NH_3
42	lq. 2.59	687	....	....	....	....
43	....	687	....	56.2^{0}	115.5^{100}	....
44	....	tr. 445, 592	....	....	....	....
45	....	612	....	sl. s.	sl. s.	....
46	....	....	....	117.9^{30}	....	....
47	....	....	....	3.878^{70}	13.7^{100}	....
48	....	....	....	sl. s.	v. s.	....
49	....	....	....	i.	i.	....
50	....	....	....	sl. s.	sl. s.	....
51	2.257	308	d. 380	73^{0}	180^{100}	sl. s. al., glyc.
52	....	d. 300	....	....	....	....
53	1.846	....	....	41.7^{17}	....	0.314^{16} al.; i. eth

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form color and index of refraction
	Sodium			
1	nitrite	$NaNO_2$	69.01	rhomb. col., hyg
2	nitroprusside	$Na_2Fe(CN)_5NO.2H_2O$	297.91	rhomb. red
3	oxide	Na_2O	61.99	gray, deliq
4	" per-	Na_2O_2	77.99	yel. powd
5	*ortho*phosphate, tribas.	$Na_3PO_4.12H_2O$	380.20	trig. col., 1.446, 1.452
6	" dibas.	$Na_2HPO_4.12H_2O$	358.21	rhomb. or monocl. col. effl., 1.432, 1.436, 1.437
7	" monbas.	$NaH_2PO_4.H_2O$	138.05	rhomb col., 1.456, 1.485, 1.487
8	*meta*phosphate	$NaPO_3$	102.02	amor. col., hyg
9	*hypo*phosphate	$Na_4P_2O_6.10H_2O$	430.18	monocl. 1.478, 1.482, 1.504
10	" acid	$NaHPO_3.3H_2O$	157.07	monocl. col., 1.486, 1.490, 1.504
11	*pyro*phosphate	$Na_4P_2O_7.10H_2O$	446.18	monocl. col., 1.450, 1.453, 1.460
12	" dibas.	$Na_2H_2P_2O_7.6H_2O$	330.14	monocl. 1.460, 1.465, 1.465
13	phosphide	Na_3P	100.01	red
14	*ortho*phosphite	$Na_2HPO_3.5H_2O$	216.10	rhomb. wh., deliq., β 1.443
15	" acid	$2NaH_2PO_3.5H_2O$	298.14	monocl., 1.419, 1.431, 1.449
16	*hypo*phosphite, monbas.	$NaH_2PO_2.H_2O$	106.05	monocl. col., deliq
17	platinate	$Na_2PtO_3.3H_2O$	343.27	yellow
18	plumbate	$Na_2PbO_3.3H_2O$	355.26	lt. yel., fused, hyg. lumps
19	potassium carbonate	$NaKCO_3.6H_2O$	230.19	monocl
20	*per*ruthenate	$NaRuO_4.H_2O$	206.71	blk. cr
21	selenate	Na_2SeO_4	189.19	rhomb. col
22	"	$Na_2SeO_4.10H_2O$	369.35	wh. cr
23	selenide	Na_2Se	125.19	deliq. cr
24	selenite	Na_2SeO_3	173.19	wh. cr
25	silicate	Na_2SiO_3	122.05	monocl. col., α 1.518, γ 1.527
26	"	$Na_2SiO_3.9H_2O$	284.19	
27	*di*silicate (water glass)	$Na_2Si_4O_9$	302.23	amor. col., deliq
28	silicododecatungstate	$Na_4[SiW_{12}O_{40}].20H_2O$	3328.36	col. tricl
29	stannate	$Na_2SnO_3.3H_2O$	266.74	hex. col
30	*meta*stannate	$Na_2Sn_5O_{11}.4H_2O$	887.56	cr. powd
31	sulfate	Na_2SO_4	142.05	rhomb
32	"	Na_2SO_4	142.05	monocl. col
33	"	Na_2SO_4	142.05	hex. col
34	"	$Na_2SO_4.7H_2O$	268.16	rhomb. or tetr
35	" (Glauber's salt)	$Na_2SO_4.10H_2O$	322.21	monocl. col. effl., β 1.44
36	" (mirabilite)	$Na_2SO_4.10H_2O$	322.21	monocl. col., 1.394, 1.396, 1.398
37	" acid	$NaHSO_4$	120.06	tricl. col
38	" "	$NaHSO_4.H_2O$	138.08	monocl. col
39	*per*sulfate	$Na_2S_2O_8$	238.11	wh. cr. powd
40	*pyro*sulfate	$Na_2S_2O_7$	222.11	wh. cr
41	sulfide, mono-	Na_2S	78.05	amor. yel.-pink
42	" "	$Na_2S.9H_2O$	240.19	tetr. col., deliq
43	" penta-	Na_2S_5	206.29	yel
44	sulfite	Na_2SO_3	126.05	hex. pr. or wh. powd
45	"	$Na_2SO_3.7H_2O$	252.16	monocl. col
46	" acid	$NaHSO_3$	104.06	monocl. wh
47	*hypo*sulfite	$Na_2S_2O_4.2H_2O$	210.15	monocl. (?) col cr. or yel.-wh. powd.
48	*pyro*sulfite (metabisulfite)	$Na_2S_2O_5$	190.11	col. pr

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	2.168	271	d. 320	72^{0}; 81.5^{15}	163^{100}	$.3^{20}$ eth.; 4.4^{20} meth. al. .3 abs. al.; v. s. NH_3
2	1.72	....	....	40^{16}	....	s. al.
3	2.27	....	subl.	d.	d.	d. al.
4	2.805	d.	....	s.	d.	s. dil. a.; i. al.
5	1.62	d. 73.4	$-12H_2O$, 100	28.3^{15}	∞	i. CS_2
6	1.52	34.6	$-12H_2O$, 100	6.3^{0}	∞	i. al.
7	2.040	d. 200	....	112^{20}	448^{99}	v. sl. s. chl., eth.; i. al.
8	2.476	616 d.	....	sl. s.	sl. s.	s. a. alk.
9	1.832	....	....	33	v. s.	....
10	1.849	d.	....	2.2	20	i. al.
11	1.82	anh. 988	....	5.4^{0}	93^{100}	i. al., NH_3
12	1.848	....	....	s. d.	....	....
13	....	d.	....	ev. PH_3	....	....
14	....	53	....	s.	v. s.	i. al
15	....	42	$-5H_2O$, 100	56^{0}	193^{42}	....
16	....	d.	....	100	667^{100}	v. s. al.; s. glyc.; sl. s. NH_3
17	....	$-3H_2O$, 150–70	....	s.	....	i. al.
18	....	....	....	d. to PbO_2	....	....
19	1.633	$-6H_2O$, 100	....	185^{15}	....	....
20	....	d. $440^{vac.}$	....	v. s.	d.	....
21	3 098	....	....	84^{35}	72.8^{100}	....
22	....	....	....	43.5^{20}	....	....
23	....	>875	....	d.	....	i. NH_3
24	....	....	....	s.	....	i. al.
25	2.4	1088	....	s.	s. d.	i. al., Na and K salts
26	....	48	$-6H_2O$, 100	v. s.	v. s.	29^{18} $N/2$ NaOH
27	....	....	....	s.	s.	i. al., Na and K salts
28	....	$-7H_2O$, 100	d.	s.	v. s.	sl. s. al.
29	....	....	....	67.4^{0}	61.3^{20}	i. al., acet.
30	....	....	....	sl. s.	....	i. al.
31	2.693	tr.-mcl. 100	....	4.76^{0}	42.7^{100}	i. al.
32	....	tr.-hex. 500	....	48.8^{40}	42.5^{100}	....
33	....	884	....	s.	s.	....
34	....	....	....	19.5^{0}	44^{20}	....
35	1.464	d. 32.4	....	5^{0}	40.8^{30}	i. al.
36	1.48	....	....	....	....	....
37	2.742	>315	....	50^{0}	100^{100}	d. al.; i. NH_3
38	....	300	....	ca. 67	v. s.	i. al.
39	....	....	....	s.	....	....
40	2.658^{25}	400.9	d. 460	....	....	....
41	1.856	ca. 920	....	15.4^{10}	59.2^{90}	sl. s. al.; i. eth.
42	2.471	d.	....	ca. 50	s.	s. al.
43	....	251.8	....	s.	s.	sl. s. al.
44	2.633^{15}	....	d.	13.9^{0}	28.3^{80}	v. sl. s. al.
45	1.561	$-7H_2O$, 150	d.	32.8^{0}	196^{40}	i. al.
46	1.48	d.	....	sl. s.	s.	i. al., acet.
47	....	d.	....	v. s.	d.	i. al.; s. alk.
48	....	d. >150	....	65.3^{20}	$96.5^{97.2}$	i. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	thioantimonate (Schlippe's salt)	$Na_3SbS_4.9H_2O$	481.13	cub. pa. yel.
2	thioarsenate	$2Na_3AsS_4.15H_2O$	814.56	monocl. yel.
3	thiocarbonate	$Na_2CS_3.H_2O$	172.19	yel.
4	thiocyanate	NaCNS	81.07	rhomb. col. pois., deliq.
5	thionate, di-	$Na_2S_2O_6.2H_2O$	242.15	rhomb., 1.482, 1.495, 1.519
6	thioplatinate	$Na_4Pt_3S_6$	870.04	rhomb. copper red
7	thiosulfate (hypo)	$Na_2S_2O_3.5H_2O$	248.19	monocl. col., effl., 1.489, 1.508, 1.536
8	tungstate	$Na_2WO_4.2H_2O$	330.03	rhomb. col.
9	*para*tungstate	$Na_6W_7O_{24}.16H_2O$	2098.23	tricl.
10	uranate	Na_2UO_4	348.13	yel. powd.
11	*per*uranate	$Na_2UO_5.5H_2O$	454.21	red cr.
12	*ortho*vanadate	Na_3VO_4	183.94	col. hex. pr.
13	"	$Na_3VO_4.16H_2O$	472.19	cr.
14	*meta*vanadate	$NaVO_3$	121.95	col. monocl. pr.
15	*pyro*vanadate	$Na_2V_2O_7.8H_2O$	404.02	col. hex. pl.
16	**Stannous and Stannic**	See under *Tin*		
17	**Strontium**	Sr	87.63	cub. silv. wh.-pa. yel. met.
18	*ortho*arsenate	$SrHAsO_4.H_2O$	245.58	rhomb. need.
19	*ortho*arsenite	$Sr_3(AsO_3)_2.4H_2O$	580.81	cr. or wh. powd.
20	*tetra*borate	$SrB_4O_7.4H_2O$	314.97	
21	boride	SrB_6	152.55	blk. cr.
22	bromate	$Sr(BrO_3)_2.H_2O$	361.48	monocl. col.-yelsh., hyg.
23	bromide	$SrBr_2$	247.46	wh. need., hyg.
24	"	$SrBr_2.6H_2O$	355.56	hex. col., hyg.
25	carbide	SrC_2	111.63	tetr. blk.
26	carbonate	$SrCO_3$	147.63	rhomb. col. or wh. powd., 1.516, 1.664, 1.666
27	chlorate	$Sr(ClO_3)_2$	254.54	rhomb. col. or wh. powd., 1.567, 1.605, 1.626
28	"	$Sr(ClO_3)_2.8H_2O$	398.67	wh. need.
29	chloride	$SrCl_2$	158.54	cub. col., <1.6
30	"	$SrCl_2.6H_2O$	266.64	trig. col., 1.536, 1.487
31	chromate	$SrCrO_4$	203.64	monocl. yel.
32	cyanide	$Sr(CN)_2.4H_2O$	211.71	deliq. cr.
33	ferrocyanide	$Sr_2Fe(CN)_6.15H_2O$	657.38	monocl. yel.
34	fluoride	SrF_2	125.63	cub. col. or wh. powd.
35	fluochloride	$SrF_2.SrCl_2$	284.17	tetr. 1.651, 1.627
36	fluosilicate	$SrSiF_6.2H_2O$	265.72	monocl.
37	hydrosulfide	$Sr(SH)_2$	153.77	cryst.
38	hydroxide	$Sr(OH)_2$	121.65	wh. deliq.
39	"	$Sr(OH)_2.8H_2O$	265.77	tetr. col., deliq., 1.499, 1.476
40	iodide	SrI_2	341.47	col. pl.
41	"	$SrI_2.6H_2O$	449.56	hex. col.-yelsh., deliq.
42	*per*manganate	$Sr(MnO_4)_2.3H_2O$	379.54	cub. purp.
43	molybdate	$SrMoO_4$	247.63	
44	nitrate	$Sr(NO_3)_2$	211.65	cub. col., 1.567
45	"	$Sr(NO_3)_2.4H_2O$	283.71	monocl. wh.
46	nitrite	$Sr(NO_2)_2.H_2O$	197.66	hex.
47	oxide	SrO	103.63	cub. gray-wh.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.839	d.	....	33	100	i. al.
2	....	....	....	v. s.	....	i. al.
3	....	d.	....	s.	d.	....
4	....	287	....	v. s.	v. s.	v. s. al.
5	2.189	....	....	47.6^{16}	90.9^{100}	i. al. HCl
6	....	d.	....	d.	d.	....
7	1.685	d. 48.0	....	74.7^{0}	301.5^{60}	s. NH_3; i. al.
8	3.23-.25	anh. 698	$-2H_2O$, 100	41^{0}; 82.5^{20}	123.5^{100}	i. a., al.; sl. s. NH_3
9	....	$-16H_2O$, 300	....	S	d.	....
10	....	....	....	i.	i.	s. dil. a., alk. carb.
11	....	d. 100	....	d.	d.	d. HCl
12	....	866	....	s.	....	i. al.
13	....	....	....	v. s.	d.	i. al.
14	....	630	....	....	....	....
15	....	654	....	s.	....	i. al.
16	....	....	....	....	....	....
17	2.6	752(800)	1150	d.	d.	s. a., al., liq. NH_3
18	3.606^{15}	$-H_2O$, 125	....	$0.284^{15.5}$	d.	s. a.
19	....	....	....	sl. s.	....	s. a.; sl. s. al.
20	....	....	....	....	77^{100}	s. HNO_3, NH_4 salts
21	3.3	....	....	i.	i.	s. HNO_3
22	3.773	$-H_2O$, 120	d. 240	33^{16}	....	....
23	4.216^{24}	643	d.	85.2^{0}	222.5^{100}	s. al., amyl. al.
24	2.358^{15}	d. 20	$-6H_2O$, >180	204.2^{0}	∞	s. al.; i. eth.
25	3.2	....	....	d.	d.	d. a.
26	3.70	$1497^{60 atm.}$	$-CO_2$, 1340	0.0011^{18}	0.065^{100}	0.12 aq. CO_2; s. a., NH_4 salts
27	3.152	120 d.	....	174.9^{18}	v. s.	s. al.; i. abs. al.
28	....		....	s.	v. s.	s. al.
29	3.052	873	....	43.5^{0}	100.8^{100}	v. sl. s. abs. al., acet.; i. NH_3
30	1.93	$-4H_2O$, 60	$-6H_2O$, 100	106.2^{0}	205.8^{40}	3.8^{6} al.
31	3.895^{15}	....	....	0.12^{15}	3^{100}	s. ac. a. HCl, HNO_3, NH_4 salts
32	....	d.	....	v. s.	....	....
33	....		....	50	100	....
34	2.44	1190	....	0.011^{0}	0.012^{27}	s. h. HCl; i. HF
35	4.18	962	....	d.	d.	s. conc. HCl, HNO_3; i. al.
36	$2.99^{17.5}$	d.	....	3.2^{15}	v. s.	$.065^{15}$ 50% al.; s. HCl
37	....	d.	....	s.	d.	....
38	3.625	375	....	0.41^{0}	21.83^{100}	s. a., NH_4Cl
39	1.40	$-8H_2O$, 100	....	0.90^{0}	47.71^{100}	s. a., NH_4Cl; i. acet.
40	4.549^{25}	402	d.	165.3^{0}	383^{100}	....
41	4.415	....	....	448.9^{0}	∞	s. al.; i. eth.
42	....	d.	....	270^{0}	291^{18}	....
43	4.145	....	....	0.0104^{17}	....	s. a.
44	2.986	570	....	40.1^{0}	100^{90}	.012 abs. al.; sl. s. acet.
45	2.2	....	....	60.43^{0}	206.5^{100}	v. sl. s. abs. al.; i. HNO_3
46	2.4088	$-H_2O$, 44	....	58.9^{0}	182^{100}	$.42^{20}$ 90% al.
47	4.7	2430	....	d. $Sr(OH)_2$	....	sl. s. al.; i. eth., acet.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Strontium			
1	oxide per-	SrO_2	119.63	wh. powd
2	" "	$SrO_2.8H_2O$	263.75	col. cr
3	*ortho*phosphate, acid	$SrHPO_4$	183.66	rhomb. col
4	selenate	$SrSeO_4$	230.83	rhomb
5	silicate	$SrSiO_3$	163.69	col. pr., 1.618
6	sulfate (celestite)	$SrSO_4$	183.69	rhomb. col., 1.622, 1.624, 1.631
7	" acid	$Sr(HSO_4)_2$	281.77	
8	sulfide, mono-	SrS	119.69	cub. lt. gray
9	" tetra-	$SrS_4.6H_2O$	323.96	redsh. cr
10	sulfite	$SrSO_3$	167.69	col. cr
11	thiocyanate	$Sr(CNS)_2.3H_2O$	257.81	deliq
12	thionate, di-	$SrS_2O_6.4H_2O$	319.81	trig., 1.530, 1.525
13	thiosulfate	$SrS_2O_3.5H_2O$	289.83	monocl. need
14	tungstate	$SrWO_4$	335.63	tetr
15	**Sulfamide**	$SO_2(NH_2)_2$	96.11	rhomb. pl
	Sulfur			
16	rhombic (α)	S_8	256.48	rhomb. yel., 1.957
17	monoclinic (β)	S_8	256.48	monocl. pa. yel., 2.038
18	amorphous (γ)	S_8	256.48	pa. yel. amor
19	bromide, mono-	S_2Br_2	223.95	red. liq., 1.736
20	chloride, mono-	S_2Cl_2	135.03	yelsh. red liq., 1.666^{14}
21	" di-	SCl_2	102.97	dk. red liq., 1.557^{14}
22	" tetra-	SCl_4	173.89	yel. br. liq
23	chloroiodide	SCl_7I	407.18	red yel. pr
24	fluoride, mono-	S_2F_2	102.12	col. gas
25	" tetra-	SF_4	108.06	gas
26	" hexa-	SF_6	146.06	col. gas
27	iodide	SI_6	793.58	gray-blk. cr
28	monoxytetrachloride	S_2OCl_4	221.95	deep red liq
29	nitride	N_4S_4	184.27	monocl. or.-red
30	oxide, sesqui-	S_2O_3	112.12	bl. grn. cr
31	" di-	SO_2	64.06	col. gas or liq., suffoc. odor, 1.410 lq.
32	" tri- (α)	SO_3	80.06	trim. col. cr. or liq., 1.4097
33	" " (β)	$(SO_3)_2$	160.12	silky, fibrous need
34	" hept-	S_2O_7	176.12	visc. liq. or need
35	oxychlorobromide	$SOClBr$	163.43	yel
36	*pent*oxydichloride (pyrosulfuryl chloride)	$S_2O_5Cl_2$	215.03	col. liq., 1.449^{19}
37	oxytetrachloride, mon-	S_2OCl_4	221.95	dk. red liq
38	" tri-	$S_2O_3Cl_4$	253.95	rhomb need. or pl., wh
39	**Sulfuric acid**	H_2SO_4	98.08	col. oily liq. or hex. cr., 1.429
40	" "	$H_2SO_4.H_2O$	116.09	col. liq. or monocl. pr., 1.438
41	" "	$H_2SO_4.2H_2O$	134.11	col. liq., 1.405
42	" "	$H_2SO_4.4H_2O$	170.14	
43	" " pyro-	$H_2S_2O_7$	178.14	col. cr., hyg
44	" " per- (peroxydisulfuric)	$H_2S_2O_8$	194.14	hyg. cr
45	" " *peroxy*-mono- (diper-)	H_2SO_5	114.08	wh. cr

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	4.56	d.	....	0.008^{20}	d.	v. s. al., NH_4Cl; i. acet.
2	....	$-8H_2O$, 100	d.	0.018^{20}	d.	s. al., NH_4Cl; i. NH_4OH
3	3.544^{15}	....	....	i.	i.	s. a., NH_4 salts
4	4.23	....	....	i.	....	s. h. HCl; i. HNO_3
5	3.65	1580	....	i.	....	....
6	3.96	1580 d.	d.	0.0113^{0}	0.0114^{30}	sl. s. a.; i. dil. H_2SO_4, al
7	....	d.	....	d.	....	14^{70} H_2SO_4
8	3.70^{15}	....	....	s. d.	....	s. a., al.; i. acet.
9	....	25	....	s.	....	s. al.
10	....	d.	....	0.0033^{17}	....	v. s. H_2SO_3; s. a.
11	....	$-3H_2O$, 100	d. 160–70	v. s.	....	v. s. al.
12	2.373	$-4H_2O$, 78	....	22^{16}	67^{100}	i. al.
13	2.17^{17}	$-4H_2O$, 100	....	25^{13}	57^{100}	i. al.
14	6.187	....	....	0.14	....	d. a.; i. al.
15	....	91.5	d. 250	s.	....	s. al.
16	2.07	112.8; tr.-mcl. 95.5	444.6	i.	i.	23^{0} CS_2; s. toluene; sl. s. al.
17	1.96	119	444.6	i.	i.	70 CS_2; s. al., bz.
18	1.92	*ca.* 120	444.6	i.	i.	i. CS_2
19	2.635	−46	$54^{0.2}$	d.	d.	s. CS_2
20	1.678	−80	135.6	d.	d.	s. CS_2, bz., eth.
21	1.621 [illegible]	−78	59	d.	d.	d. al. eth.; s. bz., CCl_4
22	....	−30	d. −15	d.	d.	....
23	....	d.	....	d.	....	....
24	lq. 1.5^{-100}	−105.5	−99	d	d.	d. KOH
25	....	−124	−40	d.	d.	....
26	6.50 g/l; lq. 1.91	−50.8	−63.8 subl.	v. sl. s.	sl. s.	s. KOH; sl. s. al.
27	....	....	....	....	d.	s. CS_2
28	1.656^{0}	d.	60	d.	d.	....
29	2.22^{15}	179 subl.	exp. 160	i.	d.	s. CS_2, chl. bz., NH_3; sl. s al., eth.
30	....	d.	....	d.	d.	s. fum. H_2SO_4
31	2.927 g/l; lq. 1.434^{0}	−72.7	−10.0	22.8^{0}	0.58^{90}	s. al., H_2SO_4, ac. a.
32	2.75; lq. 1.925^{13}	16.83	44.8	d.	d.	d. H_2SO_4
33	lq. 1.97	32.2^{398}	44.6; (subl. 50)	d.	d.	d. H_2SO_4
34	....	0	subl. 10	d.	d.	s. H_2SO_4
35	lq. 2.31	....	115 d.	d.	....	....
36	g 9.6 g/l; lq. 1.818	−37–9	140	d.	d.	d. a.
37	1.656^{0}	....	60	d.	d.	....
38	....	57 d.	....	d.	d.	d. al.
39	1.834	10.49	330 (98.3%) d.	∞ ev. ht.	∞	d. al.; misc. org. solv
40	1.788	8.62	290	∞	∞	d. al.
41	1.650^{0}	−38.9	167	∞	∞	d. al., eth.
42	....	−24.5	....	∞	∞	d. al., eth.
43	1.9	35	d.	d.	d.	d. al.
44	....	65 d.	d.	d.	d.	s. al., eth., H_2SO_4
45	....	45 d.	....	d.	d.	s. H_3PO_4

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Sulfuric** oxychloride (sulfuryl chloride)	SO_2Cl_2	134.97	col. liq., 1.444
2	" oxyfluoride (sulfuryl fluoride)	SO_2F_2	102.06	col. gas
3	**Sulfurous acid**	H_2SO_3	82.08	in solution only
	Sulfurous			
4	oxybromide (thionyl bromide)	$SOBr_2$	207.89	or.-yel. liq
5	oxychloride (thionyl chloride)	$SOCl_2$	118.97	col. yel. liq., 1.527^{10}
6	oxyfluoride (thionyl fluoride)	SOF_2	86.06	col. gas
7	**Tantalum**	Ta	181.40	cub. gray-blk. met. or blk. powd
8	bromide	$TaBr_5$	580.98	yel. cr
9	chloride	$TaCl_5$	358.69	lt.-yel. cr. powd
10	fluoride	TaF_5	276.40	tetr. col
11	hydroxide	$Ta(OH)_5$	266.44	wh. amor
12	nitride	Ta_3N_5	614.24	amor. yel
13	oxide, di-	TaO_2	213.40	br. powd
14	" tetr-	Ta_2O_4	426.80	dk. gray powd
15	" pent-	Ta_2O_5	442.80	rhomb. col
16	potassium fluoride	TaK_2F_7	392.60	rhomb. col
17	sulfide	Ta_2S_4	491.04	
18	**Telluric acid**, allo-	$(H_2TeO_4)_3$	580.55	wh. powd
19	" " ortho-	$H_2TeO_4.2H_2O$	229.55	cub. or monocl. col
20	" " "	$H_2TeO_4.6H_2O$	301.61	hex. need
21	" "	H_6TeO_6	229.55	cub. or monocl. col
22	**Tellurium**	Te_2	255.00	rhbdr. sil.-wh. met., 1.0025
23	"	Te_2	255.00	amor. br.-blk., 1.0025
24	bromide, di-	$TeBr_2$	287.33	steel gray-grn. need., unst
25	" tetra-	$TeBr_4$	447.16	or. cr
26	chloride, di-	$TeCl_2$	198.41	blk. cr. or amor., unst
27	" tetra-	$TeCl_4$	269.33	wh. to yel. cr., deliq
28	fluoride, tri-	$TeF_3.4H_2O$	256.56	
29	" tetra-	TeF_4	203.50	cr. wh
30	" hexa-	TeF_6	241.50	col. gas, 1.0009
31	iodide, di-	TeI_2	381.34	blk. cr
32	" tetra-	TeI_4	635.18	gray cr
33	nitrate, basic	$Te_2O_3(OH)NO_3$	382.02	rhomb. col
34	oxide, mon-	TeO	143.50	amor., blk
35	" di- (tellurite)	TeO_2	159.50	tetr. or rhomb. wh., 2.00, 2.18 (Li), 2.35
36	" tri-	TeO_3	175.50	or. cr
37	oxysulfate	$(TeO_2)_2SO_3$	399.06	rhomb. col
38	sulfide	TeS_2	191.62	red-blk. amor. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.6674	−54.1	69.1	d.	d.	s. ac. a., bz.
2	3.72 g/l	-120^{65}	−52	10^{9}	....	s. al., sl. s. alk.
3	....	....	....	s.	....	s. al., eth., ac. a.
4	2.68^{18}	−50	138^{773}	d.	d.	s. bz., chl., CS_2, CCl_4
5	1.638	−105	78.8	d.	d.	s. bz. chl.; d. a., al., alk.
6	2.93	−110	−30	d.	d.	s. eth., bz., chl., acet. $AsCl_3$
7	met. 16.6; powd. 14.491	2850	*ca.* 4100	i.	i.	s. HF, fused alk.; i. a.
8	....	240	320	d.	d.	s. abs. al., eth.
9	3.68^{27}	221	242	d.	....	s. abs. al., H_2SO_4
10	4.74	96.8	229.5	s.	....	s. HF
11	....	....	....	i.	....	s. alk.; i. a.
12	....	ign.	....	i.	....	s. HNO_3 + HF; i. a.
13	....	d.	....	i.	....	i. a., HNO_3 + HF
14	....	oxidizes	....	i.	....	i. a.
15	$8.735^{61.2}$	1470 d.	....	i.	i.	s. fus. $KHSO_4$; i. a.
16	....	....	....	sl. s., d.	....	sl. s. HF
17	....	d.	....	i.	i.	sl. s. HF + HNO_3; i. HCl
18	$3.44^{19.2}$	d. >160	....	sl. s.	s.	s. al.; sl. s. KOH
19	3.053–.071	$-2H_2O$, 140	....	19.7^{0}	258.5^{100}	s. a., alk.; i. al.
20	....	$-4H_2O$, 10	....	13.92^{0}	....	s. alk., dil. a.; sl. s. strong a.; i. al.
21	(cub.) 3.05 (mcl.) 5.09	$-H_2O$	....	....	259.7^{22}	....
22	6.25	452	1390	i.	i.	s. H_2SO_4, HNO_3, aq. reg., KCN, KOH; i. HCl, CS_2
23	6.00	452	1390	i.	i.	s. H_2SO_4, HNO_3, aq. reg., KCN, KOH; i. HCl, CS_2
24	....	210(280)	339	d.	....	sl. s. min. a., tart. a.; d. NaOH
25	4.31^{15}	380	421	sl. s. d.	d.	s. min. a., tart. a., NaOH
26	7.05	209 ± 5(175)	327	d.	....	sl. s. min. a., tart. a.; d. NaOH
27	3.26; lq. 2.559^{232}	224(214)	414	s. d.	s. d.	s. HCl, bz., al., chl., CCl_4 i. CS_2
28	....	....	....	s.	....	....
29	....	subl.	....	d.	d.	....
30	$3.025^{-35.5}$	−36	−35.5	d.	d.	d. a., alk.
31	....	....	....	i.	i.	....
32	8.403^{15}	259	d.	sl. s.	d.	s. HI, alk., aq. NH_3
33	....	$-NO_2$, 190	d.	sl. d.	d.	s. NaOH, a.
34	....	d.	d.	i.	i.	s. HCl, dil. a., H_2SO_4, NaOH
35	tetr. 5.67^{15} rhomb. 5.91^{0}	dull red	subl. 450	0.00067	....	s. HCl, HNO_3, alk.; i. NH_4OH
36	$5.08^{10.5}$	d.	....	i.	i.	s. h. KOH, conc. HCl; i. a., al.
37	4.7	d. 500	....	d.	....	s. HCl, HNO_3
38	....	....	....	i.	....	s. alk. sulfides; i. a.

PHYSICAL CONSTANTS OF

No	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tellurium			
1	sulfotrioxide	$TeSO_3$	207.56	amor. deep red
2	**Tellurous acid**	H_2TeO_3	177.52	rhomb. or monocl. col
3	**Terbium**	Tb	159.20	
4	chloride	$TbCl_3$	265.57	wh. need
5	"	$TbCl_3.6H_2O$	373.66	col. cr., hyg
6	nitrate	$Tb(NO_3)_3.6H_2O$	453.32	monocl. need. col
7	oxide	Tb_2O_3	366.40	amor. wh.-or
8	" per-	Tb_4O_7	748.80	dk. br. or blk
9	sulfate	$Tb_2(SO_4)_3.8H_2O$	750.70	cryst
10	**Thallium**	Tl	204.39	tetr. bl. wh. met
11	ammonium chloride	$(NH_4)_3TlCl_6.2H_2O$	507.28	col
12	bromate	$TlBrO_3$	332.31	col
13	bromide, mono-	TlBr	284.31	cub. yelsh. wh
14	" di-	$TlBr_2$	364.22	yel. need
15	" tri-	$TlBr_3$	444.14	yel., deliq
16	" "	$TlBr_3.4H_2O$	516.20	lt. yel. need
17	carbonate	Tl_2CO_3	468.78	monocl. col
18	chlorate	$TlClO_3$	287.85	
19	*per*chlorate	$TlClO_4$	303.85	col
20	chloride, mono-	TlCl	239.85	cub. col. or wh. powd
21	" tri-	$TlCl_3$	310.76	hex. pl
22	" "	$TlCl_3.H_2O$	328.78	
23	" "	$TlCl_3.4H_2O$	382.82	col. need
24	" sesqui-	Tl_2Cl_3	515.15	hex. yel. or yel. powd
25	chloroplatinate	Tl_2PtCl_6	816.75	pa. orange cr
26	chromate	Tl_2CrO_4	524.79	yel
27	*di*chromate	$Tl_2Cr_2O_7$	624.80	red cr
28	cyanide	TlCN	230.40	tabl
29	ferrocyanide	$Tl_4Fe(CN)_6.2H_2O$	1065.48	tricl. yel
30	fluoride, mono-	TlF	223.39	cub. oct. col
31	" tri-	TlF_3	261.39	olive grn
32	fluosilicate	$Tl_2SiF_6.2H_2O$	586.87	hex. pl
33	hydroxide (ic)	TlO.OH	237.40	yel. cr. or red. br. amor
34	" "	$Tl(OH)_3$	255.41	hex. br
35	" (ous)	Tl(OH)	221.40	pa. yel. need
36	iodide, mono-	TlI	331.31	cub. red; rhomb. yel
37	" sesqui-	Tl_2I_3	789.54	blk. need
38	" tri-	TlI_3	585.15	br. need
39	nitrate (ic)	$Tl(NO_3)_3$	390.41	cryst
40	" "	$Tl(NO_3)_3.3H_2O$	444.46	rhomb. col., deliq
41	" (ous) (α)	$TlNO_3$	266.40	cubic
42	" " (β)	$TlNO_3$	266.40	trig
43	" " (γ)	$TlNO_3$	266.40	rhomb., α 1.817
44	nitride	TlN_3	246.41	yel
45	oxide (ic)	Tl_2O_3	456.78	hex. blk., amor. br
46	" (ous)	Tl_2O	424.78	blk., deliq
47	*ortho*phosphate	Tl_3PO_4	708.19	col. need
48	selenate	Tl_2SeO_4	551.98	rhomb. need., 1.949, 1.959, 1.964
49	selenide	Tl_2Se	487.98	gray leaf
50	sulfate (ic)	$Tl_2(SO_4)_3.7H_2O$	823.07	col. leaf
51	" (ous)	Tl_2SO_4	504.84	rhomb. col., 1.860, 1.867, 1.885

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	...	soft. 30	d.	d.	...	...
2	...	d. 40	...	0.00067	d.	s. NaOH, a.; sl. s. NH_4OH; i. al.
3	...	...	...	...	...	...
4	4.25	588	...	s.	...	s. al.
5	...	...	...	v. s.	...	...
6	...	89.3	...	s.	...	...
7	...	...	...	...	...	s. dil. a.
8	...	...	...	...	...	s. min. a.
9	...	$-8H_2O$, 360	...	3.561^{20}	2.51^{10}	...
10	11.85	303.5	1650	i.	i.	s. HNO_3, H_2SO_4; sl. s. HCl
11	2.39	...	...	s.	...	...
12	...	...	...	0.35^{20}	...	...
13	$7.557^{17.3}$	460	815	$.05^{25}$	$.25^{68}$	s. al.; i. al., HBr
14	...	...	...	d.	d.	...
15	...	d.	...	s.	v. s.	v. s. al.
16	...	...	...	v. s.	...	s. al.
17	7.11	273	...	$4.03^{15.5}$	27.2^{100}	i. abs. al., eth., acet.
18	5.047^{9}	...	...	2^{0}	57.31^{100}	...
19	4.89	501	d.	20.5^{30}	167^{100}	sl. s. al.
20	7.00	430	720(806)	0.32^{20}	1.97^{100}	sl. s. HCl; i. a. NH_4OH, al.
21	...	25	d.	v. s.	...	...
22	...	$-H_2O$, 60	d. 100	v. s.	d.	...
23	...	37	...	86.2^{17}	d.	s. al., eth.
24	5.9	400–500	d.	0.26^{15}	1.9^{100}	...
25	5.76^{17}	...	...	0.0064^{15}	0.05^{100}	...
26	...	...	...	0.03^{80}	0.2^{100}	sl. s. a. alk.; i. ac. a.
27	...	...	...	i.	...	d. a.
28	...	d.	...	$16.8^{28.5}$	...	...
29	4.641	...	...	0.37^{18}	3.93^{101}	...
30	...	...	300	78.6^{15}	v. s.	sl. s. al.
31	...	...	...	i.	...	i. c. HCl
32	...	...	...	v. s.	...	...
33	...	$-H_2O$, 115	...	i.	...	s. a., NH_4 salts, al.; i. alk.
34	...	>340	...	i.	...	v. s. dil. a.
35	...	...	d. 139	25.9^{0}	52^{40}; 148^{100}	s. al.
36	7.09	440	824	$.0064^{20}$	0.120^{100}	s. HNO_3, aq. reg.; sl. s. al.; i. KI
37	...	...	...	i.	...	sl. s. al.
38	...	...	...	...	...	s. al., eth.
39	...	...	...	s.	...	...
40	...	d. 100	...	d.	d.	...
41	...	206	430	9.55^{20}	413^{100}	i. al.; s. acet.
42	...	tr. 145-α	...	...	...	...
43	$5.556^{21.4}$	tr., 75-β	...	3.91^{0}	414^{100}	s. acet.; i. al.
44	...	334	...	v. sl. s.	...	...
45	amor. 9.65^{21}; hex. 10.19^{22}	717 ± 5	$-2O$, 875	i.	i.	s. a.; i. alk.
46	...	300	$-O$, 1865	v. s., d. to	TlOH	s. a., al.
47	6.89	...	...	0.5^{15}	0.67^{100}	s. NH_4 salts; i. al.
48	6.875	>400	...	2.13^{10}	8.5^{80}	i. al., eth.
49	...	340	...	i.	...	i. a.
50	...	$-6H_2O$, 220	d.	d.	...	s. dil. H_2SO_4
51	6.77	632	d.	4.87^{20}	$15.57^{99.7}$	...

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Thallium			
1	sulfate, acid (ous)	$TlHSO_4$	301.46	
2	sulfide (ic)	Tl_2S_3	504.96	blk. amor
3	" (ous)	Tl_2S	440.84	tetr. bl.-blk
4	sulfite (ous)	Tl_2SO_3	488.84	cryst
5	thiocyanate	$TlCNS$	262.46	tetr. col
6	**Thorium**	Th	232.12	cub. gray, radioactive
7	boride	ThB_4	275.40	pr
8	"	ThB_6	297.04	amor., violet
9	bromide	$ThBr_4$	551.78	col. cr
10	carbide	ThC_2	256.12	yel. cr
11	carbonate	$Th(CO_3)_2$	352.12	
12	chloride	$ThCl_4$	373.95	rhomb. wh., deliq
13	fluoride	$ThF_4.4H_2O$	380.18	cryst
14	hydroxide	$Th(OH)_4$	300.15	wh. gelat
15	iodide	ThI_4	739.80	
16	nitrate	$Th(NO_3)_4$	480.15	plates
17	"	$Th(NO_3)_4.4H_2O$	552.21	col
18	"	$Th(NO_3)_4.12H_2O$	696.34	white, deliq
19	oxide, di- (thorianite)	ThO_2	264.12	cubic, white, 2.20 (lq.)
20	" per-	Th_2O_7	576.24	
21	oxysulfide	$ThOS$	280.18	yel. cr
22	*ortho*phosphate	$Th_3(PO_4)_4.4H_2O$	1148.50	gelat. wh
23	*hypo*phosphate	$ThP_2O_6.11H_2O$	588.33	amor. wh. ppt
24	platinocyanide	$Th[Pt(CN)_4]_2.16H_2O$	1118.89	rhomb. yel. grn
25	potassium fluoride	$ThK_2F_6.H_2O$	442.34	col
26	silicate	$ThO_2.SiO_2$	324.18	col
27	sulfate	$Th(SO_4)_2$	424.24	white, cryst
28	"	$Th(SO_4)_2.4H_2O$	496.30	need. or wh. cr. powd
29	"	$Th(SO_4)_2.9H_2O$	586.38	monocl. wh
30	sulfide	ThS_2	296.24	yel. br. cryst
31	vanadate	$ThO_2.V_2O_5.5H_2O$	536.10	yellow
32	**Thulium**	Tm	169.40	
33	chloride	$TmCl_3.7H_2O$	401.88	grn. cr
34	oxide	Tm_2O_3	386.80	grnsh. wh. powd
35	**Tin** (gray) (α)	Sn	118.70	cubic, gray
36	" (ordinary) (β)	Sn	118.70	tetr. wh. met
37	" (brittle) (γ)	Sn	118.70	rhomb. wh
	Tin, acids of:			
38	stannic acid, ortho-	H_4SnO_4	186.73	wh. gel
39	" " meta- (α acid)	H_2SnO_3	168.72	amor. or coll. ppt., wh
40	" " penta- (β acid)	$H_{10}Sn_5O_{15}$	843.58	amor. or gel. wh
41	" " chloro-	$H_2SnCl_6.6H_2O$	441.55	col. leaf

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	120 d.	....	....	....	v. sl. s. aq. H_2SO_4
2	....	1.2	d.	i.	i.	s. h. H_2SO_4
3	8.0	448	d.	0.02^{20}	sl. s.	s. a.; i. alk., acet.
4	6.427	....	....	3.34^{15}	v. s.	i. al.
5	....	....	....	0.315^{20}	0.727^{40}	i. al.
6	11.2	1845	>3000	i.	i.	s. HCl, H_2SO_4, aq. reg.; sl. s., HNO_3
7	7.5^{15}	....	....	i.	i.	s. HNO_3, HCl, h. H_2SO_4
8	6.4^{15}	....	....	i.	i.	s. HNO_3; i. H_2SO_4, HCl HF, aq. alk.
9	5.67	....	subl. 610	s.	s.	....
10	8.96	ign. 2500	5000	d.	....	v. sl. s. conc. a.
11	....	....	....	i.	d.	s. conc. Na_2CO_3; i. aq. CO_2
12	4.59	820; subl. 720–50	d. 1100	v. s.	v. s.	s. KCl, al., eth., a.
13	....	$-H_2O$, 100	$-2H_2O$, 140–200	i.	....	i. HF
14	....	d.	....	i.	i.	s. a.; i. alk., $H_2C_2O_4$, HF
15	....	....	....	s.	....	....
16	....	....	....	deliq.	....	s. al.
17	....	swells	....	v. s.	....	v. s. al.
18	....	d. 500	....	v. s.	....	v. s. al., a.
19	9.69	>2800	4400	i.	i.	s. h. H_2SO_4; i. alk., dil. a.
20	....	....	....	i.	i.	....
21	6.44^{0}	d.	....	i.	....	s. aq. reg.; sl. s. HNO_3
22	....	....	....	i.	i.	i. a.
23	....	....	....	i.	i.	i. a., alk.
24	2.460	....	....	sl. s.	s.	....
25	....	....	....	$6 \times 10^{-5}(25°)$	....	....
26	5.3	....	....	v. sl. s.	....	....
27	4.225^{17}	....	....	sl. s.	s.	v. s. $NH_4C_2H_3O_2$
28	....	....	....	sl. s.	2.54^{50}	....
29	2.77	$-9H_2O$, 400	....	$.74^{0}$; 1.57^{20}	6.76^{55}	s. HCl, HNO_3
30	6.80	d.	....	i.	i.	s. h. aq. reg.; sl. s. a.
31	....	....	....	i.	i.	s. conc. a.
32	....	....	....	i.	i.	....
33	....	....	....	v. s.	....	v. s. al.
34	....	....	....	....	....	s. min. a.
35	5.75	231.9 stab. <18	2270	i.	i.	d. HCl, H_2SO_4, dil. HNO_3, aq. reg., h. KOH, NaOH
36	7.28	231.9 stab. 18–170	2270	i.	i.	
37	6.52–.56	231.9 stab. >161	2270	i.	i.	
38	....	....	....	s.	....	d. KOH, NaOH, a.
39	....	....	....	i.	i.	d. KOH, NaOH; i. a.
40	....	....	....	i.	i.	d. KOH, NaOH; i. a.
41	1.93	9	....	s.	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Tin** amminochloride, di- (ic)	$SnCl_4.2NH_3$	294.59	cr.
2	arsenate (ic)	$2SnO_2.As_2O_5$	531.26	wh. gel. ppt
3	*pyro*arsenate (ous)	$2SnO.As_2O_5$ (or $Sn_2As_2O_7$)	499.26	flocculent ppt.
4	bromide (ic)	$SnBr_4$	438.36	rhomb. pyramids, col., deliq.
5	" (ous)	$SnBr_2$	278.53	rhomb. pa. yel.
6	bromochloride, tri- (ic)	$SnBr_3Cl$	393.91	liq.
7	bromodichloride, di- (ic)	$SnBr_2Cl_2$	349.45	
8	bromodiiodide, di- (ic)	$SnBr_2I_2$	532.37	or.-red. hex. pl.
9	bromotrichloride, (ic)	$SnBrCl_3$	304.99	col. liq.
10	chloride, (ic)	$SnCl_4$	260.53	col. liq. <33°C
11	" "	$SnCl_4.3H_2O$	314.57	monocl. cr.
12	" "	$SnCl_4.4H_2O$	332.59	opaque
13	" "	$SnCl_4.5H_2O$	350.61	monocl. cr.
14	" (ous)	$SnCl_2$	189.61	rhomb. wh.
15	" "	$SnCl_2.2H_2O$	225.65	wh. monocl.
16	chlorodiiodide, di- (ic)	$SnCl_2I_2$	443.45	red mobile liq.
17	chromate (ic)	$Sn(CrO_4)_2$	350.72	br.-yel. cr. powd
18	ferricyanide (ous)	$Sn_3[Fe(CN)_6]_2$	779.88	wh.
19	ferrocyanide (ic)	$SnFe(CN)_6$	330.59	grnsh. wh. gel.
20	" (ous)	$Sn_2Fe(CN)_6$	449.29	wh. gel.
21	fluoride (ic)	SnF_4	194.70	wh. cr. mass, hyg.
22	" (ous)	SnF_2	156.70	wh. monocl. cr.
23	fluosilicate (ous)	$SnSiF_6$	260.76	pr.
24	hydroxide (ous)	$Sn(OH)_2$	152.72	amor. yel.-redsh.-yel. cr.
25	hydroxysulfate, di- (ic)	$Sn(OH)_2SO_4$	248.78	slender wh. need.
26	iodide (ic)	SnI_4	626.38	cub. yel.
27	" (ous)	SnI_2	372.54	monocl. yel.-red
28	nitrate (ic)	$Sn(NO_3)_4$	366.73	silky need.
29	" (ous)	$Sn(NO_3)_2.20H_2O$	603.03	col. leaf.
30	nitroxychloride, di- (ic)	$3SnCl_4.4NOCl$	1043.44	yel. cr.
31	oxide, (ic), (cassiterite)	SnO_2	150.70	tetr. wh., 1.997, 2.093
32	" (ous)	SnO	134.70	tetr. (cub.) blk.
33	oxychloride, (ic)	$SnOCl_2$	205.61	wh.
34	" (ous)	$SnO.SnCl_2.3H_2O$	378.36	wh. cr.
35	oxydiphosphate, (ic)	$Sn_2O(PO_4)_2$	443.44	oct. cr.
36	oxynitrate (ous)	$Sn_2O(NO_3)_2$	377.42	wh. cr. mass
37	*ortho*phosphate (ous)	$Sn_3(PO_4)_2$	546.14	wh. amor. solid
38	*meta*phosphate (ous)	$Sn(PO_3)_2$	276.74	amor. mass
39	*pyro*phosphate, (ous)	$Sn_2P_2O_7$	411.44	amor. powd.
40	phosphate (ic)	$2SnO_2.P_2O_5.10H_2O$	623.60	
41	" hydro- (ous)	$SnHPO_4$	214.73	cr.
42	" dihydro- (ous)	$Sn(H_2PO_4)_2$	312.77	rhomb. cr.
43	phosphide (ic)	SnP	149.72	silv. wh.
44	" tri-	SnP_3	211.76	cr.
45	"	Sn_4P_3	567.86	wh. cr.
46	phosphoric chloride (ic)	$SnCl_4.PCl_5$	468.83	cr.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	s.	....	d. HCl
2	....	d.	....	....	....	i. dil. HNO_3
3	....	d. $As_2O_3 + SnO_2$		i.	i.	i. conc. ac. a.
4	lq. 3.340^{35}	31	202^{734}	s. d.	d.	s. acet. $AsBr_3$, PCl_3
5	5.117^{17}	215.5	620	85.2^{0}	222.5^{100}	....
6	3.12^{13}	1	73^{30}			....
7	2.82^{13}	−20	65^{3}; d. 191	$d.^{6}$	d.	....
8	3.631^{15}	d. 50	....	s.	d. <80	....
9	2.51^{13}	−1	50^{30}			....
10	2.232	−33	114.1	s.	d.	d. eth.
11	....	....	stab. 64–83	s.	....	....
12	....	....	stab. 56–63	s.	....	....
13	....	....	stab. 19–56	s.	....	....
14	lq. 3.393^{246}	246.0	623	83.9^{0} d.	269.8^{15} d.	s. al., eth., acet.; pyr., ac eth., meth. acet.
15	$2.710^{15.5}$	37.7	d.	118.7 d.	∞ d.	s. al., eth. acet., glac. ac. a
16	3.287^{15}	....	297	s. conc. sol.	d. dil. sol.	s. bz., CS_2, chl.
17	....	d.	....	s.	....	....
18	....	d.	....	i.	....	d. HCl
19	....	....	....	i.	i.	reacts with hot HCl
20	....	....	....	i.	i.	d. HCl
21	4.780^{19}	....	705	v. s.	d. to SnO_2	....
22	....	....	....	s.	....	....
23	....	....	....	v. s.	....	....
24	....	....	....	0.0002	d. to SnO	d. a., alk.; i. NH_4OH; s. alk. carb.
25	....	....	....	s. d.	d.	....
26	4.696^{11}	143.5	341; subl. 180	d.	d.	145^{15} CS_2; s. al., eth. chl., bz.
27	5.28^{25}	320	720	$1.32^{20.8}$	$3.55^{98.5}$	d. KOH, HCl; s. HF, CS_2
28	....	d. compl. 50	....	d.	....	....
29	....	−20	....	d.	d.	d. HNO_3
30	2.60	180	....	d.	d.	d. bz. chl.; i. CS_2
31	6.95	1127 d.	....	i.	i.	i. aq. a.; d. KOH, NaOH
32	6.446^{0}	d. 700–950	....	i.	i.	d. a., fxd. alk. hydx.; sl. s. NH_4Cl
33	1.8	....	....	s.	....	....
34	....	d.	....	s.	d. to SnO	d. HCl, dil. HNO_3, H_2SO_4
35	....	....	....	i.	i.	sl. s. HNO_3
36	....	d. < 100 exp.	....	d.	d.	....
37	3.823^{17}	....	....	i.	i.	d. a., alk. hydx.
38	$3.380^{22.8}$	....	....	....	....	....
39	$4.009^{16.4}$	....	....	....	....	....
40	anh. 3.98	....	....	i.	i.	i. HNO_3
41	$3.476^{15.5}$	stab. <100	d.	i.	i.	....
42	$3.167^{22.8}$	....	....	....	....	....
43	6.56	....	....	i.	....	s. HCl; i. HNO_3
44	4.10^{0}	d. <415 to Sn_4P_3	....	i.	i.	d. HNO_3; i. HCl
45	5.181	d. <480	....	i.	i.	d. HCl, fxd. alk. hydr.
46	....	subl. 200	....	d.	d.	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin			
1	phosphorylchloride (ic)	$SnCl_4POCl_3$	413.92	cr
2	selenide (ic)	$SnSe_2$	277.10	cr
3	" (ous)	$SnSe$	197.90	steel gray cr
4	sulfate (ic)	$Sn(SO_4)_2.2H_2O$	346.85	hex. pr., deliq
5	" (ous)	$SnSO_4$	214.76	wh.-yelsh. cr. powd
6	sulfide (ic) (mosaic gold)	SnS_2	182.82	hex. gold. yel
7	" (ous)	SnS	150.76	rhomb. gray-blk
8	sulfochloride (ic)	$SnCl_4.2SCl_4$	608.30	yel. cr
9	sulfoiodide (ic)	SnS_2I_4	690.50	rhomb. redsh
10	telluride (ic)	$SnTe_2$	373.70	blk. floc. ppt
11	" (ous)	$SnTe$	246.20	gray cr
12	**Titanic acid**	H_2TiO_3	97.92	wh. amor. powd
13	**Titanium**	Ti	47.90	cub. gray
14	bromide, tetra-	$TiBr_4$	367.56	or.-yel., deliq
15	chloride, di-	$TiCl_2$	118.81	blk., deliq
16	" tri-	$TiCl_3$	154.27	dk. vlt., deliq
17	" tetra-	$TiCl_4$	189.73	col.-lt. yel. liq., 1.61
18	cyanide	$Ti_5(CN)_4$	343.53	cub. red
19	fluoride, tri-	TiF_3	104.90	purp. red
20	" tetra-	TiF_4	123.90	wh. powd
21	hydroxide, per-	$Ti(OH)_6$	149.95	red-yel. amor
22	iodide, tetra-	TiI_4	555.58	cub. red
23	nitrate	$5TiO_2.N_2O_5.6H_2O$	615.61	lust. wh. cr. pl
24	nitride	TiN	61.91	bronze red cr
25	oxide, di- (anatase)	TiO_2	79.90	tetr., 2.554, 2.493
26	" " (brookite)	TiO_2	79.90	rhomb., 2.583, 2.586, 2.741
27	" " (rutile)	TiO_2	79.90	tetr. bl., 2.616, 2.903
28	" "	$TiO_2.2H_2O$	115.93	wh
29	" sesqui-	Ti_2O_3	143.80	trig., vlt. blk
30	" per-	TiO_3	95.90	yel
31	potassium fluoride	$TiK_2F_6.H_2O$	258.12	monocl. col
32	sulfate	$Ti_2(SO_4)_3$	383.98	grn., deliq
33	sulfide	TiS_2	112.02	grn
34	**Titanyl** sulfate	$TiOSO_4$	159.96	wh. or sl. yelsh. powd
35	**Tungsten**	W	184.00	cub. gray-blk
36	bromide, di-	WBr_2	343.83	bl.-blk., need
37	" penta-	WBr_5	583.58	vlt.-br., need
38	" hexa-	WBr_6	663.50	bl. blk., need
39	carbide	WC	196.00	gray
40	"	W_2C	380.00	grn
41	chloride, di-	WCl_2	254.91	gray, amor
42	" tetra-	WCl_4	325.83	gray, deliq
43	" penta-	WCl_5	361.29	blk., deliq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	58	180	d.	d.	....
2	5.133	650	....	i.	i.	i. dil. a.; d. h. conc. a.
3	6.179^{0}	861	....	i.	i.	d. HCl, HNO_3, aq. reg. alk. sulfd.
4	....	....	....	v. s.	d.	s. eth., dil. H_2SO_4; reacts with HCl
5	....	d. <360 to SO_2	....	18.8^{19}	18.2^{100}	d. H_2SO_4
6	4.5	d.	....	0.00002^{18}	....	d. alk. sulf., aq. reg. PCl_5, $SnCl_2$, alk. hydx.; i. HCl, HNO_3
7	5.080^{0}	882	1230	$.00002^{18}$	....	d. HCl, alk., $(NH_4)_2S_x$
8	....	37	d. <40	d.	d.	d. HNO_3; s. CS_2, eth., bz. ac. eth.
9	....	....	....	d. to S +	SnO_2 + HI	d. HCl, aq. reg. HNO_3, alk hydx.; s. CS_2, chl.
10	....	....	....	i.	i.	d. dil. a., alk. hydx., $(NH_4)_2S_x$
11	6.48	780	....	i.	i.	d. alk. sulfd.
12	....	....	....	i.	i.	s. a., alk.; i. al.
13	4.5^{10}	1800	>3000	i.	d.	s. dil. a.
14	2.6	39	230	d.	....	s. abs. al., abs. eth.
15	....	subl. in H_2	....	d.	....	s. al.; i. eth., chl., CS_2
16	....	d. 440	....	s.	s.	v. s. al.; s. HCl; i. eth.
17	lq. 1.726	−30	136.4	s.	d.	s. dil. HCl, al.
18	5.28	....	wh. ht.	i.	i.	s. HNO_3 + HF; i. a.
19	....	....	....	s.	....	....
20	$2.798^{20.5}$	....	284	d.	....	s. H_2SO_4, al., C_5H_5N; i. eth
21	....	....	....	i.	....	s. a.; i. alk.
22	....	150	>360	v s	d.	....
23	....	....	....	s.	d.	....
24	5.29	2930	....	i.	....	i. a.
25	3.84	....	....	i.	i.	s. H_2SO_4, alk.; i. a.
26	4.17	....	....	i.	i.	s. H_2SO_4, alk.; i. a.
27	4.26	1640 d.	....	i.	i.	s. H_2SO_4, alk.; i. a.
28	....	d.	....	v. sl. s.	....	....
29	4.6	d.	....	i.	i.	s. H_2SO_4; i. HCl
30	....	....	....	....	....	s. a.
31	....	....	....	1.3^{20}	....	....
32	....	....	....	i.	i.	s. dil. a.; i. al., eth.
33	....	....	....	hyd. sly.	....	....
34	....	....	....	d.	....	....
35	19.3	3370	5900	i.	i.	s. h. conc. KOH; sl. s HNO_3, aq. reg.
36	....	d. 400	....	d. to WO_2	....	....
37	....	276	333	d.	....	s. alk., abs. al., chl., eth.
38	6.9	....	....	i.	d.	s. NH_4OH
39	15.7^{18}	2777	6000	i.	....	....
40	16.06^{13}	2877	6000	i.	....	s. HNO_3; sl. s. HCl, H_2SO_4
41	5.436	....	....	d.	....	....
42	4.624	d.	d.	d.	....	....
43	3.875	248	275.6	d. to W_2O_5	....	v. sl. s CS_2

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tungsten			
1	chloride, hexa-	WCl_6	396.74	cub. dk. bl
2	fluoride, hexa-	WF_6	298.00	lt. yel. liq
3	iodide, di-	WI_2	437.84	br.-grn. amor
4	" tetra-	WI_4	691.68	blk. cr
5	oxide, di-	WO_2	216.00	rhomb. br
6	" tri-	WO_3	232.00	rhomb. yel. or yel.-or. powd
7	oxydibromide, di-	WO_2Br_2	375.83	red pr
8	oxydichloride, di-	WO_2Cl_2	286.91	lt. yel. tabl
9	oxytetrabromide	$WOBr_4$	519.66	blk., deliq
10	oxytetrachloride	$WOCl_4$	341.83	red need
11	oxytetrafluoride	WOF_4	276.00	col. pl., hyg
12	phosphide	WP	215.02	gray pr
13	"	W_4P_2	798.04	dk. gray pr
14	"	WP_2	246.04	blk. cr
15	sulfide, di-	WS_2	248.12	dk. gray cr
16	" tri-	WS_3	280.18	choc. br. powd
17	**Tungstic acid**	H_2WO_4	250.02	yel
18	" "	$H_2WO_4.H_2O$	268.03	wh
19	" " meta-	$H_2W_4O_{13}$	946.02	cub. yel
20	**Uranic acid** (uranyl hydroxide)	H_2UO_4	304.16	rhomb. or yel. powd
21	**Uranium**	U	238.14	cub. silv. wh. or blk. radioact
22	bromide, tri-	UBr_3	477.89	dk. br. need
23	" tetra-	UBr_4	557.80	br. leaf., deliq
24	carbide	UC_2	262.14	gray cr
25	chloride, tri-	UCl_3	344.51	need. dk. red, hyg
26	" tetra-	UCl_4	379.97	cub. oct. dk. grn., deliq
27	" penta-	UCl_5	415.43	dk. grn. need., red by trans. light, deliq.
28	fluoride, tetra-	UF_4	314.14	grn. amor. powd
29	" hexa-	UF_6	352.14	monocl. col.-pa. yel., deliq
30	iodide, tetra-	UI_4	745.82	blk. need
31	nitride	U_3N_4	770.45	yel
32	oxide, di-	UO_2	270.14	rhomb. or cub., br.-blk
33	" tri- (uranyl oxide)	UO_3	286.14	yel.-red powd
34	" per-	$UO_4.2H_2O$	338.17	pa.-yel. cr., hyg
35	" (ous, ic) (pitchblende)	U_3O_8	842.42	olive grn
36	sulfate, (ous)	$U(SO_4)_2.4H_2O$	502.32	rhomb. grn
37	" "	$U(SO_4)_2.8H_2O$	574.38	monocl. grn
38	sulfide, di-	US_2	302.26	tetr. gray-blk
39	" sesqui-	U_2S_3	572.46	gray-blk. need
	Uranyl			
40	amonium carbonate	$UO_2CO_3.2(NH_4)_2CO_3.2H_2O$	558.33	monocl. yel

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	3.52	275	346.7	d.	d.^{60}	v. s. CS_2, $POCl_3$; s. al., eth., bz.
2	g. 12.9 g/l; lq. 3.44	2.5	19.5	d.	d.	s. alk.
3	6.9	....	....	i.	d.	s. f. KOH, alk.; i. CS_2, al.
4	5.2	d.	d.	d.	d.	s. abs. al.
5	12.11	....	....	i.	i.	s. a., KOH; i. a., alk.
6	7.16	1473	....	i.	i.	s. h. alk., HF; i. a.
7	....	d.	d.	....	....	....
8	....	266	....	s.	d.	s. alk., NH_4OH; i. al.
9	....	277	327	d.	d.	....
10	....	211	227.5	d.	d.	s. CS_2, S_2Cl_2, bz.
11	....	110	187.5	d.	....	sl. s. CS_2; i. CCl_4
12	8.5	....	....	i.	....	s. $HNO_3 + H_2F_2$; i. alk. HCl
13	5.21	....	....	....	....	s. fus. $Na_2CO_3 + NaNO_3$; i. a. aq. reg.
14	5.8	d.	....	i.	i.	s. $HNO_3 + H_2F_2$, aq. reg.: i. al., eth.
15	7.5^{10}	....	....	i.	....	s. $HNO_3 + H_2F_2$, fus. alk.: i. al.
16	....	....	....	sl. s.	s.	s. alk.
17	5.5	$-\frac{1}{2}H_2O$, 100	....	i.	sl. s.	s. alk., HF, NH_3
18	....	$H_2W_2O_7$ at 100	....	sl. s.	....	s. alk.
19	....	....	....	s.	....	s. alk.
20	5.92	$-H_2O$, 250–300	....	i.	i.	s. a., alk. carb.; i. alk.
21	18.7	<1850	ign.	i.	i.	s. a.; i. alk., al.
22	....	....	v. volat.	s.	....	....
23	4.84	....	volat.	s.	s.	s. acet.; i. al.
24	11.28	2260	4100	d.	d.	s. a.
25	5.44	....	....	v. s.	d.	s. HCl, NH_4Cl
26	4.85	subl.	....	v. s.	d.	s. al., acet., benz. a., ac. a., NH_4Cl; i. eth.
27	....	d. 120	....	d.	....	s. abs. al., ac. a. NH_4Cl; i. eth., bz.
28	....	ca. 1000	....	i.	....	s. conc. a.; i. dil. a.
29	4.68$^{20.7}$	69.2$^{2\ atm.}$	56.2$^{764.6}$	s.	....	v. s. $C_2H_2Cl_4$; s. CCl_4, chl.; d. al., eth.; i. CS_2
30	5.6^{15}	500	....	s.	s.	....
31	....	....	....	d.	....	....
32	10.5	2176	....	i.	i	s. HNO_3, H_2SO_4
33	5.92	d.	....	i.	....	s. min. a.; i. $K_2C_4H_4O_6$
34	....	d. 115	....	.00059–95	....	d. HCl
35	7.19–.31	d.	....	i.	i.	s. HNO_3, H_2SO_4
36	....	$-4H_2O$, 300	....	d.	....	s. dil. a.
37	....	d. 90	....	s. d.	....	s. dil. a.; i. al.
38	....	>1100	oxidizes	sly. d.	....	s. dil. a.
39	....	ign.	....	....	....	+O aq. reg., conc. HNO_3; i. dil. a.
40	2.773	d. 100	....	6.04$^{18.6}$	d.	s. $(NH_4)_2CO_3$ aq. SO_2

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Uranyl			
1	chloride	UO_2Cl_2	341.05	yel., deliq.
2	iodate	$UO_2(IO_3)_2.H_2O$	638.00	α prismatic, stable β pyramidal
3	nitrate	$UO_2(NO_3)_2.6H_2O$	502.25	rhomb. yel., deliq., β 1.4967
4	phosphate	$UO_2HPO_4.4H_2O$	438.23	tetr. yel. pl.
5	potassium carbonate	$UO_2CO_3.2K_2CO_3$	606.54	hex. yel.
6	" sulfate	$UO_2SO_4.K_2SO_4.2H_2O$	576.49	monocl. yel.
7	sodium carbonate	$UO_2CO_3.2Na_2CO_3$	542.13	yel. cr.
8	sulfate	$UO_2SO_4.3H_2O$	420.25	yel.-grn. cr.
9	"	$2UO_2SO_4.7H_2O$	858.51	yel.
10	sulfide	UO_2S	302.20	br.-blk.
11	sulfite	$UO_2SO_3.4H_2O$	422.26	pa. grn. cr.
12	**Vanadic acid**, meta-	HVO_3	99.96	yel. sc.
13	" " pyro-	$H_4V_2O_7$	217.93	amor., br.
14	**Vanadium**	V	50.95	cub. lt. gray met., 3.03
15	ammonium sulfate	$VNH_4(SO_4)_2.12H_2O$	477.30	red to blue
16	bromide, tri-	VBr_3	290.70	grn. blk., deliq.
17	carbide	VC	62.95	gray
18	chloride, di-	VCl_2	121.86	hex. grn., deliq.
19	" tri-	VCl_3	157.32	pink, deliq. cr.
20	" tetra-	VCl_4	192.78	red-br. liq.
21	fluoride, tri-	VF_3	107.95	rhomb. grn.
22	" "	$VF_3.3H_2O$	162.00	rhomb.
23	" tetra-	VF_4	126.95	br. yel.
24	" penta-	VF_5	145.95	
25	iodide	$VI_3.6H_2O$	539.80	grn. cr.
26	nitride	VN	64.96	grn.-br.
27	oxide, di-	V_2O_2	133.90	lt. gray cr.
28	" tri-	V_2O_3	149.90	blk. cr.
29	" tetr-	V_2O_4	165.90	bl. cr.
30	" pent-	V_2O_5	181.90	rhomb. yel.-red
31	oxydibromide	$VOBr_2$	226.78	br., deliq.
32	oxytribromide	$VOBr_3$	306.70	red liq.
33	oxymonochloride	VOCl	102.41	br. powd.
34	" di-	V_2O_2Cl	169.36	yel. cr.
35	oxydichloride	$VOCl_2$	137.86	grn., deliq.
36	oxytrichloride	$VOCl_3$	173.32	yel. liq., deliq.
37	silicide	VSi_2	107.07	met., prisms
38	"	V_2Si	129.96	silv. wh. pr.
39	sulfate (hypovanadous)	$VSO_4.7H_2O$	273.12	monocl. vlt.
40	sulfide, di-	V_2S_2	166.02	blk., pl.
41	" tri-	V_2S_3	198.08	grn.-blk. pl. or powd.
42	" penta-	V_2S_5	262.20	blk.-grn. powd.
43	**Vanadyl** sulfate	$(VO)(SO_4)$	163.01	bl.
44	" "	$(VO)_2(SO_4)_3$	422.08	blue, deliq.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	<red ht.	d.	320^{18}	s.	s. al., eth., amyl. al.
2	α 5.220^{18} β 5.052^{18}	....	....	α $.1049^{18}$ β $.1214^{18}$	....	sl. s. dil. HNO_3
3	2.81	59; d. 100	118	170^{0}	$630^{71.8}$	v. s. al., eth., ac. a., acet. meth. al.
4	....	....	....	i.	i.	s. aq. Na_2CO_3, HNO_3; i. ac. a.
5	....	$-CO_2$, 300	....	7.4^{15}	d.	i. al.
6	$3.363^{19.1}$	$-2H_2O$, 120	....	s.	....	....
7	....	....	....	sl. s.	....	i. al.
8	$3.28^{16.5}$	d. 100	....	19^{13}	22.2^{100}	4 al.; s. H_2SO_4
9	....	anh. 300	....	v. s.	v. s.	s. H_2SO_4
10	....	d. 40–50	....	sl. s.	....	s. dil. a., al. $(NH_4)_2CO_3$; i. abs. al.
11	....	....	....	i.	....	s. H_2SO_3
12	....	....	....	i.	....	s. a., alk.; i. NH_3
13	....	....	....	i.	....	s. a., alk., NH_4OH
14	5.866^{15}	1715	3000	i.	i.	s. HNO_3, H_2SO_4, HF, aq. reg.; i. HCl, alk.
15	1.687	49	....	28.45^{20}	....	....
16	....	d.	....	s.	....	s. al., eth.; i. HBr
17	5.4	2830	3900	i.	....	s. HNO_3, fus. KNO_3
18	3.23^{18}	....	....	s. d.	s. d.	s. al., eth.
19	3.00^{18}	d.	....	s. d.	s. d.	s. abs. al., eth.
20	1.816^{30}	−109	148.5^{755}	s. d.	....	s. abs. al., eth., chl., ac. a.
21	3.363^{19}	>800	subl.	i.	....	i. al., chl., CS_2
22	....	$-3H_2O$, 130	....	s.	v. s. d.	i. abs. al.
23	2.975^{23}	d. 325	....	s.	....	s. acet.; sl. s. al., chl
24	2.177^{19}	....	111.2	s.	....	s. al., chl.; i. CS_2
25	....	....	....	....	....	s. al.
26	5.63	2050	....	i.	....	....
27	3.64	ign.	....	i.	i.	s. a.
28	4.87^{18}	1970	....	sl. s.	s.	s. HNO_3, HF, alk.
29	4.339	1967	....	i.	i.	s. a., alk.
30	3.357^{18}	690	d. 1750	0.8^{20}	....	s. a., alk.; i. abs. al.
31	....	d. 180	....	s.	....	....
32	$2.933^{14.5}$	d. 180	130^{100}	s.	....	....
33	2.824	....	127	i.	....	v. s. HNO_3
34	3.64	....	....	i.	....	s. HNO_3
35	2.88^{13}	....	....	d.	....	s. dil. HNO_3
36	1.829	<−15	127.19	s. d.	....	s. al., eth., ac. a.
37	4.42	....	....	i.	i.	s. HF; i. a., al., eth.
38	5.48^{17}	....	....	i.	i.	s. HF; i. a., al., eth.
39	....	d.	....	....	....	....
40	4.20	d.	....	....	....	s. h. H_2SO_4, HNO_3; sl. s. KSH; i. alk., HCl
41	4.7^{21}	d.	....	i.	....	s. alk. sulf.; sl. s. alk., HCl, HNO_3, H_2SO_4
42	3.00	d.	....	i.	....	s. dil. HNO_3, alk. sulf., alk.
43	....	....	....	v. s.	....	....
44	....	....	....	v. s.	d.	s. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Water**	H_2O	18.02	col. liq. or hex. col. cr., lq. 1.333, sld. 1.309, 1.313
2	**Xenon**	Xe	131.3	col. inert. gas
3	**Ytterbium**	Yb	173.50	
4	chloride	$YbCl_3.6H_2O$	387.96	rhomb. grn
5	oxide	Yb_2O_3	395.00	col
6	"	$Yb_2O_3.6H_2O$	503.09	gelat
7	selenate	$Yb_2(SeO_4)_3.8H_2O$	920.72	hex. pl
8	selenite	$Yb_2(SeO_3)_3$	728.60	
9	sulfate	$Yb_2(SO_4)_3$	635.18	col
10	"	$Yb_2(SO_4)_3.8H_2O$	779.30	prisms
11	**Yttrium**	Y	88.92	hex. gray-blk. met
12	bromate	$Y(BrO_3)_3.9H_2O$	634.81	hex. pr
13	bromide	YBr_3	328.67	
14	"	$YBr_3.9H_2O$	490.81	col. tabl., deliq
15	carbide	YC_2	112.92	micro-cr. yel
16	carbonate	$Y_2(CO_3)_3.3H_2O$	411.89	wh.-redsh. powd
17	chloride	YCl_3	195.29	shin. wh. leaf
18	"	$YCl_3.H_2O$	213.31	col
19	"	$YCl_3.6H_2O$	303.38	rhomb. redsh.-wh., deliq
20	fluoride	$YF_3.\frac{1}{2}H_2O$	154.93	gelat
21	hydroxide	$Y(OH)_3$	139.94	wh.-yel., gelat. or powd
22	iodide	YI_3	469.68	deliq
23	nitrate	$Y(NO_3)_3.4H_2O$	347.01	redsh. wh. pr
24	"	$Y(NO_3)_3.6H_2O$	383.04	redsh.-col., deliq. cr
25	oxide	Y_2O_3	225.84	col.-yelsh. cr. or powd
26	sulfate	$Y_2(SO_4)_3$	466.02	wh. powd
27	"	$Y_2(SO_4)_3.8H_2O$	610.14	monocl. col.-redsh., 1.543, 1.549, 1.576
28	sulfide	Y_2S_3	274.02	yel. powd
29	**Zinc**	Zn	65.38	hex. bluish.-wh. met
30	aluminate (gahnite)	$ZnAl_2O_4$	183.32	
31	amide	$Zn(NH_2)_2$	97.43	amor
32	ammonium sulfate	$ZnSO_4.(NH_4)_2SO_4.6H_2O$	401.67	monocl. wh., 1.489, 1.493, 1.499
33	*ortho*arsenate (koettigite)	$Zn_3(AsO_4)_2.8H_2O$	618.12	monocl. 1.662, 1.683, 1.717
34	borate	$ZnBO_3$	124.20	wh. amor. powd
35	bromate	$Zn(BrO_3)_2.6H_2O$	429.31	cub. wh
36	bromide	$ZnBr_2$	225.21	rhomb. col., hyg
37	carbonate (smithsonite)	$ZnCO_3$	125.38	trig. col., 1.818, 1.618
38	" sub-	$2ZnCO_3.3Zn(OH)_2$	548.95	impalpable, wh. powd
39	chlorate	$Zn(ClO_3)_2.4H_2O$	304.36	cub. col.-yelsh., deliq
40	chloride	$ZnCl_2$	136.29	cubic wh., deliq
41	" ammonia	$ZnCl_2.2NH_3$	170.36	col
42	" "	$ZnCl_2.5NH_3.H_2O$	239.47	wh. powd., deliq., $-NH_3$ on expos.
43	*di*chromate	$ZnCr_2O_7$	281.40	or.-yel. powd
44	cyanide	$Zn(CN)_2$	117.40	rhomb. col
45	ferrocyanide	$Zn_2Fe(CN)_6$	342.65	wh. powd
46	"	$Zn_2Fe(CN)_6.3H_2O$	396.69	wh. powd
47	fluoride	ZnF_2	103.38	monocl. or tricl

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	lq. 1.000_4^4; s. $.9168^0$	0	100	....	....	∞ al.
2	5.851 g/l; lq. 3.06^{-109}; s. 2.7^{-140}	−112	−107.1	28.4^{17}cm³	....	....
3	....	1800	....	d. ev. H_2	....	....
4	2.575	150–5	$-6H_2O$, 180	v. s.	v. s.	s. abs. al.
5	9.17	....	....	i.	i.	s. h. dil. a.
6	....	....	....	i.	....	v. s. a., KOH; i. NH_4OH
7	3.30	....	....	s. d.	s.	....
8	....	....	....	i.	....	....
9	3.793	d. 900	....	44.2^0	4.7^{100}	....
10	3.286	....	....	34.78^{20}	22.9^{40}	....
11	5.51	1490	2500 d.	sl. d.	d	v. s. dil. a., h. KOH
12	....	74	$-6H_2O$, 100	168^{25}	....	sl. s. al.; i. eth.
13	....	....	....	v. s.	....	s. al.; i. eth.
14	....	....	....	v. s.	....	sl. s. al.; i. eth.
15	4.13^{18}	....	....	d.	....	....
16	....	....	....	i.	....	sl. s. aq. CO_2; s. $(NH_4)_2CO_3$, dil. min. a.; i. al. eth.
17	2.8^{18}	680	....	78^{10}	82^{50}	60.1^{15} al., 60.6^{15} pyr.
18	....	$-H_2O$, 160	....	v. s.	....	....
19	2.8^{18}	$-5H_2O$, 100	....	217^{20} (75^{25})	233^{50}	s. al.; i. eth.
20	....	....	....	i.	....	v. sl. s. dil. a.
21	....	d.	....	i.	i.	s. a., NH_4Cl; i. alk.
22	....	....	....	v. s.	....	s. al.; sl. s. eth.
23	2.682	....	....	s.	....	s. al., HNO_3
24	2.68	$-3H_2O$, 100	....	$134.7^{22.5}$	....	v. s. al., eth., HNO_3
25	4.84	2410	....	$.00018^{29}$	....	s. a.; i. alk
26	2.52	d. 1000	....	5.38^{25}	s	s. satd., aq., K_2SO_4
27	2.558	$-8H_2O$, 120	d. 700	9.763^{20}	$4\ 90^{40}$	s. conc. H_2SO_4; i. al., alk.
28	....	....	....	d.	....	....
29	7.14	419.4	907	i.	i.	s. a., alk., ac. a.
30	....	....	....	....	....	i. a., alk.
31	....	d.	....	d.	d.	d. al.; i. eth.
32	1.931	d.	....	anh. 7^0	anh. 42^{80}	....
33	3.309^{15}	d. 100	....	i.	i.	s. HNO_3, H_3AsO_4, alk.
34	....	....	....	s.	....	....
35	2.566	100	$-6H_2O$, 200	100	v. s.	....
36	4.219	394	650	471^{25}	675^{100}	v. s. al., eth., NH_4OH
37	4.44	$-CO_2$, 300	....	0.001^{15}	....	s. a. alk., NH_4 salts; i. NH_3, acet., pyr.
38	....	....	....	i.	....	s. dil. a., NH_4OH, NH_4CO_3 soln.; i. al.
39	2.15	d. 60	d.	208.6^{30}	v. s.	167 al.; s. glyc., eth.
40	2.91^{25}	262	732	432^{25}	615^{100}	$100^{12.5}$ al.; v. s. eth.; i. NH_3
41	....	210.8	d. 271	d. to $Zn(NH_3)_4$		....
42	....	....	....	s. d.	....	s. a., NH_4OH
43	....	....	....	i.	....	s a.; i. al., eth.
44	....	d. 800	....	i.	i.	s. alk., KCN, NH_3; i. al.
45	....	....	....	i.	....	s. excess alk.; i. dil. a.
46	....	d.	....	i.	i.	s. NH_4OH; v. sl. s. NH_3; i. HCl, al.; d. NaOH
47	4.84^{15}	872		sl. s.	s.	s. h. a., NH_4OH; i al., NH_3

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Zinc			
1	fluoride	$ZnF_2.4H_2O$	175.44	rhomb.
2	fluosilicate	$ZnSiF_6.6H_2O$	315.53	hex. pr., col.
3	hydroxide	$Zn(OH)_2$	99.40	rhomb. col.
4	iodate	$Zn(IO_3)_2$	415.22	wh. cr. powd.
5	"	$Zn(IO_3)_2.2H_2O$	451.25	
6	iodide	ZnI_2	319.22	cub. col. or wh. powd., hyg.
7	*per*manganate	$Zn(MnO_4)_2.6H_2O$	411.33	vlt. br. or blk., deliq.
8	manganese chloride	$2ZnCl_2.MnCl_2.3H_2O$	452.48	rose-red cr.
9	nitrate	$Zn(NO_3)_2.3H_2O$	243.44	
10	"	$Zn(NO_3)_2.6H_2O$	297.49	tetr. col.
11	nitride	Zn_3N_2	224.16	gray
12	oxide	ZnO	81.38	wh. or yelsh., amor. powd.
13	" (zincite)	ZnO	81.38	hex. wh., 2.008, 2.029
14	" per-	ZnO_2	97.38	wh.-yel. powd.
15	*ortho*phosphate	$Zn_3(PO_4)_2$	386.18	rhomb. col.
16	" (α hopeite)	$Zn_3(PO_4)_2.4H_2O$	458.24	rhomb. col., 1.572, 1.591, 1.59
17	" (β hopeite)	$Zn_3(PO_4)_2.4H_2O$	458.24	rhomb. col., 1.574, 1.582, 1.582
18	" (parahopeite)	$Zn_3(PO_4)_2.4H_2O$	458.24	tricl. col. 1.614, 1.625, 1.665
19	"	$Zn_3(PO_4)_2.8H_2O$	530.30	rhomb. pl.
20	" acid	$ZnH_4(PO_4)_2.2H_2O$	295.48	tricl.
21	*pyro*phosphate	$Zn_2P_2O_7$	304.80	wh. powd.
22	phosphide	Zn_3P_2	258.18	cub. dk. gray
23	*ortho*phosphite	$ZnHPO_3.2\frac{1}{2}H_2O$	190.45	gran., cr. powd.
24	*hypo*phosphite	$Zn(H_2PO_2)_2.H_2O$	213.47	col., hyg. cr. powd.
25	selenide	$ZnSe$	144.58	hex., 2.89
26	silicate	$ZnSiO_3$	141.44	hex. col.
27	" (willemite)	$2ZnO.SiO_2$	222.82	trig., 1.694, 1.723
28	" (calamine)	$2ZnO.SiO_2.H_2O$	240.84	rhomb., 1.614, 1.617, 1.636
29	sulfate (zinkosite)	$ZnSO_4$	161.44	rhomb. col., 1.658, 1.669, 1.670
30	"	$ZnSO_4.6H_2O$	269.53	monocl. or tetr. col.
31	" (goslarite)	$ZnSO_4.7H_2O$	287.55	rhomb. col., effl., 1.457, 1.480, 1.484
32	sulfide (α) (würzite)	ZnS	97.44	hex. col., 2.356, 2.378
33	" (β) (sphalerite)	ZnS	97.44	cub. col., 2.368
34	" (blende)	ZnS	97.44	gray
35	"	$ZnS.H_2O$	115.46	yelsh.-wh. powd.
36	sulfite	$ZnSO_3.2H_2O$	181.47	wh. cr. powd.
37	"	$ZnSO_3.2\frac{1}{2}H_2O$	190.48	
38	telluride	$ZnTe$	192.88	cub. red, 3.56
39	thiocyanate	$Zn(CNS)_2$	181.52	wh. powd.
40	**Zirconium**	Zr	91.22	cub. silv. wh.-gray
41	ammonium fluoride	$Zr(NH_4)_3F_7$	278.34	col.
42	bromide	$ZrBr_4$	410.88	wh. cr. powd.
43	carbide	ZrC	103.22	hard metallic
44	chloride, tetra-	$ZrCl_4$	233.05	wh. lust. cr.
45	fluoride	ZrF_4	167.22	hex. col.
46	hydroxide	$Zr(OH)_4$	159.25	gelat. or wh. amor. powd.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	2.535^{12}	$-4H_2O$, 100	....	1.6[illegible]	s.	s. NH_4OH, a., alk.
2	2.104	....	....	v. s.	....	....
3	3.053	d. 125	....	$.00042^{15}$	i.	s. a., alk.
4	4.98	d.	....	sl. s.	....	s. HNO_3, alk.
5	....	....	....	0.877	1.32	s. HNO_3, NH_4OH
6	$4.666^{14.2}$	446	624	430^{0}	510^{100}	s. a., al., eth., NH_3, $(NH_4)_2CO_3$
7	....	$-5H_2O$, 100	....	v. s.	v. s.	d. al., a.
8	....	....	....	s. with turbidity		s. al.
9	....	45.5	....	....	....	....
10	2.065^{14}	36.4	$-6H_2O$, 105–131	324.5	∞	v. s. al.
11	....	....	....	d.	....	s. HCl
12	5.47	>1800	....	$.00016^{29}$	....	s. min. a., dil. ac. a., NH_4OH
13	5.606	>1800	subl. 1800	$.00016^{29}$	....	s. a. alk., NH_4Cl; i. NH_3, al.
14	....	....	....	0.0022	....	d. a.
15	3.998^{15}	900	....	i.	i.	s. a. NH_4OH; i. al.
16	3.04	tr. > 105	....	i.	i.	v. s. a., NH_4OH, NH_4 salts
17	3.03	tr. > 140	....	i.	i.	v. s. a., NH_4OH, NH_4 salts
18	....	tr. > 163	....	i.	i.	v. s. a. NH_4OH, NH_4 salts
19	3.109^{15}	....	....	i.	....	s. alk.
20	....	100 d.	....	d.	....	....
21	3.75^{23}	....	....	i.	i.	s. a., alk., NH_4OH
22	4.55^{13}	>420	1100	i.	....	s. dil. a.; i. al.; d. H_2SO_4 ev. H_3P, HNO_3 viol.
23	....	....	....	s.	v. sl. s.	....
24	....	....	....	s.	....	s. alk.
25	5.42^{15}	....	....	i.	....	s. a.
26	3.52	1437	....	i.		....
27	3.9	1509	....	....	i.	....
28	3.45	....	....	i.	i.	....
29	3.74^{15}	d. 740	....	86.5^{30}	80.8^{100}	sl. s. al.
30	2.072^{15}	tr. 70	....	s.	s.	....
31	1.97	tr. 39	$-7H_2O$, 280	115.2^{0}	663.6^{100}	sl. s. al.
32	4.087	$1850^{150\ atm}$	subl. 1185	$.00069^{15}$	i.	v. s. a.; i. ac. a.
33	4.102^{25}	tr. 1020	....	$.000065^{15}$	....	v. s. a.
34	4.03–.07	1800–1900	subl. 1180	i.	i.	v. s. a.; i. ac. a.
35	3.98	1049	subl. 1180	i.	....	s. a.
36	....	....	....	v. sl. s.	d.	s. H_2SO_3; i. al.
37	....		....	0.16	d.	s. H_2SO_3, NH_4OH; i. al.
38	5.54^{13}	1238.5		i.	i.	s. a.
39	....	....		s.	....	s. al., NH_4OH
40	6.4	1900	>2000	i.	i.	s. HF, aq. reg.; sl. s. a.
41	....	....	....	sl. s.	....	....
42	....	volat.	....	i.	....	s. al., eth.
43	....	....	[illegible]	i.	....	s. a., dil. HF
44	2.80	subl. 300		s.	d. to Zn_2OCl_2	s. al., eth.
45	4.43	subl.	d.	1.39	d.	s. HF; i. a.
46	3.25		....	0.02	....	s. a.; i. alk. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Zirconium			
1	iodide, tetra-	ZrI_4	598.90	red. br. cr
2	oxide, di- (baddeleyite)	ZrO_2	123.22	monocl., 2.13, 2.19, 2.20
3	" " (free from Hf)	ZrO_2	123.22	
4	" per-	ZrO_3	139.22	wh. ppt
5	phosphide	ZrP_2	153.26	
6	selenate	$Zr(SeO_4)_2.4H_2O$	449.68	hex. transp. cr
7	silicate (zircon or hyacinth)	$ZrSiO_4$	183.28	tetr. red or var. color, 1.92–96, 1.97–2.02
8	silicide	$ZrSi_2$	147.34	rhomb. lust. met
9	sulfate	$Zr(SO_4)_2.4H_2O$	355.40	rhomb. col. or wh. cr. powd
	Zirconyl			
10	bromide	$ZrOBr_2.8H_2O$	411.18	brill. need., deliq
11	chloride	$ZrOCl_2.8H_2O$	322.26	tetr. need. wh., effl., 1.552, 1.563
12	hydroxide	$ZrO(OH)_2$	141.24	gelat. wh
13	iodide	$ZrI_2O.8H_2O$	505.18	col. need., hyg
14	sulfide	$ZrOS$	139.28	yel. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	s.	s.	v. s. eth.; s. bz., CS_2, a., eth.; sl. s. CS_2
2	5.49	2700	(4300)	i.	i.	s. H_2SO_4, HF
3	5.73	....	....	i.	i.	s. H_2SO_4, HF
4	....	....	....	....	....	i. c. dil. H_2SO_4
5	4.77^{25}	....	....	i.	....	....
6	....	$-3H_2O$, 100	$-4H_2O$, 130	s.	....	....
7	4.56	2550	....	i.	....	i. a., aq. reg., alk.
8	4.88^{22}	....	....	....	....	....
9	....	$-3H_2O$, 120	....	$146^{39.5}$	....	s. H_2SO_4; i. al.
10	....	$-4H_2O$, 120	....	s.	....	s. hot conc. HBr
11	....	$-6H_2O$, 150	$-8H_2O$, 210	s.	d.	s. al., eth.; sl. s. HCl
12	....	....	....	v. s.	....	s. al.; sl. s. dil. HCl, dil. HNO_3, oxal. a.
13	....	d.	....	v. s.	v. s.	v. s. eth.; s. al.
14	4.87	....	....	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Aluminum			
1	acetate	$Al(C_2H_3O_2)_3$	204.04	known only in soln
2	" basic	$Al_2O(C_2H_3O_2)_4.4H_2O$	378.10	wh. amor. powd
3	acetylacetonate	$Al(C_5H_7O_2)_3$	324.13	
4	benzoate	$Al(C_7H_5O_2)_3$	390.09	wh. cr. powd
5	butoxide	$Al(OC_4H_9)_3$	246.18	
6	ethoxide	$Al(OC_2H_5)_3$	162.09	
7	lactate	$Al(C_3H_5O_3)_3$	294.09	wh.-yelsh. powd
8	oleate	$Al(C_{18}H_{33}O_2)_3$	870.74	wh. powd
9	oxalate	$Al_2(C_2O_4)_3.4H_2O$	390.00	wh. powd
10	phenolate	$Al(OC_6H_5)_3$	306.09	
11	*p*-phenolsulfonate	$Al(C_6H_4HSO_4)_3$	546.27	redsh. wh. powd
12	potassium tartrate	$KAl(C_4H_4O_6)_2$	362.13	
13	propoxide	$Al(OC_3H_7)_3$	204.13	
14	salicylate	$Al(C_6H_4OHCOO)_3$	438.09	redsh.-wh. powd
15	stearate	$Al(C_{18}H_{35}O_2)_3$	876.79	wh.-yelsh. powd
16	Triethyl aluminum	$Al(C_2H_5)_3$	114.09	$1.480^{6.5}$
17	Trimethyl aluminum	$Al(CH_3)_3$	72.04	liq., 1.432^{12}
	Ammonium			
18	acetate	$NH_4C_2H_3O_2$	77.06	wh. cr., hyg
19	aminosulfonate	$(NH_4)NH_2SO_3$	114.12	deliq
20	benzoate	$NH_4C_7H_5O_2$	139.08	rhomb. col
21	citrate, tri- (*tert.*)	$(NH_4)_3C_6H_5O_7$	243.16	wh. cr., deliq
22	ethyl sulfate	$NH_4C_2H_5SO_4$	143.14	col. to sl. yelsh. hyg. cr
23	formate	NH_4CHO_2	63.05	monocl. wh., deliq
24	lactate	$NH_4C_3H_5O_3$	107.08	col.-yelsh. syrupy liq
25	malate, (*l*)	$NH_4C_4H_5O_5$	151.08	rhomb. col
26	" bi-	$NH_4HC_4H_4O_5$	151.08	wh. cr
27	oxalate	$(NH_4)_2C_2O_4.H_2O$	142.09	rhomb. col., 1.439, 1.546, 1.594
28	" acid (binoxalate)	$NH_4HC_2O_4.H_2O$	125.06	rhomb. col
29	palmitate	$NH_4.C_{16}H_{31}O_2.C_{16}H_{32}O_2$	529.53	yelsh. soapy mass or yel. powd
30	phenolsulfonate	$C_6H_4OHSO_3.NH_4$	191.14	wh. cr
31	picramate	$NH_4.O.(NO_2)_2NH_2.C_6H_2$	216.09	redsh.-br. cr. powd
32	picrate	$NH_4C_6H_2O_7N_3$	246.08	rhomb. red or yel
33	salicylate	$NH_4C_7H_5O_3$	155.08	monocl. col
34	succinate	$NH_4COO.CH_2.CH_2.COONH_4$	152.11	col. cr
35	tartrate, (*dl*)	$(NH_4)_2C_4H_4O_6$	184.11	monocl. col.; *d*, α 1.55, β 1.581
36	" acid, (*dl*)	$NH_4HC_4H_4O_6$	167.08	monocl. pr. col., 1.519, 1.561, 1.591
37	valerate	$NH_4C_5H_9O_4$	151.11	col. or wh. cr.; disg. odor
	Antimony			
38	lactate, (antimonine)	$Sb(C_3H_5O_3)_3$	388.88	cr. yel
39	tartrate	$Sb_2(C_4H_4O_6)_3.6H_2O$	795.71	wh. cr. powd
40	thioglycollamide	$Sb(S.CH_2CO.NH_2)_3$	392.06	cr. wh
41	Pentamethyl antimony	$Sb(CH_3)_5$	196.88	
42	Triethyl antimony	$Sb(C_2H_5)_3$	208.88	liq
43	Trimethyl antimony	$Sb(CH_3)_3$	166.83	liq
	Arsenic:			
44	Diethyl arsine	$[As(C_2H_5)_2]_2$	266.02	liq

METAL-ORGANIC COMPOUNDS

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	....	d.	....	s.	d.	....
2	....	d.	....	i.	i.	s. a.; i. NH_4 salts
3	....	194	....	....	....	....
4	....	....	....	v. sl. s.	....	....
5	$1.0251^{20°}_{0}$	101.5–102	284.5^{10}	d.	d.	s. al.
6	$1.142^{20°}_{0}$	134	205^{14}	s. d.	s.	v. sl. s. al., eth.
7	....	....	....	v. s.	....	....
8	....	....	....	d.	d.	i. al.; v. sl. s. bz.
9	....	....	....	i.	i.	s. a.; i. al.
10	1.23	265 d.	....	d.	....	s. al., chl., eth.
11	....	....	....	s.	....	s. al., glyc.
12	....	....	....	s.	s.	....
13	$1.0578^{20°}_{0}$	106	248^{14}	d.	d.	s. al.
14	....	....	....	i.	....	s. dil. alk.; i. al.
15	....	....	....	i.	....	s. oil turp., pet., alk.; sl. s. al.
16	....	....	....	d. to $Al(OH)_3+C_2H_6$		....
17	....	....	....	d. to $Al(OH)_3+CH_4$		....
18	1.073	114	d.	148^4	d.	s. al.; sl. s. acet.
19	....	....	....	s.	....	i. al.
20	1.260	198 d.	subl. 160	$19.6^{14.5}$	83.3^{100}	1.63^{25} al.; i. eth.
21	....	d.	....	v. s.	d.	i. al.; eth., acet.
22	....	99	....	s.	....	....
23	1.266	116	d. 180	102^0	531^{80}	s. al., NH_3
24	$1.19–.21^{15}$	....	....	∞	....	∞ al.
25	1.5	161	d.	$32.2^{15.7}$	....	....
26	....	....	....	s.	....	....
27	1.50	d.	....	2.54^0	11.8^{50}	i. NH_3
28	1.556	d.	....	s.	....	i. eth., bz.
29	....	....	....	i.	....	s. al., eth.
30	....	....	....	s.	...	....
31	....	....	....	s.	....	s. al.
32	1.719	d.	exp. 423	1.1^{20}	s.	sl. s. al.
33	....	....	subl.	111^{25}	v. s.	28.8^{25} al.
34	....	....	....	s.	....	s. al.
35	1.601	d.	....	6.3^{15}	d.	sl. s. al.
36	1.636	d.	....	1^{20}	s.	s. a., alk.; i. al.
37	....	d.	....	s.	....	s. al., eth.
38	....	....	....	s.	s.	....
39	....	....	....	s.	....	....
40	....	139	....	200	....	sl. s. al.; i. eth.
41	....	96–100	....	i.	i.	....
42	1.324^{16}	<-29	159.5	i.	i.	s. al., eth.
43	1.523^{15}	....	80.6	sl. s.	sl. s.	s. eth.; i. al.
44	1+	....	186	i.	....	s. al., eth.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Arsenic:			
1	Dimethyl arsine	$[As(CH_3)_2]_2$	209.95	col. liq
2	Methyl arsine	CH_3AsH_2	91.97	
3	Triethyl arsine	$(C_2H_5)_3As$	162.05	liq. col
4	Trimethyl arsine	$(CH_3)_3As$	120.00	liq. col
	Barium			
5	acetate	$Ba(C_2H_3O_2)_2.H_2O$	273.42	tricl. col., 1.500, 1.517, 1.525
6	benzoate	$Ba(C_7H_5O_2)_2.2H_2O$	415.47	col. nacreous leaf
7	butyrate	$Ba(C_4H_7O_2)_2.2H_2O$	347.50	
8	citrate	$Ba_3(C_6H_5O_7)_2.7H_2O$	916.27	wh. powd
9	ethyl sulfate	$Ba(C_2H_5SO_4)_2.2H_2O$	423.59	wh. lust. leaf
10	formate	$Ba(CHO_2)_2$	227.38	rhomb. col., 1.573, 1.597, 1.636
11	malate	$BaC_4H_4O_5$	269.39	
12	malonate	$BaC_3H_2O_4.H_2O$	257.39	
13	methyl sulfate	$Ba(CH_3SO_4)_2.2H_2O$	395.56	col. effl. cr
14	oxalate	BaC_2O_4	225.36	
15	propionate	$Ba(C_2H_5CO_2)_2.H_2O$	301.45	rhomb., β 1.518
16	salicylate	$Ba(C_6H_4.OH.COO)_2.H_2O$	429.45	wh. need
17	succinate	$BaC_4H_4O_4$	253.39	
18	tartrate	$BaC_4H_4O_6.H_2O$	303.41	
	Beryllium			
19	acetate	$Be(C_2H_3O_2)_2$	127.07	plates
20	" basic	$BeO.3Be(C_2H_3O_2)_2$	406.22	oct
21	" propionate, basic	$BeO.3Be(C_2H_3O_2)(C_3H_5O_2)$	448.27	
22	acetylacetonate	$Be(C_5H_7O_2)_2$	207.13	monocl. wh
23	benzenesulfonate	$(C_6H_5SO_3)_2Be$	323.22	monocl
24	butyrate, basic	$BeO.3Be(C_4H_7O_2)_2$	574.40	
25	oxalate	$Be(C_2O_4).3H_2O$	151.07	rhomb., β 1.487
26	propionate, basic	$BeO.3Be(C_3H_5O_2)_2$	490.31	
27	Di-*n*-butyl beryllium	$Be(C_4H_9)_2$	123.16	col. liq
28	Diethyl beryllium	$Be(C_2H_5)_2$	67.10	col. liq
29	Dimethyl beryllium	$Be(CH_3)_2$	39.07	wh. need
30	Dipropyl beryllium	$Be(C_3H_7)_2$	95.13	liq
	Bismuth			
31	acetate	$Bi(C_2H_3O_2)_3$	327.05	wh. cr
32	benzoate	$Bi(C_7H_5O_2)_3$	572.12	wh. powd
33	citrate	$BiC_6H_5O_7$	398.04	wh. cr
34	lactate	$Bi(C_6H_9O_6).7H_2O$	512.18	
35	oxalate	$Bi_2(C_2O_4)_3$	682.00	
36	propionate	$BiO.C_2H_5.COO$	298.04	wh. powd.; faint odor prop. acid
37	salicylate	$Bi_2(C_7H_5O_3)_3$	829.12	wh. powd
38	tartrate	$Bi_2(C_4H_4O_6)_3.6H_2O$	970.19	wh. powd
39	Methyl bismuthine	$CH_3.BiH_2$	226.04	liq
40	Triethyl bismuthine	$Bi(C_2H_5)_3$	296.12	liq
41	Trimethyl bismuthine	$Bi(CH_3)_3$	254.07	
42	Triphenyl bismuthine	$Bi(C_6H_5)_3$	440.12	monocl
	Boron:			
43	Ethyl boric acid	$(C_2H_5)B(OH)_2$	73.87	wh. cr

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.15	...	150	i.	...	s. al., eth.
2	...	...	2	0.00085	...	s. al., eth.
3	1.152	...	140^{736}	i.	...	...
4	1.124	...	70	sl. s.	...	s. eth.
5	2.19, anh. 2.47	d.	...	76.4^{26}	74^{70}	sl. s. al.
6	...	...	...	s.	...	sl. s. al.
7	...	...	...	37.4^{20}	42.12^{80}	...
8	...	...	...	0.0406^{18}	...	sl. s. al.
9	...	...	...	s.	...	sl. s. al.
10	3.21	...	...	27.76^{0}	39.71^{80}	i. al., eth.
11	...	...	...	0.83^{20}	1.044^{80}	...
12	...	...	...	0.143^{0}	0.326^{80}	...
13	...	...	...	s.	...	s. al.
14	2.658	...	...	0.0093^{18}	0.0228^{100}	s. a., NH_4Cl; i. al.
15	...	...	...	48^{0}	67.9^{80}	...
16	...	...	...	s.	...	...
17	...	...	...	0.421^{0}	0.237^{80}	sl. s. al.
18	$2.980^{20.8}$	...	...	0.026^{18}	0.058^{90}	0.032^{18} al.
19	...	d. 300	...	i.	...	i. al., eth., CCl_4
20	1.36^{4}	284	331	sl. d.	d.	s. chl., ac. a.; sl. s. al., eth.
21	...	127	330	...	...	...
22	1.168^{4}	108	270	sl. s.	d.	s. a. al., eth.
23	...	...	...	v. s.	v. s.	v. s. ac. a., al., acet.; i. CS_2, eth., bz. CCl_4
24	...	...	239^{10}	...	...	...
25	...	$-2H_2O$, 100; $-H_2O$, 220	d. 350	38.22^{5}	...	...
26	...	120	...	...	...	...
27	...	...	170^{25}	d.	d.	...
28	...	12	110^{15}	d. to C_2H_6		...
29	...	...	subl. 200	d. to CH_4		...
30	...	<-17	245	...	...	...
31	...	d.	...	i.	i.	s. ac. a.
32	...	...	...	i.	...	s. a.; i. eth.
33	3.458	d.	...	sl. s.	sl. s.	s. NH_4OH; sl. s. al.
34	...	...	...	14.4^{25}	...	...
35	...	...	...	i.	i.	s. a.
36	...	...	...	i.	...	v. s. dil. HCl; i. al.
37	...	135 d.	...	d.	...	...
38	2.595^{25}	$-3H_2O$, 105	...	i.	i.	s. a., alk.; i. al.
39	2.30^{18}	...	110	i.	i.	s. al., eth.
40	1.82	...	107^{79}	i.	...	s. al. eth.
41	2.300^{18}	...	110	...	...	...
42	1.585	78	...	...	...	v. s. chl.; s. eth., acet.; sl. s. al.
43	...	subl. 40	...	s.	s.	s. al., eth.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Boron:			
1	Tri*iso*amyl borate	$B(OC_5H_{11})_3$	272.08	liq., 1.421
2	Tri*iso*butyl borate	$B(OC_4H_9)_3$	230.03	liq., 1.408
3	Triethyl boron	$(C_2H_5)_3B$	97.94	liq.
4	Triethoxy boron	$B(OC_2H_5)_3$	145.94	liq., 1.381
5	Trimethyl boron	$B(CH_3)_3$	55.89	
6	Trimethoxy boron	$B(OCH_3)_3$	103.89	liq.
7	Tripropoxy boron	$B(OC_3H_7)_3$	187.98	liq.
	Cadmium			
8	acetate	$Cd(C_2H_3O_2)_2.2H_2O$	266.49	monocl. col.; odor ac. a
9	benzoate	$Cd(C_6H_5COO)_2.2H_2O$	390.52	
10	chloroacetate, mono-	$(CH_2ClCOO)_2Cd.6H_2O$	407.45	
11	" di-	$(CHCl_2COO)_2Cd.H_2O$	386.27	need.
12	" tri-	$(CCl_3COO)_2Cd.1\frac{1}{2}H_2O$	464.18	rhomb.
13	cinnamate	$(C_6H_5CHCHCOO)_2Cd$	406.52	
14	formate	$Cd(CHO_2)_2.2H_2O$	238.46	monocl.
15	fumarate	$Cd_2C_4H_2O_4$	338.84	
16	lactate	$Cd(C_3H_5O_3)_2$	290.49	need.
17	maleate	$Cd_2C_4H_2O_4.2H_2O$	374.87	
18	oxalate	$CdC_2O_4.3H_2O$	254.46	wh.
19	salicylate	$Cd(C_7H_5O_3)_2.H_2O$	404.50	need. wh.
20	tartrate	$CdC_4H_4O_6$	260.44	wh. cr. powd.
21	tetrapyridine fluosilicate	$Cd(C_5H_5N)_4SiF_6$	570.66	tricl. wh.
22	Di*iso*amyl cadmium	$Cd(C_5H_{11})_2$	254.58	oil
23	Dibutyl cadmium	$Cd(C_4H_9)_2$	226.55	oil
24	Di*iso*butyl cadmium	$Cd(C_4H_9)_2$	226.55	oil
25	Diethyl cadmium	$Cd(C_2H_5)_2$	170.49	oil
26	Dimethyl cadmium	$Cd(CH_3)_2$	142.46	oil
27	Dipropyl cadmium	$Cd(C_3H_7)_2$	198.52	oil
	Calcium			
28	acetate	$Ca(C_2H_3O_2)_2$	158.13	col., 1.55, 1.56, 1.57
29	"	$Ca(C_2H_3O_2)_2.H_2O$	176.14	col. need.
30	benzoate	$Ca(C_6H_5CO_2)_2.3H_2O$	336.20	rhomb. col.
31	butyrate, normal	$Ca[CH_3(CH_2)_2CO_2]_2.H_2O$	232.20	col.
32	" iso-	$Ca[(CH_3)_2CHCO_2]_2.5H_2O$	304.27	col.
33	cacodylate	$Ca[(CH_3)_2AsO_2]_2$	314.03	wh. gran., alm. odorl. powd.
34	cinnamate	$Ca(C_9H_7O_2)_2.3H_2O$	388.24	col. cr.
35	citrate	$Ca_3(C_6H_5O_7)_2.4H_2O$	570.38	need. wh., 1.515, 1.530, 1.580
36	ethyl sulfate	$Ca(C_2H_5.SO_4)_2.2H_2O$	326.31	wh. cr.
37	formate	$Ca(CHO_2)_2$	130.10	rhomb. col., 1.510, 1.514, 1.578
38	fumarate	$CaC_4H_2O_4.3H_2O$	208.14	rhomb. col.
39	glycerophosphate	$CaO_2.PO.OC_3H_6(OH)_2$	210.15	wh. cr. hyg. powd.
40	lactate	$Ca(C_3H_5O_3)_2.5H_2O$	308.24	wh. powd.
41	linoleate	$Ca(C_{18}H_{31}O_2)_2$	598.56	wh. amor. powd.

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	0.872^{0}	...	255	...	...	...
2	0.864^{0}	...	212	...	...	...
3	0.6961^{23}	...	95	i.	i.	...
4	$0.864^{26.5}$	...	120	...	...	...
5	...	−161.5	−20.2	...	...	...
6	0.915	...	65	...	...	...
7	liq. 0.867^{16}	...	175	...	...	...
8	2.01	$-H_2O$, 130	...	v. s.	v. s.	v. s. al.
9	...	...	...	3.34^{20}	...	...
10	1.942^{25}	...	...	...	...	...
11	2.132^{25}	...	...	...	...	...
12	2.093^{25}	...	...	...	...	...
13	...	...	...	0.7^{26}	...	...
14	2.44	d.	...	v. s.	...	...
15	...	...	...	0.9^{30}	...	...
16	...	...	...	10	12.5	i. al.
17	...	...	...	0.66^{30}	...	...
18	anh. 3.32^{15}	d.	...	0.00337^{0}	0.009	s. a., NH_4OH; i. al.
19	...	...	...	sl. s.	...	s. a., NH_4OH
20	...	...	...	sl. s.	...	s. a., NH_4OH
21	2.282	...	...	...	...	...
22	1.2210^{19}	−115	121.5^{15}	...	...	...
23	$1.3056^{19.5}$	−48	$103.5^{12.5}$	...	...	...
24	1.2693^{18}	−37	90.5^{20}	...	...	...
25	$1.6564^{18.1}$	−21	$640^{19.5}$	...	...	...
26	$1.9846^{17.9}$	−4.5	105.5^{758}	...	...	...
27	$1.4201^{17.6}$	−83	$84^{21.5}$	...	...	...
28	...	d.	...	37.4^{0}	29.7^{100}	sl. s. al.
29	...	d.	...	43.6^{0}	34.3^{100}	sl. s. al.
30	1.436	...	...	2.6^{70}	8.3^{80}	
31	...	...	...	22.0^{0}	17.2^{100}	...
32	...	...	...	28.8^{0}	37.6^{100}	...
33	...	...	...	v. s.	...	...
34	...	...		0.22[illegible]	1.34^{100}	...
35	...	$-2H_2O$, 130	$-4H_2O$, 185	2.5[illegible]	2.10^{95}	0.0065^{18} al.
36	...	...	...	s.	...	s. al.
37	2.015	d.	...	16.2^{0}	18.4^{100}	i. al.
38	...	...	...	2.11^{30}	...	...
39	...	...	...	2^{25}	less s.	i. al.
40	...	$-3H_2O$, 100	...	3.1^{0}	7.9^{30}	sl. s. a.: i. al., eth.
41	...	...	...	i.	...	s. al., eth.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Calcium			
1	malate, *act*	$CaC_4H_4O_5.2H_2O$	208.14	col
2	" *rac*	$CaC_4H_4O_5.3H_2O$	226.16	rhomb. col., 1.545, 1.555, 1.575
3	" acid	$Ca(HC_4H_4O_5)_2.6H_2O$	414.25	rhomb. or wh. cr. powd., 1.493, 1.507, 1.545
4	maleate	$CaC_4H_2O_4.H_2O$	172.11	rhomb. col., 1.495, 1.575, 1.640
5	malonate	$CaC_3H_2O_4.4H_2O$	214.16	
6	oxalate	CaC_2O_4	128.08	cub. col
7	palmitate	$Ca(C_{16}H_{31}O_2)_2$	550.56	wh. or yelsh-wh. powd
8	phenate	$Ca(OC_6H_5)_2$	226.16	redsh. powd
9	phenolsulfonate	$Ca[C_6H_4(OH)SO_3]_2.H_2O$	404.29	wh. to pinkish powd
10	propionate	$Ca(CH_3CH_2CO_2)_2.H_2O$	204.17	col
11	salicylate	$Ca(C_7H_5O_3)_2.3H_2O$	368.20	oct. wh
12	succinate	$CaC_4H_4O_4.3H_2O$	210.16	col
13	tartrate, *act*	$CaC_4H_4O_6.4H_2O$	260.17	rhomb., 1.525, 1.535, 1.550
14	" *rac*	$CaC_4H_4O_6.4H_2O$	260.17	tricl
15	*iso*valerate	$Ca(C_5H_9O_2)_2.3H_2O$	296.27	wh. cr. powd
16	Dianiline calcium	$(C_6H_5NH_2)_2Ca$	226.21	wh. cr
17	Ditoluidine calcium(*o*)	$(CH_3C_6H_4NH)_2Ca$	252.22	wh. powd
18	Ethyl iodide calcium	C_2H_5CaI	196.04	amor. powd
19	Glycocoll calcium	$(CH_2NHCOO)Ca$	113.11	cr
	Cerium			
20	acetate (ous)	$Ce(C_2H_3O_2)_3.1\frac{1}{2}H_2O$	344.22	wh.-redsh. cr. powd
21	acetylacetonate (ous)	$Ce(CH_3COCHCOCH_3)_3.3H_2O$	491.34	lt. yel. cr. ppt
22	benzoate (ous)	$Ce(C_7H_5O_2)_3.3H_2O$	557.29	wh. to redsh-wh. powd
23	citrate (ous)	$Ce(C_6H_5O_7).3\frac{1}{2}H_2O$	392.22	wh. powd
24	hexaantipyrine perchlorate (ous)	$[Ce(COC_{19}H_{12}N_2)_6(ClO_4)_3]$	2215.16	col. hex. cr
25	hexaantipyrine iodide (ous)	$[Ce(COC_{19}H_{12}N_2)_6I_3]$	2297.55	large yel. cr
26	oxalate (ous)	$Ce_2(C_2O_4)_3.9H_2O$	706.40	yel.-wh. cr
27	salicylate (ous)	$Ce(C_7H_5O_3)_3$	551.25	wh. to redsh-wh. powd
28	valerate (ous)	$Ce_2(C_5H_9O_2)_6.5H_2O$	976.76	wh. to redsh-wh. powd
	Cesium			
29	acetate	$CsC_2H_3O_2$	191.83	deliq
30	benzoate	$Cs(C_7H_5O_2)$	253.85	
31	formate	$CsCHO_2$	177.82	
32	"	$CsCHO_2.H_2O$	195.83	
33	oxalate	$Cs_2C_2O_4$	353.62	
34	phthalate, acid	$CsHC_8H_4O_4$	297.85	rhomb
35	salicylate	$CsC_7H_5O_3$	269.85	
36	tartrate, acid	$CsHC_4H_4O_6$	281.85	wh. rhomb. cr
37	" dihydroxy	$Cs_2C_4H_4O_8.2H_2O$	481.68	
	Chromium			
38	acetate (ic)	$Cr(C_2H_3O_2)_3.H_2O$	247.10	gray-grn. powd. or bluish-grn., pasty mass
39	hexaurea fluosilicate	$[Cr(OCN_2H_4)_6]_2[SiF_6]_3.3H_2O$	1304.81	leaves, lt. grn
40	oxalate (ous)	$Cr(C_2O_4).H_2O$	158.03	yel. cr. powd

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	......	......	......	0.812^{0}	$1.224^{37.5}$	i. al.
2	......	......	......	0.321^{0}	$0.451^{37.5}$	i. al.
3	......	......	......	sl. s.	......	......
4	......	......	......	2.89^{25}	3.21^{40}	......
5	......	......	......	0.44^{0}	0.72^{100}	......
6	2.2^{4}	d.	......	0.00067^{13}	0.0014^{95}	s. a.; i. ac. a.
7	......	......	......	i.	......	v. sl. s. al.
8	......	......	......	sl. s.	......	sl. s. al.
9	......	......	......	s.	......	s. al.
10	......	......	......	49.0^{0}	55.8^{100}	......
11	......	......	......	2.70^{15}	44.7^{100}	s. al.
12	......	......	......	1.52^{0}	0.89^{80}	......
13	......	d.	......	0.0266^{0}	$0.0689^{37.5}$	sl. s. al.
14	......	d.	......	0.0032^{0}	$.0078^{37.5}$	
15	......	......	......	s.	......	......
16	......	d.	......	d.	......	i. eth., bz., lgn.
17	......	d.	......	d.	......	......
18	......	......	......	d.	......	sl. s.
19	......	......	......	s.	......	......
20	......	$-1\frac{1}{3}H_2O$, 115	d.	19.61^{15}	less s.	......
21	......	131-132	......	d.	......	v. s. al.
22	......	......	......	......	sl. s.	sl. s. hot al.
23	......	......	......	i.	......	s. dil. min. a.
24	......	295-300 d.	......	1.08^{20}	......	......
25	......	268-70	......	15.10^{20}	......	......
26	......	d.	......	0.053^{25}	......	s. H_2SO_4, HCl; i. $H_2C_2O_4$, al. alk., eth.
27	......	......	......	i.	......	......
28	......	......	......	v. sl. s.	......	......
29	......	194	......	$945.1^{-2.5}$	......	$1345.5^{88.5}$
30	......	......	......	294.5^{0}	398.5^{100}	......
31	......	265	......	......	$2012^{95.4}$	......
32	......	$-H_2O$, 41	......	369.9^{1}	......	......
33	......	......	......	282.9^{25}	......	......
34	2.178	......	......	......	......	......
35	......	......	......	196.2^{0}	1522^{100}	......
36	......	......	......	9.7^{25}	98^{100}	......
37	......	......	......	22.5^{0}	......	......
38	......	......	......	s.	......	i.al.
39	......	......	......	$.522^{20}$	......	i. al.
40	......	......	......	......	s.	......

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Chromium			
1	potassium oxalate	$K_3Cr(C_2O_4)_3.3H_2O$	487.36	vlt.-red cr. mass
	Cobalt			
2	acetate (ous)	$Co(C_2H_3O_2)_2.4H_2O$	249.05	monocl. red-vlt., deliq
3	benzoate (ous)	$Co(C_6H_5CO_2)_2.4H_2O$	373.08	gray-red leaf
4	*n*-butyrate (ous)	$Co(C_4H_7O_2)_2$	233.05	purp.-red gran. powd
5	citrate (ous)	$Co_3(C_6H_5O_7)_2.2H_2O$	590.93	rose-red
6	formate (ous)	$Co(CHO_2)_2.2H_2O$	184.99	red cr
7	linoleate (ous)	$Co(C_{18}H_{31}O_2)_2$	617.42	brown amor
8	oleate (ous)	$Co(C_{18}H_{33}O_2)_2$	621.45	br. amor. powd
9	oxalate (ous)	CoC_2O_4	146.94	redsh. wh
10	propionate (ous)	$Co(C_3H_5O_2)_2.3H_2O$	259.06	dk. red cr
11	tartrate (ous)	$CoC_4H_4O_6$	206.97	monocl. redsh
12	tetrapyridine fluosilicate	$Co(C_5H_5N)_4SiF_6$	517.19	rhomb. pink
	Columbium			
13	oxalate	$Cb(HC_2O_4)_5$	538.34	monocl
	Copper			
14	acetate (ic)	$Cu(C_2H_3O_2)_2.H_2O$	199.63	dk. grn. powd., 1.545, 1.550
15	" ammoniated (ic)	$Cu(C_2H_3O_2)_2.2NH_3$	215.68	vlt.-bl. cr
16	" basic	$CuO.Cu(C_2H_3O_2)_2.6H_2O$	369.28	grnsh.-bl. powd
17	acetoarsenite (ic) (Paris green)	$(CuOAs_2O_3)_3.Cu(C_2H_3O_2)_2$	1013.91	em. grn. powd
18	acetylide (ous)	$Cu_2C_2.H_2O$	169.16	amor. red
19	benzoate (ic)	$Cu(C_6H_5COO)_2.2H_2O$	341.68	lt.-bl. cr. powd
20	butyrate (ic)	$Cu(C_4H_7O_2)_2.2H_2O$	273.71	dk.-grn. cr.; odor butyric a.
21	citrate (ic)	$2Cu_2C_6H_5O_7.5H_2O$	722.44	bluish-grn. powd
22	formate (ic)	$Cu(CHO_2)_2$	153.59	monocl. bl
23	lactate (ic)	$Cu(C_3H_5O_3)_2.2H_2O$	277.68	monocl. dk. bl
24	oxalate (ic)	$CuC_2O_4.\frac{1}{2}H_2O$	160.58	bl. wh
25	palmitate (ic)	$Cu(C_{16}H_{31}O_2)_2$	574.05	grn.-bl. powd
26	phenolsulfonate	$Cu(C_6H_5SO_4)_2.6H_2O$	517.86	bl.-grn. cr
27	salicylate (ic)	$Cu(C_7H_5O_3)_2.4H_2O$	409.71	bl.-grn. need
28	stearate (ic)	$Cu(C_{18}H_{35}O_2)_2$	630.12	lt.-bl. amor. powd
29	tartrate (ic)	$CuC_4H_4O_6$	211.60	lt.-bl. powd
30	tetrapyridine fluosilicate (ic)	$Cu(C_5H_5N)_4SiF_6$	521.82	rhomb. purplish-blue
	Dysprosium			
31	acetate	$Dy(C_2H_3O_2)_3.4H_2O$	411.59	yel. need
32	oxalate	$Dy_2(C_2O_4)_3.10H_2O$	769.08	pr
	Erbium			
33	acetate	$Er(C_2H_3O_2)_3.4H_2O$	416.77	triclinic
34	oxalate	$Er_2(C_2O_4)_3.10H_2O$	779.44	redsh. micr. powd
	Gadolinium			
35	acetate	$Gd(C_2H_3O_2)_3.4H_2O$	406.43	tricl
36	oxalate	$Gd_2(C_2O_4)_3.10H_2O$	758.76	monocl
	Gallium			
37	acetate, basic	$4Ga(C_2H_3O_2)_3.2Ga_2O_3.5H_2O$	1452.12	micr. cr., wh
38	acetylacetonate	$Ga(C_5H_7O_2)_3$	366.88	α monocl. or., β rhomb. or
39	oxalate	$Ga_2(C_2O_4)_3.4H_2O$	475.50	micr. powd. wh., hyg

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	......	......	20^{15}	......	......
2	1.705^{19}	......	$-4H_2O$, 140	s.	s.	s. a., al.
3	......	$-4H_2O$, 115	......	v. s.	......	......
4	......	......	......	s.	......	......
5	......	$-2H_2O$, 150	......	0.8	......	......
6	2.129^{22}	$-2H_2O$, 140	anh. d. 175	5.03^{20}	......	......
7	......	......	......	i.	......	s. al.; eth., acet.
8	......	......	......	i.	......	s. al., eth., oils, bz.
9	2.325^{15}	......	......	i.	......	s. a., NH_4OH
10	......	ca. 250	......	anh. 33.5^{11}	......	v. s. al.
11	......	......	......	sl. s.	......	s. dil. a.
12	2.215	......	......	......	......	......
13	......	......	......	d.	d.	s. $H_2C_2O_4$; d. al.
14	1.882	115	240 d.	7.2	20	7.14 al.; s. eth.
15	......	......	......	s.	......	s. ac. a., NH_4OH; i al
16	......	......	......	sl. s.	......	s. dil. a., NH_4OH; sl. s. al.
17	......	......	......	i.	......	s. a. NH_4OH; i. al.
18	......	exp.	......	v. sl. s.	......	s. a., KCN
19	......	......	......	sl. s.	......	s. dil. a.; sl. s. al.
20	......	......	......	v. sl. s.	......	s. al., eth., NH_4OH, dil. a.
21	......	......	......	i.	......	s. a., NH_4OH
22	1.831	......	......	12.5	d.	0.25 al.
23	......	......	......	16.7	45^{100}	s. NH_4OH; sl. s. al.
24	......	......	......	$.00253^{25}$	......	s. NH_4OH; i. ac. a.
25	......	120	......	i.	......	sl. s. al.
26	......	......	......	s.	......	s. al.
27	......	......	......	v. s.	......	v. s. al., NH_4OH
28	......	125	......	i.	......	s. eth., bz., chl., turp.
29	......	......	......	v. sl. s.	......	s. a., alk.
30	2.108	......	......	......	......	......
31	......	d. 120	......	s.	......	v. sl. s. al.
32	......	......	......	i.	......	s. dil. a.
33	2.114	......	......	......	......	......
34	2.64(?)	d. 575	3000	......	......	......
35	1.611	......	......	11.6^{25}	......	......
36	......	$-6H_2O$, 110	......	0.11	......	s. HNO_3; sl. s. a.
37	......	d. > 160	......	s.	d.	i. ac. a.
38	α 1.42, β 1.41	194–5	subl. 140^{10}	s.	s.	s. acet.
39	......	d. > 160	......	0 4	......	......

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Gallium			
1	oxyquinolate	$Ga(C_9H_6NO)_3$	501.88	grn.-yel. cr
2	Dimethylgallium amide	$Ga(CH_3)_2NH_2$	115.79	wh. cr
3	Dimethylgallium chloride monammine	$Ga(CH_3)_2Cl.NH_3$	152.26	wh. cr
4	Dimethylgallium chloride diammine	$Ga(CH_3)_2Cl.2NH_3$	169.29	wh. cr
5	Methylgallium dichloride	$Ga(CH_3)Cl_2$	155.66	wh. cr
6	Methylgallium dichloride monammine	$Ga(CH_3)Cl_2.NH_3$	172.69	wh. cr
7	Methylgallium dichloride pentammine	$Ga(CH_3)Cl_2.5NH_3$	240.81	wh. cr
8	Triethylgallium	$Ga(C_2H_5)_3$	156.84	col. liq
9	Triethylgallium monammine	$Ga(C_2H_5)_3.NH_3$	173.87	col. liq
10	Triethylgallium monoetherate	$Ga(C_2H_5)_3.(C_2H_5)_2O$	230.92	col. liq
11	Trimethylgallium	$Ga(CH_3)_3$	114.79	col. liq
12	Trimethylgallium monammine	$Ga(CH_3)_3.NH_3$	131.82	wh. cr
13	Trimethylgallium monoetherate	$Ga(CH_3)_3.(C_2H_5)_2O$	188.87	col. liq
	Germanium:*			
14	Tetraethoxylgermanium	$Ge(OC_2H_5)_4$	252.76	col. liq
15	Tetraethylgermanium	$Ge(C_2H_5)_4$	188.76	1.400
	Hydrazine			
16	formate	$N_2H_4.2HCOOH$	124.08	cub
	Iron			
17	acetate (ous)	$Fe(C_2H_3O_2)_2.4H_2O$	245.95	need
18	" basic (ic)	$FeOH(C_2H_3O_2)_2$	190.89	br.-red powd
19	ammonium oxalate (ic)	$(NH_4)_3Fe(C_2O_4)_3$	373.96	monocl. grn
20	benzoate (ic)	$Fe_2(C_7H_5O_2)_6$	837.91	br. powd
21	cacodylate (ic)	$Fe[(CH_3)_2AsO_2]_3$	466.77	yelsh amor. powd
22	citrate (ic)	$FeC_6H_5O_7.3H_2O$	298.93	red-br. scales
23	formate (ic)	$Fe(CHO_2)_3$	190.86	cr., red powd
24	" "	$Fe(CHO_2)_3.H_2O$	208.88	yel. cr
25	" (ous)	$Fe(CHO_2)_2.2H_2O$	181.89	
26	glycerophosphate (ic)	$Fe_2[C_3H_5(OH)_2.OPO_3]_3$	621.90	yelsh.-grn. scales or powd
27	lactate (ic)	$Fe(C_3H_5O_3)_3$	322.96	br. amor., deliq
28	" (ous)	$Fe(C_3H_5O_3)_2.3H_2O$	287.96	grn.-wh. cr. or powd
29	malate (ic)	$Fe_2(C_4H_4O_5)_3$	507.77	br. hyg. scales
30	monomethylarsenate	$Fe_2(CH_3AsO_3)_3$	525.54	redsh.-br. lust. scales
31	oleate (ic)	$Fe(C_{18}H_{33}O_2)_3$	899.61	br.-red fatty lumps
32	oxalate (ic)	$Fe_2(C_2O_4)_3$	375.68	amor
33	" (ous)	$FeC_2O_4.2H_2O$	179.87	rhomb. pa. yel
34	potassium oxalate (ic)	$K_3Fe(C_2O_4)_3.3H_2O$	491.19	monocl. grn
35	" " (ous)	$K_2Fe(C_2O_4)_2.2H_2O$	346.07	gold need
36	sodium oxalate (ic)	$2Na_3Fe(C_2O_4)_3.9H_2O$	939.80	grn. cr
37	tartrate (ic)	$Fe_2(C_4H_4O_6)_3.H_2O$	573.79	redsh.-br. scales
38	" (ous)	$FeC_4H_4O_6$	203.87	cryst
	Lanthanum			
39	acetate	$La(CH_3COO)_3.1\frac{1}{2}H_2O$	343.01	

* See end of table.

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	> 150	subl. vac.	.0001	.0012	s. a., alk.; sl. s. al.
2	....	....	subl. 60 vac.	....	....	....
3	....	54	....	d.	d.	v. s. NH_3; s. eth.
4	....	112	....	d.	d.	v. s. NH_3; i. eth.
5	....	75	....	d.	....	v. s. eth.
6	....	....	....	d.	....	i. eth.
7	....	d. > 80	....	d.	....	i. NH_3
8	1.0576^{30}	−82.3	142.6	d.	....	s. eth.
9	....	....	....	d.	....	....
10	....	....	....	d.	....	s. eth.
11	....	−19	$55.7 \pm .2^{762}$	d.	....	s. eth., NH_3
12	....	31	subl. vac.	d.	....	s. eth., NH_3; i. pet. eth.
13	....	<−76	99^{762}	d.	....	s. NH_3, eth
14	....	−81	185 − 7	....	....	....
15	$0.991^{24.2}_{24.8}$	−90	163.5	i.	....	s. HCl
16	....	128	....	s.	....	....
17	....	d.	....	v. s.	....	....
18	....	....	....	i.	....	s. a., al.
19	1.78	d. 165	....	42.7^{0}	345^{100}	....
20	....	....	....	i.	....	s. h. eth., al.
21	....	....	....	6.67	....	sl. s. al.
22	....	....	....	s.	s.	i. al.
23	....	....	....	s.	....	v. sl. s. al.
24	....	....	....	s.	d.	....
25	....	d.	....	sl. s.	....	....
26	....	....	....	50^{25}	....	i. al.
27	....	....	....	s.	v. s.	i. eth.
28	....	d.	....	2.1^{10}	8.5^{100}	s. alk. citrate; v. sl. s. al
29	....	....	....	s.	....	s. al.
30	....	....	....	50	....	i. al., eth.
31	....	....	....	i.	....	s. a., al., eth.
32	....	d. 100	....	v. s.	v. s.	s. a.; i. al.
33	2.28	d. 160	....	0.022	0.026	s. a.
34	....	....	....	s.	....	sl. s. al.
35	....	d.	....	s.	s.	....
36	....	....	....	40	....	....
37	....	....	....	s.	....	....
38	....	....	....	0.877^{16}	....	....
39	....	....	....	16.88^{25}	....	....

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Lanthanum			
1	citrate	$2(LaC_2H_5O_7).7H_2O$	686.03	
2	hexaantipyrine *per*chlorate	$[La(COC_{19}H_{12}N_2)_6(ClO_4)_3]$	2213.95	col. hex. cr.
3	hexaantipyrine iodide	$[La(COC_{19}H_{12}N_2)_6I_3]$	2296.34	yel. cr
4	oxalate	$La_2(C_2O_4)_3.9H_2O$	703.98	wh.
	Lead			
5	acetate	$Pb(C_2H_3O_2)_2.3H_2O$	379.31	monocl. wh., β 1.576
6	"	$Pb(C_2H_3O_2)_2.10H_2O$	505.42	rhomb. cr.
7	" basic	$Pb_2(C_2H_3O_2)_3OH$	608.52	wh.
8	" "	$Pb(C_2H_3O_2)_2Pb(OH)_2.H_2O$	584.52	monocl. wh.
9	" "	$Pb(C_2H_3O_2)_22Pb(OH)_2$	807.74	wh. micr. need
10	benzoate	$Pb(C_7H_5O_2)_2.H_2O$	467.31	wh. cr. powd
11	citrate	$Pb_3(C_6H_5O_7)_2.3H_2O$	1053.78	wh. cr. powd
12	formate	$Pb(CHO_2)_2$	297.24	rhomb. wh. lust., 1.789, 1.852, 1.877
13	laurate	$Pb(C_{12}H_{23}O_2)_2$	605.58	
14	myristate	$Pb(C_{14}H_{27}O_2)_2$	661.64	
15	naphthalenesulfonate (β)	$Pb(C_{10}H_7SO_3)_2$	621.45	wh. cr. powd., pois.
16	oxalate	PbC_2O_4	295.22	heavy. wh. powd
17	palmitate	$Pb(C_{16}H_{31}O_2)_2$	717.70	
18	stearate	$Pb(C_{18}H_{35}O_2)_2$	773.77	wh. powd
19	tartrate	$PbC_4H_4O_6$	355.25	wh. cr. powd
20	Tetraethyllead	$Pb(C_2H_5)_4$	323.38	col. liq., or flame, grn. marg., 1.5218.
21	Tetramethyllead	$Pb(CH_3)_4$	267.31	liq , 1.5128
22	Tetraphenyllead	$Pb(C_6H_5)_4$	515.38	wh. need
23	Triethyllead	$Pb_2(C_2H_5)_6$	588.67	liq
	Lithium			
24	acetate	$LiC_2H_3O_2.2H_2O$	101.99	rhomb. wh., α 1.40, β 1.50
25	acetylsalicylate	$LiC_9H_7O_4$	185.99	sl. hyg. powd.; d. in moist air
26	benzoate	$LiC_7H_5O_2$	127.98	wh. cr. or powd
27	citrate	$Li_3C_6H_5O_7.4H_2O$	281.92	col. cr. or wh. powd., deliq
28	formate	$LiCHO_2.H_2O$	69.96	rhomb. col
29	lactate	$LiC_3H_5O_3$	95.98	wh. cr. powd
30	laurate	$LiC_{12}H_{23}O_2$	206.12	
31	myristate	$LiC_{14}H_{27}O_2$	234.15	
32	oxalate	$Li_2C_2O_4$	101.88	col. cr
33	" acid	$LiHC_2O_4.H_2O$	113.96	
34	palmitate	$LiC_{16}H_{31}O_2$	262.18	
35	salicylate	$LiC_7H_5O_3$	143.98	wh. powd., deliq
36	stearate	$LiC_{18}H_{35}O_2$	290.21	
37	tartrate	$Li_2C_4H_4O_6.H_2O$	179.93	wh. cr. powd
38	thallium tartrate	$TlLi(dl\text{-}C_4H_4O_6).2H_2O$	395.39	tricl
39	urate	$LiHC_5H_2N_4O_3$	174.00	wh. powd
	Magnesium			
40	acetate	$Mg(C_2H_3O_2)_2.4H_2O$	214.43	monocl. col., deliq., β 1.491
41	benzoate	$Mg(C_7H_5O_2)_2.3H_2O$	320.44	wh. powd
42	citrate	$Mg_3(C_6H_5O_7)_2.14H_2O$	703.26	wh. gran. powd
43	formate	$Mg(CHO_2)_2.2H_2O$	150.37	rhomb. col

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	......	......	......	......	......	0.8^{20} 10% clt. a.
2	......	290–5 d.	......	1.50^{20}	......	......
3	......	268–9 d.	......	41.8^{20}	......	......
4	......	d.	......	$.00008^{25}$	......	......
5	2.55	75	280	45.61^{15}	200^{100}	i. al.
6	1.69	22	......	s.	......	i. al.
7	......	......	......	v. s.	......	sl. s. al.
8	......	......	......	v. s.	......	v. s. al.
9	......	......	......	5.55	18.2	s. al.
10	......	......	......	sl. s.	......	......
11	......	......	......	s.	......	......
12	4.63	d. 190	......	1.6^{16}	18^{100}	i. al.
13	......	104.7	......	0.009^{35}	......	0.009^{25} al.
14	......	108.7	......	0.005^{35}	......	0.004^{25} al.
15	......	......	......	i.	......	s. al.
16	5.28	d. 300	......	0.00016^{18}	......	s. HNO_3; i. al.
17	......	112.3	......	0.005^{35}	......	0.000^{25} al.
18	......	115.7	......	0.005^{35}	......	0.000^{25} al.
19	......	......	......	i.	......	s. HNO_3, KOH; i. al., ac. a., amm. acetate
20	1.659^{18}	......	200 d.; 91^{19}	i.	......	s. bz., pet. eth.; sl. s. al.
21	1.995	−27.5	110	i.	......	s. bz., pet. eth.; sl. s. al.
22	......	227.7	......	......	......	s. bz.
23	1.471	......	d.	i.	......	......
24	......	70	d.	300^{15}	v. s.	21.5 al.
25	......	......	......	100	......	25 al.
26	......	......	......	33^{25}	40^{100}	7.7^{25}, 10^{78} al.
27	......	d.	......	74.5^{25}	66.7^{100}	sl. s. al. eth.
28	1.46	d.	......	24.42^{0}	57.64^{104}	s. form. a.
29	......	......	......	s.	......	......
30	......	229.5	......	0.187^{25}	......	0.447^{25} al.
31	......	223.9	......	0.036^{25}	......	0.224^{25} al.
32	$2.121^{17.5}$	d.	......	$8^{19.5}$	......	......
33	......	d.	......	8^{17}	......	......
34	......	224.5	......	0.015^{25}	......	0.118^{25} al.
35	......	d.	......	133.3	......	50 al.
36	......	221.0	......	0.010^{25}	......	0.089^{25} al.
37	......	......	......	s.	......	......
38	3.144	......	......	......	......	......
39	......	......	......	$.27^{20}$	2.5^{100}	sl. s. al.
40	1.454	d.	......	36.2^{0}; 61.1^{15}	66.4^{68}	v. s. al.
41	......	d. 200 (?)	......	6.16^{15}	19.6^{100}	s. al.
42	......	......	......	sl. s	......	s. a.
43	......	......	......	7.7	......	i. al., eth

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Magnesium			
1	lactate	$Mg(C_3H_5O_3)_2.3H_2O$	256.44	wh. cr. powd.; v. bitter taste
2	laurate	$Mg(C_{12}H_{23}O_2)_2$	422.68	
3	myristate	$Mg(C_{14}H_{27}O_2)_2$	478.74	
4	oleate	$Mg(C_{18}H_{33}O_2)_2$	586.83	yelsh. powd. or mass
5	oxalate	$MgC_2O_4.2H_2O$	148.35	wh. powd
6	palmitate	$Mg(C_{16}H_{31}O_2)_2$	534.80	
7	salicylate	$Mg(C_7H_5O_3)_2.4H_2O$	370.46	col. or sl. redsh. effl. cr. powd
8	stearate	$Mg(C_{18}H_{35}O_2)_2$	590.87	wh. powd
9	tartrate (*d*)	$Mg(C_4H_4O_6).5H_2O$	262.43	monocl
10	" (*d*) acid	$MgH_2(C_4H_4O_6)_2.4H_2O$	394.46	rhomb
	Manganese			
11	acetate	$Mn(C_2H_3O_2)_2.4H_2O$	245.04	monocl. pa. red
12	benzoate	$Mn(C_7H_5O_2)_2.3H_2O$	351.05	flat pr
13	butyrate	$Mn(C_4H_7O_2)_2$	229.04	rose-red powd
14	cacodylate	$Mn[(CH_3)_2AsO_2]_2$	328.88	redsh.-wh. cr. powd
15	citrate	$Mn_3(C_6H_5O_7)_2$	542.87	wh.-redsh. powd
16	formate	$Mn(CHO_2)_2.2H_2O$	180.98	rhomb
17	glycerophosphate	$MnC_3H_7O_2PO_4$	225.00	wh. or sl. redsh. odorl. powd
18	lactate	$Mn(C_3H_5O_3)_2.3H_2O$	287.05	monocl. pa. red
19	tartrate	$MnC_4H_4O_6$	202.96	wh. powd
20	valerate	$Mn(C_5H_9O_2)_2.2H_2O$	293.10	br. powd
	Mercury			
21	acetate (ic)	$Hg(C_2H_3O_2)_2$	318.66	wh. sc. or powd
22	" (ous)	$HgC_2H_3O_2$	259.63	micaceous scales
23	acetylide (ic)	$3C_2Hg.H_2O$	691.85	wh. powd
24	benzoate (ic)	$Hg(C_6H_5COO)_2$	442.69	wh. cr. powd
25	citrate (ous)	$Hg_3(COO)_3.CH_2.COH.CH_2$	790.87	wh. powd
26	diammonium acetate (ous)	$(NH_3)_2Hg(C_2H_3O_2)_2.H_2O$	370.74	rect. pl
27	formate (ous)	$HgCHO_2$	245.62	glist. scales
28	fulminate (ic)	$HgC_2N_2O_2$	284.63	cub. wh
29	oxalate (ic)	HgC_2O_4	288.61	
30	" (ous)	$Hg_2C_2O_4$	489.22	
31	potassium tartrate (ous)	$HgKC_4H_4O_6$	387.74	wh. cr. powd
32	tartrate (ous)	$Hg_2C_4H_4O_6$	549.25	yelsh.-wh. cr. powd
33	" bi- (ous)	$HgHC_4H_4O_6$	349.65	wh. cr. powd
34	Aminophenylmercuric acetate (*p*)	$C_6H_4(NH_2)HgO_2C_2H_3$	251.69	col. pr
35	Biphenylmercury	$(C_6H_5\text{-}C_6H_4)_2Hg$	506.75	sm. scales
36	Chloromercuriphenol (*o*)	$C_6H_4OHHgCl$	329.11	
37	Dibenzylmercury	$(C_7H_7)_2Hg$	382.72	long brittle col. need
38	Di*iso*butylmercury	$(C_4H_9)_2Hg$	314.75	col. liq
39	Diethylmercury	$(C_2H_5)_2Hg$	258.69	col. liq of hazel odor
40	Dimethylaminophenylmercuric acetate (*p*)	$C_6H_4N(CH_3)_2HgO_2C_2H_3$	379.72	long. col. need
41	Dimethylaniline mercury (*p*)	$[C_6H_4N(CH_3)_2]_2Hg$	440.78	lust. need
42	Dimethylmercury	$(CH_3)_2Hg$	230.66	col. liq., sweet odor
43	Dinaphthylmercury (*α*)	$C_{10}H_9Hg$	329.68	rhomb. wh

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	3.3	16.7^{100}	i. al., eth.
2	....	150.4	....	0.007^{25}	....	0.591^{25} al.
3	....	131.6	....	0.006^{25}	....	0.023^{25} al.
4	....	....	....	i.	....	s. linseed oil; sl. s. al., eth.
5	$2.45(2\frac{1}{2}H_2O)$	d.	....	0.07^{16}	0.08^{100}	s. a., alk. oxal.
6	....	121.5	....	0.008^{25}	....	0.058^{25} al.
7	....	....	....	s.	....	s. al.
8	....	132	....	0.004^{25}	....	0.023^{25} al.
9	1.67	d.	d.	0.8^{18}	1.44^{90}	i. al. NH_3
10	1.72	....	....	....	....	....
11	1.589	....	....	s.	....	s. al.
12	....	....	....	6.55^{15}	....	....
13	....	....	....	s.	....	....
14	....	....	....	s.	....	....
15	....	....	....	v. sl. s.	....	s. soln. sod. cit., dil. a.
16	1.953	d.	....	s.	s.	....
17	....	....	....	sl s.	....	s. a., cit. a.; i. al.
18	....	d.	....	s.	v. s.	s. al.
19	....	....	....	v sl s.	....	....
20	....	....	....	s.	....	....
21	3.270	d.	....	25^{10}	100^{100}	s al.
22	....	d.	....	0.75^{13}	....	s. H_2SO_4, HNO_3
23	5.3	exp.	....	i.	i.	i. al.
24	....	165	....	sl. s	s.	s. al., NaCl, amm. benz.
25	....	....	....	v. sl. s.	....	....
26	....	d.	....	v. s.	....	sl. s. al.
27	....	d.	....	0.4^{17}	d.	i. al.
28	4.42	exp.	....	sl. s.	s.	s. al., NH_4OH
29	....	d.	....	i.	i.	s. HCl; sl. s. HNO_3
30	....	....	....	i.	i.	sl. s. HNO_3
31	....	....	....	i.	....	i. al.
32	....	....	....	i.	....	i. a.
33	....	....	....	i.	....	....
34	....	167	....	i.	i.	s. dil. a.; sl. s. chl. al.; i. eth.
35	....	216	....	difficultly	soluble in	common solv.
36	....	152.5°	....	....	....	s. NaOH
37	....	....	....	....	....	s. al., eth., chl., CS_2, ac. a. bz., eth. acet.; sl. s. lgr.
38	1.835^{16}	volat. 100	205–7	v. sl. s.	....	s. eth., al.
39	2.44	....	159°	i.	i.	v. s. eth.; sl. s. al.
40	....	165	....	i.	i.	s. bz., chl., al., dil. a.
41	....	169	....	....	....	s. chl.; sl. s. al., eth. dil. HCl
42	3.069	....	93–96	....	....	s. al., eth.
43	1.929	243 (188)	....	i.	sl. s.	s. h. CS_2, chl.; sl. s. bz eth.; v. sl. s. h. bz.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Mercury:			
1	Diphenylmercury	$(C_6H_5)_2Hg$	354.69	wh. glassy need.
2	Dipropylmercury	$(CH_3CH_2CH_2)_2Hg$	286.72	col. mobile liq.
3	Ditolylmercury (*o*)	$C_7H_7HgC_7H_7$	382.72	wh. tabl.
4	Ethane hexamercarbide	$C_2Hg_6O_2(OH)_2$	1293.68	yelsh.-wh. powd.
5	Ethylmercuric chloride	C_2H_5HgCl	265.11	silv. irid. leaf
6	" hydroxide	C_2H_5HgOH	246.66	silv. irid. leaf
7	Methylmercuric chloride	CH_3HgCl	251.09	wh. cr., disg. odor
8	" iodide	CH_3HgI	342.55	col. pearly leaf
9	Naphthylmercuric acetate (α)	$C_{10}H_9HgO_2C_2H_3$	388.70	fine need.
10	Naphthylmercuric chloride (α)	$C_{10}H_9HgCl$	365.14	silk quad. tabl.
11	Phenylmercuric acetate	$C_6H_5HgO_2C_2H_3$	336.67	rhomb. sm. wh. lust. pr.
12	" bromide	C_6H_5HgBr	357.57	rhomb. wh. lust. tabl.
13	" chloride	C_6H_5HgCl	313.11	wh. satiny leaf
14	" cyanide	C_6H_5HgCN	303.66	rhomb. long pr.
15	" nitrate	$C_6H_5HgNO_3$	339.66	rhomb. tabl.
16	Tolylmercuric bromide (*p*)	C_7H_7HgBr	371.58	thin lust. gray sc.
17	Tolylmercuric chloride (*p*)	C_7H_7HgCl	327.12	rhomb. silky tabl.
	Neodymium			
18	acetate	$Nd(C_2H_3O_2)_3.H_2O$	339.36	
19	acetylacetonate	$Nd(CH_3COCHCOCH_3)_3$	441.43	vlt. cr.
20	hexaantipyrine perchlorate	$[Nd(COC_{19}H_{12}N_2)_6(ClO_4)_3]$	2219.30	rose hex. cr.
21	" iodide	$[Nd(COC_{19}H_{12}N_2)_6I_3]$	2301.69	rose cr.
22	oxalate	$Nd_2(C_2O_4)_3.10H_2O$	732.70	rose cr.
	Nickel			
23	acetate	$Ni(C_2H_3O_2)_2$	176.74	grn. pr.
24	dimethylglyoxime	$Ni[(CH_3)_2(CNO)_2H]_2$	288.83	scarlet red cr.
25	formate	$Ni(CHO_2)_2.2H_2O$	184.74	grn. cr.
26	oxalate	$NiC_2O_4.2H_2O$	182.72	lt.-grn. powd.
27	tetrapyridine fluosilicate	$Ni(C_5H_5N)_4SiF_6$	516.94	rhomb. bl.-grn.
	Potassium			
28	acetate	$KC_2H_3O_2$	98.12	lust. wh. powd., deliq.
29	" acid	$KH(C_2H_3O_2)_2$	158.15	need. or pl.
30	acetylsalicylate	$K.C_9H_7O_4.2H_2O$	254.19	
31	ammonium tartrate	$KNH_4C_4H_4O_6$	205.17	wh. cr. powd.
32	antimonyl tartrate (tartar emetic)	$KSbOC_4H_4O_6.\frac{1}{2}H_2O$	333.90	rhomb. col., 1.620, 1.636, 1.638
33	benzoate	$KC_7H_5O_2.3H_2O$	214.19	cr. wh. powd.
34	borotartrate	$KC_4H_4BO_7$	213.95	wh. cr.
35	cacodylate	$K(CH_3)_2AsO_2.H_2O$	194.09	wh. cr.
36	citrate	$K_3C_6H_5O_7.H_2O$	324.35	col.
37	" monobasic	$KH_2(C_6H_5O_7)$	230.15	wh. cr. powd.
38	cobalt malonate	$K_2Co(C_3H_2O_4)_2$	341.17	
39	ethylsulfate	$KC_2H_5SO_4$	164.20	monocl. wh.
40	ferric oxalate	$KFe(C_2O_4)_2.2\frac{1}{2}H_2O$	315.98	br. cr.

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.29–2.34	120, subl.	$204^{10.5}$	i.	i.	s. chl., CS_2, bz.; sl. s. eth., h. al.
2	2.124^{15}	....	189–91	i.	....	v. s. eth.; s. al.
3	....	107	219^{14}	....	....	s. h. bz.
4	....	exp. 230	....	i.	i.	i.
5	3.5	192.5	....	i.	....	v. s. h. al.; sl. s. eth.
6	....	192.5	....	i.	i.	s. eth.; sl. s. c. al.; v. s. h. al.
7	4.063	170	volat. 100	....	....	....
8	....	145	....	i.	....	v. s. meth. al.; s. eth., al.
9	....	154	....	i.	i.	s. al., ac. a., bz., CS_2, fats; sl. s. eth.
10	....	188–9	....	i.	i.	sl. s. bz., al.
11	....	149^{0}	....	sl. s.	sl. s.	s. glac. ac. a.; bz. al.
12	....	276	....	i.	i	s. al., bz., pyr.
13	....	251	....	....	....	sl. s. h. al., bz., pyr., eth.
14	....	204	....	....	sl. s.	s. h. al., bz.
15	....	176–86	....	i.	sl. s.	s. h. al., bz.
16	....	228	....	....	....	s. chl., al., bz.; i. c. CS_2
17	....	233	....	i.	i.	sl. s. h. al., bz., chl., acet., pyr.; i. eth.
18	....	....	....	26.2	....	....
19	....	114–146	....	....	....	....
20	....	285–9 d.	....	0.99^{20}	....	....
21	....	270–2	....	12.7^{20}	....	....
22	....	....	....	$.00007^{25}$	....	....
23	1.798	d.	....	16.6	....	i. al.
24	....	subl. 250	....	i.	i.	s. abs. al., a.; i. ac. a. NH_4OH
25	2.154	d.	....	s.	....	....
26	....	....	....	i.	....	s. a., NH_4 salts; v. sl. s. h. oxal. a.
27	2.307	....	....	....	....	....
28	1.8	292	....	253^{20}; 286.3^{31}	492^{62}	33 al.; i. eth.
29	....	148	d. 200	d.	d.	s. al., acet.
30	....	65	....	....	....	....
31	....	....	....	v. s.	....	....
32	2.607	$-\frac{1}{2}H_2O$, 100	....	$5.26^{8.7}$	35.7^{100}	i. al.; 6.67^{25} glyc.
33	....	....	d.	52^{25}	112^{100}	s. al.
34	1.832	....	....	sl. s.	....	....
35	....	....	....	s.	....	sl. s. al.
36	1.98	d. 230	....	167^{15}	199.7^{31}	s. glyc.; sl. s. al.
37	....	....	....	s.	....	....
38	2.234	....	....	....	....	....
39	1.843	....	....	s.	....	s. al.
40	....	d.	....	92^{21}	d.	i. al.

PHYSICAL CONSTANTS OF

No	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	ferric oxalate	$K_3Fe(C_2O_4)_3.3H_2O$	491.19	monocl.
2	fluoresceinate	$K_2C_{20}H_{10}O_5$	408.28	red powd
3	formate	$KCHO_2$	84.11	rhomb. col., deliq
4	glycerophosphate	$C_3H_7O_3PO(OK)_2$	248.27	col. to sl. yelsh. mass
5	lactate	$KC_3H_5O_3 + xH_2O$	128.14 $+xH_2O$	col. to yelsh. syrupy liq
6	lithium tartrate (*dl*)	$KLi(dl\text{-}C_4H_4O_6).H_2O$	212.09	monocl., β 1.523 (red)
7	malate	$K_2C_4H_4O_5$	210.23	col., viscid mass
8	methane disulfonate	$KSO_3CH_2KSO_3$	252.34	monocl., β 1.539
9	methylsulfate	$2KCH_3SO_4.H_2O$	318.38	wh. cr
10	naphthalene-1, 5-disulfonate	$K_2C_{10}H_6O_2S_2.2H_2O$	336.40	monocl., 1.485, 1.669, 1.697
11	oleate	$KC_{18}H_{33}O_2$	320.36	cr. or yelsh. or brnsh. soft mass, α 1.452, γ 1.465
12	oxalate	$K_2C_2O_4.H_2O$	184.22	monocl. wh., 1.440, 1.485, 1.550
13	" acid	KHC_2O_4	128.11	monocl. col., 1.415, 1.545
14	" "	$KHC_2O_4.\frac{1}{2}H_2O$	137.12	trim
15	" "	$KHC_2O_4.H_2O$	146.12	rhomb
16	" tetra-	$2K_2H(C_2O_4)_3.2H_2O$	458.45	rhomb., 1.48, 1.52, 1.55
17	" "	$KH_3(C_2O_4)_2.2H_2O$	254.15	tricl. col
18	*o*-phenolsulfonate	$C_6H_5O_4SK.2H_2O$	248.23	rhomb., 1.527, 1.568, 1.647
19	*p*- "	$C_6H_5O_4SK$	212.20	rhomb., 1.571, 1.608, 1.694
20	phthalate, acid	$C_6H_4(COOH)(COOK)$	204.14	rhomb. col
21	picrate	$KC_6H_2O_7N_3$	267.14	rhomb., 1.527, 1.903, 1.952
22	piperate	$KC_{12}H_9O_4$	256.17	lt.-yel. cr. powd
23	propionate	$KC_3H_5O_2.H_2O$	130.15	wh. hyg. cr
24	propylsulfate	$KC_3H_7SO_4$	178.21	wh. cr. powd
25	salicylate	$C_6H_4(OH)COOK$	176.14	wh. powd
26	santoninate	$KC_{15}H_{19}O_4$	302.25	wh. deliq. cr. powd
27	sodium antimonyl tartrate	$KNaC_4H_3O_6(SbO)$	346.88	wh. scales or powd
28	sodium tartrate	$KNa(C_4H_4O_6).3H_2O$	264.18	monocl. col
29	" " (Rochelle salt)	$KNa(C_4H_4O_6).4H_2O$	282.19	rhomb. col., 1.492, 1.493, 1.496
30	stearate	$KC_{18}H_{35}O_2$	322.37	wh. cr. powd
31	strontium chromium oxalate	$KSrCr(C_2O_4)_3.6H_2O$	550.83	
32	succinate	$K_2C_4H_4O_4.3H_2O$	248.28	rhomb
33	" di-	$KH(C_4H_5O_4)_2$	274.19	monocl
34	" acid	$KC_4H_5O_4$	156.14	monocl
35	" "	$KC_4H_5O_4.2H_2O$	192.17	rhomb., 1.417, 1.530, 1.533
36	tartrate (*d*)	$K_2C_4H_4O_6.\frac{1}{2}H_2O$	235.24	monocl. col., β 1.526
37	" (*dl*)	$K_2(C_4H_4O_6)$	226.23	monocl. col
38	" acid (*d*)	$KH(C_4H_4O_6)$	188.14	rhomb. col
39	" " (*dl*)	$KH(C_4H_4O_6)$	188.14	monocl. col
40	uranium oxalate	$K_4U(C_2O_4)_4.5H_2O$	836.62	monocl
41	" oxoacetate	$KUO_2(C_2H_3O_2)_3HOH$	504.33	tetr
42	urate, acid	$KHC_5H_2N_4O_3$	206.16	wh. powd
43	uroxasate, acid	$KC_6H_2N_4O_6$	253.15	α 1.468, γ 1.620

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	...	$-3H_2O$, 100	d. 230	4.7^{0}	117.7^{100}	s. acet.; i. al., NH_3
2	...	...	...	s.	...	...
3	1.91	167.5	d.	331^{18}	657^{90}	s. al.; i. eth.
4	...	...	...	v. s.	v. s.	s. al.
5	...	...	...	s.	...	s. al.; i. eth.
6	1.610	...	...	s.	...	...
7	...	...	...	s.	...	...
8	2.376	...	...	...	...	...
9	...	...	...	s.	...	s. al.
10	1.797	...	...	...	...	...
11	...	...	...	s.	...	s. al.
12	2.08...	d.	...	33^{16}	...	...
13	2.0	d.	...	2.5	16.7^{100}	sl. s. al.
14	...	d.	...	2.2	51.5^{100}	...
15	2.044	...	...	...	...	...
16	1.21^{22}	...	...	...	...	...
17	1.836	d.	...	1.8^{13}	...	...
18	1.734	...	...	...	...	...
19	1.87	>260	...	...	...	...
20	1.636	...	...	10^{25}	33^{100}	...
21	1.852	...	exp.	0.5^{15}	25^{100}	...
22	...	...	...	s.	v. s.	...
23	...	...	...	v. s.	...	...
24	...	...	...	v. s.	...	...
25	...	...	...	s.	...	s. al.
26	...	...	...	s.	...	s. al.
27	...	...	...	s.	...	...
28	1.783	...	...	...	...	...
29	1.790	70–80	$-4H_2O$, 215	26^{0}	66^{26}	v. sl. s. al.
30	...	...	...	...	s.	s. h. al.
31	2.155^{15}	...	...	...	...	...
32	1.564	...	...	...	...	...
33	1.56	162	...	...	...	...
34	1.767	242 d.	...	...	...	...
35	1.616	...	...	...	...	...
36	1.97	...	...	$12.5^{17.5}$	278^{100}	sl. s. al.
37	1.984	...	...	...	...	...
38	1.956	...	...	0.37	6.1^{100}	s. a., alk.; i. al., ac. a.
39	1.954	...	...	...	...	...
40	2.563	...	...	...	...	...
41	2.396	...	...	...	...	...
42	...	...	...	sl. s.	...	...
43	...	...	...	...	...	...

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	*iso*valerate	$KC_5H_9O_2$	140.17	wh. to yelsh., hyg. cr.
2	xanthogenate	$KS_2COC_2H_5$	160.26	col.-lt. yel. pr.
	Praseodymium			
3	acetate	$Pr(C_2H_3O_2)_3.3H_2O$	372.04	grn. need.
4	acetylacetonate	$Pr(CH_3COCHCOCH_3)_3$	438.08	cr. ppt.
5	hexaantipyrine *per*-chlorate	$[Pr(COC_{19}H_{12}N_2)_6(ClO_4)_3]$	2215.95	grn. hex. leaf
6	oxalate	$Pr_2(C_2O_4)_3.10H_2O$	726.00	lt. grn. cr.
	Rubidium			
7	acetate	$RbC_2H_3O_2$	144.46	col. nacreous leaf
8	tartrate, acid (*dl*)	$RbHC_4H_4O_6$	234.48	trim. pr.
	Samarium			
9	acetate	$Sm(C_2H_3O_2)_3.3H_2O$	381.55	
10	acetylacetonate	$Sm(CH_3COCHCOCH_3)_3$	447.59	cr. mass
11	oxalate	$Sm_2(C_2O_4)_3.10H_2O$	745.02	cryst.
	Scandium			
12	acetylacetonate	$Sc(CH_3COCHCOCH_3)_3$	342.26	col. pl.
13	oxalate	$Sc_2(C_2O_4)_3.5H_2O$	444.28	cryst.
	Silicon:			
14	Chloromethyl silicane	SiH_2ClCH_3	80.56	
15	Di-*p*-aminoazobenzene fluosilicate	$(NH_2C_6H_4N_2C_6H_5)_2.H_2SiF_6$	538.30	cinnamon br. need.
16	Di-*p*-aminobenzoic acid fluosilicate	$(NH_2C_6H_4COOH)_2.H_2SiF_6$	418.20	pr. wh.
17	Dianiline fluosilicate	$(C_6H_5NH_2)_2.H_2SiF_6$	330.20	irreg. pl. wh.
18	Dichloromethyl silicane	$SiHCl_2CH_3$	115.01	
19	Didiphenylamine fluosilicate	$[(C_6H_5)_2NH]_2.H_2SiF_6$	482.26	wh. rods
20	Diethylaniline fluosilicate	$(C_6H_5NHC_2H_5)_2.H_2SiF_6$	386.26	wh. pr.
21	Dimethyl aniline fluosilicate	$(C_6H_5NHCH_3)_2.H_2SiF_6$	358.23	monocl. wh.
22	Dimethyl silicane	$SiH_2(CH_3)_2$	60.12	
23	Di-α-naphthylamine fluosilicate	$(C_{10}H_7NH_2)_2.H_2SiF_6$	430.23	wh. need.
24	Di-β-naphthylamine fluosilicate	$(C_{10}H_7NH_2)_2.H_2SiF_6$	430.23	hex. wh.
25	Di-*m*-nitraniline fluosilicate	$(C_6H_4NH_2NO_2)_2.H_2SiF_6$	420.20	rhomb. wh. pl.
26	Dinitrosodiphenylamine fluosilicate	$[(C_6H_5)_2N=NO]_2.H_2SiF_6$	540.26	indigo cr.
27	Di-*o*-toluidine fluosilicate	$(C_6H_4NH_2CH_3)_2.H_2SiF_6$	358.23	rhomb. wh.
28	Di-*m*-toluidine fluosilicate	$(C_6H_4NH_2CH_3)_2.H_2SiF_6$	358.23	wh. rect. pr.
29	Di-*p*-toluidine fluosilicate	$(C_6H_4NH_2CH_3)_2.H_2SiF_6$	358.23	wh. need., unst.
30	Hexamethyl disilicane	$Si_2(CH_3)_6$	146.26	
31	Methyl silicane	SiH_3CH_3	46.11	
32	Phenylene diamine fluosilicate (*m*)	$C_6H_4(NH_2)_2.H_2SiF_6$	252.15	choc. br. pr.

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	…	…	…	v. s.	…	…
2	$1.558^{21.5}$	d. > 200	200	v. s.	…	20 al.; i. eth.
3	…	…	…	v. s.	…	…
4	…	146	…	…	…	s. CS_2
5	…	286–91 d.	…	…	…	…
6	…	…	…	0.098^{25}	…	s. a.
7	…	…	…	s.	…	…
8	2.282	d.	…	1.18^{25}	11.7^{100}	…
9	$4H_2O$, 1.94	…	…	15^{25}	…	…
10	…	146–7	…	s.	…	…
11	…	…	…	0.000054	…	…
12	…	187.5	subl. 210–15	s.	…	s. al., bz., chl.
13	…	$-4H_2O$, 140	…	…	…	…
14	0.935^{-80}	−134.5	7	…	…	…
15	…	220	…	…	…	$.187^{25}$, 95% al.
16	…	…	…	…	…	0.91^{25}, 95% al.
17	…	subl. 230	…	v. s	…	i. al.
18	0.93^{0}	−93	…	…	…	…
19	…	169	…	…	…	2.4492^{25}, 95% al.
20	…	165.3	…	…	…	$.979^{25}$, 95% al.
21	…	…	…	…	…	s. h. al.; i. c. al.
22	0.68^{-80}	−150	−20.1	…	…	…
23	…	218	…	…	…	$.1504^{25}$, 95% al.
24	…	236.3	…	…	…	$.0816^{25}$, 95% al.
25	…	200	…	…	…	$.121^{25}$, 95% al.
26	…	124.5	…	…	…	$.84^{25}$, 95% al.
27	…	…	…	…	…	s. h. al.; i. c. al.
28	…	…	…	…	…	s. h. al.; i. c. al.
29	…	…	…	…	…	…
30	…	12.5–14	112.5	…	…	…
31	0.62^{-57}	−156.5	−56.8	…	…	…
32	…	243–4	…	…	…	0.065^{25}, 95% al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Silicon:			
1	Phenylene diamine fluosilicate (*p*)	$C_6H_4(NH_2)_2.H_2SiF_6$	252.15	pink irreg. pl
2	Silico-oxalic acid	$Si_2O_2(OH)_2$	122.14	wh. amor. powd
3	Tolidine fluosilicate (*o*)	$(CH_3NH_2C_6H_3)_2.H_2SiF_6$	356.22	wh. pr
	Silver			
4	acetate	$AgC_2H_3O_2$	166.90	wh. pl
5	benzoate	$AgC_7H_5O_2$	228.92	wh. powd
6	citrate	$Ag_3C_6H_5O_7$	512.68	wh. need
7	fulminate	$Ag_2C_2N_2O_2$	299.78	sm. need
8	lactate	$AgC_3H_5O_3.H_2O$	214.93	wh. or sl. gray cr. powd
9	laurate	$AgC_{12}H_{23}O_2$	307.06	
10	myristate	$AgC_{14}H_{27}O_2$	335.09	
11	oxalate	$Ag_2C_2O_4$	303.76	col. cr
12	palmitate	$AgC_{16}H_{31}O_2$	363.12	
13	salicylate	$AgC_6H_4OH.COO$	244.92	wh. to redsh. wh. cr
14	stearate	$AgC_{18}H_{35}O_2$	391.15	
15	tartrate (*d*)	$Ag_2C_4H_4O_6$	363.79	scales
	Sodium			
16	acetate	$NaC_2H_3O_2$	82.02	wh. powd
17	"	$NaC_2H_3O_2.3H_2O$	136.07	monocl. col., effl., β 1.464
18	benzenesulfonate	$NaC_6H_5SO_3$	180.10	wh. cr
19	benzoate	$NaC_7H_5O_2$	144.04	col. cr
20	cacodylate	$(CH_3)_2AsOONa.3H_2O$	214.02	wh. amor. powd. pois
21	cinnamate	$NaC_6H_5CH:CH.CO_2$	170.05	wh. cr. powd
22	citrate	$2Na_3C_6H_5O_7.11H_2O$	714.23	rhomb. wh
23	ethylsulfate	$NaC_2H_5SO_4.H_2O$	166.11	wh., v. hyg. cr
24	ferric oxalate	$2Na_3Fe(C_2O_4)_3.10H_2O$	957.82	monocl. grn
25	formate	$NaCHO_2$	68.00	monocl. col., deliq
26	furacrylate	$C_4H_3OCHCHCOONa$	160.03	lt. br. powd
27	glycerophosphate	$Na_2C_3H_7PO_6.H_2O$	234.08	yelsh., viscid liq.; wh. cr. or powd
28	"	$Na_2C_3H_5(OH)_2PO_4.5\frac{1}{2}H_2O$	315.15	wh. odorl. plates or scales, or powd.
29	lactate	$NaC_3H_5O_3$	112.04	col. or yelsh. liq
30	magnesium tartrate	$Na_2Mg(C_4H_4O_6)_2.10H_2O$	546.53	wh. powd
31	methylate	$CH_3ONa.2CH_3OH$	118.08	wh. powd
32	methylarsenate	$CH_3AsO:(NaO)_2.6H_2O$	292.04	wh. cr. powd
33	methylsulfate	$NaCH_3SO_4.H_2O$	152.10	col. hyg. cr
34	oenanthate	$NaCH_3(CH_2)_5COO$	152.10	wh. cr. powd. or leaf
35	oxalate	$Na_2C_2O_4$	133.99	col. cr
36	" acid	$NaHC_2O_4.H_2O$	130.02	monocl
37	phenate	NaC_6H_5O	116.04	wh. deliq. cr
38	phenolsulfonate	$C_6H_4OH.SO_2ONa.2H_2O$	232.13	col. cr. or gran., sl. effl
39	phthalate	$C_6H_4(COONa)_2$ (1:2)	210.03	wh. powd

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	...	d.	...	...	...	0.014^{25}, 95% al.
2	...	d.	...	i.	i.	...
3	...	268	...	...	...	$.013^{25}$, 95% al.
4	3.259^{15}	d.	...	0.72^{0}; 1.02^{20}	2.52^{80}	...
5	...	...	...	...	s.	v. sl. s. al.
6	...	d.	...	0.028^{18}	...	s. a., NH_4OH, KCN, $Na_2S_2O_3$
7	...	exp.	...	0.075^{13}	s.	v. s. NH_4OH; i. HNO_3
8	...	...	...	*ca.* 7.7	...	...
9	...	212.5	...	...	...	0.009^{25} al.
10	...	211	...	0.007^{35}	...	0.008^{25} al.
11	5.029^{4}	exp. 140	...	0.00339^{18}	...	s. a., NH_4OH, KCN
12	...	209	...	0.004^{35}	...	0.007^{25} al.
13	...	...	...	s.	...	s. al.
14	...	205	...	0.004^{35}	...	0.007^{25} al.
15	3.432^{15}	d.	...	0.2^{18}	0.203^{25}	s. a., NH_4OH, KCN
16	1.528	324	...	119^{0}	170^{100}	2.1^{18} al.
17	1.45	58; 78	...	s.	303^{50}	2.1^{18} al.
18	...	...	...	s.	...	...
19	...	...	...	62.5^{25}	76.9^{100}	2.3^{25}, 8.3^{78}, al.
20	...	...	...	s.	...	s. al.
21	...	...	...	9.1	5^{100}	s. glyc.,; 0.625 90% al.
22	$1.857^{23.5}$	$-11H_2O$, 150	d.	91^{25}	250^{100}	sl. s. al.
23	...	...	...	142	...	142 al.
24	$1.973^{17.5}$	$-4H_2O$, 100	$-10H_2O$, 200	32.5	182^{100}	...
25	1.92	253	...	44^{0}	160^{100}	sl. s. al.; i. eth.
26	1.919	d.	...	s.	...	sl. s. al.; i. eth.
27	...	...	...	s.	...	s. al.
28	...	...	d. > 130	v. s.	...	i. al.
29	...	d.	...	v. s.	...	s. al.; i. eth.
30	...	...	...	s.	...	...
31	...	...	...	s. d.	...	...
32	...	130-140	...	*ca.* 100	...	sl. s. al.; i. bz., eth. pet. eth., oils
33	...	...	...	s.	...	s. al.
34	...	...	...	s.	...	s. al.
35	...	...	...	3.7^{20}	6.33^{100}	...
36	...	...	...	1.7^{15}	...	...
37	...	...	...	v. s.	...	s. al.
38	...	...	...	23.8	125^{100}	20^{25} glyc.; 7.4^{100} al.
39	...	...	...	v. s.	...	...

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	propionate	$NaC_3H_5O_2$	96.04	wh. gran. powd
2	saccharate	$NaC_{12}H_{21}O_{11}$	364.16	wh. powd
3	salicylate	$NaC_7H_5O_3$	160.04	wh. cr. powd
4	stearate	$NaC_{18}H_{35}O_2$	306.27	wh. powd., fatty odor
5	succinate	$Na_2C_4H_4O_4.6H_2O$	270.12	wh. gran. or powd
6	sulfanilate	$C_6H_4(NH_2)SO_2ONa.2H_2O$	231.14	wh., lust. cr. leaf
7	sulfoxylate formaldehyde	$NaHSO_2.CH_2O.2H_2O$	154.11	rhomb. pr
8	tartrate	$Na_2C_4H_4O_6.2H_2O$	230.06	rhomb. col
9	" acid	$NaHC_4H_4O_6.H_2O$	190.05	wh. cr. powd
10	urate	$Na_2C_5H_2O_3N_4.H_2O$	230.06	hard, cr. nodules or wh. gran. powd.
11	" acid	$NaHC_5H_2N_4O_3$	190.05	wh. gran. powd
12	valerate	$NaC_5H_9O_2$	124.07	col. cr. or wh. deliq. mass
13	xanthogenate	$S:C(OC_2H_5)SNa$	144.16	yelsh. powd
	Strontium			
14	acetate	$Sr(C_2H_3O_2)_2.\frac{1}{2}H_2O$	214.68	wh. cr. powd
15	formate	$Sr(CHO_2)_2$	177.65	rhomb., 1.559, 1.574, 1.598
16	"	$Sr(CHO_2)_2.2H_2O$	213.68	rhomb. col., 1.484, 1.521, 1.538
17	glycerophosphate	$SrO_2:PO.OC_3H_5(OH)_2$	257.70	wh. powd
18	lactate	$Sr(C_3H_5O_3)_2.3H_2O$	319.75	wh. cr. or gran. powd
19	oxalate	$SrC_2O_4.H_2O$	193.65	col
20	salicylate	$Sr(C_7H_5O_3)_2.2H_2O$	397.74	col. cr
21	tartrate	$SrC_4H_4O_6.4H_2O$	307.72	monocl
	Thallium			
22	acetate	$TlC_2H_3O_2$	263.41	silk. wh. cr., deliq
	Thorium			
23	acetylacetonate	$Th(CH_3COCHCOCH_3)_4$	628.34	col. cr
24	oxalate	$Th(C_2O_4)_2$	408.12	wh. cr
25	"	$Th(C_2O_4)_2.6H_2O$	516.21	wh. amor. powd
26	picrate	$Th(C_6H_2N_3O_7)_4.10H_2O$	1324.43	
	Thulium			
27	oxalate	$Tm_2(C_2O_4)_3.6H_2O$	710.89	grnsh. wh. ppt
	Tin			
28	acetate (ous)	$Sn(C_2H_3O_2)_2$	236.75	yelsh. powd
29	oxalate (ous)	SnC_2O_4	206.70	wh. cr. or heavy wh. powd
30	tartrate (ous)	$SnC_4H_4O_6$	266.73	heavy wh. powd
31	Di*iso*amyltin dibromide	$(C_5H_{11})_2SnBr_2$	420.70	
32	" dichloride	$(C_5H_{11})_2SnCl_2$	331.79	
33	Dibenzyldiethylstannane	$(C_6H_5.CH_2)_2Sn(C_2H_5)_2$	358.89	liq
34	Dibenzylethylpropyl stannane	$(C_6H_5.CH_2)_2(C_2H_5)(C_3H_7)Sn$	372.90	liq
35	Dibenzyltin acetate	$(C_6H_5CH_2)_2Sn(O.CO.CH_3)_2$	418.86	col. need. f. al
36	" dibromide	$(C_6H_5.CH_2)_2SnBr_2$	460.64	col. need. f. pet
37	" dichloride	$(C_6H_5.CH_2)_2SnCl_2$	371.72	col. need. f. acet-HCl

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	s.	....	s. al.
2	....	....	....	v. s.	....	....
3	....	....	....	111^{15}	125^{25}	17^{15} al.; 25 glyc.
4	....	....	....	s.	s.	s. h. al.
5	....	....	....	s.	....	v. sl. s. al.
6	....	....	....	s.	....	....
7	....	64	d.	v. s.	melts	s. al., alk.; d. a.
8	1.818	....	....	29^{6}	66^{43}	i. al.
9	....	....	....	*ca.* 11	*ca.* 50^{100}	v. sl. s. al.
10	....	....	....	1.3	1.3^{100}	v. sl. s. 90% al.
11	....	....	....	0.083	0.8^{100}	....
12	....	140	....	s.	....	s. al.
13	....	....	....	s.	....	s. al.
14	....	....	....	s.	....	sl. s. al.
15	2.69	71.9	....	s.	s.	....
16	2.695	d.	....	s.	s.	....
17	....	....	....	sl. s.	....	i. al.
18	....	....	....	25	200^{100}	sl. s. al.
19	....	d.	....	0.0051^{18}	5^{100}	s. HCl, HNO_3
20	....	d.	....	5.6^{25}	28.6^{100}	1.5^{25}, 9.5^{78} al.
21	1.966	....	....	0.112^{0}	0.755^{85}	....
22	3.68	110	....	v. s.	....	v. s. al.
23	....	171; subl. 160^{10}	$260–270^{10}$	....	....	....
24	4.637^{16}	d.	....	i.	i.	s. h. aq. $(NH_4)_2C_2O_4$; sl. s. a.
25	....	....	....	i.	....	s. Na_2CO_3, $(NH_4)_2C_2O_4$ soln.; i. HNO_3
26	....	....	....	0.305^{25}	....	....
27	....	....	....	....	....	s. soln. alk. oxal.
28	....	182	240	d.	....	s. dil. HCl
29	3.56^{18}	....	....	....	....	d. HCl; sl. s. NH_4Cl, $(NH_4)_2C_2O_4$
30	....	....	....	s.	....	v. s. dil. HCl
31	....	−25 to −24	....	....	....	....
32	....	28	....	....	....	....
33	1+	<20	$223–24^{20}$	....	....	s. common org. solv.
34	....	>0	$220–5^{15}$	....	....	misc. all org. solv.
35	....	136–37	....	....	....	s. acet., chl., bz.
36	....	130	....	....	....	s. acet., al. eth. chl. CCl_4
37	....	163–64	....	....	....	s. acet. al. eth. chl. CCl_4, h. ac. a.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Dibenzyltin diiodide....	$(C_6H_5.CH_2)_2SnI_2$...	554.65	col. lng. silky yel. need. f. eth. pet...
2	Dibutyltin dibromide...	$(C_4H_9)_2SnBr_2$......	392.67	sm. need....................
3	" dichloride...	$(C_4H_9)_2SnCl_2$......	303.75	need..........................
4	Diethyl*iso*amyltin bromide	$(C_2H_5)_2(C_5H_{11})SnBr$	327.78	....
5	Diethyl*iso*amyltin chloride	$(C_2H_5)_2(C_5H_{11})SnCl$	283.32	....
6	Diethyl*iso*butyltin bromide	$(C_2H_5)_2(C_4H_9)SnBr$	313.76	....
7	Diethyldi*iso*amyltin....	$(C_2H_5)_2Sn(C_5H_{11})_2$.	318.95	....
8	Diethyldi*iso*butyltin...	$(C_2H_5)_2Sn(C_4H_9)_2$..	290.92	....
9	Diethyl-*n*-propyltin bromide	$(C_2H_5)_2(C_3H_7)SnBr$	299.75	....
10	Diethyl-*n*-propyltin chloride	$(C_2H_5)_2(C_3H_7)SnCl$.	255.29	....
11	Diethyl-*n*-propyltin fluoride	$(C_2H_5)_2(C_3H_7)SnF$.	238.83	....
12	Diethyltin............	$(C_2H_5)_2Sn$.........	176.78	sl. yel. oily liq..............
13	" dibromide...	$(C_2H_5)_2SnBr_2$......	336.61	col. need......................
14	" dichloride...	$(C_2H_5)_2SnCl_2$......	247.69	wh. need.......................
15	" difluoride....	$(C_2H_5)_2SnF_2$.......	214.78	sq. pl. or long rhomb. tab. f. meth. al
16	" diiodide.....	$(C_2H_5)_2SnI_2$.......	430.62	wh. need.......................
17	" oxide........	$(C_2H_5)_2SnO$.......	192.78	wh. powd.......................
18	Dimethyldi*iso*butyltin..	$(CH_3)_2Sn(C_4H_9)_2$...	262.89	....
19	Dimethyldiethyltin.....	$(CH_3)_2Sn(C_2H_5)_2$..	206.82	col. liq.......................
20	Dimethyltin.........	$[(CH_3)_2Sn]_x$	$(148.75)_x$	yel. solid.....................
21	" dibromide..	$(CH_3)_2SnBr_2$.......	308.58	col. pr........................
22	" dichloride..	$(CH_3)_2SnCl_2$.......	219.66	....
23	" difluoride..	$(CH_3)_2SnF_2$.......	186.75	wh. fine plates................
24	" diiodide...	$(CH_3)_2SnI_2$........	402.59	rhomb. wh......................
25	" oxide......	$(CH_3)_2SnO$........	164.74	wh. powd.......................
26	Di-β-naphthyltin.......	$(C_{10}H_7)_2Sn$........	372.81	....
27	Diphenyltin..........	$(C_6H_5)_2Sn$.........	272.78	yel. amor. powd................
28	" dibromide..	$(C_6H_5)_2SnBr_2$......	432.61	col. cr........................
29	" dichloride..	$(C_6H_5)_2SnCl_2$......	343.69	col. cr........................
30	" difluoride..	$(C_6H_5)_2SnF_2$.......	310.78	....
31	" diiodide....	$(C_6H_5)_2SnI_2$.......	526.62	col. cr........................
32	" hydroxy-chloride	$(C_6H_5)_2Sn(OH)Cl$..	325.24	amor. wh. powd.................
33	" oxide......	$(C_6H_5)_2SnO$.......	288.78	col. amor. powd................
34	Dipropyltin dibromide..	$(C_3H_7)_2SnBr_2$......	364.64	col. need......................
35	" dichloride..	$(C_3H_7)_2SnCl_2$......	275.72	col. cr........................
36	" difluoride..	$(C_3H_7)_2SnF_2$.......	242.81	leaf...........................
37	" diiodide....	$(C_3H_7)_2SnI_2$.......	458.65	col. oily liq..................
38	Di*iso*propyltin dibromide	$(C_3H_7)_2SnBr_2$......	364.64	pale yel. hyg. cr..............
39	" dichloride	$(C_3H_7)_2SnCl_2$......	275.72	col. transp. cr................
40	" oxide....	$(C_3H_7)_2SnO$.......	220.81	....
41	Di-*p*-tolyltin.........	$(CH_3C_6H_4)_2Sn$....	300.81	or.-yel. amor. powd............
42	Di-*p*-xylyltin..........	$[(CH_3)_2C_6H_3]_2Sn$..	328.84	....
43	Ethylchlorostannic acid.	$H_2SnC_2H_5Cl_5$......	327.04	col. deliq. pr.................

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	......	86–87	......	......	......	s. acet., al., eth., chl., CCl_4
2	......	20	......	......	......	......
3	......	43	......	......	......	......
4	1.4881^{17}	......	137.5^{17}	......	......	......
5	1.2994$^{19.9}$	......	125.5^{13}	......	......	......
6	1.5108	......	122^{17}	......	......	......
7	1.0725^{19}	......	131$^{13.5}$	......	......	......
8	1.1030	......	108.2^{13}	......	......	......
9	1.5910^{21}	......	112.2^{16}	......	......	......
10	1.3848$^{15.7}$	......	108^{17}	......	......	......
11	......	271	......	......	......	6.93^{31} meth. al.; 3.78^{31} al.; .05^{31} bz.
12	1.654	<-12	150 d.!	i.	i.	s. bz., eth., lgr., chl., CCl_4
13	2.068^{74}	63	232–3	s.	s.	s. eth., org. solv.
14	......	84–5	220	s.	s.	s. HCl, org. solv.
15	......	229	......	......	......	.45^{31} al., 2.64^{31} meth. al.; .047^{31} bz.
16	......	44.5–45.0	240–5 d.	v. sl. s.	sl. s.	s. org. solv.
17	......	infus.	......	i.	i.	s. HCl, dil. a., conc. alk.; i. org. solv.
18	1.1179$^{20.1}$	......	85$^{16.5}$	......	......	......
19	1.231^{19}	<-13	144–6	i.	i.	s. org. solv.
20	......	......	......	i.	i.	i. org. solv.
21	......	74–6	208–13	s.	s.	s. org. solv.
22	......	90 (107)	188–90	s.	......	s. org. solv.
23	......	......	d. $<$ 360	4.66$^{30.7}$	......	.08^{31} al., 33^{31} meth. al.
24	2.872	43 (30)	228	sl. s.	s.	s. org. solv.
25	......	infus.	d.	i.	i.	s. a. NaOH: i. org. solv. NH_4OH
26	......	200	d. 255	......	......	......
27	......	225.7; (126–30)	......	i.	i.	s. chl. bz. eth.; i. abs. al.
28	......	38	230^{42}	......	......	s. al. eth.
29	......	42	333–7 d.	v. sl. s., d.	......	s. al., eth., lgr.
30	......	360	......	......	......	......
31	......	71–72	176–82^{2}	i.	i.	s. org. solv.
32	......	187	......	i.	i.	s. conc. a.; i. org. solv.
33	......	infus.	......	i.	i.	s. conc. a.; i. org. solv.
34	......	49	......	v. sl. s.	......	s. org. solv.
35	......	81	......	v. sl. s.	......	s. org. solv.
36	......	205	......	0.22^{32}	......	.93^{32} al., 1.91^{32} meth. al.
37	......	<-15	270–3	i.	i.	s. org. solv.
38	......	54	......	d.	d.	i. org. solv.
39	......	80–84	......	s.	s.	s. al., h. bz., glac. ac. a.
40	......	d.	......	i.	i.	s. h. HCl; i. org. solv., alk.
41	......	111.5	d. $<$ 245	......	......	s. bz.
42	......	157	d. 240	......	......	......
43	......	d.	......	d.	......	......

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Ethyldi*iso*amyltin bromide	$(C_2H_5)(C_5H_{11})_2SnBr$	369.83	....
2	Ethyldi*iso*butyltin bromide	$(C_2H_5)(C_4H_9)_2SnBr$	341.80	....
3	Ethyl-*n*-propyldi*iso*-amyltin	$(C_2H_5)(C_3H_7)Sn(C_5H_{11})_2$	332.97	....
4	Ethylpropyltin dichloride	$(C_2H_5)(C_3H_7)SnCl_2$.	261.71	need. f. lt. pet.
5	Ethyl stannic acid	$C_2H_5.SnO.OH$	180.75	wh. amor. gel. or powd
6	Ethyltin tribromide	$(C_2H_5)SnBr_3$	387.49	col. feath. cr.
7	Hexaethylditin	$[(C_2H_5)_3Sn]_2$	411.63	liq
8	Hexaphenylditin	$[(C_6H_5)_3Sn]_2$	699.63	....
9	Hexa-*p*-tolylditin	$[(C_6H_4CH_3)_3Sn]_2$	783.73	flat tabl. f. bz.
10	Hexa-*p*-xylylditin	$[((CH_3)_2C_6H_3)_3Sn]_2$	867.82	flat rhomb. tabl. f. bz-al.
11	Methylstannic acid	$(CH_3)SnOOH$	166.73	wh. amor. powd
12	Methyltin tribromide	CH_3SnBr_3	373.47	wh. need
13	" trichloride	CH_3SnCl_3	240.09	col. cr.
14	" triiodide	CH_3SnI_3	514.48	lt. yel. need
15	Phenylbenzyltin dichloride	$(C_6H_5)(C_6H_5CH_2)SnCl_2$	357.71	col. need. f. dil. HCl
16	Phenyltin tribromide	$C_6H_5SnBr_3$	435.49	....
17	" trichloride	$C_6H_5SnCl_3$	302.11	....
18	Phenyltribenzyltin	$(C_6H_5)Sn(C_6H_5CH_2)_3$	468.90	liq
19	*Iso*propylstannic acid	$C_3H_7SnO.OH$	194.76	wh. amor.
20	*Iso*propyltin tribromide	$C_3H_7SnBr_3$	401.50	pa. yel. deliq., pr
21	Stannic bisacetylacetone dibromide	$(C_5H_7O_2)_2SnBr_2$	476.64	col. six sided cr.
22	Stannic bisacetylacetone dichloride	$(C_5H_7O_2)_2SnCl_2$	387.72	col. six sided cr.
23	Stannic bisbenzoylacetone dibromide	$(C_{10}H_{16}O_2)_2SnBr_2$	614.78	pa. yel. powd
24	Stannic bisdibenzoylmethane dibromide	$(C_{15}H_{10}O_2)_2SnBr_2$	722.69	sulfur yel. cr.
25	Stannic bis-3-ethylacetylacetone dibromide	$(C_7H_{11}O_2)_2SnBr_2$	532.70	col. six sided pr.
26	Tetra*iso*amyltin	$(C_5H_{11})_4Sn$	403.04	liq
27	Tetraaquastannic bisacetylacetone stannibromide	$(C_5H_7O_2)_2Sn(OH_2)_4SnBr_6$	987.07	col. tab. pr.
28	Tetrabenzyltin	$(C_6H_5CH_2)_4Sn$	482.92	col. pr. f. lt. pet.
29	Tetra*iso*butyltin	$(C_4H_9)_4Sn$	346.98	col. liq
30	Tetracyclohexyltin	$(C_6H_{11})_4Sn$	451.04	wh. micr. grains
31	Tetraethyltin	$(C_2H_5)_4Sn$	234.86	col. liq
32	Tetramethyltin	$(CH_3)_4Sn$	178.79	col. liq
33	Tetraphenyltin	$(C_6H_5)_4Sn$	426.86	tetr. col. f. xylene

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	1.3650	....	$154\text{–}5^{16}$	....	....	....
2	$1.4089^{19.5}$	....	130.6^{13}	....	....	....
3	$1.0654^{21.9}$	....	141^{17}	....	....	....
4	....	57–58	....	s.	....	s. eth. al.
5	....	d. below red heat		i.	i.	s. dil. min. a., KOH; i. al., eth., chl., xylene
6	....	310	....	s.	....	s. al.
7	1.412^{0}	....	d. 270	....	....	....
8	....	232.5	d. < 280	....	....	.029 eth.; 18.08 chl.; 7.82 bz.
9	....	143.5	d. 335	....	....	sl. s. bz., eth.; v. sl. s. abs. al.
10	....	192.5	d. 368	....	....	$21^{30.4}$ bz.
11	....	infus.	....	i.	i.	s. a., alk.; i. org. solv.
12	....	53–5	$210\text{–}11^{24}$	s.	....	s. eth. al. bz. lgr. hyd. by alk.
13	....	43	....	s.	....	hyd. by alk.; s. org. solv.
14	....	86.5	....	s.	s.	s. eth., al., bz., chl., meth. al.
15	....	83–84	80–100	....	....	....
16	....	....	$182\text{–}3^{29}$	....	....	....
17	....	....	$142\text{–}3^{25}$	$s.^{0}$	....	....
18	....	....	290^{5}	....	....	s. all ord. org. solv. except al.
19	....	d.	....	i.	....	s. dil. min. a., KOH; i. org. solv.
20	....	112	....	....	....	s. glac. ac. a.; sl. s. h. bz., chl.; i. dry eth.
21	....	....	187	....	....	s. bz., chl., acet.; sl. s. eth. CCl_4
22	....	....	202–3	s.	....	s. bz., acet.
23	....	....	213–4	....	....	sl. s. org. solv.
24	....	....	276–8	i.	....	sl. s. org. solv.
25	....	164–6	....	....	....	s. c. chl., bz.; sl. s. lt. pet.
26	$1.035^{19.6}$	....	188^{24}	....	....	....
27	....	105–7	....	....	....	s. bz.
28	....	42–3	....	i.	i.	s. most common org. solv.; sl. s. lt. pet.
29	1.054^{23}	−13	267; $143^{16.5}$	i.	i.	s. org. solv.
30	....	263–4	....	i.	i.	6.25^{30} bz.; $.086^{30}$ al.; s. chl., CS_2
31	1.187^{23}	−112	181	i.	i.	s. org. solv.
32	1.314^{0}	....	78	i.	i.	s. org. solv.
33	1.490^{0}	226	>420	i.	i.	s. h. bz., pyr., CCl_4, chl., ac. a.; sl. s. al.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Tetrapropyltin	$(C_3H_7)_4Sn$	290.92	col. liq
2	Tetra-*o*-tolyltin	$(C_6H_4CH_3)_4Sn$	482.92	wh cr. powd
3	" -*m*- "	$(C_6H_4CH_3)_4Sn$	482.92	col. need
4	" -*p*- "	$(C_6H_4CH_3)_4Sn$	482.92	col. need
5	Tetra-*m*-xylyltin	$[(CH_3)_2C_6H_3]_4Sn$	538.98	rhomb need. f. bz-al
6	" -*p*- "	$[(CH_3)_2C_6H_3]_4Sn$	538.98	wh. quad. pr
7	Tri*iso*amyltin bromide	$(C_5H_{11})_3SnBr$	411.87	
8	" chloride	$(C_5H_{11})_3SnCl$	367.41	
9	" fluoride	$(C_5H_{11})_3SnF$	350.96	need
10	" iodide	$(C_5H_{11})_3SnI$	458.88	
11	Tribenzylethyl tin	$(C_6H_5CH_2)_3(C_2H_5)Sn$	420.90	col. tabl. f. al.-lt. pet
12	Tribenzyltin chloride	$(C_6H_5CH_2)_3SnCl$	427.32	wh. need
13	" hydroxide	$(C_6H_5CH_2)_3SnOH$	408.87	rhomb., col. tabl
14	" iodide	$(C_6H_5CH_2)_3SnI$	518.78	need. like pr. f. glac. ac. a
15	Tri*iso*butyl*iso*amyl tin	$(C_4H_9)_3Sn(C_5H_{11})$	361.00	
16	Tri*iso*butylethyltin	$(C_4H_9)_3Sn(C_2H_5)$	318.95	
17	Tri*iso*butyltin bromide	$(C_4H_9)_3SnBr$	369.83	
18	" chloride	$(C_4H_9)_3SnCl$	325.37	
19	" fluoride	$(C_4H_9)_3SnF$	308.91	fine long pr
20	" iodide	$(C_4H_9)_3SnI$	416.83	col. liq
21	Triethyl*iso*amyl tin	$(C_2H_5)_3Sn(C_5H_{11})$	276.90	
22	Triethyl*iso*butyl tin	$(C_2H_5)_3Sn(C_4H_9)$	262.89	
23	Triethylphenyl tin	$(C_2H_5)_3(C_6H_5)Sn$	282.86	col. liq
24	Triethyl-*n*-propyl tin	$(C_2H_5)_3Sn(C_3H_7)$	248.87	
25	Triethyltin	$(C_2H_5)_3Sn$	205.82	col. liq
26	Triethyltin bromide	$(C_2H_5)_3SnBr$	285.73	col. liq
27	" chloride	$(C_2H_5)_3SnCl$	241.27	col. liq
28	" ethoxide	$(C_2H_5)_3Sn(OC_2H_5)$	250.86	col. liq
29	" hydroxide	$(C_2H_5)_3SnOH$	222.82	col. cr
30	" iodide	$(C_2H_5)_3SnI$	332.74	col. liq
31	Trimethylethyltin	$(CH_3)_3(C_2H_5)Sn$	192.81	col. liq
32	Trimethyltin	$(CH_3)_3Sn$	163.77	col. liq
33	" bromide	$(CH_3)_3SnBr$	243.69	col. cr. or liq
34	" chloride	$(CH_3)_3SnCl$	199.23	col. cr
35	" fluoride	$(CH_3)_3SnF$	182.77	wh. short thick rect. pr
36	" hydride	$(CH_3)_3SnH$	164.78	col. oily liq
37	" hydroxide	$(CH_3)_3SnOH$	180.78	col. pr
38	" iodide	$(CH_3)_3SnI$	290.69	col liq
39	" oxide	$[(CH_3)_3Sn]_2O$	343.54	wh. amor. powd
40	" sulfide	$[(CH_3)_3Sn]_2S$	359.60	lt. yel. oil
41	Triphenylbenzyl tin	$(C_6H_5)_3Sn(C_6H_5CH_2)$	440.87	col. pl. f. al
42	Triphenylethyl tin	$(C_6H_5)_3SnC_2H_5$	378.86	wh. pr. f. al
43	Triphenylmethyl tin	$(C_6H_5)_3SnCH_3$	364.84	col. tetr. f. eth

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of: Cold water	Hot water	Alcohol, acids, etc.
1	1.1065$^{20.2}$	....	222–5	i.	i.	s. org. solv.
2	....	158–9 (215)	....	i.	i.	s. bz. eth.; i. al.
3	....	128.5	....	i.	i.	s. bz. h. eth., h. al.
4	....	230–3	....	i.	i.	s. bz., chl., CS_2, pyr.; sl. s. al., eth.
5	....	219.5	d. 360	....	....	.314^{30} al.; 5.28^{30} eth.; 35.1^{30} bz.; 43.2^{30} chl.
6	....	272–3	d. 360	i.	i.	.015^{30} al.; 1.73^{30} bz.; 2.80^{30} chl.; .29^{30} eth.; .017^{30} meth. al.
7	1.2613$^{20.7}$	21	177^{15}	....	....	....
8	1.1290$^{34.2}$	−30.2	114^{13}	....	....	....
9	....	288	....	....	....	1.03^{31} al.; .967^{31} bz.; 1.22^{31} meth. al.
10	1.3777$^{26.5}$	−22	182^{13}	....	....	....
11	....	31–2	....	....	....	s. eth., bz., chl.; sl. s. al.
12	....	142–4	d.	i.	i.	s. ac. a., acet., bz., eth., chl., pyr.; i. al.
13	....	117–21	....	....	....	s. h. al., CS_2, bz.; sl. s. eth., lgr.; i. KOH
14	....	102–3	....	....	....	....
15	1.0356$^{26.8}$	....	152.9$^{16.5}$	....	....	....
16	1.0779^{21}	....	125^{16}	....	....	....
17	1.3523	−26.5	148^{13}	....	....	....
18	1.1290$^{34.2}$	+30.2	174^{13}	....	....	....
19	....	244	....	....	....	.414^{32} al.; .614^{32} meth. al.; .1^{32} bz.
20	1.378$^{26.5}$	−22	284–6	....	....	s. eth., org. solv.
21	1.1203$^{20.1}$	....	111$^{18.5}$	....	....	....
22	1.139$^{20.3}$	....	96.5^{17}	....	....	....
23	1.2639	....	254	i.	i.	s. al., eth., org. solv.
24	1.1680$^{20.6}$	....	82^{13}	....	....	....
25	1.3774	< −75	161^{23}	i.	i.	s. al., org. solv.
26	1.630	−13.5	223–4	v. sl. s.	....	s. org. solv.
27	1.428^{8}	10(15.5)	208–10	i.	....	s. org. solv.
28	1.2634	....	190	d.	....	s. org. solv.
29	....	43	271	s.	s.	s. org. solv.
30	1.833	−34.5	225(231)	v. sl. s.	....	s. org. solv.
31	....	....	108.2	i.	i.	s. org. solv.
32	1.570^{25}	23	182	i.	i.	s. org. solv.
33	....	27	165	s.	s.	s. org. solv.
34	....	37	....	s.	s.	s. org. solv.
35	....	360 seal. tube	d. < 375	....	....	2.45^{31} meth. al.; 1.08^{31} al.; 0.05^{31} bz.
36	....	....	60	v. sl. s.	....	s. org. solv.
37	....	118 d.	subl. > 80	s	s.	s. a., al. bz., chl., CCl_4, alk.
38	2.1432	3.4	170	v. sl. s.	....	s. bz., al., eth., acet.
39	....	d.	....	i.	i.	s. a., alk.; i. org. solv.
40	1.649^{25}	6	233.5	i.	....	s. org. solv., HNO_3
41	....	90	250^{3}	....	....	s. org. solv. except al.
42	1.2953^{62}	56	....	....	....	....
43	1.3113$^{63.85}$	60–1	....	....	....	s. bz., chl., eth.

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Triphenyl-α-naphthyl-tin	$(C_6H_5)_3Sn(C_{10}H_7)$	476.87	col. pr
2	Triphenyltin	$(C_6H_5)_3Sn$	349.82	wh. powd
3	" bromide	$(C_6H_5)_3SnBr$	429.73	col. cr
4	" chloride	$(C_6H_5)_3SnCl$	385.27	col. cr
5	" fluoride	$(C_6H_5)_3SnF$	368.82	fine pr
6	" iodide	$(C_6H_5)_3SnI$	476.74	4-sided monocl. wh
7	Triphenyl-*p*-tolyltin	$(C_6H_5)_3Sn(C_7H_7)$	440.87	need. f. eth
8	Triphenyl-*p*-xylyltin	$(C_6H_5)_3Sn[C_6H_3(CH_3)_2]_2$	559.96	col. lng. hex. sheets f. al
9	Tri-*n*-propyl*iso*amyl tin	$(C_3H_7)_3Sn(C_4H_9)$	304.93	
10	Tri-*n*-propylethyl tin	$(C_3H_7)_3Sn(C_2H_5)$	276.90	
11	Tri*iso*propyltin bromide	$(C_3H_7)_3SnBr$	327.78	
12	Tripropyltin chloride	$(C_3H_7)_3SnCl$	283.32	col. liq
13	Tri*iso*propyltin iodide	$(C_3H_7)_3SnI$	374.78	
14	Tri-*n*-propyltin chloride	$(C_3H_7)_3SnCl$	283.32	
15	" fluoride	$(C_3H_7)_3SnF$	266.86	flat pr
16	" iodide	$(C_3H_7)_3SnI$	374.78	col. liq
17	Tri-*o*-tolyltin bromide	$(C_6H_4CH_3)_3SnBr$	471.78	rhomb. tabl. f. al
18	" chloride	$(C_6H_4CH_3)_3SnCl$	427.32	sh. thick pr. f. al
19	" iodide	$(C_6H_4CH_3)_3SnI$	518.78	rhomb. cr. al. eth
20	Tri-*p*-tolyltin bromide	$(C_6H_4CH_3)_3SnBr$	471.78	rhbdr. f. al
21	" chloride	$(C_6H_4CH_3)_3SnCl$	427.32	rhomb. pl. f. al
22	" fluoride	$(C_6H_4CH_3)_3SnF$	410.86	hairlike felted need
23	" iodide	$(C_6H_4CH_3)_3SnI$	518.78	rhomb. pl. f. eth.-al
24	Tri-*m*-xylyltin fluoride	$[(CH_3)_2C_6H_3]_3SnF$	452.91	fine felted need
25	Tri-*p*-xylyltin bromide	$[(CH_3)_2C_6H_3]_3SnBr$	513.83	elongated 6-cornered cr. f. al
26	" chloride	$[(CH_3)_2C_6H_3]_3SnCl$	469.37	6-cornered col. f. al
27	" fluoride	$[(CH_3)_2C_6H_3]_3SnF$	452.91	fine lng. microneed
28	" iodide	$[(CH_3)_2C_6H_3]_3SnI$	560.83	6-cornered tabl. f. al
	Titanium			
29	ammonium oxalate	$(NH_4)_2TiO(C_2O_4)_2.H_2O$	293.99	wh. cr. mass
30	oxalate	$Ti_2(C_2O_4)_3.10H_2O$	539.96	yel. pr
31	potassium oxalate	$TiO:(COO.COOK)_2.2H_2O$	354.13	grn.-wh. lust. cr
	Uranyl			
32	acetate	$UO_2(C_2H_3O_2)_2.2H_2O$	424.22	rhomb. yel
33	benzoate	$UO_2.(C_7H_5O_2)_2$	512.22	yel. powd
34	formate	$UO_2(HCO_2)_2.H_2O$	378.17	oct. yel
35	oxalate	$UO_2(C_2O_4).3H_2O$	412.19	yel. cr
	Ytterbium			
36	acetate	$Yb(C_2H_3O_2)_3.4H_2O$	422.63	hex. pl
37	oxalate	$Yb_2(C_2O_4)_3.10H_2O$	791.16	col. cr
	Yttrium			
38	acetate	$Y(C_2H_3O_2)_3.4H_2O$	338.05	
39	hexaantipyrine *per*-chlorate	$[Y(COC_{10}H_{12}N_2)_6(ClO_4)_3]$	2163.95	col. hex. cr
40	" iodide	$[Y(COC_{10}H_{12}N_2)_6I_3]$	2246.34	col. cr
41	oxalate	$Y_2(C_2O_4)_3.9H_2O$	603.98	wh. cr. powd

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of Cold water	Hot water	Alcohol, acids, etc.
1	....	125	....	....	....	s. bz., chl., eth.
2	....	232.5	d. 280	i.	i.	$.079^{30}$ al.; 7.82^{30} bz.; $.92^{30}$ eth.; 18.1^{30} chl.
3	....	120.5	$249^{13.5}$	i.	i.	s. al. eth., org. solv.
4	....	106	$240^{13.6}$	i.	i.	s. org. solv.
5	....	357	....	sl. s.	....	sl. s. c. al., eth.
6	....	121	$253^{13.5}$	i.	i.	s. org. solv.
7	....	124	....	....	....	s. bz., chl., eth.
8	....	100.5	....	....	....	s. bz., eth. chl.
9	$1.0841^{24.1}$	....	128^{18}			
10	$1.1225^{21.8}$	....	$117.5^{23.3}$	....	....	....
11	$1.4263^{25.2}$	−49	133^{12}	....	....	....
12	1.2678^{28}	−23.5		....	....	s org. solv.
13	$1.4378^{22.2}$	....	151^{18}	....	....	s. org. solv.
14	1.2678^{28}	−23.5	123^{13}	....	....	....
15	....	275	....	....	....	4.26^{31} meth. al.; 2.73^{31} al.; 0.118^{31} bz.
16	1.692^{16}	−53	260–2; 141^{13}			
17	....	99.5	....	....	....	s. org. solv.
18	....	99.5	....	....	....	s. bz., eth.; sl. s. al.
19	....	119.5	....	....	....	s. bz., eth.; sl. s. al.
20	....	98.5	....	....	....	s. bz., eth.; sl. s. al.
21	....	97.5	....	....	....	s. bz., eth.; sl. s. al.
22	....	305	....	....	....	sl. s. al., bz., eth.
23	....	120–5	....	....	....	s. al.
24	....	205	....	....	....	s. bz.-eth.; sl. s. al.
25	....	151	....	....	....	s. bz., eth., al.
26	....	141.5	....	....	....	s. bz., chl., eth.; i. c. al.
27	....	247	....	....	....	s. bz., chl., eth.; i. c. al.
28	....	159.5	....	....	....	sl. s. bz.; h. eth., al.
			....	....	....	s. bz., chl., eth.; i. c. al.
29	....	....	....	v. s.	....	....
30	....	....	....	s.	s.	i. al., eth.
31	....	....	....	v. s.	....	....
32	2.893^{15}	$-H_2O$, 110	d. 275	7.694^{15}	d.	s. al.
33	....	....				
34	3.695^{19}	$-H_2O$, 110	....	sl. s.	....	sl. s. al.
35	....	$-H_2O$, 110	....	sl. s.	....	sl. s. form. a.
			....	0.8^{14}	3.3^{100}	s. min. a., alk. oxal.
36	2.09	$-4H_2O$, 100	....	v s.	v. s.	....
37	2.644	....	....	$.000033^{25}$	....	sl. s. dil. a.
38	....	....	....	9.03^{25}		
39	....	293–6 d.	....	0.55^{20}	....	....
40	....	280–2	....	4.65^{20}	....	....
41	....	d.	....	0.0001	....	sl. s. HCl

PHYSICAL CONSTANTS OF

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Zinc			
1	acetate	$Zn(C_2H_3O_2)_2$	183.43	monocl
2	"	$Zn(C_2H_3O_2)_2.2H_2O$	219.46	monocl. col. β 1.494
3	benzoate	$Zn(C_7H_5O_2)_2$	307.46	wh. powd
4	citrate	$Zn_3(C_6H_5O_7)_2.2H_2O$	610.25	wh. amor. powd
5	formate	$Zn(CHO_2)_2$	155.40	
6	formaldehydesulfoxylate	$Zn(HSO_2.CH_2O)_2$	255.55	rhomb. pr
7	" " basic	$Zn(OH)HSO_2.CH_2O$	177.47	rhomb. pr
8	formate	$Zn(CHO_2)_2.2H_2O$	191.43	monocl. wh
9	glycerophosphate	$ZnC_3H_5(OH)_2OPO_3$	235.45	wh. amor' powd
10	lactate	$Zn(C_3H_5O_3)_2.3H_2O$	297.50	wh. cr
11	oxalate	$ZnC_2O_4.2H_2O$	189.41	wh. powd
12	picrate	$Zn[(C_6H_2(NO_2)_3O]_2.8H_2O$	665.58	yel. cr. powd., exp
13	phenolsulfonate	$Zn(C_6H_5SO_4)_2.8H_2O$	555.70	clear, col. cr. or fine wh. powd., effl.
14	salicylate	$Zn(C_7H_5O_3)_2.3H_2O$	393.50	need
15	tartrate	$ZnC_4H_4O_6.H_2O$	231.43	wh. powd
16	tetrapyridine fluosilicate	$Zn(C_5H_5N)_4SiF_6$	523.63	rhomb. wh
17	valerate	$Zn(C_5H_9O_2)_2.2H_2O$	303.55	wh. glist. sc. or powd., disg. odor
18	Diethylzinc	$Zn(C_2H_5)_2$	123.46	col. liq. ign. in air or Cl
	Zirconium			
19	acetate, basic	$Zr(C_2H_3O_2)_3OH$	285.30	wh. cr
	Germanium:			
20	Hexaethyldigermane	$[(C_2H_5)_3Ge]_2$	319.43	col. liq
21	Hexaphenyldigermane	$[(C_6H_5)_3Ge]_2$	607.43	cryst., wh
22	Octaphenyltrigermane	$(C_6H_5)_8Ge_3$	834.11	cryst., wh
23	Tetraethyl germanium	$(C_2H_5)_4Ge$	188.76	oil, col., $1.443^{17.5}$; 1.554^{0}
24	Tetraphenyl germanium	$(C_6H_5)_4Ge$	380.76	tetr., col
25	Triethylgermanium bromide	$(C_2H_5)_3GeBr$	239.63	col. liq
26	Triethylgermanium chloride	$(C_2H_5)_3GeCl$	195.17	col. liq
27	" fluoride	$(C_2H_5)_3GeF$	178.72	col. liq
28	" hydride	$(C_2H_5)_3GeH$	160.72	col. liq
29	" imine	$[(C_2H_5)_3Ge]_2NH$	334.45	col. liq
30	" iodide	$(C_2H_5)_3GeI$	286.64	col. liq
31	" oxide	$[(C_2H_5)_3Ge]_2O$	335.43	col. liq
32	Triphenylgermanium bromide	$(C_6H_5)_3GeBr$	383.63	hex., col
33	" chloride	$(C_6H_5)_3GeCl$	339.17	cryst., wh
34	" fluoride	$(C_6H_5)_3GeF$	322.72	cryst., wh
35	" hydride	$(C_6H_5)_3GeH$	304.72	cryst., wh. (two forms)
36	" iodide	$(C_6H_5)_3GeI$	430.64	cryst., wh
37	" oxide	$[(C_6H_5)_3Ge]_2O$	623.43	col. pl
38	Triphenyl germanol	$(C_6H_5)_3GeOH$	320.72	cryst., wh
39	Tri-triphenyl germanium nitride	$[(C_6H_5)_3Ge]_3N$	925.16	need., col

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 cm³ of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.84	142	subl. vac.	30^{20}	44.6^{100}	2.8^{25}, 166^{79} al.
2	1.735	237	$-2H_2O$, 100	31.1^{20}	66.6^{100}	2 al.
3	....	....	....	s.	sl. s.	....
4	....	....	....	sl. s.	....	....
5	2.36	....	d.	....	....	....
6	....	d.	....	v. s.	v. s.	trans. by alk.; i. al.; d. a.
7	....	d.	....	i.	i.	trans. by alk.; i. al.; d. a.
8	2.205	....	d.	s.	....	i. al.
9	....	....	....	s.	....	i. al., eth.
10	....	....	....	1.67^{15}	16.7^{100}	....
11	2.562	s. 100	....	$.0007^{918}$	....	s. a., alk.
12	....	....	....	s.	....	....
13	....	....	....	62.5	250^{100}	55.6^{25} al.
14	....	....	....	5^{20}	....	s. al.
15	....	....	....	sl. s.	....	....
16	2.197	....	....	....	....	....
17	....	....	....	*ca.* 1	s.	*ca.* 2.5 al.; v. sl. s. eth.
18	1.182^{18}	....	118	d.	....	....
19	....	....	....	s.	....	....
20	....	<-60	265^{758}	i.	i.	s. bz., eth.
21	....	340	....	i.	i.	i. liq., NH_3; sl. s. h. bz., h. $CHCl_3$; i. lgr.
22	....	247–8	....	i.	i.	s. h. bz., h. $CHCl_3$
23	1.198^{0}	....	162.5–3.0	d.	d.	s. bz., eth.
24	....	235.7	>400	i.	i.	s. $CHCl_3$, bz., tol.; sl. s. eth., acet. lgr.
25	....	−33	190.9	hyd.	hyd.	s. bz., eth., $CHCl_3$, CCl_4
26	....	<-50	175.9	hyd.	hyd.	s. bz., eth., $CHCl_3$, CCl_4
27	....	....	149.0^{751}	hyd.	hyd.	s. bz., eth., $CHCl_3$, CCl_4
28	....	....	124.4^{751}	i.	i.	s. bz., eth.; i. liq. NH_3
29	....	....	$100^{0.1}$	hyd.	hyd.	i. liq. NH_3; s. bz., eth., CCl_4, $CHCl_3$
30	....	<-50	212.3	hyd.	hyd.	s. bz., eth., $CHCl_3$, CCl_4 i. liq. NH_3
31	....	<-50	253.9	i.	i.	s. $C_2H_5NH_2$, bz, eth.
32	....	138.7	....	i.	hyd.	s. bz., $CHCl_3$; sl. s. lgr.
33	....	117–8	....	i.	hyd.	s. bz., eth.
34	....	76.6	....	i.	hyd.	v. s. bz., eth. lgr., $CHCl_3$; i. liq. NH_3
35	....	α, 47°; β, 27°	....	i.	i.	sl. s. liq. NH_3; v. s. bz., tol., $CHCl_3$, eth., CCl_4
36	....	157	....	hyd.	hyd.	s. bz., eth.
37	....	183–4	....	i.	i.	s. bz., lgr., eth.
38	....	134.2	....	i.	i.	s. bz., $CHCl_3$; sl. s. lgr.
39	....	163–4	....	hyd.	hyd.	s. lgr., eth., bz.

PHYSICAL CONSTANTS OF ORGANIC COMPOUNDS

The naming and arrangement of compounds, the preparation of the abridged form of the International Union Rules for the Naming of Organic Compounds and the Prefix Names of Organic Radicals have been in charge of

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INTERNATIONAL UNION RULES FOR THE NAMING OF ORGANIC COMPOUNDS

Editor's Note.—These rules are taken from the "Definitive Report of the Commission on the Reform of the Nomenclature of Organic Chemistry," which was unanimously adopted by the Commission and by the Council of the International Union of Chemistry at Liége in 1930. A translation of the report, with comments, appeared in the *Journal of the American Chemical Society*, **55**, 3905–25 (1933), and the reader is referred there for the full text and more extended comments. The comments here given in fine type are the editor's. A. M. P.

I. General

1. As few changes as possible will be made in terminology universally adopted.

2. For the present, only the nomenclature of compounds of known constitution will be dealt with; the question of substances of imperfectly known constitution is postponed.

3. The precise form of words, endings, etc., prescribed in the rules should be adapted to the genius of each language by the subcommittees.

II. Hydrocarbons

4. The ending *ane* is adopted for saturated hydrocarbons. Open-chain hydrocarbons will have the generic name *alkanes*.

5. The present names of the first four normal saturated hydrocarbons (methane, ethane, propane, butane) are retained. Names derived from the Greek or Latin numerals will be used for those having more than four atoms of carbon.

As the names in this series are also used in forming names of unsaturated hydrocarbons, of alcohols, aldehydes, acids, etc. a list of them is here given, with the numbers of carbon atoms:

1 Methane
2 Ethane
3 Propane
4 Butane
5 Pentane
6 Hexane
7 Heptane
8 Octane
9 Nonane
10 Decane
11 Hendecane (Undecane)
12 Dodecane
13 Tridecane
14 Tetradecane
15 Pentadecane
16 Hexadecane
17 Heptadecane
18 Octadecane
19 Nonadecane
20 Eicosane
21 Heneicosane
22 Docosane
23 Tricosane
24 Tetracosane
25 Pentacosane
26 Hexacosane
27 Heptacosane
28 Octacosane
29 Nonacosane
30 Triacontane
31 Hentriacontane
32 Dotriacontane
33 Tritriacontane
34 Tetratriacontane
35 Pentatriacontane
36 Hexatriacontane
37 Heptatriacontane
38 Octatriacontane
39 Nonatriacontane
40 Tetracontane
41 Hentetracontane
42 Dotetracontane
43 Tritetracontane
44 Tetratetracontane
45 Pentatetracontane
46 Hexatetracontane
47 Heptatetracontane
48 Octatetracontane
49 Nonatetracontane
50 Pentacontane
51 Henpentacontane
52 Dopentacontane
53 Tripentacontane

54 Tetrapentacontane
55 Pentapentacontane
56 Hexapentacontane
57 Heptapentacontane
58 Octapentacontane
59 Nonapentacontane
60 Hexacontane

6. Branched-chain hydrocarbons are regarded as derivatives of the normal hydrocarbons; their names will be referred to the longest normal chain present in the formula by adding to it the designations of the side chains. In case of ambiguity, or if a simpler name would result, that chain which admits of the maximum of substitutions will be selected as the fundamental chain.

A simple example is 2-methylbutane, $CH_3CH(CH_3)CH_2CH_3$. The principle of "maximum of substitutions" may be illustrated as follows: In the compound

$$\begin{array}{l} CH_3CH_2CH_2CH_2\overset{}{C}HCH_2CH_2CH_2CH_3 \\ \qquad\qquad\qquad\quad\;\; | \\ \qquad\qquad\qquad\quad\;\; CH(CH_3)CH(CH_3)CH_3 \end{array}$$

the longest straight chain contains nine carbon atoms, which would lead to the name 5-(1, 2-dimethylpropyl)nonane; the number of substitutions in the main chain is only one, but the radical is a complicated one. By selecting a chain of eight we get three substitutions of simpler radicals and arrive at the name 4-butyl-2,3-dimethyloctane. Rules 6 and 7 apply to saturated hydrocarbons only.

7. In case there are several side chains, the order in which such chains are named will correspond to the order of their complexity. The chain having the greatest number of secondary and tertiary atoms will be considered the most complex. The alphabetic order may also be followed in such cases.

Two possible orders to be followed in arranging the names of substituting radicals in a compound are here referred to. In the "order of complexity" the radical of lowest weight comes first, then that of next lowest weight, and so on; of those having the same weight the least branched comes first and the most branched last, thus: methyl, ethyl, propyl, isopropyl, butyl, isobutyl, etc. The "alphabetic order" would of course be: butyl, ethyl, isobutyl, isopropyl, methyl, propyl (or else butyl, *iso*butyl, ethyl, methyl, propyl, *iso*propyl). (The alphabetic order is followed in the Organic Table in this handbook.)

8. In the names of open-chain unsaturated hydrocarbons having one double bond the ending *ane* of the corresponding saturated hydrocarbon will be replaced by the ending *ene;* if there are two double bonds, the ending will be *diene*, etc. These hydrocarbons will bear the generic names *alkenes*, *alkadienes*, *alkatrienes*, etc. Examples: propene, hexene, etc.

9. The names of triple-bond hydrocarbons will end in *yne*, *diyne*, etc. They will bear the generic name *alkynes*. Examples: propyne, heptyne, etc.

The ending *-yne* replaces *-ine* because the latter is reserved for bases (see Rule 33).

10. If there are both double and triple bonds in the fundamental chain the endings *enyne*, *dienyne*, etc., will be used. The generic names of these hydrocarbons will be *alkenynes*, *alkadienynes*, etc.

The double bonds are expressed first in the name (ene before yne) and take precedence in numbering (cf. Rule 64). Example: CH_2:CHCH:CH-C:CH, hexa-1,3-dien-5-yne, not hex-1-yne-3,5-diene. No provision is made for branched unsaturated hydrocarbons. It seems best, for general use, to select as the fundamental straight chain the longest one that contains the maximum of double and triple bonds. Example: CH_2:C(C_2H_5)CH_2CH_3, 2-ethyl-1-butene, not 3-methylenepentane.

11. Saturated monocyclic hydrocarbons will take the names of the corresponding open-chain saturated hydrocarbons, preceded by the prefix *cyclo*. They will bear the generic name *cycloalkanes*.

Examples: cyclopropane, cyclobutane, cycloheptane.

12. When they are unsaturated, rules 8–10 will be applied. However, in the case of partially saturated polycyclic aromatic compounds the prefix *hydro*, preceded by *di*-, *tetra*-, etc., will be used. Example: dihydroanthracene.

Further examples: cyclobutadiene, cyclohexene (not tetrahydrobenzene).

13. Aromatic hydrocarbons will be denoted by the ending *ene* and will otherwise retain their customary names. However, the name *phene* may be used instead of benzene.

Examples: benzene, toluene, xylene (not benzol, toluol, xylol).

III. Fundamental Heterocyclic Compounds

14. The endings of customary names, endings which do not correspond to the function of the substance, will undergo the following modifications, so far as they are in accord with the genius of each language: (a) The ending *ol* will be changed to *ole*. Example: pyrrole. (b) The ending *ane* will be changed to *an*. Example: pyran.

15. When nitrogenous heterocycles not having the ending *ine* give basic compounds on progressive hydrogenation, such derivation will be indicated by the successive endings *ine*, *idine*. Examples: pyrrole, pyrroline, pyrrolidine; oxazole, oxazoline.

16. The ending *a* is adopted for hetero atoms occurring in a ring. Oxygen will accordingly be indicated by *oxa*, sulfur by *thia*, nitrogen by *aza*, etc. The letter *a* may be elided before a vowel. Examples: thiadiazole, oxadiazole, thiazine, oxazine.

While the universally accepted names of heterocyclic compounds are retained, the names of other heterocyclic compounds are derived from that of the corresponding homocyclic compound by adding to it the names of the hetero atoms ending in *a*. Example: 2, 7, 9-triazaphenanthrene.

The custom of naming complex heterocyclic ring systems from the names of their component rings (as, anthrapyrrole, naphthopyridine) is so "universally accepted" that it will no doubt continue to be followed. The rule adds a useful new device for certain cases.

IV. Simple Functions

17. Substances of simple functions are defined as those containing a function of one kind only, which may be repeated several times in the same molecule.

That is, an alcohol may have one, two or more OH groups and still be a substance of simple function, while a hydroxy aldehyde or an amino acid is one of complex function.

18. When there is only one functional group, the fundamental chain will be selected so as to contain this group. When there are several functional groups the fundamental chain will be selected so as to contain the maximum number of these groups.

Example: $CH_3CH_2CH(COOH)_2$, 2-ethylpropanedioic acid (ethylmalonic acid). According to the original Geneva system it was butanoic-2-methyloic acid.

19. Halogen derivatives will be designated by the name of the hydrocarbon from which they are derived, preceded by a prefix indicating the nature and number of the halogen atoms.

Examples: C_2H_5Cl, chloroethane; CH_2BrCH_2Br, 1, 2-dibromoethane.

20. Alcohols and phenols will be given the name of the hydrocarbon from which they are derived, followed by the suffix *ol*. In accordance with rule 1 names universally adopted will be retained, as: phenol, cresol, naphthol, etc.

This nomenclature may also be applied to heterocycles. Example: quinolinol.

Further examples: $CH_3CHOHCH_3$, 2-propanol; $C_6H_{11}OH$, cyclohexanol.

21. In naming polyhydric alcohols or phenols, one of the forms *di*, *tri*, *tetra*, etc., will be inserted between the name of the parent hydrocarbon and the suffix *ol*.

Examples: CH_2OHCH_2OH, 1, 2-ethanediol; *p*-$C_6H_4(OH)_2$, 1, 4-benzenediol.

22. The name *mercaptan* as a suffix is abandoned; this function will be denoted by the suffix *thiol*.

Examples: CH_3SH, methanethiol; CH_2SHCH_2SH, 1, 2-ethanedithiol.

23. Ethers are considered as hydrocarbons in which one or several hydrogen atoms are replaced by alkoxy groups. However, for symmetrical ethers the present nomenclature may be retained. Examples: $CH_3OC_2H_5$, methoxyethane; CH_3OCH_3, methoxymethane or methyl ether.

24. Oxygen linked, in a chain of carbon atoms, to two of these atoms will be denoted by the prefix *epoxy* in all cases where it would be unprofitable to name the substance as a cyclic compound. Examples: ethylene oxide = epoxyethane; epichlorohydrin = 3-chloro-1,2-epoxypropane; tetramethylene oxide = 1,4-epoxybutane.

25. Sulfides, disulfides, sulfoxides and sulfones will be named like the ethers, *oxy* being replaced by *thio*, *dithio*, *sulfinyl* and

sulfonyl, respectively. Examples: $CH_3SO_2C_2H_5$, methylsulfonylethane; $CH_3SC_3H_7$, methylthiopropane; $CH_3CH_2CH_2$-$SOCH_2CH_2CH_2CH_3$, 1-(propylsulfinyl)butane.

26. Aldehydes are characterized by the suffix *al* added to the name of the hydrocarbon from which they are derived; thioaldehydes, by the suffix *thial*. Acetals will be named as 1,1-dialkoxyalkanes.

Examples: CH_3CHO, ethanal; CHOCHO, ethanedial; CH_3CH_2CHS, propanethial; $CH_3C(OC_2H_5)_2$, 1,1-diethoxyethane; C_6H_5CHO, benzenecarbonal? (cf. rule 32, paragraph 2).

27. Ketones will receive the ending *one*. Diketones, triketones, thioketones will be designated by the suffixes *dione*, *trione*, *thione*.

Examples: CH_3COCH_3, 2-propanone; $CH_3COCOCH_3$, 2, 3-butanedione; $CH_3CSCH_2CH_3$, 2-butanethione; cyclohexanone.

28. The name *ketene* is retained.

Example: $(CH_3)_2C{:}CO$, dimethylketene.

29. For acids the rule of the Geneva nomenclature is retained. However, in cases where the use of that nomenclature would not be convenient the carboxyl group will be considered as a substituting group and the name of the acid will be formed by adding to the name of the hydrocarbon the suffix *carbonique* or *carboxylic*, according to the language.

Examples: CH_3CH_2COOH, propanoic acid; $HOOCCH_2COOH$, propanedioic acid; $HOOCCH_2CH(COOH)CH_2COOH$, 1, 2, 3-propanetricarboxylic acid. In the Geneva system the last-named compound would have been called pentanedioic-3-methyloic acid.

30. Acids in which an atom of sulfur replaces an atom of oxygen will be named according to the Geneva nomenclature. Example: ethanethioic, -thiolic, -thionic, -thionothiolic. If the carboxyl is considered as a substituent the compounds will be named *carbothioic* acids. The suffix *carbothiolic* will be used if it is certain that the oxygen of the OH group is replaced by sulfur; the suffix *carbothionic* if it is the oxygen of the CO group; the suffix *carbodithioic* will be used if both oxygen atoms are replaced.

Examples of the two systems of names: CH_3COSH or CH_3CSOH (either one), ethanethioic acid, methanecarbothioic acid; CH_3COSH, ethanethiolic acid, methanecarbothiolic acid; CH_3CSOH, ethanethionic acid, methanecarbothionic acid; CH_3CSSH, ethanethionothiolic acid, methanecarbodithioic acid.

31. The existing conventions will be retained for salts and esters.

Examples: Sodium butanoate or sodium salt of butanoic acid; diethyl 1,2-ethanedicarboxylate or diethyl ester of 1,2-ethanedicarboxylic acid; sodium acetate; methyl succinate.

32. Acid anhydrides will retain their present mode of designation according to the names of the corresponding acids. For names formed in accordance with the Geneva nomenclature,

the amides, amidoximes, amidines, imides and nitriles will be named like the acids by adding to the name of the corresponding hydrocarbon the endings *amide*, *amidine*, *amidoxime*, *imide*, and *nitrile*, respectively, while the halides will be named by combining *chloride*, etc., with the name of the radical. Examples: C_3H_7COCl, butanoyl chloride; $C_3H_7CONH_2$, butanamide; etc.

If the carboxyl is considered as a substituent the endings *carbonamide*, *carbonamidine*, *carbonamidoxime*, *carbonimide*, *carbonitrile* will be used. Examples: C_3H_7COCl, propanecarbonyl chloride; $C_3H_7CONH_2$, propanecarbonamide; etc.

33. The ending *ine* is reserved exclusively for nitrogenous bases. The present nomenclature of monoamines is retained. For polyamines, the name of the hydrocarbon will be followed by the suffixes *diamine*, *triamine*, etc.

For aliphatic compounds containing quinquevalent nitrogen the ending *ine* will be changed to *onium*. For cyclic substances containing quinquevalent nitrogen in the ring the ending *ine* will be changed to *inium;* for those with the ending *ole*, this will be changed to *olium*. Examples: pyridine, pyridinium; imidazole, imidazolium.

Further examples: CH_3NH_2, methylamine; $(CH_3)_2NH$, dimethylamine; $(CH_3)_3N$, trimethylamine; $NH_2CH_2CH_2NH_2$, 1, 2-ethanediamine; dextrin (not dextrine); glycerol (not glycerine).

34. The nomenclature of the derivatives of phosphorus, arsenic, antimony and bismuth, being very complicated, will be considered later.

35. Compounds derived from hydroxylamine by replacement of the hydrogen of the hydroxyl will be regarded as alkoxy derivatives; those in which an atom of hydrogen of the NH_2 group is replaced, as alkylhydroxylamines. Oximes will be named by adding the suffix *oxime* to the name of the corresponding aldehyde, ketone or quinone. Examples: $C_2H_5ONH_2$, ethoxyamine; C_2H_5NHOH, ethylhydroxylamine.

Further examples: $CH_3CH_2CH{:}NOH$, propanal oxime; $CH_3C({:}NOH)CH_3$, propanone oxime.

36. The generic term *urea* is retained; it will be used as a suffix for the alkyl and acyl derivatives of urea. Examples: butylurea, $C_4H_9NHCONH_2$; butyrylurea, $C_3H_7CONHCONH_2$. The bivalent radical -NHCONH- will be named *ureylene*.

37. The generic name *guanidine* is retained.

38. The name *carbylamine* is retained.

Example: C_2H_5NC, ethylcarbylamine (or ethyl isocyanide).

39. Isocyanic and isothiocyanic esters (RNCO, RNCS) will be named *isocyanates* and *isothiocyanates*.

40. The name *cyanate* is reserved for true esters which on saponification yield cyanic acid or its hydration products. The name *sulfocyanate* will be replaced by *thiocyanate*.

41. Nitro derivatives: no change in the present nomenclature.

Examples: C_6H_5NO, nitrosobenzene; $(NO_2)_3C_6H_2OH$, trinitrophenol.

42. Azo derivatives: the forms *azo*, *azoxy* are retained.

43. (a) Diazonium compounds, RN_2X, are named by addition of the suffix *diazonium* to the name of the parent substance (benzenediazonium chloride).

(b) Compounds having the same empirical formula but containing trivalent nitrogen will be named by replacing diazonium with *diazo* (benzenediazohydroxide).

(c) Substances of the type RN_2OM will be named *diazoates*.

(d) Compounds in which the two nitrogen atoms are united to a single carbon atom will be designated by the prefix *diazo* (diazomethane, diazoacetic acid).

(e) The term *diazoamino* is retained; however, these compounds may also be regarded as derivatives of triazene.

(f) Derivatives of the substances $H_2NNHNHNH_2$; $NH{:}NNHNH_2$; $NH{:}NNHN{:}NH$ will be named *tetrazanes*, *tetrazenes*, *pentazdienes*, etc.

Examples: (a) $C_6H_5N(\vdots N)Cl$, benzenediazonium chloride; (b) $C_6H_5N{:}NOH$, benzenediazohydroxide; (c) $C_6H_5N{:}NONa$, sodium benzenediazoate; (d) N_2CH_2, diazomethane; N_2CH_2COOH, diazoacetic acid, diazoethanoic acid or diazomethanecarboxylic acid; (e) $C_6H_5N{:}NNHC_6H_5$, diazoaminobenzene or 1,3-diphenyltriazene; (f) $C_6H_5NHNHNHNHC_6H_5$, 1,4-diphenyltetrazane; $C_6H_5N{:}NNHNH_2$, 1-phenyl-1-tetrazene.

44. Hydrazines are designated by the name of the alkyl radicals from which they are derived, followed by the suffix *hydrazine*. In cases where the amino group of carbonamides is replaced by the hydrazino group, the suffix *hydrazide* will be used. Hydrazo derivatives are regarded as derivatives of hydrazine. Examples: CH_3NHNH_2, methylhydrazine; $C_2H_5NHNHC_3H_7$, 1-ethyl-2-propylhydrazine; $C_3H_7CONHNH_2$, butyrohydrazide or propanecarbohydrazide.

45. Hydrazones and semicarbazones are named like the oximes. The term *osazone* is retained.

Examples: $CH_3CH{:}NNHC_6H_5$, ethanal (or acetaldehyde) phenylhydrazone; $(CH_3)_2C{:}NNHCONH_2$, propane (or acetone) semicarbazone.

46. The name *quinone* is retained.

Examples: *p*-benzoquinone or *p*-quinone, 1, 2-naphthoquinone or 1, 2-naphthaquinone, phenanthrenequinone or phenanthraquinone.

47. Sulfonic and sulfinic acids will be designated by adding the suffixes *sulfonic* and *sulfinic* to the name of the hydrocarbon. The analogous acids of selenium and tellurium will bear the names *alkaneselenonic* and *-seleninic* acids; *alkanetelluronic* and *-tellurinic* acids.

Examples: $C_2H_5SO_3H$, ethanesulfonic acid; $C_{10}H_6(SO_2H)_2$, naphthalenedisulfinic acid; CH_3SeO_3H, methaneselenonic acid; $C_6H_5TeO_2H$, benzenetellurinic acid.

48. Organometallic compounds will be designated by the names of the organic radicals united to the metal which they contain, followed by the name of the metal. Examples: dimethylzinc, tetraethyllead, methylmagnesium chloride.

However, if the metal is united in a complex manner it may be considered as a substituent. Example: $ClHgC_6H_4CO_2H$, chloromercuribenzoic acid.

49. The nomenclature of cyclic derivatives having side chains will be considered later.

50. If it is necessary to avoid ambiguity, the names of complex radicals will be placed in parentheses. Examples: (dimethylphenyl)amine = $(CH_3)_2C_6H_3NH_2$; dimethylphenylamine = $C_6H_5N(CH_3)_2$.

V. Complex Functions

51. For compounds of complex function, that is to say, for compounds possessing different functions, only one kind of function (the principal function) will be expressed by the ending of the name. The other functions will be designated by appropriate prefixes.

Example: 2-aminoethanol (not ethanolamine). By rule 1 very commonly used names like phenolsulfonic acid, naphthylaminesulfonic acid might still be used.

52. The following prefixes and suffixes will be used for designating the functions.

Function	Prefix	Suffix
Acid and derivatives	carboxy	carboxylic, carbonyl, carbonamide, etc., or oic, oyl, etc.
Alcohol	hydroxy	ol
Aldehyde	oxo, aldo (for aldehyde O) or formyl (for CHO)	al
Amine	amino	amine
Azo derivative	azo	. . .
Azoxy derivative	azoxy	. . .
Carbonitrile (nitrile)	cyano	carbonitrile or nitrile
Double bond	. . .	ene
Ether	alkoxy	. . .
Ethylene oxide, etc.	epoxy	. . .
Halide	halogeno (halo)	. . .
Hydrazine	hydrazino	hydrazine
Ketone	oxo or keto	one
Mercaptan	mercapto	thiol
Nitro derivative	nitro	. . .
Nitroso derivative	nitroso	. . .
Quinquevalent nitrogen	. . .	onium, inium (olium)
Sulfide	alkylthio	. . .
Sulfinic derivative	sulfino	sulfinic
Sulfone	sulfonyl	. . .
Sulfonic derivative	sulfo	sulfonic
Sulfoxide	sulfinyl	. . .
Triple bond	. . .	yne
Urea	ureido	urea

The order in which the functions are here listed has no significance; the rules do not establish any general order of precedence (cf. rules 7, 63).

53. The names of derivatives of fundamental heterocyclic substances will be formed according to the preceding rules.

Example: Hydroxyquinolinecarbonamide, not quinolinolcarbonamide.

VI. Radicals

54. Univalent radicals derived from saturated aliphatic hydrocarbons by removal of one atom of hydrogen will be named by replacing the ending *ane* of the hydrocarbon by the ending *yl*.

Examples: methyl, ethyl, pentyl (or amyl), etc. Since isopropylidene is recognized (rule 56) it was no doubt the intention of the Committee to recognize isopropyl similarly.

55. The names of univalent radicals derived from unsaturated aliphatic hydrocarbons will have the endings *enyl, ynyl, dienyl*, etc., the positions of the double or triple bonds being indicated by numerals or letters where necessary.

Examples: CH_2:CH—, ethenyl (or vinyl); CH⋮C—, ethynyl; CH_3—CH:CH—CH_2—, 2-butenyl; CH_2:CH—CH:CH—, 1, 3-butadienyl.

56. Bivalent or trivalent radicals derived from saturated hydrocarbons by removal of 2 or 3 hydrogen atoms from the same carbon atom will be named by replacing the ending *ane* of the hydrocarbon by the endings *ylidene* or *ylidyne*. For radicals derived from unsaturated hydrocarbons, these endings will be added to the name of the hydrocarbon. The names isopropylidene and methylene are retained.

Examples: $CH_2<$, methylene; $CH_3CH<$, ethylidene; $CH_3CH_2CH<$, propylidene; $(CH_3)_2C<$, (1-methylethylidene) or isopropylidene; CH_3C⋮, ethylidyne; CH_2:CH—$CH_2CH<$, 3-butenylidene.

57. The names of bivalent radicals derived from aliphatic hydrocarbons by removal of a hydrogen atom from each of the two terminal carbon atoms of the chain will be ethylene, trimethylene, tetramethylene, etc.

Only saturated radicals are provided for: —CH_2CH_2—, ethylene; —CH_2-CH_2CH_2—, trimethylene, etc.

58. Radicals derived from acids by removal of OH will be named by changing the ending carboxylic to *carbonyl* or, if the Geneva nomenclature is used, oic to *oyl*.

Examples: CH_3CO, ethanoyl or methanecarbonyl (or acetyl).

59. Univalent radicals derived from aromatic hydrocarbons by removal of a hydrogen atom from the ring will in principle be named by changing the ending *ene* to *yl*. However, the radicals C_6H_5 and $C_6H_5CH_2$ will continue provisionally to be named phenyl and benzyl respectively. Moreover, certain abbreviations sanctioned by usage are authorized, as *naphthyl* instead of *naphthalyl*.

Examples: $CH_3C_6H_4$—, tolyl (instead of toluyl), anthryl (instead of anthracyl), phenanthryl, fluoryl.

60. Univalent radicals derived from heterocyclic compounds by removal of hydrogen from the ring will be named by changing their endings to *yl*. In cases where this would give rise to ambiguity, merely the final *e* will be changed to *yl*. Examples: pyridine, pyridyl; indole, indolyl; pyrroline, pyrrolinyl; triazole, triazolyl; triazine, triazinyl.

61. Radicals formed by removal of a hydrogen atom from a side chain of a cyclic compound will be regarded as substituted aliphatic radicals.

Examples: $C_6H_5CH_2CH_2$—, (2-phenylethyl); $C_6H_5CH{:}CHCH_2$—, (3-phenyl-2-propenyl). (For $C_6H_5CH_2$, see rule 59.)

62. In general, special names will not be given to multivalent radicals derived from cyclic compounds by removal of several hydrogen atoms from the ring. In this case prefixes or suffixes will be used. Examples: triaminobenzene or benzenetriamine; dihydroxypyrrole or pyrrolediol.

Comparison with rules 21, 33 and 51 will show that of the names given as examples, "benzenetriamine" and "pyrrolediol" are the ones ordinarily to be preferred (according to the rule of expressing the principal function in the ending of the name where there is a suffix denoting it).

63. The order in which prefixes or radicals are stated (alphabetic order or conventional order) remains optional.

See the comments on rule 7. There is no generally accepted "conventional order" for all prefixes.

VII. Numbering

64. In aliphatic compounds the carbon atoms of the fundamental chain will be numbered from one end to the other with the use of arabic numerals. In case of ambiguity the lowest numbers will be given (1) to the principal function, (2) to double bonds, (3) to triple bonds, (4) to atoms or radicals designated by prefixes. The expression "lowest numbers" signifies those that include the lowest individual number or numbers. Thus, 1, 3, 5 is lower than 2, 4, 6; 1, 5, 5 lower than 2, 6, 6; 1, 2, 5 lower than 1, 4, 5; 1, 1, 3, 4 lower than 1, 2, 2, 4.

Examples: $CH_2{:}CHCH_2CH_3$, 1-butene (not 3-butene); $CH_2{:}CHC{:}CH$, 1-buten-3-yne (not 3-buten-1-yne); $CH_2{:}CH$—CH_2OH, 2-propen-1-ol (not 1-propen-3-ol; the name allyl alcohol may also be used); $CHCl_2$—$CH_2CH{:}CH_2$, 4, 4-dichloro-1-butene. The principle of "low numbers" also applies to cyclic compounds, with due regard to their different structures (e.g., bridges and hetero atoms are usually given preferred positions). Examples: 1, 3-cyclohexadiene; 3-cyclohexen-1-one or simply 3-cyclohexenone; 4, 4-dichlorocyclohexene.

Position of Numbers.—Where shall position numbers be placed, *before* or *after* the parts of the name to which they refer? Usage varies; some chemists place them before, some place them after, some use a combination. The Committee has left full latitude on this point. The examples in the French version usually show the numbers placed after; the examples in these comments follow the practice of *Chemical Abstracts* in being placed before. Each method has certain advantages. In Beilstein numbers placed after are in parentheses, those placed before are not, e.g., "2-methyl-butanol-(4)."

65. Positions in a side chain will be designated by numerals or letters, starting from the point of attachment. The numerals or letters will be in parentheses with the name of the chain.

Examples: $(CH_3)_2CH$—, (1-methylethyl) or isopropyl; $CH_3CHClCH_2$—, (2-chloropropyl). The rule equally permits Greek letters, ordinary letters, primed numbers (1′, 2′), numbers with indices (4^1, 4^2) or other designations.

66. In case of ambiguity in the numbering of atoms or radicals designated by prefixes, the order will be that chosen for the prefixes before the name of the fundamental compound or side chain of which they are substituents.

Example: $CH_2BrCH_2CH_2Cl$, 1-bromo-3-chloropropane (alphabetic order), or 1-chloro-3-bromopropane (order of increasing radical weight). The purpose of the rule is to decide which prefixes shall have which numbers, when the set of numbers (in the above example 1, 3) for the prefixes has been determined.

67. The prefixes, *di*, *tri*, *tetra*, etc. will be used before simple expressions (for example, diethylbutanetriol) and the prefixes *bis*, *tris*, *tetrakis*, etc., before complex expressions. Examples: bis(methylamino)propane, $CH_3NH(CH_2)_3NHCH_3$; bis-(dimethylamino)ethane, $(CH_3)_2NCH_2CH_2N(CH_3)_2$. The prefix *bi* will be used only to denote the doubling of a radical or compound; for example, biphenyl.

Additional example of the use of *bi:* *p*-$(C_6H_4CO_2H)_2$, 4, 4′-bibenzoic acid or biphenyl-4, 4′-dicarboxylic acid.

68. A catalog of cyclic systems, with their numberings according both to the existing system and to that of Mr. Patterson, is in preparation under the auspices of the National Research Council of the United States and of the American Chemical Society.

Work on this project is now in abeyance pending better financial conditions for publication.

In order to avoid all confusion the Commission recommends placing a scheme of numbering at the head of each article.

INDEX
to
INTERNATIONAL UNION RULES

(Numbers refer to the individual rules)

PREFIX NAMES OF ORGANIC RADICALS

NOTE: This compilation is substantially that published in the indexes to *Chemical Abstracts* with modifications resulting from recent international committee work.

A. M. P.

Name	Formula
acenaphthenyl (from acenaphthene)	$C_{12}H_9$—
acetamido	CH_3CONH—
acetenyl = ethynyl	
acetimido	$CH_3C(:NH)$—
acetonyl	CH_3COCH_2—
acetonylidene	CH_3COCH:
acetoxy	CH_3COO—
acetyl	CH_3CO—
acetylene	:CHCH:
acridyl (from acridine)	$C_{13}H_8N$—
acrylyl	$CH_2:CHCO$—
adipyl	—$OC(CH_2)_4CO$—
alanyl	CH_3CHNH_2CO—
aldo (O replacing H_2 to form HCO—)	O:
alkoxy (any alkyl radical attached by oxygen)	RO—
alkylthio (any alkyl radical attached by sulfur)	RS—
allyl (2-propenyl)	$CH_2:CHCH_2$—
β-allyl = isopropenyl	
amidoxalyl = oxamyl	
amino (amido)	H_2N—
amoxy	$CH_3(CH_2)_4O$—
amyl	$CH_3(CH_2)_4$—
tert-amyl	$(C_2H_5)(CH_3)_2C$—
amylidene	$CH_3(CH_2)_3CH$:
anilino	C_6H_5NH—
anisal	p-$CH_3OC_6H_4CH$:
anisoyl	p-$CH_3OC_6H_4CO$—
anisyl	(o, m or p)$CH_3OC_6H_4$—
anisylidene = anisal	
anthranilo	o-C_6H_4CON—
anthranoyl	o-$H_2NC_6H_4CO$—
anthraquinonyl (from anthraquinone, 2 isomers)	$C_{14}H_7O_2$—
anthryl (from anthracene, 3 isomers)	$C_{14}H_9$—
anthrylene (from anthracene)	$C_{14}H_8$:(11 isomers)
antimono	Sb:Sb—
antipyryl (from antipyrine)	$CO{\cdot}N(C_6H_5){\cdot}N(CH_3){\cdot}C(CH_3):C$—
arseno	—As:As—
arsenoso	O:As—
arsinico (from arsinic acid)	(HO)OAs:
arsino	H_2As—
arso	O_2As—
arsono (from arsonic acid)	$(HO)_2OAs$—
arsylene	HAs:
asaryl	2, 4, 5-$(CH_3O)_3C_6H_2$—
asparagyl	$H_2NCOCH_2CH(NH_2)CO$—
aspartyl	—$COCH_2CH(NH_2)CO$—
auro	Au—
azimino, azimido = diazoamino	
azido = triazo	

Name	Formula
azino	$:NN:$
azo	—$N:N$—
azoxy	—NON—
benzal	$C_6H_5CH:$
benzamido	C_6H_5CONH—
benzenyl	$C_6H_5C\vdots$
benzidino (from benzidine)	$H_2NC_6H_4C_6H_4NH$—
benzilyl	$(C_6H_5)_2C(OH)CO$—
benzimidazolyl (from benzimidazole)	$C_7H_5N_2$—
benzimido	$C_6H_5C(:NH)$—
benzofuryl (from benzofuran)	C_8H_5O—
benzohydryl	$(C_6H_5)_2CH$—
benzohydrylidene = diphenylmethylene	
benzopyranyl (from benzopyran, 2-α-, etc.)	C_9H_7O—
benzoxazolyl (from benzoxazole)	C_7H_4NO—
benzoxy	C_6H_5COO—
benzoyl	C_6H_5CO—
benzoylene	—C_6H_4CO—
benzyl	$C_6H_5CH_2$—
benzylidene = benzal	
biphenylene	—$C_6H_4C_6H_4$—
biphenylenedisazo	—$N:NC_6H_4C_6H_4N:N$—
bornyl (from borneol)	$C_{10}H_{17}$—
boryl	$O:B$—
bromo	Br—
1-butenyl	$CH_3CH_2CH:CH$—
2-butenyl	$CH_3CH:CHCH_2$—
3-butenyl	$CH_2:CH(CH_2)_2$—
butoxy	$CH_3(CH_2)_3O$—
butyl	$CH_3(CH_2)_3$—
sec-butyl	$(C_2H_5)(CH_3)CH$—
tert-butyl	$(CH_3)_3C$—
butylene (1, 4) = tetramethylene	
butylidene	$CH_3(CH_2)_2CH:$
butyryl	$CH_3(CH_2)_2CO$—
a mphanyl (from camphane, 3 isomers)	$C_{10}H_{17}$—
camphoroyl (from camphoric acid)	$C_{10}H_{14}O_2:$
camphoryl (from camphor)	$C_{10}H_{15}O$—
camphorylidene (from camphor)	$C_{10}H_{14}O:$
caproyl	$CH_3(CH_2)_4CO$—
capryl	$CH_3(CH_2)_8CO$—
caprylyl	$CH_3(CH_2)_6CO$—
carbamido = ureido	
carbamyl	H_2NCO—
carbanilino = phenylcarbamyl	
carbazyl (from carbazole, 5 isomers)	$C_{12}H_8N$—
carbethoxy	C_2H_5OOC—
carbomethoxy	CH_3OOC—
carbonyl	$OC:$
carbonyldioxy	—$OCOO$—
carboxy	$HOOC$—
carbyl	—C—
carvacryl (from carvacrol)	$C_{10}H_{13}$—
cetyl	$CH_3(CH_2)_{14}CH_2$—
chloro	Cl—
chloromercuri	$ClHg$—
cinnamal	$C_6H_5CH:CHCH:$
cinnamenyl = styryl	
cinnamyl	$C_6H_5CH:CHCO$—
cinnamylidene = cinnamal	

Name	Formula
citral (from citraldehyde)	$C_9H_{15}CH:$
cresotyl (from cresotic acid)	$HO(CH_3)C_6H_3CO$—
cresoxy = toloxy	
cresyl (10 isomers)	(*o*, *m* or *p*)$(HO)(CH_3)C_6H_3$—
cresylene = tolylene	
crotonyl	$CH_3CH:CHCO$—
cumal	*p*-$(CH_3)_2CHC_6H_4CH:$
cumenyl	$(CH_3)_2CHC_6H_4$—
cumidino	$(CH_3)_2CHC_6H_4NH$—
cuminal = cumal	
cyano	$N\vdots C$—
cyclobutyl	$CH_2CH_2CH_2CH$—
cyclohexadienyl (2, 4, etc.)	C_6H_7—
cyclohexadienylidene (2, 4, etc.)	$C_6H_6:$
cyclohexenyl (from cyclohexene, 3 isomers)	C_6H_9—
cyclohexyl (from cyclohexane)	C_6H_{11}—
cyclohexylidene	$CH_2CH_2CH_2CH_2CH_2C:$
cyclopentenyl (from cyclopentene)	C_5H_7—
cyclopentyl (from cyclopentane)	C_5H_9—
cyclopropyl	CH_2CH_2CH—
cymyl (from cymene)	$C_{10}H_{13}$—
2-*p*-cymyl = carvacryl	
3-*p*-cymyl = thymyl	
desyl	$(C_6H_5)(C_6H_5CO)CH$—
diazo	—$N:N$—
diazoamino	—$N:NNH$—
diazoxy	—$N(:O):N$—
dithio	—SS—
duryl	2, 3, 5, 6-$(CH_3)_4C_6H$—
durylene	2, 3, 5, 6-$(CH_3)_4C_6:$
epoxy	—O—(to different radicals already united in some other way)
ethene = ethylene	
ethenyl = vinyl; = ethylidyne	
ethoxalyl	C_2H_5OOCCO—
ethoxy	C_2H_5O—
ethyl	CH_3CH_2—
ethylene	—CH_2CH_2—
ethylenedioxy	—$O(CH_2)_2O$—
ethylidene	$CH_3CH:$
ethylidyne	$CH_3C\vdots$
ethynyl	$HC\vdots C$—
ethynylene	—$C\vdots C$—
fenchyl (from fenchyl alcohol)	$C_{10}H_{17}$—
fluoro	F—
fluoryl (from fluorene, 5 isomers)	$C_{13}H_9$—
fluorylidene	$C_{13}H_8:$
formamido	$HCONH$—
formazyl	$(C_6H_5N:N)(C_6H_5NHN:)C$—
formyl	HCO—
fural (2 isomers)	$OCH:CHCH:CCH:$
furfural = fural	
furfuryl = furyl	
furfurylidene = fural	
2-furoyl = pyromucyl	
3-furoyl	$CH:CH\cdot O\cdot CH:CCO$—
furyl (from furan, 2 isomers)	C_4H_3O—

Name	Formula
furylidene, 3(2)-form	$CH{:}CH{\cdot}O{\cdot}CH_2{\cdot}C{:}$ (also a 2(3)-form)
geranyl (from geraniol)	$C_{10}H_{17}$—
glutamyl	—$OCCH(NH_2)(CH_2)_2CO$—
glutaryl	—$OC(CH_2)_3CO$—
glyceryl	—$CH_2(CH$—$)CH_2$—
glycolyl	$HOCH_2CO$—
glycyl	H_2NCH_2CO—
glyoxyl	HCOCO—
guaiacyl = *o*-anisyl	
guanido	$H_2NC({:}NH)NH$—
guanyl	$H_2NC({:}NH)$—
halogeno, halo (any halogen atom)	Hl—
hendecyl	$CH_3(CH_2)_{10}$—
heptyl	$CH_3(CH_2)_6$—
hexadecyl = cetyl	
hexyl	$CH_3(CH_2)_5$—
hippuryl	$C_6H_5CONHCH_2CO$—
homopiperonyl	3, 4-$(CH_2O_2)C_6H_3CH_2CH_2$—
hydrazi	—NHNH—(to same atom)
hydrazino	H_2NNH—
hydrazo	—NHNH—(to different atoms)
hydrazono	$H_2NN{:}$
hydroxamino	HONH—
hydroximino = isonitroso	
hydroxy	HO—
imidazolyl (from imidazole, 4 isomers)	$C_3H_3N_2$—
imino (imido)	HN:
indanyl (from indan, 4 isomers)	C_9H_9—
indenyl (from indene, 7 isomers)	C_9H_7—
indolyl (from indole, 7 isomers)	C_8H_6N—
indolylidene (3(2) form shown)	$C_6H_4NHCH_2C{:}$
indyl = indolyl	
indylidene = indolylidene	
iodo	I—
iodoso	OI—
iodoxy	O_2I—
isoallyl = propenyl	
isoamoxy	$(CH_3)_2CHCH_2CH_2O$—
isoamyl	$(CH_3)_2CHCH_2CH_2$—
isoamylidene	$(CH_3)_2CHCH_2CH{:}$
isobutenyl	$(CH_3)_2C{:}CH$—
isobutoxy	$(CH_3)_2CHCH_2O$—
isobutyl	$(CH_3)_2CHCH_2$—
isobutyryl	$(CH_3)_2CHCO$—
isocyano	C:N—
isodiazo	—NHN: (to same atom)
isohexyl	$(CH_3)_2CH(CH_2)_3$—
isoindyl (from isoindole, 4 isomers)	C_8H_6N—
isoleucyl	$CH_3CH_2CH(CH_3)CH(NH_2)CO$—
isonitro	HOON:
isonitroso	HON:
1-isopentenyl	$(CH_3)_2CHCH{:}CH$—
isophthalal (isophthalylidene)	$:HCC_6H_4CH{:}(m)$
isopropenyl	$CH_2{:}C(CH_3)$—
isopropoxy	$(CH_3)_2CHO$—
isopropyl	$(CH_3)_2CH$—
isopropylidene	$(CH_3)_2C{:}$

Name	Formula
isoquinolyl (from isoquinoline, 9 isomers)	C_9H_6N—
isothiocyano	S:C:N—
isovaleryl	$(CH_3)_2CHCH_2CO$—
isoxazolyl (from isoxazole, 5 isomers)	(C_3H_2NO)—
keto	O: (to same atom; properly used for ketones only; cf. "oxo")
leucyl	$(CH_3)_2CHCH_2CH(NH_2)CO$—
malonyl	—$OCCH_2CO$—
menthyl (from menthane): as, 2-*p*-menthyl	$C_{10}H_{19}$—
mercapto	HS—
mercuri	—Hg—
α-mesityl	3.5-$(CH_3)_2C_6H_3CH_2$—
2-mesityl	2, 4, 6-$(CH_3)_3C_6H_2$—
methene = methylene	
methenyl = methylidyne	
methionyl	$CH_2(SO_2)_2{:}$
methoxy	CH_3O—
methyl	CH_3—
methylene	H_2C
methylenedioxy	—OCH_2O—
methylidyne	HC⋮
methylol = hydroxymethyl	
naphthal	$C_{10}H_7CH{:}$
naphthalimido (from naphthalic acid)	$C_{10}H_6(CO)_2N$—
naphthenyl	$C_{10}H_7C.$
naphthobenzyl	$C_{10}H_7CH_2$—
naphthoxy	$C_{10}H_7O$—
naphthoyl	$C_{10}H_7CO$—
naphthyl (1 or 2)	$C_{10}H_7$—
naphthylene	$C_{10}H_6{:}$
naphthylidene (1(4) form shown)	$C_6H_4CH_2CH{:}CH{\cdot}C$
nitramino	O_2NNH—
nitrilo	N⋮
nitro	O_2N—
aci-nitro = isonitro	
nitroso	ON—
norcamphanyl (from norcamphane)	C_7H_{11}—
octyl	$CH_3(CH_2)_7$—
oxalyl	—OCCO—
oxamido	$H_2NCOCONH$—
oxamyl	H_2NCOCO—
oximido = isonitroso	
oxo	O: (to same atom; broader than "keto")
oxy	—O—(used as a connective; cf. aldo, epoxy, keto and oxo)
pentamethylene	—$CH_2(CH_2)_3CH_2$—
pentazyl	$N{:}N{\cdot}N{:}N{\cdot}N$—
pentenyl (like butenyl)	C_5H_9—
pentyl = amyl	
perimidyl (from perimidine, 8 isomers)	$C_{11}H_7N_2$—
perthio (replacing O only)	S:S:
phenacyl	$C_5H_5COCH_2$—
phenacylidene	$C_6H_5COCH{:}$
phenanthryl (from phenanthrene, 5 isomers)	$C_{14}H_9$—

Name	Formula
phenanthrylene (several isomers)	$C_{14}H_8$:
phenenyl (*s*, *as*-, *v*-)	C_6H_3:
phenethyl	$C_6H_5CH_2CH_2$—
phenetidino	$C_2H_5OC_6H_4NH$—
phenetyl (*o*, *m*, *p*)	$C_2H_5OC_6H_4$—
phenoxy	C_6H_5O—
phenyl	C_6H_5—
phenylazo	C_6H_5N:N—
phenylcarbamido = phenylureido	
phenylene (*o*, *m*, *p*)	C_6H_4:
phenylenedisazo (*o*, *m*, *p*)	—N:NC_6H_4N:N—
phenylidene = cyclohexadienylidene	
phenylureido	$C_6H_5NHCONH$—
phospharseno	—P:As—
phosphazo	—P:N—
phosphinico	(HO)OP:
phosphino	H_2P—
phospho	O_2P—
phosphono	$(HO)_2OP$—
phosphoro	—P:P—
phosphoroso	O:P—
phthalal	:HCC_6H_4CH: (*o*)
phthalamido	$HO_2C·C_6H_4·CONH$— (*o*)
phthalidene (from phthalide)	C_6H_4COOC:
phthalidyl	C_6H_4COOCH—
phthalimido	$C_6H_4(CO)_2N$— (*o*)
phthalyl	—OCC_6H_4CO— (*o*)
picryl	2, 4, 6-$(NO_2)_3C_6H_2$—
piperidyl (from piperidine, 4 isomers)	$C_5H_{10}N$—
piperonyl	3, 4-$(CH_2O_2)C_6H_3CH_2$—
piperonylidene	3, 4-$(CH_2O_2)C_6H_3CH$:
pivalyl (from pivalic acid)	$(CH_3)_3CCO$—
prolyl (from proline)	$NHCH_2CH_2CH_2CHCO$—
propargyl (2-propynyl)	HC:CCH_2—
propenyl (1-propenyl)	CH_3CH:CH—
propenylidene (1-propenylidene)	CH_3CH:C:
propiolyl	HC:CCO—
propionyl	CH_3CH_2CO—
propoxy	$CH_3CH_2CH_2O$—
propyl	$CH_3CH_2CH_2$—
propylene	—$CH(CH_3)CH_2$—
propylidene	CH_3CH_2CH:
pseudoallyl = isopropenyl	
as-pseudocumyl	2, 3, 5-$(CH_3)_3C_6H_2$—
s-pseudocumyl	2, 4, 5-$(CH_3)_3C_6H_2$—
v-pseudocumyl	2, 3, 6-$(CH_3)_3C_6H_2$—
pseudoindyl (from pseudoindole, 7 isomers)	C_8H_6N—
pyranyl (2-α, 2-γ, 3-α, etc.)	C_5H_5O
pyrazolyl (from pyrazole, 4 isomers)	$C_3H_3N_2$—
pyridyl (from pyridine, 3 isomers)	C_5H_4N—
pyridylidene (4(1) form shown)	CH:CHNHCH:CHC:
pyrimidyl (from pyrimidine)	$C_4H_3N_2$—
pyromucyl	OCH:CHCH:CCO—

Name	Formula
pyrrolidyl (from pyrrolidine, 3 isomers)	C_4H_8N—
pyrroyl	CH:CHCH:CHNCO
pyrryl (from pyrrole, 3 isomers)	C_4H_4N—
quinolyl (from quinoline, 7 isomers)	C_9H_6N—
quinonyl (from quinone)	$C_6H_3O_2$—
quinoxalyl (from quinoxaline)	$C_8H_5N_2$—
salicyl	HOC_6H_4— (*o*)
salicylal	HOC_6H_4CH: (*o*)
salicylyl	HOC_6H_4CO— (*o*)
selenino	(HO)OSe—
seleninyl	OSe:
seleno	Se:
selenocyano	NCSe—
selenono	HO_3Se—
selenonyl	—SeO_2—
selenyl	HSe—
semicarbazido	$H_2NCONHNH$—
silicono	(HO)OSi—
silicyl	H_3Si—
silicylene	H_2Si:
stannyl	H_3Sn—
stearyl	$CH_3(CH_2)_{16}CO$—
stibarseno	—Sb:As—
stibinico	(HO)OSb:
stibino	H_2Sb—
stibo	O_2Sb—
stibono	$(HO)_2OSb$—
stiboso	O:Sb—
stibylene	HSb:
styrene (styrolene)	—$CH(C_6H_5)CH_2$—
styryl	C_6H_5CH:CH—
succinamyl	$H_2NCOCH_2CH_2CO$—
succinyl	—$OCCH_2CH_2CO$—
sulfamino	HO_3SNH—
sulfamyl	H_2NO_2S—
sulfhydryl = mercapto	
sulfino	HO_2S—
sulfinyl	OS:
sulfo	HO_3S—
sulfonamido	—SO_2NH—
sulfonyl (sulfuryl)	—SO_2—
tauryl	$H_2NCH_2CH_2SO_2$—
telluro	Te:
terephthalal	:HCC_6H_4CH: (*p*)
tetramethylene	—$CH_2CH_2CH_2CH_2$—
tetrazyl (from tetrazole, 2 isomers)	CHN_4—
thenoyl (from thiophenecarboxylic acid, 2 isomers)	C_4H_3SCO—
thiazyl (from thiazole, 3 isomers)	C_3H_2NS—
thienyl (from thiophene, 2 isomers)	C_4H_3S—
thio	—S—
thiocarbonyl	SC:
thiocyano	NCS—
thiohydroxy = mercapto	
thiol (*S* replacing *O* in *OH*)	Used in place of "thio" when required for distinction
thiono (*S* replacing *O* in *CO*)	Used in place of "thio" when required for distinction
thionyl = sulfinyl	

Name	Formula
thujyl (from sabinane)	$C_{10}H_{17}$— (attached at one of 2 positions)
thymyl (from thymol)	$C_{10}H_{13}$—
toloxy (*o*, *m*, or *p*)	$CH_3C_6H_4O$—
toluino (*o*, *m*, or *p*)	$CH_3C_6H_4NH$—
toluyl (*o*, *m*, or *p*)	$CH_3C_6H_4CO$—
α-toluyl	$C_6H_5CH_2CO$—
tolyl (*o*, *m*, or *p*)	$CH_3C_6H_4$—
α-tolyl = benzyl	
tolylene (6 isomers)	$CH_3C_6H_3$:
α-tolylene = benzal	
triazeno	$H_2NN{:}N$—
triazinyl (from triazine)	$C_3H_2N_3$—
triazo	$N{:}N{\cdot}N$—
triazolyl (from triazole)	$C_2H_2N_3$—
trimethylene	—$CH_2CH_2CH_2$—
tryptophyl (from tryptophan)	$(C_{11}H_{11}N_2O)$—
tyrosyl (from tyrosine)	*p*-$HOC_6H_4CH_2CH(NH_2)CO$—
undecyl = hendecyl	
uramino = ureido	
ureido	H_2NCONH—
ureylene	—$NHCONH$—
valeryl	$CH_3(CH_2)_3CO$—
valyl (from valine)	$(CH_3)_2CHCH(NH_2)CO$—
vanillal	3, 4-$(CH_3O)(HO)C_6H_3CH$:
vanilloyl	3, 4-$(CH_3O)(HO)C_6H_3CO$—
vanillyl	3, 4-$(CH_3O)(HO)C_6H_3CH_2$—
veratral	3, 4-$(CH_3O)_2C_6H_3CH$:
veratroyl	3, 4-$(CH_3O)_2C_6H_3CO$—
veratryl	3, 4-$(CH_3O)_2C_6H_3CH_2$—
veratrylidene = veratral	
vinyl (ethenyl)	$H_2C{:}CH$—
vinylene	—$CH{:}CH$—
vinylidene (ethenylidene)	$H_2C{:}C$:
xanthyl (from xanthene, 6 isomers)	$C_{13}H_9O$—
xyloyl (from xylic acid, 7 isomers)	$(CH_3)_2C_6H_3CO$—
xylyl (dimethylphenyl)	$(CH_3)_2C_6H_3$—
xylylene	—$H_2CC_6H_4CH_2$—

EXPLANATION OF TABLE

The table presents data for over 5000 compounds. They have been selected to include those of general or commercial importance as well as those commonly met with in the laboratory.

Arrangement. The entries are arranged alphabetically by *parent compounds*, substituting atoms and groups like bromo-, chloro-, ethyl-, methyl-, nitro-, etc. being placed after the rest of the name instead of before it; e.g., Acetic acid, dichloro- (and not Dichloroacetic acid). This practice, which is followed in some of the indexes to journals, makes it possible to bring many derivatives of the same parent together. Radicals such as propyl, butyl and amyl, and also compounds such as butyric acid and valeraldehyde, are assumed to be of normal structure unless otherwise stated.

Nomenclature. Compounds are indexed under their common names wherever these are acceptable, but a large number of *synonyms* and *cross references* are included. In particular, many names formed according to the International Union Rules (see preceding pages) are given and are distinguished by the symbol (*).

An **alphabetic order of substituting radicals** is employed in each name; e.g., Ether, ethyl methyl (not Ether, methyl ethyl). For a table of radicals, see preceding pages.

Acids are entered under their "trivial" names where these exist. Systematic names are derived from trivial names where this is feasible; as, Valeric acid, α-bromo-.

Alcohols. Important alcohols having common names, as Amyl alcohol, Isoamyl alcohol, Propyl alcohol, are so entered. For others the International Union names are used; as, 3-Buten-1-ol.

Aldehydes and **amides** are usually entered under names derived from the acid name; as, Propionaldehyde, Propionamide (from propionic acid).

Amines will be found under their usual names; as, Ethylamine, Triethylamine, Ethylenediamine.

Carbylamines are entered as Ethyl isocyanide, Phenyl isocyanide, etc.

Cyanides. See Nitriles, below.

Esters of organic acids will in general be found under the names of the corresponding acids, but those of glycerol and glycol are under the names of the alcohols. Esters of inorganic acids have independent entries; as, Ethyl sulphate, Ethylsulfuric acid.

Ethers. Simple, unsubstituted ethers occur under their own names; as, Ethyl ether, Phenyl ether. Most other monoethers are under *Ether;* as, Ether, isoamyl phenyl.

Halogen derivatives of hydrocarbons, when simple, are entered under their common names (as, Propyl chloride) or, when more complex, under their International Union names (as, 1-Pentane, 2-chloro-).

Hydrazine derivatives are found under *Hydrazine* or, if monoacyl derivatives, under the name of the corresponding acid (as, Benzoic acid, hydrazide). But **hydrazones** are placed under the corresponding carbonyl compound (as, Acetone, phenylhydrazone).

Hydrocarbons of the aliphatic series are entered under their Geneva (International Union) names; other hydrocarbons, under their commonly accepted names.

Isocyanides (**Isonitriles**) are named as Ethyl isocyanide, Phenyl isocyanide, etc.

Ketones having simple names are so entered (e.g., Acetone, Acetophenone); others are given International Union names if possible (as, 2-Butanone). Those familiar with "ketone" names will find a number of cross references under *Ketone*.

Mercaptans are named, according to the International Union rule, as Ethanethiol (C_2H_5SH), Benzenethiol (C_6H_5SH), etc.

Metallic salts of organic acids will be found in the preceding table, "Physical Constants of Metal-Organic Compounds."

Metal-organic compounds should be looked for under the name of the metal; as, Lead, tetraethyl-.

Nitriles (cyanides) are given names derived from the corresponding acid; as, Acetonitrile.

Oximes are entered under the corresponding carbonyl compound; as, Formaldehyde, oxime.

Phenols will be found under their usual names; as, Phenol, Resorcinol.

Salts of bases are entered under the names of the bases; as, Aniline, hydrochloride. For metal salts of organic acids see the preceding table, "Physical Constants of Metal-Organic Compounds."

Semicarbazones are placed under the corresponding carbonyl compound; as, Acetone, semicarbazone.

Sulfides, sulfones and **sulfoxides** are treated like ethers (see Ethers, above); as, Ethyl sulfide; Sulfone, ethyl phenyl.

Sulfonic acids are named as Ethanesulfonic acid, Naphthalenedisulfonic acid, etc.

Boldface type is used to distinguish the parent compounds and their substituting radicals. When a parent compound is followed by derivatives its name is not repeated but is replaced in each succeeding entry by a dash.

Formulas. Structural formulas have been given in most cases, and the structure has been indicated as fully as is feasible without taking undue space.

Order of Data. Each entry is presented in the same invariable order: name; synonym; formula; molecular weight; color and crystalline form, index of refraction n, and specific rotation $[\alpha]$; density; melting point; boiling point; solubility.

Numbers have been assigned to all compounds for use in connection with the formula index which immediately follows the organic table. In the process of final editing (due to duplication or other causes) an occasional compound with its number has been deleted.

Crystalline form and color are stated in easily interpreted abbreviations. Other important characteristics are often added. The **index of refraction,** n, follows. For crystals of two or three indices they are invariably given in the order ω, ϵ or α, β, γ. The **specific rotation,** $[\alpha]$, is given for certain compounds. Temperature and wavelength are indicated by the superior and inferior figures and letters following the numerical value. When not otherwise indicated the index of refraction and specific rotation are understood to be at 20°C. and for sodium light.

For example: n 1.5236^{20}_{D} indicates an index of refraction of 1.5236 for sodium light (λ = 589.3 mμ) at 25°C; $[\alpha]$ $-65.6°^{20}_{D}$ indicates a negative specific rotation of 65.6° for sodium light and a temperature of 20°C.

Density, D., is normally given in grams per milliliter, at 20°C, numerically equivalent to the specific gravity at 20°C referred to water at 4°C. Specific gravity at other temperatures is shown with superior and inferior figures indicating, respectively, the temperature of the substance and that of water to which it is referred. The density of gases is given in grams per liter at 0°C and 760 mm Hg pressure unless otherwise indicated.

Example: **D.** 1.536 indicates a density in grams per milliliter at 20°C; **D.** 1.634^{25}_{4} indicates a specific gravity of 1.634 at 25°C referred to water at 4°. **D.** 2.143g/l indicates the density of a gas at standard conditions, 0°C and 760 mm pressure, as 2.143 grams per liter.

Melting point, m. p., and **boiling point, b. p.** are given in °C. Other effects of temperature elevation such as dehydration, sublimation, decomposition, explosion are recorded in connection with the melting or boiling points. Decomposition on heating is indicated by the abbreviation d. All such statements will follow the abbreviation **m. p.** or **b. p.** If decomposition occurs at a definite temperature, the form d. 120 is used, while 120 d. indicates melting or boiling with decomposition. Loss of water of crystallization is indicated by $-H_2O$. The boiling point is stated at normal atmospheric pressure (760 mm of Hg) unless otherwise indicated by a superior figure which shows the pressure in millimeters under which the compound boils at the temperature given.

Example: **b.p.** 125^{720} indicates a boiling point of 125°C at a pressure of 720 mm.

Solubility, Soly., is stated in grams of substance dissolving in 100 cm³ of the solvent. Normal room temperatures, 20°C, is assumed unless the temperature is indicated by a superior figure. The term insoluble (i.) must usually be interpreted to mean that a negligible quantity of the compound dissolves. Many compounds commonly regarded as insoluble really dissolve to a slight extent. The terms very soluble (v.s.), soluble (s.), slightly soluble (sl.s.) are used for lack of definite figures. Conflicting statements are very common in the literature. Quantitative statements of solubility are likewise subject to uncertainty due to inexact statement of conditions. Values may be variously stated as parts by weight of solute in parts by weight or volume of the solvent or of the solution, and values are often given and quoted in the literature without proper designation. In the large number of values given there are many which are uncertain in this respect.

The form s. d. indicates solubility with more or less decomposition. The occurrence of d. alone in the statement of solubility indicates that decomposition is the primary action. The statement of solubility in acids or alkalis is usually understood to be accompanied by decomposition.

The policy has been followed of giving the solubility in water, ethyl alcohol and ethyl ether first, followed by statements in regard to other solvents.

As examples:

23.4^{20}w. indicates a solubility of 23.4 grams of the substance in 100 cm³ of water at 20°C.

250 cm³ al. indicates the solubility of a gas in ethyl alcohol as 250 cm³ of the gas in 100 cm³ of alcohol.

∞^{35}w. indicates that the substance is miscible with water above 35°C.

ABBREVIATIONS

[α]	specific rotation
a	acid
abs	absolute
abt	about
ac.a	acetic acid
acet	acetone
al	alcohol
alk	alkali
amor	amorphous
anh	anhydrous
arom	aromatic
art	artificial
asym. or as	asymmetric
b.p	boiling point
bi-py	bipyramidal
bl	blue
blk	black
boil.	boiling
br	brown
bz	benzene
c	cold
ca	about
carb	carbonates
caust	caustic
chl	chloroform
col	colorless
comp.	compound
conc	concentrated
cr. or cryst.	crystals
d	decomposes
d	dextrorotatory
D	density
deliq.	deliquescent
dil	dilute
dk	dark
dl	racemic
efflor.	efflorescent
et	ethyl or ethyl ether
et. ac.	ethyl acetate
eth	ether
exp	explodes
f	from
feath	feathery
fl	flakes
fluores.	fluorescent
frz	freezes
fum	fuming
gel.	gelatinous
gen.	generally
glac	glacial
glit	glittering
glyc	glycerin
h	hot
hex	hexagonal
hyd	hydrate or hydrolyzes
hyg	hygroscopic
i	inactive
i	insoluble
ign	ignites
inflam	inflammable
infus	infuses
irid	iridescent
l	levorotatory
leaf. or lf.	leaflets
lg	large
lgr	ligroin
liq	liquid
lng	long
lt	light
lust	lustrous
lvs	leaves
m	meta-
me	methyl
met	metallic
micr	microscopic
min	mineral
mixt	mixture
mod	modification
monocl.	monoclinic
m.p	melting point
n	normla or index of refraction
need. or nd	needles
o	ortho-
octahdr.	octahedral
or	orange
ord	ordinary
org	organic
orth	orthorhombic
p	para-
pa	pale
pet	petroleum
pet. eth	petroleum ether
ph	phenyl
pl	plates
pois	poison
powd	powder
pr	prisms
purp	purple
pyr	pyridine
pyram	pyramids
quad	quadrilateral
rac	racemic
resin	resinous
rhomb	rhombic
rhbdr	rhombohedral
s	soluble
sc	scales
sec	secondary
sh	short
sl	slightly
slend	slender
sm	small
soft	softens
sol	solution
solv	solvents
soly	solubility
st	steel
stab	stable
subl	sublimes
sym	symmetrical
tab	tablets
tert	tertiary
tetr	tetragonal
tol	toluene
trans.	transparent
tricl	triclinic
trim	trimetric
uns	unsymmetrical
unst	unstable
v	very
var	variable
vic	vicinal
visc	viscous
volat	volatile or volatilizes
vlt	violet
w	water
wh	white
yel	yellow
ylsh	yellowish
>	above
<	below
∞	soluble in all proportions

1 **Abietic acid** (*abietinic acid; sylvic acid*). $(CH_3)_2CH(CH_3)_2C_{14}H_{16}COOH$, 302.23. Yel. amor. powd., *n* 1.510, 1.578, 1.618. **m.p.** 137–66, var. **Soly.** i.w.; v.s.al.; v.s.et.; s.glac.ac.a., acet., bz., CS_2, me.al.

2 **Acenaphthene** (*naphthyleneethylene*). $C_{10}H_6(CH_2)_2$, 154.08. Wh. lng. need., *n* 1.407, 1.468, 1.620; liq. *n* 1.6048^{100}. **D.** 1.024^{99}_{4}, **m.p.** 95, **b.p.** 277.5. **Soly.** i.w.; 4.2^{20}, 66.7^{70} al.; s.h.et.; 36.9^{20} chl.; 76^{20}, 284.6^{60} tol.; s.h.bz.

3 **Acetal** (1, 1-*diethoxyethane*; acetaldehyde diethyl acetal; ethylidene diethyl ether*). $CH_3CH(OC_2H_5)_2$, 118.11. Col. volat. liq., *n* 1.38193. **D.** 0.8254^{20}_{4}, 0.8461^{0}_{4}, **b.p.** 102–4. **Soly.** 4.58^{25}w.; ∞al.; ∞et.

4 —, **amino-.** See *Ethylamine, β, β-diethoxy-**.

5 —, **dichloro-** (1, 1-*dichloro*-2, 2-*diethoxyethane**). $CHCl_2CH(OC_2H_5)_2$, 187.01. Liq. **D.** 1.138^{14}, **b.p.** 184.

6 —, **diethylamino-.** See *Triethylamine, β, β-diethoxy-*.

7 —, **dimethyl.** See *Ethane*, 1, 1-*dimethoxy-**.

8 —, **dimethylamino-.** See *Ethylamine, β, β-diethoxy-N, N-dimethyl-*.

9 —, **trichloro-.** See *Ethane*, 1, 1, 1-*trichloro*-2, 2-*diethoxy-**.

10 **Acetaldehyde** (*ethanal*; acetic aldehyde; aldehyde*). CH_3CHO, 44.03. Col. fum. inflam. liq., *n* 1.3316. **D.** 0.7834^{18}_{4}, **m.p.** −123.5, **b.p.** 21. **Soly.** ∞w.; ∞al.; ∞et.; ∞bz.

11 —, cyanohydrin. See *Lactonitrile.*

12 —, diethyl acetal. See *Acetal.*

13 —, dimethyl acetal. See *Ethane*, 1, 1-*dimethoxy-**.

14 —, oxime (*ethanal oxime*; acetaldoxime*). $CH_3CH{:}NOH$, 59.05. Wh. cr. or col. liq., liq. *n* $1.42567^{20.4}$. **D.** 0.9645^{20}_{4}, **m.p.** 47, frz. 13, **b.p.** 114–5. **Soly.** ∞w.; ∞al.; ∞et.

15 —, phenylhydrazone (*N-ethylidene-N′-phenylhydrazine*). $CH_3CH{:}NNHC_6H_5$, 134.09. Col. need. **m.p.** 99, **b.p.** 133–6, $236–7^{20}$. **Soly.** s.pet.eth.

16 —, semicarbazone (*ethanal semicarbazone**). $CH_3CH{:}NNHCONH_2$, 101.08. Need. f.w. or al. **D.** 1.0300^{0}_{4}, **m.p.** 162–3. **Soly.** 3^{17}w.; s.al.

17 —, **butylethyl-.** See *Caproaldehyde, α-ethyl-*.

18 —, **dichloro-** (*dichloroethanal*; dichloroaldehyde*). $CHCl_2CHO$, 112.93. Col. liq. **b.p.** 90.5.

19 —, **methyl-.** See *Propionaldehyde.*

20 —, **phenyl-.** See *α-Tolualdehyde.*

21 —, **thio-,** trimer. See *s-Trithiane*, 2, 4, 6-*trimethyl-*.

22 —, **tribromo-.** See *Bromal.*

23 —, **trichloro-.** See *Chloral.*

24 —, **trimethyl-.** See *Pivalaldehyde.*

25 —, *α-* or **β-trithio-.** See *s-Trithiane*, 2, 4, 6-*trimethyl-*.

26 —, **γ-trithio-.** $(CH_3CHS)_3$, 180.27. **m.p.** 81, **b.p.** 100.

27 **Acetaldehyde-ammonia** (1-*aminoethanol*; α-aminoethyl alcohol; aldehyde-ammonia*). $CH_3CH(NH_2)OH$, 61.06. Col. rhomb. **m.p.** 97 (70–80), **b.p.** 100 sl. d. **Soly.** v.s.w.; v.s.al.; sl.s.et.

28 **Acetaldoxime.** See *Acetaldehyde, oxime.*

29 —, **trimethyl-.** See *Pivalaldehyde, oxime.*

30 **Acetalylamine.** See *Ethylamine, β, β-diethoxy-**.

31 **Acetamide** (*ethanamide**). CH_3CONH_2, 59.05. Col. hex., or rhbdr., deliq. need. f. chl., *n* 1.54, 1.46 (stable mod.); *n* 1.370, 1.485, 1.585 (metastable mod.); liq. *n* $1.4274^{78.3}$. **D.** 1.159^{20}_{4}, **m.p.** 81 (69.4), **b.p.** 222. **Soly.** 97.5^{20}, 178^{60}w.; 25.0^{20}, 257.1^{60}al.; sl.s.et.; v.s.glyc.; s.chl.

32 —, ***N*-benzyl-** (*N-acetylbenzylamine; acetobenzylamide*). $C_6H_5CH_2NHCOCH_3$, 149.09. Leaf. f. et. **m.p.** 61, **b.p.** > 300. **Soly.** i.w.; s.al.; s.et.; s.lgr.

33 —, ***N*-bromo-** (*acetobromamide*). $CH_3CONHBr$, 137.96. + 1 H_2O, lg. pl. **m.p.** + H_2O, 70–80; anh. 108. **Soly.** s., d.^{100}w.; s.al.; s.et.

34 —, **α-chloro-** (2-*chloroethanamide**). $ClCH_2CONH_2$, 93.50. Monocl. need. **m.p.** 119.5, **b.p.** 225.6. **Soly.** 10^{24}w.; s.al.; v.sl.s.et.

35 —, **cyanonitro-.** See *Fulminuric acid.*

36 —, **α, α-dichloro-** (2, 2-*dichloroethanamide**). $CHCl_2CONH_2$, 127.95. Monocl. pr. **m.p.** 98, **b.p.** 234.6. **Soly.** v.s.h.w.; v.s.al.; v.s.et.

37 —, ***N, N*-diphenyl-** (*N-acetyldiphenylamine, N-phenylacetanilide*). $(C_6H_5)_2NCOCH_3$, 211.11. Lng. need. or rhomb. f.w. **m.p.** 103 (99–100), **b.p.** subl. **Soly.** sl.s.w.; s.al.; sl.s.et.

38 —, ***N*-ethyl-** (*acetoethylamide*). $CH_3CONHC_2H_5$, 87.08. Liq. **D.** $0.942^{4.5}_{4}$, **b.p.** 205. **Soly.** ∞w.; ∞al.; s.a.; i.dil.alk.

For explanations and abbreviations see beginning of table.

39. **Acetamide, hydroxy-.** See *Glycolamide.*

40 —, ***N*-(2-hydroxy-1-naphthyl)-.** See 2-*Naphthol, 1-acetamido-.*

41 —, ***N*-(4-hydroxy-1-naphthyl)-.** See 1-*Naphthol, 4-acetamido-.*

42 —, **isopropyl-.** See *Isovaleramide.*

43 —, ***N*-methyl-*N*-1-naphthyl-.** See 1-*Naphthylamine, N-acetyl-N-methyl-.*

44 —, ***N*-naphthyl-.** See *Naphthylamine, N-acetyl-.*

45 —, ***N*-phenyl-.** See *Acetanilide.*

46 —, ***N*-2-thienyl-** (*N-acetyl-2-thiophenine, 2-acetothiophenide*). CH_3-$CONHC_4H_3S$, 141.12. Wh. pl. **m.p.** 160–1. **Soly.** sl.s.w.; s.al.; sl.s.et.

47 —, **thio-** (*ethanethionamide*, acetothioamide*). CH_3CSNH_2, 75.11. Yel. monocl. tab. f. et. **m.p.** 108.5 **Soly.** v.s.w.; s.al.; s.et.

48 —, ***N*-(thiocarbamyl)-.** See *Urea, acetyl-thio-.*

49 —, **trichloro-** (2, 2, 2-*trichloroethanamide**). CCl_3CONH_2, 162.39. Monocl.tab.f.w. **m.p.** 141. **b.p.** 239–40. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

50 **Acetamidine** (*ethanamidine**). $CH_3C(:NH)NH_2$, 58.06. Unstable. **m.p.** 166–7 d. **Soly.** s., d.h.w.; s.al.; s.a.

51 —, ***N, N'*-diphenyl-** (*ethenyldiphenylamidine*). $CH_3C(:NC_6H_5)NHC_6H_5$, 210.13. Need.f.al. **m.p.** 131–2. **Soly.** sl.s.c., v.s.h.al.: v.s.et.; s.a.

52 **Acetanilide** (*N-phenylacetamide, antifebrin*). $CH_3CONHC_6H_5$, 135.08. Rhomb., wh.leaf.f.w. **D.** 1.21^{4}_{4}. **m.p.** 114, **b.p.** 305. **Soly.** 0.563^{25}. 3.5^{80}w.; 36.9^{20}al.; s.et.; 13.6^{20}, 44.9^{50}chl.; 69.5^{20}me.al.; s.glyc.

53 —, ***α*-acetyl-.** See *Acetoacetanilide.*

54 —, ***o*-amino-** (*N-acetyl-o-phenylenediamine*). $CH_3CONHC_6H_4NH_2$. 150.09. Sm. lust. pl. **m.p.** 132 (145). **Soly.** s.w.; sl.s.et.

55 —, ***m*-amino-** (*N-acetyl-m-phenylenediamine*). $NH_2C_6H_4NHCOCH_3$. 150.09. Cr. mass. **m.p.** 70, **b.p.** d. 86.5–7.5. **Soly.** v.s.w.; s.al.; sl.s.et.

56 —, ***p*-amino-** (*N-acetyl-p-phenylenediamine*). $CH_3CONHC_6H_4NH_2$, 150.09. Col.need.f.w. **m.p.** 161–2. **b.p.** 267. **Soly.** sl.s.w.; v.s.al.; v.s.et.

57 —, ***o*-bromo-** (*N-acetyl-o-bromoaniline*). $BrC_6H_4NHCOCH_3$, 213.99. Need.f.al. **m.p.** 99. **Soly.** i.w.; s.al.; s.et.

58 —, ***m*-bromo-.** $CH_3CONHC_6H_4Br$, 213.99. Need.f.dil.al. **m.p.** 87.5. **Soly.** s.al.; s.et.

59 —, ***p*-bromo-** (*N-acetyl-p-bromoaniline, antisepsin, asepsin, bromanilid*). $BrC_6H_4NHCOCH_3$, 213.99. Need. or monocl. pr. **m.p.** 168 (165–7). **Soly.** v.sl.s.h.w.; sl.s al.; sl.s.et.; s.chl., bz.

60 —, ***o*-chloro-** (*N-acetyl-o-chloroaniline*). $CH_3CONHC_6H_4Cl$, 169.53. Need.f.dil.ac.a. **m.p.** 88. **Soly.** sl.s.w.; s.al.; v.s.et.; s.bz.

61 —. ***m*-chloro-** (*N-acetyl-m-chloroaniline*). $CH_3CONHC_6H_4Cl$, 169.53. Need.f.dil.ac.a. **m.p.** 72.5. **Soly.** sl.s.w.; s.al.; v.s.et.; s.CS_2, bz.

62 —, ***p*-chloro-** (*N-acetyl-p-chloroaniline*). $CH_3CONHC_6H_4Cl$, 169.53. Rhomb. need. or pl. **D.** 1.385^{22}_{4}, **m.p.** 178.4 (176–7). **Soly.** sl.s.w.; s.al.; s.et.; s.CS_2.

63 —, **2, 4-dimethyl-.** See 2, 4-*Acetoxylide.*

64 —, **2, 4-dinitro-.** $CH_3CONHC_6H_3$-$(NO_2)_2$, 225.08. Need.f.al. **m.p.** 120. **Soly.** i.c.w.; v.s.h.al.; s.et.

65 —, ***p*-ethoxy-.** See *p-Acetophenetide.*

66 —, ***o*-hydroxy-** (*o-acetamidophenol; o-acetylaminophenol*). CH_3CONHC_6-H_4OH, 151.08. Col. leaf. f. dil. al. **m.p.** 203. **Soly.** sl.s.w.; s.al.; s.et.; s.KOH.

67 —, ***m*-hydroxy-** (*m-acetamidophenol*) $CH_3CONHC_6H_4OH$, 151.08. Col. need. f.w. **m.p.** 149. **Soly.** s.w.; s.al.; sl.s.et.; sl.s.chl., bz.

68 —, ***p*-hydroxy-** (*p-acetamidophenol*). $CH_3CONHC_6H_4OH$, 151.08. Col. monocl. f. al. **D.** 1.293^{21}_{4}, **m.p.** 168. **Soly.** v.sl.s.w.; v.s.al.; sl.s.et.

69 —, ***o*-hydroxy-*N*-methyl-** (*o-(acetylmethylamino)phenol*). $CH_3CON(CH_3)$ C_6H_4OH, 165.09. Need. **m.p.** 150. **Soly.** sl.s.w.; v.s.al.; s.et.

70 —, ***p*-hydroxy-*N*-methyl-.** CH_3-$CON(CH_3)C_6H_4OH$, 165.09. Cr. **m.p.** 240. **Soly.** v.sl.s.w.; v.s.al.; s.et.

71 —, ***p*-iodo-.** $CH_3CONHC_6H_4I$, 260.99. Monocl. **D.** 1.989^{15-20}_{4}, **m.p.** 183–4. **Soly.** s.h.w.; 5.05^{21}al.; i.et.; v.s.ac.a.

72 —, ***p*-methoxy-.** See *p-Acetaniside.*

73 —, ***N*-methyl-** (*exalgin*). CH_3CON-$(CH_3)C_6H_5$, 149.09. Col. rhomb. pr. f. al., *n* 1.560, 1.576, 1.647. **D.** 0.977^{130}_{4}, **m.p.** 101–4 (97–99), **b.p.** 254.7 (253^{712}). **Soly.** i.(sl.s.)w.; s.al.

74 —, ***o*-methyl-.** See *o-Acetotoluide.*

* Name approved by the International Union of Chemistry.

75 Acetanilide, *N*-methyl-*p*-nitro-. $CH_3CON(CH_3)C_6H_4NO_2$, 194.09. Leaf. f. w. **m.p.** 152–3. **Soly.** s.al.; s.et.

76 —, ***o*-nitro-.** $CH_3CONHC_6H_4NO_2$, 180.08. Yel.monocl.leaf. **D.** 1.419^{15}_{4}, **m.p.** 93 (90–1). **Soly.** s.h.w.; s.al.; v.s.et.; v.s.KOH.

77 —, ***m*-nitro-.** $CH_3CONHC_6H_4NO_2$, 180.08. Col.-yel. leaf. **m.p.** 155 (150.5). **Soly.** s.h.w.; s.al.; i.et.; s.chl. KOH.

78 —, ***p*-nitro-.** $CH_3CONHC_6H_4NO_2$, 180.08. Yel. rhomb. pr. **m.p.** 213–4 (207). **Soly.** v.sl.s.w.; s.al.; s.et.; s.KOH.

80 —, ***N*-phenyl-.** See *Acetamide, N, N-diphenyl-.*

81 —, ***α*-phenyl-.** See *α-Toluanilide.*

82 —, ***p*-phenylazo-.** See *Azobenzene, p-acetamido-.*

83 —, **thio-.** $CH_3CSNHC_6H_5$, 151.14. Need.f.w. **m.p.** 75, **b.p.** d. **Soly.** i.w.; i.et.; s.alk., NaOH.

84 *o*-Acetaniside (*N-acetyl-o-anisidine; o-acetanisidide*). $CH_3OC_6H_4NHCO$-CH_3, 165.09. Wh. cr. f. w. **m.p.** 87–8 (84), **b.p.** 305. **Soly.** v.s.h.w.; 55^{21}al.; s.et.; v.s.ac.a.

85 *p*-Acetaniside (*p-methoxyacetanilide; p-acetamidoanisole; N-acetyl-p-anisidine; methacetin; p-acetanisidide*). $CH_3CONHC_6H_4OCH_3$, 165.09. Wh. powd., or pl. f. w. **m.p.** 127. **Soly.** 0.2^{15}, 8.3^{100}w.; 12.7^{21}al.; s.chl., acet.

86 Acetic acid (*ethanoic acid**). CH_3 $COOH$, 60.03. Col. liq., *n* 1.37182. **D.** 1.049^{20}_{4}, **m.p.** 16.6, **b.p.** 118.1. **Soly.** ∞w.; ∞al.; ∞te.; i.CS_2.

87 —, esters. For esters other than those listed below see also "acetate" under *o-Cresol, Cyclohexanol*, etc.

88 —, allyl ester (*allyl acetate, 2-propenyl ethanoate**). $CH_3COOCH_2CH{:}CH_2$, 100.06. Col. liq., *n* 1.40448. **D.** 0.928, **b.p.** 103–4. **Soly.** sl.s.w.; ∞al.; ∞et.

89 —, amyl ester (*amyl acetate; 1-pentanol acetate; amyl acetic ester*). CH_3COO-$(CH_2)_4CH_3$, 130.11. Col. liq., *n* 1.4012. **D.** 0.879^{20}_{20}, **b.p.** 148^{737} (145–7). **Soly.** 0.18^{20}w.; ∞al.; ∞et.

90 —, benzyl ester (*benzyl acetate; benzyl ethanoate**). $CH_3COOCH_2C_6H_5$. 150.08. Col. liq., *n* 1.5232. **D.** 1.057^{16}_{4}, **m.p.** −51.5, **b.p.** 213.5^{756}. **Soly.** v.sl.s.w.; ∞al.; ∞et.

91 —, butyl ester (*butyl acetate; butyl ethanoate**). $CH_3COO(CH_2)_3CH_3$, 116.09. Col. inflam. liq., *n.* 1.3951. **D.** 0.882^{20}_{4}; 0.9016^{0}_{0}, **m.p.** −76.8, **b.p.** 126.5 (124–6). **Soly.** 0.5^{25}w.; ∞al.; ∞et.

92 —, *sec*-butyl ester (*2-butanol acetate; α-methylpropyl ethanoate**). CH_3-$COOCH(CH_3)C_2H_5$, 116.09. Col. liq., *n* 1.3866^{25}. **D.** 0.8648^{25}_{4}, **b.p.** 112–3. **Soly.** i.w.; s.al. s.et.

93 —, cetyl ester (*cetyl acetate; hexadecyl ethanoate*; n-hexadecyl acetate*). CH_3-$COO(CH_2)_{15}CH_3$, 284.28. Need., *n* $1.4358^{33.9}$. **D.** 0.858^{20}_{4}, **m.p.** 18.5 (16–9), **b.p.** 200.5^{15}. **Soly.** i.w.; v.sl.s.al.; v.s.et

94 —, ethyl ester (*ethyl ethanoate*; acetic ester*). $CH_3COOC_2H_5$. 88.06. Col. inflam. liq., *n* $1.37216^{18.9}$. **D.** 0.901^{20}_{4}; 0.90657^{15}_{4}, **m.p.** −83.6, **b.p.** 77.15. **Soly.** 8.6^{20}, 7.4^{35}w.; ∞al.; ∞et.; ∞chl., oils.

95 —, ethylene ester. See *Glycol, diacetate.*

96 —, furfuryl ester. See *Furfuryl alcohol, acetate.*

97 —, heptyl ester (*n-heptyl acetate*). $CH_3COOC_7H_{15}$, 158.14. Col. liq., *n* 1.4153. **D.** 0.874^{16}_{16}, **b.p.** 191.5. **Soly.** i.w.; s.al.; s.et.

98 —, hexyl ester (*n-hexyl acetate*). $CH_3COO(CH_2)_5CH_3$, 144.12. Col. liq. **D.** 0.8902^{0}_{0}, **b.p.** 169.2. **Soly.** i.w.; v.s.al.; v.s.et.

99 —, isoamyl ester (*isoamyl acetate; 3-methyl-1-butanol acetate; γ-methylbutyl ethanoate**). $CH_3COO(CH_2)_2$ $CH(CH_3)_2$, 130.11. Col. liq., *n* $1.40170^{17.9}$. **D.** 0.8699^{25}_{4}, **m.p.** −78.5, **b.p.** 142.5 (138–40). **Soly** 0.16^{25}w.; ∞al.; ∞et.; s.amyl al.

00 —, isobutyl ester (*isobutyl acetate; β-methylpropyl ethanoate**). CH_3-$COOCH_2CH(CH_3)_2$, 116.09. Col. liq., *n* $1.39114^{17.8}$. **D.** 0.8712, **m.p.** −98.9, **b.p.** 116.5 (115–7). **Soly.** 0.63^{25}w.; ∞al.; ∞et.

01 —, isopropyl ester (*isopropyl acetate*). $CH_3COOCH(CH_3)_2$, 102.08. Col.liq. **D.** 0.877^{16}_{4}; 0.8690^{25}_{4}, **m.p.** −73.4, **b.p.** 89. **Soly.** 3.09^{20}w.; ∞al.; ∞et.

02 —, methylene diester (*methylene acetate; methylene diacetate; methanediol diacetate*). $(CH_3COO)_2CH_2$, 132.06. Col.liq. **D.** 1.136^{20}_{4}, **b.p.** 170. **Soly.** sl.s.w.; ∞al.; ∞et.

03 —, methyl ester (*methyl acetate*) CH_3COOCH_3, 74.05. Col.liq., *n* 1.35935. **D.** 0.92740^{25}_{4}, **m.p.** −98.1, **b.p.** 57.1. **Soly.** 31.9^{20}w.; ∞al.; ∞et

For explanations and abbreviations see beginning of table.

04 Acetic acid, β-phenylhydrazide. See *Hydrazine, 1-acetyl-2-phenyl-.*

05 —, piperazinium salt. $C_4H_{10}N_2 \cdot 2C_2H_4O_2$, 206.16. Wh.cr. **m.p.** 208.5–209. **Soly.** s.w.; s.al.; i.et.; s.h.*n*-butanol.

06 —, piperidide. See *Piperidine, 1-acetyl-.*

07 —, propyl ester (*n-propyl acetate*). $CH_3COOC_3H_7$, 102.08. Col.liq., *n* 1.38438. **D.** 0.887^{20}_{4}, **m.p.** −92.5, **b.p.** 101.6. **Soly.** 1.89^{20}w.; ∞al.; ∞et.

08 —, **acetamido-.** See *Aceturic acid.*

09 —, (*p*-**acetamidoanilino**)-. See *Glycine, N-(p-acetamidophenyl)-.*

10 —, **allyl-.** See 4-*Pentenoic acid**.

11 —, **amino-.** See *Glycine.*

12 —, (*p*-**aminoanilino**)-. See *Glycine, N-(p-aminophenyl)-.*

13 —, **anilino-.** See *Glycine, N-phenyl-.*

14 —, **anthranilido-.** See *Anthranilic acid, N-(carboxymethyl)-.*

15 —, **benzamido-.** See *Hippuric acid.*

16 —, **benzoyl-** (*β-ketohydrocinnamic acid; 3-oxo-3-phenylpropanoic acid*). $C_6H_5COCH_2COOH$, 164.06. Col.need. f.bz. **m.p.** 103–4 d. **Soly.** sl.s.w.; s.al.; s.et.; sl.s.lgr.

17 —, —, ethyl ester (*ethyl-β-ketohydrocinnamate; benzoylacetic ester*). $C_6H_5COCH_2COOC_2H_5$, 192.09. Col.liq., *n* 1.53115^{16}. **D.** 1.122^{20}_{4}, **m.p.** <0, **b.p.** 265–70 d. **Soly.** v.v.sl.s.w.; ∞al.; ∞et.

18 —, —, methyl ester. $C_6H_5COCH_2COOCH_3$, 178.08. Col.-yel.liq., *n* $1.53654^{24.7}$. **D.** 1.158^{20}_{4}, **b.p.** 265 d. **Soly.** i.w.; ∞al.; ∞et.

19 —, **bromo-** (*bromoethanoic acid**). $CH_2BrCOOH$, 138.94. Col.hex. or rhomb. **D.** 1.934^{20}_{4}, **m.p.** 50, **b.p.** 208. **Soly.** ∞, deliq.w.; ∞al.; ∞et.

20 —, —, ethyl ester (*ethyl bromoethanoate**). $CH_2BrCOOC_2H_5$, 166.97. Col. liq., *n* 1.451. **D.** 1.514^{15}_{4}, **b.p.** 159; $57–9^{15}$. **Soly.** i.w.; ∞al.; ∞et.

21 —, *sec*-**butyl-.** See *Valeric acid, β-methyl-.*

22 —, **butylethyl-.** See *Caproic acid, α-ethyl-.*

23 —, **chloro-** (*chloroethanoic acid**). $CH_2ClCOOH$, 94.48. Col.rhomb., *n* 1.4297^{65}. **D.** 1.58^{20}_{20}, **m.p.** α63, β55–6, γ50, **b.p.** 189. **Soly.** v.s.w.; s.al.; s.et.; s.chl., CS_2, bz.

24 —, —, butyl ester (*butyl 2-chloroethanoate**). $CH_2ClCOOC_4H_9$, 150.54. Liq. **D.** 1.103^{9}_{4} **b.p.** 175 (181–3).

25 —, —, ethyl ester (*ethyl chloroacetate; ethyl chloroethanoate**). $CH_2ClCOOC_2H_5$, 122.51. Col.liq., *n* 1.42274. **D.** 1.159^{20}_{4}, **m.p.** −26.0, **b.p.** 144.2. **Soly.** i.w.; ∞al.; ∞et.

26 —, —, methyl ester (*methyl chloroethanoate**). $CH_2ClCOOCH_3$, 108.50. Col.liq. **D.** 1.227^{25}_{4}, **m.p.** −32.7, **b.p.** 131.5. **Soly.** v.sl.s.w.; ∞al.; ∞et.

27 —, —, *p*-phenylphenacyl ester. $CH_2ClCOOCH_2COC_6H_4C_6H_5$, 288.56. **m.p.** 116.

28 —, —, piperazinium salt. $C_4H_{10}N_2 \cdot 2CH_2ClCOOH$, 275.05. Wh.cr., **m.p.** 145–6. **Soly.** s.w.; s.h.al.; i.et.

29 —, **cyano-** (*cyanoethanoic acid**; *malonic mononitrile*). $CNCH_2COOH$, 85.03. Deliq.col.cr. **m.p.** 66 (69–70), **b.p.** 108^{15}, d. 160. **Soly.** s.w.; s.al.; s.et.; sl.s.bz., chl.

30 —, —, ethyl ester. $CH_2(CN)COOC_2H_5$, 113.06. Col.liq., *n* $1.41793^{20.5}$. **D.** 1.063^{20}_{4}, **m.p.** −22.5, **b.p.** 206. **Soly.** i.w.; ∞al.; ∞et.

31 —, —, methyl ester (*methyl cyanoethanoate**). $CNCH_2COOCH_3$, 99.05. Col.liq. **D.** 1.123^{15}, **m.p.** −22.5, **b.p.** 200. **Soly.** i.w.; ∞al.; ∞et.

32 —, **diazo-,** ethyl ester (*ethyl diazoethanoate**). $N_2CHCOOC_2H_5$, 114.06. Yel.oil. **D.** 1.073^{22}, **m.p.** −22, **b.p.** 141. **Soly.** sl.s.w.; s.al.; s.et.

33 —, **dibromo-** (*dibromoethanoic acid**). $CHBr_2COOH$, 217.85. Col.deliq.cr. **m.p.** 48, **b.p.** 232; $195–7^{250}$. **Soly** sl.s.w.; s.al.; s.et.

34 —, —, ethyl ester (*ethyl dibromoethanoate**). $CHBr_2COOC_2H_5$, 245.88. Oil, *n* 1.498. **D.** 1.903^{20}_{26} **b.p.** 194. **Soly.** i.w.; ∞al.; ∞et.

35 —, **dichloro-** (*dichloroethanoic acid**), $CHCl_2COOH$, 128.93. Col.liq., *n* 1.4659^{23}. **D.** 1.5634^{20}_{4}, **m.p.** 5–6; frz. 11, **b.p.** 194. **Soly.** 8.63w.; s.al.; s.et.

36 —, —, ethyl ester (*ethyl dichloroethanoate**). $CHCl_2COOC_2H_5$, 156.96. Col. liq., *n* 1.43860. **D.** 1.2821^{20}_{4}, **b.p.** 158.2. **Soly.** v.sl.s.w.; ∞al., ∞et.

37 —, **diethyl-.** See *Butyric acid, α-ethyl-.*

38 —, **diethylmethyl-.** See *Butyric acid, α-ethyl-α-methyl-.*

39 —, **diiodo-** (*diiodoethanoic acid**). CHI_2COOH, 311.86. Yel.cr. **m.p.** 110(95–6). **Soly.** sl.s.w.; s.al.; s.et.; s.bz.

40 —, **dimethyl-.** See *Isobutyric acid.*

41 —, **di-*n*-octyl-.** See *Capric acid, α-octyl-.*

* Name approved by the International Union of Chemistry.

42 Acetic acid, diphenyl- (*diphenylmethane-α-carboxylic acid*). $(C_6H_5)_2$-CHCOOH, 212.09. Col.need.f.w. or lf.f.al. **m.p.** 148, **b.p.** subl. **Soly.** v.s.h.w.;v.s.al.; v.s.et.; s.chl.

43 —, **ethoxy-** (*ethoxyethanoic acid*; ethyloglycolic acid; glycolic acid ethyl ether*). $C_2H_5OCH_2COOH$, 104.06. Col. liq. **D.** 1.102^{20}_{4}, **b.p.** 206. **Soly.** v.s.w.; v.s.al.; v.s.et.

44 —, **ethyl-.** See *Butyric acid.*

45 —, (**ethylamino**)-. See *Glycine, N-ethyl-.*

46 —, **ethyldimethyl-.** See *Butyric acid, α, α-dimethyl-.*

47 —, **ethylene-.** See *Cyclopropanecarboxylic acid*.*

48 —, **ethylmethyl-.** See *Butyric acid, α-methyl-.*

49 —, **ethylpropyl-.** See *Valeric acid, α-ethyl-.*

50 —, 2-**fural-.** See 2-*Furanacrylic acid.*

51 —, **guanido-.** See *Glycocyamine.*

52 —, **hydroxy-.** See *Glycolic acid.*

53 —, **iminodi-** (*diglycolamidic acid; iminoacetic acid (incorrect)*). NH-$(CH_2COOH)_2$, 133.06. Col.rhomb. **m.p.** *ca.* 225. **Soly.** 2.43^{5}w.; i.al.; i.et.

54 —, **iodo-** (*iodoethanoic acid**). CH_2-ICOOH, 185.94. Col.rhomb.pl. **m.p.** 82, **b.p.** d. **Soly.** s.w.; s.al.; s.et.

55 —, **isoamyl-.** See *Caproic acid, δ-methyl-.*

56 —, **isobutyl-.** See *Isocaproic acid.*

57 —, **isopropyl-.** See *Isovaleric acid.*

58 —, **isopropylmethyl-.** See *Butyric acid, α, β-dimethyl-.*

59 —, **isothiocyano-** (*mustard oil acetic acid*). $SCNCH_2COOH$, 117.09. Rhomb. pl. **m.p.** 125–6. **b.p.** subl. **Soly.** s.h.w.

60 —, **mercapto-** (2-*mercaptoethanoic acid*; thioglycolic acid*). $HSCH_2COOH$, 92.09. Liq. **D.** 1.3253^{20}_{4}, **m.p.** −16.5, **b.p.** 104.–6^{11}. **Soly.** s.w.; s.al.; s.et.

61 —, **methoxy-** (*methoxyethanoic acid*; methyloglycolic acid*). CH_3OCH_2-COOH, 90.05. Col.hyg.liq. **D.** 1.1768^{20}_{4}, **b.p.** $89–91^{7}$. **Soly.** s.w.; s.al.; s.et.

62 —, **methyl-.** See *Propionic acid.*

63 —, (α-**methylguanido**)-. See *Creatine.*

64 —, **methylpropyl-.** See *Valeric acid, α-methyl-.*

65 —, **oxydi-.** See *Diglycolic acid.*

66 —, **phenoxy-** (*glycolic acid phenyl ether*). $C_6H_5OCH_2COOH$, 152.06. Col. pl. or need.f.w. **m.p.** 99, **b.p.** 285 sl.d. **Soly.** 1.2^{10}w.; s.al.; s.et.; s. ac.a., bz.

67 —, **phenyl-.** See *α-Toluic acid.*

68 —, **pyromucyl-,** ethyl ester (*ethyl 2-furoylacetate; ethyl β-keto-2-furanpropionate*). $C_4H_3OCOCH_2COOC_2H_5$, 182.08. Liq. **b.p.** $142–3^{10}$; **Soly.** i.w.; s.al.; s.et.

69 —, **salicyl-.** See *Benzoic acid, o-(carboxymethoxy)-.*

70 —, **silico-.** See *Methanesiliconic acid.*

71 —, **sulfo-** (*sulfoethanoic acid**). HO_3S-CH_2COOH, 140.09. Hyg.tab.f.w. **m.p.** 86, **b.p.** *ca.* 245 d. **Soly.** s.w.; v.s.al.; i.et.

72 —, **2-thienyl-.** See 2-*Thiopheneacetic acid.*

73 —, **thiol-** (*ethanethiolic acid*; methanecarbothiolic acid; thioacetic acid*). CH_3COSH, 76.09. Col.liq. **D.** 1.074^{10}_{4}, **m.p.** < −17, **b.p.** 93. **Soly.** s.w.; ∞al.; ∞et.

74 —, —, ethyl ester. $CH_3COSC_2H_5$, 104.12. Liq. **D.** 0.9739^{2}_{4}, **b.p.** 115–16. **Soly.** i.w.; v.s.al.; v.s.et.

75 —, **tolyl-.** See *α-Toluic acid, methyl-.*

76 —, **tribromo-** (*tribromoethanoic acid**). CBr_3COOH, 296.76. Col.monocl.tab. **m.p.** 135, **b.p.** 245 d. **Soly.** v.s.w.; v.s.al.; v.s.et.; sl.s.c.lgr.

77 —, **trichloro-.** CCl_3COOH, 163.38. Col.rhomb.deliq. **D.** 1.6298^{61}_{4}, **m.p.** 57.5, **b.p.** 197.5. **Soly.** 120^{25}w.; s.al.; s.et.

78 —, —, ethyl ester. $CCl_3COOC_2H_5$, 191.41. Col.liq., *n* 1.45068. **D.** 1.383^{20}_{4}, **b.p.** 168. **Soly.** i.w.; ∞al.; ∞et.

79 —, —, methyl ester, CCl_3COOCH_3, 177.39. Col. **D.** $1.4868^{19.2}_{4}$, **m.p.** −17.5, **b.p.** 153.8. **Soly.** d.w.; d.al.; s.et.

80 —, —, piperazinium salt. $C_4H_{10}N_2$·-$2CCl_3COOH$, 412.85. Wh.cr. **m.p.** 121–1.5. **Soly.** s.w.; s.h.al.; i.et.

81 —, **triiodo-** (*triiodoethanoic acid**). CI_3COOH, 437.77. Yel.leaf. **m.p.** 150 d. **Soly.** s.w.; s.al.; s.et.

82 —, **trimethyl-.** See *Pivalic acid.*

83 —, **triphenyl-.** $(C_6H_5)_3CCOOH$, 288.12. Monocl.pr. **m.p.** 265. **Soly.** sl.s.w.; s.al.; sl.s.et.; s.bz.

84 —, **ureido-.** See *Hydantoic acid.*

85 —, **vinyl-.** See 3-*Butenoic acid*.*

86 Acetic aldehyde. See *Acetaldehyde.*

For explanations and abbreviations see beginning of table.

87 **Acetic anhydride** (*ethanoic anhydride**), $(CH_3CO)_2O$, 102.05. Col. liq., *n* 1.39038. **D.** 1.08712^{15}_{4}; 1.0820^{20}_{4}, **m.p.** −73.1, **b.p.** 140.0. **Soly.** 13.6 c., d.w.; ∞al.; ∞et.; s.chl., bz.

88 **Acetic ester.** See *Acetic acid, ethyl ester.*

89 **Acetin.** See *diacetate, monoacetate, triacetate,* under *Glycerol.*

90 **Acetoacetanilide** (*β-ketobutyranilide; α-acetylacetanilide*). $CH_3COCH_2CONHC_6H_5$, 177.09. Leaf. **m.p.** 85. **Soly.** sl.s.w.; s.al.; s.et.; s.a., alk., h.bz.

91 —, α-**bromo-** (*2-bromo-3-oxo-N-phenylbutanamide*). $CH_3COCHBrCONHC_6H_5$, 256.00. Col.need. **m.p.** 138 d., **b.p.** d. **Soly.** i.w.; s.al.; s.et.

92 **Acetoacetic acid,** ethyl ester (*ethyl acetoacetate; acetoacetic ester; ethyl 3-oxobutanoate**). $CH_3COCH_2COOC_2H_5$, 130.08. Col.liq., *n* $1.42092^{16.6}$. **D.** 1.025^{20}_{4}; **m.p.** < −80, **b.p.** 180. **Soly.** $14.3^{16.5}$w.; s.al.; s.et.; s.bz., chl.

93 —, methyl ester (*methyl acetoacetate*). $CH_3COCH_2COOCH_3$, 116.06. Col.liq., *n* $1.41837^{20.5}$. **D.** 1.077, **b.p.** 170. **Soly.** 38.0w.; ∞al.; ∞et.

94 —, γ-**chloro-,** ethyl ester (*ethyl 4-chloro-3-oxobutanoate**). $CH_2ClCOCH_2COOH_2H_5$, 164.53. Col.liq. **D.** 1.176^{25}_{4}, **b.p.** 200. **Soly.** v.sl.s.w.; ∞al.; ∞et.

95 —, α, α-**diethyl-,** ethyl ester (*ethyl 2, 2-diethyl-3-oxobutanoate**). $CH_3COC(C_2H_5)_2COOC_2H_5$, 186.14. Wh.-yel.liq., *n* $1.43266^{17.2}$. **D.** 0.960^{25}_{4}, **b.p.** 211–6 d. **Soly.** i.w.; ∞al.; ∞et.

96 —, α, α′-**ethylidenebis-,** diethyl ester. See *Glutaric acid, α, γ-diacetyl-β-methyl-, diethyl ester.*

97 —, α-**isopropyl-,** ethyl ester (*ethyl 2-isopropyl-3-oxobutanoate**). $CH_3COCH(C_3H_7)COOC_2H_5$, 172.12. Col. liq. **D.** 0.957^{25}_{4}, **b.p.** 205 d. **Soly.** v.sl.s.w.; ∞al.; ∞et.

98 —, α-**methyl-,** ethyl ester (*ethyl 2-methyl-3-oxobutanoate*; methylacetoacetic ester*). $CH_3COCH(CH_3)COOC_2H_5$, 144.09. Col.liq., *n*4 $2066^{17.8}$. **D.** 1.019^{20}_{4}, **b.p.** 186.8. **Soly.** v.sl. s.w.; s.al.; s.et.

99 **Acetoacetic ester.** See *Acetoacetic acid, ethyl ester.*

00 **Acetobenzylamide.** See *Acetamide, N-benzyl-.*

01 **Acetobromamide.** See *Acetamide, N-bromo-.*

02 **Acetocinnamone.** See *Acetone, benzal-.*

03 **Acetoethylamide.** See *Acetamide, N-ethyl-.*

04 **Acetoethyl nitrate.** $C_2H_4O{\cdot}(C_2H_5NO_3)_2$?, 226.13. Liq. **D.** 1.045^{18}_{4}, **b.p.** 89 exp. **Soly.** i.w.; s.al.

05 **Acetoglyceral** (*glycerol ethylidene ether*). $C_3H_5(OH)O_2C_2H_4$, 118.08. Liq. (mixt.?). **D.** 1.081^{0}_{4}, **b.p.** 184–8. **Soly.** sl.s.w.; s.al.

06 **Acetoin** (*3-hydroxy-2-butanone*; acetylmethylcarbinol*). $CH_3CHOHCOCH_3$, 88.06. Liq., *n* 1.4194^{15}. **D.** 1.002^{15}_{4}, **m.p.** 15, **b.p.** 142. **Soly.** ∞w.; s.al.; sl.s.et.; i.lgr.

07 **Acetol** (*1-hydroxy-2-propanone*; hydroxyacetone; acetylcarbinol*). CH_3COCH_2OH, 74.05. Col.liq., *n* 1.4295. **D.** 1.082^{20}_{20}, **m.p.** −17, **b.p.** 146, d. **Soly.** ∞w.; ∞al.; ∞et.

08 **Acetonaphthalide.** See *Naphthylamine, N-acetyl-.*

09 **1-Acetonaphthone, α-phenyl-.** See *Ketone, benzyl 1-naphthyl.*

10 **2-Acetonaphthone, 4-bromo-1-hydroxy-** (*2-acetyl-4-bromo-1-naphthol*). $CH_3COC_{10}H_5BrOH$, 264.99. Yel.need. **m.p.** 127. **Soly.** i.w.; s.al.; s.et.

11 **2-Acetonaphthone, 1-hydroxy-** (*1-hydroxy-2-naphthyl methyl ketone; 2-acetyl-1-naphthol*). $CH_3COC_{10}H_6OH$, 186.08. Yel.need. **m.p.** 99–101 (103), **b.p.** 325 d. **Soly.** i.w.; s.al.; s.et.

12 **2-Acetonaphthone, 1-hydroxy-4-nitro-.** $CH_3COC_{10}H_5(NO_2)OH$, 231.08. Yel.need. **Soly.** i.w.; sl.s.al.; s.et.

13 **Acetone** (*2-propanone*; dimethyl ketone*). CH_3COCH_3, 58.05. Col.inflam. liq., *n* $1.35886^{19.4}$. **D.** 0.792^{20}_{4}, 0.8186^{0}_{4}, **m.p.** −95, **b.p.** 56.5. **Soly.** ∞w.; ∞al.; ∞et.; s.chl.

For derivatives see also 2-*Propanone.*

15 —, azine (*dimethylketazine; diisopropylidenehydrazine*). $(CH_3)_2C{:}NN{,}C(CH_3)_2$, 112.11. Col.liq., *n* 1.45102^{25}: **D.** 0.8381^{25}_{4}, **b.p.** 131. **Soly.** s.w.; ∞al.; ∞et.

16 —, cyanohydrin. See *Isobutyronitrile, α-hydroxy-.*

17 —, dichloride. See *Propane, 2, 2-dichloro-*.*

18 —, oxime. See *Acetoxime.*

19 —, phenylhydrazone (*2-propanone phenylhydrazone**). $(CH_3)_2C{:}N_2HC_6H_5$, 148.11. Rhomb.cr. or oil. **m.p.** 23–5 (27), **b.p.** 163^{50}. **Soly.** s.w.; s.al.; s.et.; s.dil.min.a.

20 —, semicarbazone (*2-propanone semicarbazone**). $(CH_3)_2C{:}NNHCONH_2$, 115.09. Col.need.f.w. **m.p.** 187–8. **Soly.** sl.s.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

21 **Acetone,** sodium bisulfite compound. $(CH_3)_2C(OH)OSO_2Na$, 162.11. Wh.leaf. **m.p.d.** **Soly.** v.s.w.; sl.s. al.; i.et.

22 —, **acetonyl-.** See 2,5-*Hexanedione**.

23 —, **acetyl-.** See 2, 4-*Pentanedione**.

24 —, **allyl-.** See 5-*Hexen-2-one**.

25 —, **anisal-.** See 3-*Buten-2-one, 4-p-anisyl-*.

26 —, **benzal-** (*methyl styryl ketone; 4-phenyl-3-buten-2-one*; benzylideneacetone; cinnamyl methyl ketone; acetocinnamone*). $C_6H_5CH{:}CHCOCH_3$, 146.08. Col.lustr.pl. **D.** 1.0377^{15}_{15}, **m.p.** 42, **b.p.** 260–2. **Soly.** i.w.; v.s.al.; s.et.; s.chl.bz.

27 —, **benzoyl-** (*1-phenyl-1, 3-butanedione*; α-acetylacetophenone; methyl phenacyl ketone; acetylbenzoylmethane*). $C_6H_5COCH_2COCH_3$, 162.08. Col. pr., n $1.56775^{77.5}$. **D.** 1.090^{60}_{4}, **m.p.** 61 (57–8), **b.p.** 261–2 (132^{14}). **Soly.** sl.s.c.w.; s.al.; s.et.; s.conc.alk.

28 —, **benzyl-.** See 2-*Butanone, 4-phenyl-**.

29 —, **benzylidene-.** See *Acetone, benzal-*.

30 —, **dibenzal-.** See *Styryl ketone*.

31 —, *sym*-**diisopropyl-.** See 4-*Heptanone, 2, 6-dimethyl-**.

32 —, **diisopropylidene-.** See *Phorone*.

33 —, *sym*-**dimethyl-.** See 3-*Pentanone**.

34 —, **diphenyl-.** See 2-*Propanone, 1,3-diphenyl-**.

35 —, **ethylidene-.** See 3-*Penten-2-one**.

36 —, *unsym*-**ethylmethyl-.** See 2-*Pentanone, 3-methyl-**.

37 —, **2-fural-.** See 3-*Buten-2-one, 4-(2-furyl)-**.

38 —, **furfurylidene-.** See 3-*Buten-2-one, 4-(2-furyl)-**.

39 —, **hydroxy-.** See *Acetol*.

40 —, **isonitroso-.** See *Pyruvaldehyde, aldoxime*.

41 —, **isopropylidene-.** See *Mesityl oxide*.

42 —, **p-methoxybenzal-.** See 3-*Buten-2-one, 4-p-anisyl-*.

43 —, **phenacyl-.** See *Valerophenone, γ-keto-*.

44 **Acetone chloride.** See *Propane, 2,2-dichloro-**.

45 **Acetone-chloroform.** See *Chloretone*.

46 **Acetonediacetic acid** (*γ-ketopimelic acid; 4-oxoheptanedioic aci **), $CO(CH_2CH_2COOH)_2$, 174.08. Rhomb.f w. **m.p.** 143. **Soly.** s.h.w.; s.al.; sl.s.et.; i.bz.

47 **Acetonedicarboxylic acid** (*β-ketoglutaric acid; 3-oxopentanedioic acid**). $(COOH)CH_2COCH_2COOH$, 146.05. Need.f.et. **m.p.** 135 d., **b.p.** d. **Soly.** v.s.w.; s.al.; v.sl.s.et.; i.bz., chl., lgr.

48 **Acetone diethylsulfone.** See *Propane, 2, 2-bis(ethylsulfonyl)-**.

49 **Acetonic acid.** See *Isobutyric acid, α-hydroxy-*.

50 **Acetonitrile** (*ethanenitrile*; methyl cyanide*). CH_3CN, 41.03. Col. liq., n $1.34596^{16.5}$. **D.** 0.7828^{20}_{4}, **m.p.** −41 to −44, **b.p.** 82. **Soly.** ∞w.; ∞al.; ∞et.

51 —, **allyl-.** See 4-*Pentenenitrile**.

52 —, **benzoyl-** (*β-ketohydrocinnamonitrile; 3-oxo-3-phenylpropanenitrile; α-cyanoacetophenone*). $C_6H_5COCH_2CN$, 145.06. Leaf. **m.p.** 80–1. **Soly.** sl.s. c.w.; s.al.; s.et.; s.chl., bz., alk., KCN.

53 —, **diethyl-.** See *Butyronitrile, α-ethyl-*.

54 —, **ethylmethyl-.** See *Butyronitrile α-methyl-*.

55 —, **2-furyl-.** See 2-*Furanacetonitrile*

56 —, **iminodi-** (*α, α′-dicyanodimethyl amine; iminoacetonitrile (incorrect)*) $NH(CH_2CN)_2$, 95.06. Col.leaf.f.et. **m.p.** 75. **Soly.** s.w.; s.al.; sl.s.et.

57 —, **isobutyl-.** See *Isocapronitrile*.

58 —, **phenyl-.** See *α-Tolunitrile*.

59 —, **trimethyl-.** See *Propionitrile, α, α-dimethyl-*.

60 —, **trinitro-** (*trinitroethanenitrile**). $(NO_2)_3CCN$, 176.03. Waxy. **m.p.** 41.5, **b.p.** exp. 220. **Soly.** d.w.; d.al.; s.et.

61 —, **vinyl-.** See *Allyl cyanide*.

62 **Acetonitrolic acid** (*ethylnitrolic acid*). $CH_3(NO_2)C{:}NOH$, 104.05. Yel. rhomb.f.w. or et. **m.p.** 88, **b.p.** d. **Soly.** s.w.; s.al.; s.et.

63 **Acetonylamine.** See 2-*Propanone, 1-amino-*.

64 *o*-**Acetophenetide** (*o-ethoxyacetanilide; N-acetyl-o-phenetidine*). $CH_3CONHC_6H_4OC_2H_5$, 179.11. Leaf. **m.p.** 79, **b.p.** > 250. **Soly.** i.w.; s.al.; s.et.

For explanations and abbreviations see beginning of table.

65 **p-Acetophenetide** (*p-ethoxyacetanilide; p-acetphenetidine*). $CH_3CONHC_6H_4OC_2H_5$, 179.11. Wh. powd., or monocl. pr. or leaf., n 1.54, 1.571, 1.59. **m.p.** 134.7, **b.p.** d. **Soly.** 0.0055^{14}, 0.11^{25} w.; 4.93 al.; 1.3 et.; 7.1 chl.

66 —, **α-amino-.** See *Phenocoll.*

67 **Acetophenone** (*methyl phenyl ketone; hypnone; acetylbenzene*). $CH_3COC_6H_5$, 120.06. Col.liq. or pl., n 1.53418^{19}. **D.** 1.026^{20}_{4}, **m.p.** 19.7, **b.p.** 202.3. **Soly.** i.w.; s.al.; s.et.; s.bz., chl., conc. H_2SO_4.

68 —, oxime. $C_6H_5C(:NOH)CH_3$, 135.08. Col.need.f.w. **m.p.** 58. **Soly.** sl.s.w.; s.al.; s.et.

69 —, **α-acetonyl-.** See *Valerophenone, γ-keto-.*

70 —, **α-acetyl-.** See *Acetone, benzoyl-.*

71 —, **o-amino-** (*o-aminophenyl methyl ketone; o-acetylaniline*). $CH_3COC_6H_4$-NH_2, 135.08. Yel. oil. **b.p.** 252 sl.d. **Soly.** i.w.; s.et.

72 —, **m-amino-** (*m-aminophenyl methyl ketone*). $CH_3COC_6H_4NH_2$, 135.08. Yel.leaf.f.dil.al. **m.p.** 99.5 (96.5), **b.p.** 290.

73 —, **p-amino-** (*p-aminophenyl methyl ketone*). $CH_3COC_6H_4NH_2$, 135.08. Yel.need.f.w. **m.p.** 106, **b.p.** 295. **Soly.** v.sl.s.w.; s.al.; s.et.; s.HCl, bz.; sl.s.lgr.

74 —, **benzal-.** See *Chalcone.*

75 —, **p-bromo-.** $BrC_6H_4COCH_3$, 198.97. Wh.leaf.f.al. **D.** 1.647, **m.p.** 50, **b.p.** 255.5; $129–30^{15}$. **Soly.** v.sl.s. w.; s.al.; s.et.; s.ac.a., bz., lgr.

76 —, **α-bromo-** (*phenacyl bromide*). $BrCH_2COC_6H_5$, 198.97. Trim. (rhomb.) pr.f.al. **D.** 1.647^{20}_{4}, **m.p.** 50, **b.p.** 140^{12}. **Soly.** i.w.; v.s.al.; v.s.et.

77 —, **α-bromo-p-methyl-** (*p-methylphenacyl bromide*). $CH_3C_6H_4COCH_2$-Br, 212.99. Col.need. or leaf.f.al. **m.p.** 49–51. **Soly.** i., d.w.; d.al.; s.et.

78 —, **α-bromo-p-phenyl-** (*p-phenylphenacyl bromide*), $BrCH_2COC_6H_4$-C_6H_5, 275.00. Lng.col.need. **m.p.** 125.5. **Soly.** 1.3^{25}, 6.7^{78} al.

79 —, **4-*tert.*-butyl-2-methyl-3, 6-dinitro-** (*musk ketone; musk C*). $CH_3COC_6H(C_4H_9)(CH_3)(NO_2)_2$, 280.14. **m.p.** 136. **Soly.** i.w.; s.al.; s.et.

80 —, **p-chloro-** (*methyl p-chlorophenyl ketone*). $CH_3COC_6H_4Cl$, 154.51. Cr. **D.** 1.188^{20}_{4}, **m.p.** 20 (14–15), **b.p.** 232. **Soly.** i.w.; ∞al.; ∞et.

81 —, **α-chloro-** (*phenacyl chloride*). $ClCH_2COC_6H_5$, 154.51. Col.rhomb. **D.** 1.324^{15}_{4}, **m.p.** 59, **b.p.** 247. **Soly.** i.w.; s.al.; s.et.; 31.4 CS_2.

82 —, **α-cyano-.** See *Acetonitrile, benzoyl-.*

83 —, **p, α-dibromo-** (*p-bromophenacyl bromide*). $BrCH_2COC_6H_4Br$, 277.88. Fine need. **m.p.** 109.7. **Soly.** i.w. sl.s.al.; s.et.

84 —, **2, 4-dihydroxy-.** See *Resacetophenone.*

85 —, **2, 5-dihydroxy-** (*2-acetylhydroquinone; quinacetophenone*). CH_3-$COC_6H_3(OH)_2$, 152.06. Yel.need **m.p.** 202. **Soly.** i.w.; s.al.; sl.s.et.

86 —, **α-ethoxy-α-phenyl-.** See *Benzoin, ethyl ether.*

87 —, **α-hydroxy-** (*benzoylcarbinol; phenacyl alcohol; acetophenone alcohol*). $C_6H_5COCH_2OH$, 136.06. Hex. pl. **D.** 1.013, **m.p.** 95 (83–84), **b.p.** 119^{11}. **Soly.** v.s.h.w.; s.al.; s.et.

88 —, **2-hydroxy-4-methoxy-.** See *Peonol.*

89 —, **α-hydroxy-p-phenyl-.** See also "*p-phenylphenacyl ester*" under *Acetic acid, chloro-; Butyric acid; Caproic acid;* etc.

90 —, —, acetate (*p-phenylphenacyl acetate*). $CH_3COOCH_2COC_6H_4C_6H_5$, 254.11. **m.p** 111.

91 —, —, benzoate (*p-phenylphenacyl benzoate*). $C_6H_5COOCH_2COC_6H_4C_6H_5$, 316.12. **m.p.** 167.

92 —, **α-hydroxy α-phenyl-.** See *Benzoin.*

93 —, **5-isopropyl-2-methyl-** (*carvacryl methyl ketone; 2-acetyl-p-cymene*). $CH_3COC_6H_3(CH_3)CH(CH_3)_2$, 176.12. Liq. **D.** 0.956^{20}_{4}, **b.p.** 240; $130–134^{12}$.

94 —, **p-methoxy-** (*p-anisyl methyl ketone; p-acetylanisole*). $CH_3OC_6H_4$-$COCH_3$, 150.08. Pl.f.et., n $1.54684^{41.3}$. **D.** 1.0493^{80}_{4}, 1.0818^{41}_{4}, **m.p.** 38–9(36–8), **b.p.** 258. **Soly.** sl.s.w.; s.al.; s.et.

95 —, **p-methyl-** (*methyl p-tolyl ketone*). $CH_3COC_6H_4CH_3$, 134.08. Col.need. or pa.yel.liq., n $1.53533^{17.4}$. **D.** 0.9891^{22}_{4}; 1.013^{13}_{4}, **m.p.** 28, **b.p.** 222. **Soly.** i.w.; v.s.al.; v.s.et.

96 —, **m-nitro-.** $CH_3COC_6H_4NO_2$, 165.06. Need. **m.p.** 81(74–76), **b.p.** 202. **Soly.** i.w.; s.al.; v.s.et.

97 —, **α-phenyl-.** See *Desoxybenzoin.*

98 —, **2, 3, 4-trihydroxy-.** See *Gallacetophenone.*

99 —, **α-triphenyl-.** See *β-Benzopinacolin.*

* Name approved by the International Union of Chemistry.

00 **o-Acetophenonecarboxylic acid.** See *Benzoic acid, o-acetyl-.*

01 **Acetophenone pinacol.** See 2, 3-*Butanediol*, 2, 3-*diphenyl-.*

02 **Acetophenone pinacolin.** See 2-*Butanone*, 3, 3-*diphenyl-.*

03 **Acetopropionic acid.** See *Levulinic acid.*

04 **α-Acetothienone.** See *Ketone, methyl 2-thienyl.*

05 **Acetothioamide.** See *Acetamide, thio-.*

06 **2-Acetothiophenide.** See *Acetamide, N-2-thienyl-.*

07 **o-Acetotoluide** (*o-methylacetanilide; N-acetyl-o-toluidine; acet-o-toluidide*). $CH_3CONHC_6H_4CH_3$, 149.09. Col. monocl., *n* 1.556, 1.587, 1.700. **D.** 1.168^{15}_{4}, **m.p.** 110, **b.p.** 296. **Soly.** 0.86w.; 8.08al.; s.et.; v.s.chl., glac.ac.a.; s.bz., glyc.

08 —, ***N*-methyl-** (*N-acetyl-N-methyl-o-toluidine*). $(CH_3)(CH_3CO)NC_6H_4CH_3$, 163.11. Cr. **m.p.** 56, **b.p.** 260. **Soly.** s.al.

09 ***m*-Acetotoluide** (*N-acetyl-m-toluidine; acet-m-toluidide*). CH_3CONH-$C_6H_4CH_3$, 149.09. Monocl.f.w. **D.** 1.141^{15}_{4}, **m.p.** 65.5, **b.p.** 303. **Soly.** 0.44^{13}w.; s.al.; s.et.

10 —, ***N*-methyl-.** $(CH_3)(CH_3CO)$-$NC_6H_4CH_3$, 163.11. Cr. **m.p.** 66 (60–61). **Soly.** s.al.

11 ***p*-Acetotoluide** (*N-acetyl-p-toluidine; acet-p-toluidide*). $CH_3CONHC_6H_4$-CH_3, 149.09. Col.monocl. or tricl., *n* 1.495, 1.625, 1.807. **D.** 1.212^{15}_{4}, **m.p.** 151–3, **b.p.** 307. **Soly.** 0.09w.; 8.05c., v.v.s.h.al.; s.h.et.; s.et.ac., glac.ac.a.; sl.s.bz., glyc.

12 —, ***N*-methyl-.** $(CH_3)(CH_3CO)NC_6H_4$-CH_3, 163.11. Leaf. **m.p.** 80, **b.p.** 283. **Soly.** s.al.; s.h.lgr.

13 **Acetoxime** (*2-propanone oxime*; acetone oxime*). $(CH_3)_2C{:}NOH$, 73.06. Col., pr., *n* 1.4156. **D.** 0.97^{20}_{20}, **m.p.** 61, **b.p.** 136.3. **Soly.** v.s.w.; v.s.al.; v.s.et.; s.lgr.

14 **2, 4-Acetoxylide** (*aceto-as-m-xylidide; 2, 4-dimethylacetanilide*). CH_3-$CONHC_6H_3(CH_3)_2$, 163.11. Need. **m.p.** 129–30. **Soly.** v.sl.s.w.; v.s.al.

15 **Acetphenetidine.** See *Acetophenetide.*

16 **Acettoluidide.** See *Acetotoluide.*

17 **Aceturic acid** (*N-acetylglycine; acetamidoacetic acid*). $CH_3CONHCH_2$-$COOH$, 117.06. Need.f.w. **m.p.** 206. **Soly.** 2.7^{15}w.; s.al.; i.et.; sl.s.ac.a., acet., chl.; i.bz.

18 —, ***N*-phenyl-** (*N-acetyl-N-phenylglycine*). $C_6H_5N(CH_3CO)CH_2COOH$, 193.09. **m.p.** 172–3.5.

Acetyl-. For acetyl derivatives, see the parent compounds (e.g., for acetylbenzoic acid see *Benzoic acid, acetyl-.*) See also "acetate" under the names of alcohols and phenols.

19 **Acetyl bromide** (*ethanoyl bromide**). CH_3COBr, 122.94. Col.fum.liq. **D.** $1.52^{9.5}_{4}$, **m.p.** −96.5, **b.p.** 76.7. **Soly.** d.w.; d.al.; v.sl.s.et.

20 —, **bromo-** (*bromoethanoyl bromide**) $CH_2BrCOBr$, 201.85. Liq. **D.** $2.317^{21.5}_{21.5}$, **b.p.** 147–50. **Soly.** d.w.; d.al.

21 **Acetyl chloride** (*ethanoyl chloride**). CH_3COCl, 78.48. Col.inflam.liq., *n* 1.38976. **D.** 1.1051^{20}_{4}, **m.p.** −112, **b.p.** 51–2. **Soly.** d.w.; d.al.; ∞et.; ∞ bz., chl., acet., glac.ac.a.

22 —, **chloro-** (*chloroethanoyl chloride**). $CH_2ClCOCl$, 112.93. Col.liq. **D.** 1.495^{0}_{4}, **b.p.** 108–10(105–106). **Soly.** d.w.; d.al; ∞et.

23 —, **dichloro-** (*dichloroethanoyl chloride**). $CHCl_2COCl$, 147.38. Col.liq. **b.p.** 108. **Soly.** d.w.; d.al.; ∞et.

24 —, **phenyl-.** See *α-Toluyl chloride.*

25 —, **trichloro-.** CCl_3COCl, 181.83. Col.liq. **D.** 1.629, **b.p.** 118. **Soly.** d.w.; d.al.; ∞et.

26 **Acetyl cyanide.** See *Pyruvonitrile.*

27 **Acetyl disulfide** (*diacetyl disulfide*). $(CH_3CO)_2S_2$, 150.17. Col.cr. **m.p.** 20, **b.p.** d. **Soly.** i.w.; s.al.; v.s.et.; s.CS_2.

28 **Acetylene** (*ethyne*; ethine*). $CH{:}CH$, 26.02. Col.inflam.gas. **D.** liq. 0.6208^{-82}_{4}; solid 0.73^{-85}; gas 1.173^{0} g/l, **m.p.** −81.8, **b.p.** −88.5; −83.6 subl. **Soly.** $100^{18}cm^3$w.; $600^{18}cm^3$al.; $2500^{15}cm^3$acet.; s.bz., chl.

29 —, dibromide. See *Ethylene*, 1, 2-*dibromo-.*

30 —, tetrabromide. See *Ethane*, 1,1,2,2-*tetrabromo-*.*

31 —, tetrachloride. See *Ethane*, 1, 1, 2, 2-*tetrachloro-*.*

32 —, **amyl-.** See 1-*Heptyne*.*

33 —, **bromo-** (*bromoethyne*; ethynyl bromide*). $CH{:}CBr$, 104.92. Pois. gas. **D.** 4.684^{0}_{760} g/l, **b.p.** −2. **Soly.** sl.s.w.; s.et.; s.dil.HNO_3.

34 —, **butyl-.** See 1-*Hexyne*.*

35 —, **butylmethyl-.** See 2-*Heptyne*.*

36 —, **chloro-** (*chloroethyne**). $CH{:}CCl$, 60.46. Unst.spon.inflam.gas. **D.** 2. **b.p.** −32 to −30 exp. **Soly.** s.w.; s.al.

37 Acetylene dimethyl-. See 2-*Butyne**.

38 —, diphenyl- (*diphenylethyne; tolan*). $C_6H_5CC{:}C_6H_5$, 178.08. Col.monocl. leaf.f.al. **m.p.** 62.5(60), **b.p.** 300. **Soly.** i.w.; v.s.h.al.; v.s.et.

39 —, divinyl-. See 1, 5-*Hexadien*-3-*yne**.

40 —, ethyl-. See 1-*Butyne**.

41 —, ethylmethyl-. See 2-*Pentyne**.

42 —, ethylphenyl-. See *Benzene, 1-butynyl-*.

43 —, *n*-heptyl-. See 1-*Nonyne**.

44 —, *n*-hexyl-. See 1-*Octyne**.

45 —, isopropyl-. See 1-*Butyne, 3-methyl-**.

46 —, methyl-. See *Propyne**.

47 —, methylphenyl-. See *Propyne, 1-phenyl-*.

48 —, methylpropyl-. See 2-*Hexyne**.

49 —, *n*-octyl-. See 1-*Decyne**.

50 —, phenyl-. See *Benzene, ethynyl-*.

51 —, *n*-propyl-. See 1-*Pentyne**.

52 —, vinyl-. See 3-*Buten*-1-*yne**.

53 Acetylenecarboxylic acid, ethyl-. See 2-*Pentynoic acid**.

54 Acetylenedicarboxylic acid (*butynedioic acid**). $COOHC{:}CCOOH$, 114.02. Lng.pr. **m.p.** 179. **Soly.** v.s.w.; v.s.al.; v.s.et.

55 Acetylenediurein. See *Glycoluril*.

56 Acetyl fluoride (*ethanoyl fluoride**). CH_3COF, 62.02. Col.liq. or gas. **D.** 0.993^{20}_{4}, **m.p.** <-60, **b.p.** 20–1. **Soly.** 5, d.w.; ∞al.; ∞et.; s.bz., ac.a., chl.; v.sl.s.CS_2.

57 Acetyl iodide (*ethanoyl iodide**). CH_3COI, 169.94. Col.-br.fum.liq. **D.** 2.067, **b.p.** 104–6. **Soly.** d.w.; d.al.; s.et.

58 Acetyl peroxide (*ethanoyl peroxide*; diacetyl peroxide*). $(CH_3CO)_2O_2$, 118.05. Col.leaf. **m.p.** 30, **b.p.** 63^{21}. **Soly.** sl.s.w.; v.s.et.; d.NaOH.

59 Achroödextrin. $C_{36}H_{62}O_{31}$?, 990.48. Amor. wh. **Soly.** s.w.; i.al.; col. with I_2.

60 Aconic acid (4, 5-*dihydro-5-keto-3-furancarboxylic acid; formylsuccinic acid lactone*). $OCH{:}C(COOH)CH_2CO$, 128.03. Rhomb.f.w., n α1.385, γ1.530. **m.p.** 164, **b.p.** d. **Soly.** 18^{15}w.; s.me.al.

61 Aconine. $C_{25}H_{41}NO_{11}$, 523.17. *d.* (salts *l.*) amor.hyg. **m.p.** 132. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.; s.chl.

62 —, acetylbenzoyl-. See *Aconitine*.

63 —, benzoyl-. See *Benzaconine*.

64 Aconitic acid (1, 2, 3-*propenetricarboxylic acid**). $C_3H_3(COOH)_3$, 174.05. Col.leaf. or need.f.w. **m.p.** 194–5(191) d. **Soly.** 18^{13}w.; 50^{12} al.; sl.s.et.

65 Aconitine (*acetylbenzoylaconine*). $C_{34}H_{49}NO_{11}$, 647.39. Rhomb.pr.f.chl., $[\alpha]+11°^{23}_{D}$ 3% al. **m.p.** 188–97.8(204). **Soly.** $.031^{25}$w.; 4.54^{25}al.; 2.27^{25}et.; 14.3^{25}bz.; s.chl.

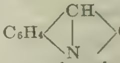
66 —, hydrobromide. $C_{34}H_{49}NO_{11}\cdot HBr\cdot \frac{1}{2}H_2O$, 737.32. Wh. to ylsh.hex.tab. f.w., $[\alpha]-30.47^{\circ}_{D}$ in w. **m.p.** 163; anh. 176–80. **Soly.** s.w.; s.al.; s.et.

67 —, hydrochloride (*l*). $C_{34}H_{49}O_{11}N\cdot HCl\cdot 3H_2O$, 737.90. Wh.cr. **m.p.** 149. **Soly.** s.w.; s.al.; s.et.

68 —, nitrate (*l*). $C_{34}H_{49}NO_{11}\cdot HNO_3\cdot 5H_2O$, 800.48. **Soly.** s.w.; s.al.

69 —, sulfate (*l*). $(C_{34}H_{49}NO_{11})_2\cdot H_2SO_4$, 1392.86. Ylsh.amor.powd. **Soly.** s.w.; s.al.

70 —, diacetyl- (*aconitine O-diacetate*). $C_{34}H_{47}(C_2H_{30})_2NO_{11}$, 731.42. Cr. **m.p.** 158. **Soly.** s.w.

71 Acridine.  C_6H_4, 179.08. Col.leaf. or need., rhomb.f.al. **D.** $1.1005^{19.7}_{4}$, **m.p.** 108; subl. 100, **b.p.** 346. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.bz., CS_2.

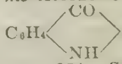
72 —, 2-amino-5-*p*-aminophenyl-. See *Chrysaniline*.

73 —, 5, 10-dihydro- (*ms-dihydroacridine*). $C_6H_4CH_2C_6H_4NH$, 181.09. Col. cr.f.al. **m.p.** 169, **b.p.** subl.; d. 300. **Soly.** i.w.; s.h.al.; s.et.

74 —, dihydroketo-. See *ms-Acridone*.

75 —, 3-methyl-. $C_{13}H_8N\cdot CH_3$, 193.09. Yel.need.f.dil.al. **m.p.** 134. **Soly.** v.s.al.; v.s.et.; v.s.bz.

76 —, 5-phenyl- (*ms-phenylacridine*). $C_6H_5C_{13}H_8N$, 255.11. Yel.monocl. need.f.al. **m.p.** 181, **b.p.** 404. **Soly.** i.w.; sl.s.al.; s.et.; v.s.bz.

77 *ms*-Acridone (*dihydroketoacridine*).  C_6H_4, 195.08. Yel. need. **m.p.** 354. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.h.ac.a., KOH; i.bz., chl.

* Name approved by the International Union of Chemistry.

78 Acrolein (*acrylaldehyde; propenal*; acrylic aldehyde*). CH_2:CHCHO, 56.03. Col.inflam.liq., unst. *n* 1.39975. **D.** 0.841^{20}_{4}, **m.p.** −87.7, **b.p.** 52.5. **Soly.** 40w.; s.al.; s. et.

79 —, α, **β-dimethyl-.** See *Tiglaldehyde.*

80 —, **α-ethyl-β-propyl-.** See *2-Hexenal, 2-ethyl-.*

81 —, **β-2-furyl-** (*3-(2-furyl)propenal*; furacrolein*). C_4H_3OCH:CHCHO, 122.05. Yel.cr. **m.p.** 51, **b.p.** 200. **Soly.** i.w.; ∞al.; s.et.

82 —, **β-methyl-.** See *Crotonaldehyde.*

83 —, **β-phenyl-.** See *Cinnamaldehyde.*

84 Acrylaldehyde. See *Acrolein.*

85 Acrylic acid (*propenoic acid*; ethylenecarboxylic acid*). CH_2:CHCOOH, 72.03. Col.liq., *n* 1.4224. **D.** 1.062^{16}, **m.p.** 12.3, **b.p.** 141.9. **Soly.** ∞w.; ∞al.; ∞et.

86 —, **ethyl ester** (*ethyl acrylate; ethyl propenoate**). CH_2:$CHCOOC_2H_5$, 100.06. Col.liq. **D.** 0.924^{20}_{4}, **b.p.** 99.8.

87 —, **methyl ester** (*methyl acrylate*). CH_2:$CHCOOCH_3$, 86.05. Col.liq., *n* 1.3984. **D.** 0.956^{18}_{4}, **b.p.** 80.5. **Soly.** s.al.; s.et.

88 —, **β-benzoyl-** (*4-oxo-4-phenyl-2-butenoic acid*). C_6H_5COCH:CHCOOH, 176.06. Leaf. (+1H_2O). **m.p.** +1H_2O, 64, anh. 99. **Soly.** s.w.; s.al.; s.et.

89 —, **α-chloro-** (*2-chloropropenoic acid**). CH_2:CClCOOH, 106.48. Need. **m.p.** 65, **b.p.** subl.; 176–81 d. **Soly.** s.w.; s.al.; s.et.

90 —, **β-chloro-** (*3-chloropropenoic acid**). CHCl:CHCOOH, 106.48. Leaf. **m.p.** 85. **Soly.** s.w.; s.al.; s.et.

91 —, α, **β-dimethyl-.** See *Tiglic acid.*

92 —, α, **β-diphenyl-.** See *Cinnamic acid, α-phenyl-.*

93 —, **β-2-furyl-.** See *2-Furanacrylic acid.*

94 —, **β-hydroxy-** (*3-hydroxypropenoic acid**). HOCH:CHCOOH, 88.03. Liq. **Soly.** v.s.w.; v.s.al.; v.s.et.

95 —, **β-isopropyl-.** See *2-Pentenoic acid, 4-methyl-*.*

96 —, **α-methyl-.** See *Methacrylic acid.*

97 —, *cis*(?)**-β-methyl-.** See *Isocrotonic acid.*

98 —, *trans*(?)**-β-methyl-.** See *Crotonic acid (α or solid).*

99 —, **β-(3, 4-methylenedioxystyryl)-.** See *Piperic acid.*

00 —, **α-phenyl-.** See *Atropic acid.*

01 —, **β-phenyl-.** See *Cinnamic acid.*

02 —, **β-propyl-.** See *2-Hexenoic acid*.*

03 —, **β-vinyl-.** See *2, 4-Pentadienoic acid*.*

04 Acrylic aldehyde. See *Acrolein.*

05 2-Acrylonaphthone, 1-hydroxy-β-phenyl- (*1-hydroxy-2-naphthyl styryl ketone; 2-cinnamyl-1-naphthol*). C_6H_5-CH:$CHCOC_{10}H_6OH$, 274.11. Or.leaf. **m.p.** 126. **Soly.** i.w.; s.al.; s.et.

06 Acrylonitrile (*propenenitrile*; vinyl cyanide*). CH_2:CHCN, 53.03. Col. liq. **m.p.** −82, **b.p.** 78–9. **Soly.** s.w.

07 Adenine (*6-aminopurine*). $C_5H_3N_4$·NH_2, 135.08. +3H_2O, need.f.c.w. **m.p.** 365. **Soly.** 0.09 c.w.; sl.s.al.; i.et.; s.h.NH_4OH; i.chl.

08 Adipaldehyde (*hexanedial*; adipic dialdehyde*). $CHO(CH_2)_4CHO$, 114.08. Oil. **b.p.** 94. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

09 Adipamide (*hexanediamide*; adipic diamide*). $(CH_2CH_2CONH_2)_2$, 144.11. Col.pl. **m.p.** 220(226-227). **Soly.** 0.44^{12}w.; v.s.al.; v.sl.s.et.

10 Adipic acid (*hexanedioic acid*; 1, 4-butanedicarboxylic acid*). $COOH(CH_2)_4$COOH, 146.08. Col.monocl.pr. **D.** 1.366, **m.p.** 151–3, **b.p.** 265^{100}. **Soly.** 1.5^{15}w.; v.s.al.; 0.6^{15}et.; s.HNO_3.

11 —, **dibutyl ester.** $(CH_2CH_2COOC_4H_9)_2$, 258.20. **D.** 0.9652^{20}_{4}, **m.p.** −37.5, **b.p.** 183^{14}. **Soly.** i.w.; ∞al.; ∞et.

12 —, **diethyl ester** (*ethyl adipate*). $(CH_2CH_2COOC_2H_5)_2$, 202.14. Col.liq. **D.** 1.009^{20}_{4}, **m.p.** −21, **b.p.** $239–41^{761}$. **Soly.** 0.423^{20}w.; s.al.; s.et.

13 —, **piperazinium salt.** $C_4H_{10}N_2$·$C_6H_{10}O_4$, 232.17. Wh. cr. **m.p.** 244–5 d. **Soly.** s.w.; v.sl.s.h.al.; i.et.

14 Adipic dialdehyde. See *Adipaldehyde.*

15 Adipic diamide. See *Adipamide.*

16 Adipic ketone. See *Cyclopentanone*.*

17 Adipyl chloride (*hexanedioyl chloride**). $ClCO(CH_2)_4COCl$, 192.98. Col. liq. **b.p.** $112–15^{10}$ (sl.d.). **Soly.** d.h.w.; d.h.al.

18 Adrenaline (*3, 4-dihydroxy-α-(methylamino methyl) benzyl alcohol; suprarenine; epinephrine*). $(HO)_2C_6H_3CH$ $(CH_2NHCH_3)OH$, 183.11. Wh.-brnsh.powd. **m.p.** 216 d. **Soly.** 0.027^{20}w.; sl.s.al.; i.et.; s.a., alk.; i.chl., acet., oils.

19 Aesculetin, Aesculin. See *Esculetin, Esculin.*

20 Alanine, β, β′-dithiodi-. See *Cystine.*

21 —, **β-hydroxy-.** See *Serine.*

For explanations and abbreviations see beginning of table.

22 **Alanine, β-p-hydroxyphenyl-.** See *Tyrosine.*

23 —, **β-(3-indyl)-.** See *Tryptophan.*

24 —, **β-mercapto-.** See *Cysteine.*

25 —, **N-methyl-.** $CH_3CH(NHCH_3)COOH$, 103.08. Col.rhomb.f.al. **m.p.** 260 d., **b.p.** subl. 292 sl.d. **Soly.** s.w.; v.sl.s.c.al.

26 ***dl*-Alanine** (*dl-2-aminopropanoic acid*; dl-α-aminopropionic acid*). $CH_3CH(NH_2)COOH$, 89.06. Need. or pr.f.w. **m.p.** 295, **b.p.** subl. 200. **Soly.** 16.6^{25}, 32.2^{75}w.; 0.57^{75} 75%, 0.084^{25} 90% al.; i.et.

27 —, ethyl ester hydrochloride (*ethyl α-aminopropionate hydrochloride*). $CH_3CHNH_2COOC_2H_5 \cdot HCl$, 153.56. Col. need. **m.p.** 64–8(85–7), **b.p.** d. **Soly.** v.s.w.; v.s.al.; v.s.et.

28 —, **N-benzoyl-** (*α-benzamidopropionic acid*). $CH_3CH(NHCOC_6H_5)COOH$, 193.09. Col. pl. or pr. **m.p.** 163–5, **b.p.** d. **Soly.** s.w.; sl.s.al.; sl.s.et.

29 —, **β-phenyl-.** $C_6H_5CH_2CH(NH_2)COOH$, 165.09. Monocl.f.w. or leaf. f.al. **m.p.** 318–20 d., **b.p.** subl. **Soly.** 1.42^{25}, 3.70^{75}w.; sl.s.c.al.; v.v.sl.s.et.

30 ***d*-Alanine** (*d-α-aminopropionic acid; d-2-aminopropanoic acid**). $CH_3CH(NH_2)COOH$, 89.06. Rhomb.f.w. **m.p.** 297 d. **Soly.** 16.65^{25}, 28.5^{75}w.; 0.16al.; i.et.; i.acet.

31 —, **β-[(3, 5-diiodo-4-hydroxyphenoxy)-3, 5-diiodophenyl]-.** See *d-Thyroxine.*

32 —, **β-phenyl-** (*d-α-amino-β-phenylpropionic acid*). $C_6H_5CH_2CH(NH_2)COOH$, 165.09. Leaf.f.w., $[\alpha]+35.08°^{16}_{D}$ in w. **m.p.** 283–4 d. **Soly.** 2.83^{16}w.; i.al.; i.et.

33 ***l*-Alanine** (*l-α-aminopropionic acid; l-2-aminopropanoic acid**). $CH_3CH(NH_2)COOH$, 89.06. Pr.f.al. **m.p.** 295 d., **b.p.** subl. **Soly.** 2.2^{17}w.; 0.2c. 80%al.; i.et.

34 —, **β-phenyl-** (*l-α-aminohydrocinnamic acid*). $C_6H_5CH_2CH(NH_2)COOH$, 165.09. Leaf. *n* 1.600, 1.610, 1.675. **m.p.** 283 d. **Soly.** 3^{25} w.; sl.s.h.al.; i.et.

35 **β-Alanine** (*3-aminopropanoic acid*; β-aminopropionic acid*). $NH_2CH_2CH_2COOH$, 89.06. Rhomb.pr.f.al. **m.p.** 196 d. **Soly.** v.s.w.; v.sl.s.al.; i.et.; i.acet.

36 **Alantolactone.** See *Helenin*

37 **Alcohol.** See *Ethyl alcohol.*

38 **Aldehyde.** See *Acetaldehyde.*

39 **Aldehyde-ammonia.** See *Acetaldehyde-ammonia.*

40 **Aldehydine** (*5-ethyl-2-methylpyridine*). $(C_2H_5)(CH_3)C_5H_3N$, 121.09. Liq. **D.** 0.9184^{23}_{4}, **b.p.** 174. **Soly.** i.w.; s.al.; s.et.; s.H_2SO_4.

41 **Aldol** (*3-hydroxybutanal*; β-hydroxybutyraldehyde*). $CH_3CHOHCH_2CHO$, 88.06. Col. syrupy liq. **D.** 1.103^{20}_{4}, **b.p.** 83^{20}. **Soly.** ∞w.; ∞al.; ∞et.

42 **Alizarin** (*1, 2-dihydroxyanthraquinone*). $C_6H_4(CO)_2C_6H_2(OH)_2$, 240.06. Or. or red tricl. or rhomb. **m.p.** 290, **b.p.** 430. **Soly.** 0.034^{100}w.; v.s.al.; v.s.et.; s.me.al., bz., ac.a., CS_2, alk.

43 —, **3-methyl-.** $C_6H_4(CO)_2C_6HCH_3(OH)_2$, 254.08. Or.need. **m.p.** 229, **b.p.** subl. 200. **Soly.** s.al.; s.et.; s.acet.

44 —, **3-nitro-** (*alizarin orange; β-nitroalizarin*). $C_6H_4(CO)_2C_6H(OH)_2NO_2$, 285.06. Or.need.f.bz. **m.p.** 244 d., **b.p.** subl.d. **Soly.** sl.s.w.; s.al.; s.chl., bz.

45 —, **4-nitro-** (*α-nitroalizarin*). $C_6H_4(CO)_2C_6H(OH)_2NO_2$, 285.06. Yel. need.f.al. **m.p.** 289 d., **b.p.** subl.d.; **Soly.** sl.s.w.; s.al.; s.chl., bz., dil.alk., H_2SO_4.

46 **β-Alizarin amide.** See *Anthraquinone, 2-amino-1-hydroxy-.*

47 **Alizarin bordeaux.** See *Quinalizarin.*

48 **6 (*or* 7)-Alizarincarboxylic acid** (*5, 6 (or 7, 8)-dihydroxy-2-anthraquinonecarboxylic acid*). $(OH)_2C_6H_2(CO)_2C_6H_3COOH$, 284.06. Red. need. **m.p.** 305, **b.p.** subl. **Soly.** v.sl.s.w.; s.al.; sl.s.et.

49 **Alizarin orange.** See *Alizarin, 3-nitro-.*

50 **Alizarin yellow A.** See *Benzophenone, 2, 3, 4-trihydroxy-.*

51 **Alkannin.** $C_{15}H_{14}O_4(?)$, 258.11. Red amor., **m.p.** d. <100. **Soly.** i.w.; sl.s.al.; v.sl.s.et.; s.glac.ac.a., alk.; sl.s.chl.

52 **Alkargen.** See *Cacodylic acid.*

53 **Alkarsin, Alkarsine.** See *Cacodyl oxide.*

54 **Allantoin** (*5-ureidohydantoin; glyoxyldiureide*). $C_4H_6N_4O_3$, 158.08. Wh.monocl.f.h.w. **m.p.** 235, **b.p.** d. **Soly.** 0.6^{20}w.; v.sl.s.al.; i.et.; s.NaOH.

55 **Allanturic acid** (*5-hydroxy-2,4-imidazoledione; glyoxalylurea*). NHCONHCOCHOH, 116.05 Hyg. gum. **Soly.** s.w.; i.al.; d.h.alk.

* Name approved by the International Union of Chemistry.

56 Allene. See *Propadiene**.

57 —, ethyl-. See 1, 2-*Pentadiene**.

58 —, methyl-. See 1, 2-*Butadiene**.

59 Allocinnamic acid. See allo-*Cinnamic acid*.

60 Allocrotonic acid. See *Isocrotonic acid*.

61 Allophanamide. See *Biuret*.

62 Allophanic acid, ethyl ester (*ethyl allophanate; ethyl ureacarboxylate*). $NH_2CONHCOOC_2H_5$, 132.08. Need. f.w. **m.p.** 192, **b.p.** d. **Soly.** s.h., i.c.w.; 0.5^{21} al.; 0.1^{20} et.

63 Alloxan (*pyrimidinetetrone; mesoxalylurea*). NHCONHCOCOCO, 142.03. Anh., dk.yel.; hyd., col. rhomb.pr. **m.p.** 256 d. **Soly.** v.s.w.; s.al.

64 —, 5-oxime. See *Violuric acid*.

65 Alloxanic acid (*tetrahydro-4-hydroxy-2, 5-diketo-4-imidazolecarboxylic acid*). NHCONHCOC(OH)COOH, 160.05. Tricl. **m.p.** d. **Soly.** v.s.w.; 15.8 al.; sl.s.et.

66 Alloxantin. $C_8H_4N_4O_7$, 268.06. Wh. powd. or rhomb.pr. **m.p.** 170 d. **Soly.** sl.s.w.; v.sl.s.al.; v.sl.s.et.

67 —, tetramethyl-. See *Amalic acid*.

Allyl. For allyl derivatives see the parent compounds (e.g., for allylaniline see *Aniline, allyl-*). For allyl esters of organic acids see the acids.

68 Allyl alcohol (2-*propen-l-ol**). CH_2:$CHCH_2OH$, 58.05. Col.liq., *n* 1.41345. **D.** 0.855^{20}_{4}, **m.p.** −129 (−50), **b.p.** 97. **Soly.** ∞w.; ∞al.; ∞et.

69 Allyl alcohol. (For derivatives see also 2-*Propen-1-ol*.)

70 —, dibromide. See 1-*Propanol*, 2, 3-*dibromo-**.

71 —, dichloride. See 1-*Propanol*, 2, 3-*dichloro-**.

72 —, γ-methyl-. See 2-*Buten-1-ol**.

73 —, γ-phenyl-. See *Cinnamic alcohol*.

74 Allylamine (2-*propenylamine**). CH_2:$CHCH_2NH_2$, 57.06. Col.liq., *n* 1.41943^{22}. **D.** 0.761^{20}_{4}, **b.p.** 53.2. **Soly.** ∞w.; ∞al.; ∞et.; s.chl.

75 —, *N*-methyl-. CH_2:$CHCH_2NHCH_3$, 71.08. Col.liq. **b.p.** 65. **Soly.** ∞w.

76 Allyl bromide (3-*bromopropene**). CH_2:$CHCH_2Br$, 120.96. Col.liq., *n* 1.46545. **D.** 1.398^{20}_{4}, **m.p.** −119.4, **b.p.** 71.3. **Soly.** i.w.; ∞al.; ∞et.; s.chl., CS_2, CCl_4.

77 Allyl bromide, α-bromo-. See *Propene, 2, 3-dibromo-**.

78 Allyl chloride (3-*chloropropene**). CH_2:$CHCH_2Cl$, 76.50. Liq., *n* 1.41538. **D.** 0.938^{20}_{4}, **m.p.** −136.4, **b.p.** 44.6. **Soly.** i.w.; s.al.; ∞et.

79 Allyl chloride, α-chloro-. See *Propene, 2, 3-dichloro-**.

80 Allyl cyanide (3-*butenenitrile**; *vinylacetonitrile; β-butenonitrile*). CH_2:$CHCH_2CN$, 67.05. Col.liq., *n* 1.40602. **D.** 0.8318^{20}_{4}. **b.p.** 116–9. **Soly.** v.sl.s.w.; ∞al.; ∞et.

81 Allylene. See *Propyne**.

82 —, γ-bromo-. See *Propyne, 3-bromo-**.

83 Allylene dichloride. See *Propene, 1, 2-dichloro-**.

84 Allylene oxide. See *Propene, 1, 2-epoxy-**.

85 Allyl ether (3-(2-*propenoxy) propene**; *diallyl ether*). $(CH_2$:$CHCH_2)_2O$, 98.08. Liq. **D.** 0.805, **b.p.** 94.3. **Soly.** sl.s.w.; ∞al.; ∞et.

86 —, thio-. See *Allyl sulfide*.

87 Allyl fluoride (3-*fluoropropene**). CH_2:$CHCH_2F$, 60.04. Gas. **b.p.** −10. **Soly.** 2.8^{13}cm³w.; 60^{13}cm³al.; 90cm³et.

88 Allyl iodide (3-*iodopropene**). CH_2:$CHCH_2I$, 167.96. Yel.liq. **D.** 1.848^{12}_{12}, **m.p.** −99.3, **b.p.** 103.1. **Soly.** i.w.; s.al.; s.et.; s.chl.

89 Allyl isocyanide. CH_2:$CHCH_2NC$, 67.05. Liq **D.** 0.794^{17}_{4}, **b.p.** 106. **Soly.** sl.s.w.; ∞al.; ∞et.

90 Allyl mercaptan. See 2-*Propene-1-thiol**.

91 Allyl mustard oil. See *Isothiocyanic acid, allyl ester*.

92 Allyl sulfide (3-(2-*propenylthio*) *propene**; 2-*propenyl sulfide**; *thioallyl ether; diallyl sulfide; allyl thioether*). $(CH_2$:$CHCH_2)_2S$, 114.14. Col.oil w. garlic odor, *n* 1.4877^{27}. **D.** 0.88765^{27}_{4}; **m.p.** −83, **b.p.** *ca.* 138; 138.6^{758} (140–2). **Soly.** sl.s.w.; ∞al.; ∞et.; s.chl., CCl_4, CS_2.

93 Allyl sulfocyanide. See *Thiocyanic acid, allyl ester*.

94 Allyltribromide. See *Propane*, 1,2,3-*tribromo-**.

95 Allyltrichloride. See *Propane*, 1,2,3-*trichloro-**.

96 **Allyl trisulfide** (*diallyl trisulfide*). $(C_3H_5)_2S_3$, 178.26. Liq. **D.** 1.085^{15}, **b.p.** 140. **Soly.** i.w.; i.al.; ∞et.

97 **Aloïn.** $C_{20}H_{18}O_9$, 402.14. Yel.need. **m.p.** 147.9. **Soly.** sl.s.c.w.; sl.s.c.al.; i.et.; s.acet., KOH; i.chl.

98 **Alstonine** (*chlorogenine*) $C_{21}H_{20}N_2O_4 \cdot 3\frac{1}{2}H_2O$, 427.23. Br.amor. **m.p.** < 100; 195 anh. **Soly.** sl.s.w.; s.al.; v.sl.s.et.; s.chl.

99 **Aluminum, triethoxy-*** (*aluminum ethoxide*). $Al(OC_2H_5)_3$, 162.09. **D.** 1.1422^{20}_{4}, **m.p.** 150–60, **b.p.** 320. **Soly.** d.w.

00 —, **triethyl-*** (*aluminum ethyl*). $Al(C_2H_5)_3$, 114.09. Col.liq., ign. in air, n $1.480^{6.5}$. **m.p.** < −18, **b.p.** 194. **Soly.** exp.w.; s.et.

01 —, **trimethyl-*** (*aluminum methyl*). $Al(CH_3)_3$, 72.04. Col.liq., ign. in air, n 1.432^{12}. **m.p.** 0, **b.p.** 130. **Soly.** d.w.; s.et.

02 **Amalic acid** (*tetramethylalloxantin*). $C_8(CH_3)_4N_4O_7$, 324.13. Cr. **m.p.** 245 d. **Soly.** sl.s.h.w.; v.sl.s.al.; s.KOH.

03 **Amanitine.** See *Choline.*

04 **Amarine** (4, 5-*dihydro*-2, 4, 5-*triphenylimidazole*), $(C_6H_5)CH(C_6H_5)CH$, $NH(C_6H_5)C{:}N$ 298.16. Pr. **m.p.** 129, **b.p.** d. 198 (anh.). **Soly.** i.w.; s.al.; s.et.

05 **Amaron** (*tetraphenylpyrazine; benzoin imide; ditolan azotide*). $(C_6H_5)_2(CNC)_2(C_6H_5)_2$, 384.17. Sm.need.f.acet. **m.p.** 246, **b.p.** subl. **Soly.** i.w.; s.al.; s.et.; s.chl., h.bz.

06 **Amidine, benzenylnaphthyl-.** See *Benzamidine, N-1-naphthyl-.*

07 —, **ethenyldiphenyl-.** See *Acetamidine, N, N′-diphenyl-.*

08 **Amidol.** See *Phenol*, 2, 4-*diamino-, dihydrochloride.*

Amino-. See the parent compounds (e.g., for aminoacetophenone see *Acetophenone, amino-*).

10 **Amino G acid.** See 2-*Naphthylamine*-6, 8-*disulfonic acid.*

11 **Ammelide** (6-*amino-s-triazine*-2, 4-*diol; cyanuramide*). $N{:}C(OH)N{:}C(OH)N{:}C(NH_2)$, 128.06. Wh.cr. powd. **m.p.** d. **Soly.** v.sl.s.w.; s.et.; s.alk., min.a.

12 **Ammeline** (4, 6-*diamino-s-triazin*-2-*ol; cyanurodiamide*). $N{:}C(OH)N{:}C(NH_2)N{:}C(NH_2)$, 127.08. Wh. minute need. dendritic groups. **m.p.** d. **Soly.** 0.021^{23}w.; i.al.; i.et.; s.KOH, alk., min.a.

13 **Ammonium bromide, (β-acetoxyethyl) trimethyl-.** See *Choline, O-acetyl-, bromide.*

14 —, **ethyl-*.** See *Ethylamine, hydrobromide.*

15 —, **tetraethyl-.** $(C_2H_5)_4NBr$, 210.08 Cr.f.al. **D.** 1.397^{20}_{4}. **Soly.** v.s.al.; s.chl.

16 **Ammonium chloride,** derivatives of. See also "hydrochloride" under the various amines.

17 —, **tetramethyl-.** $(CH_3)_4NCl$, 109.56. Col.cr. **D.** 1.169^{20}_{4}. **Soly.** s.w.; s.al.; i.et.

18 **Ammonium hydroxide, (carboxymethyl) trimethyl-,** anhydride. See *Betaine.*

19 —, **tetraethyl-.** $(C_2H_5)_4NOH$, 147.17. Deliq.need. **m.p.** 190 d. **Soly.** s.w.; s.al.

20 —, **tetramethyl-.** $(CH_3)_4NOH \cdot 5H_2O$, 181.19. Hyg.need. **m.p.** anh. 63, **b.p.** d. **Soly.** ∞^{63}w.; v.s.al.; i.et.

21 —, **trimethylvinyl-.** See *Neurine.*

22 **Ammonium purpurate.** See *Murexide.*

23 **Amygdalic acid** (*amygdalinic acid; mandelic acid gentiobioside*). $C_{20}H_{28}O_{13}$ or $C_{19}H_{27}O_{11} \cdot COOH$, 476.22. Col. cr. **m.p.** 118. **Soly.** deliq.w.; i.al.; i.et.

24 **Amygdalin** (*mandelonitrile gentiobioside; amygdaloside*). $C_{20}H_{27}NO_{11}$, 457.22. Rhomb.f.w. **m.p.** 214–6. **Soly.** 8.3^{10}, ∞^{100}w.; 0.11^{10}, 9^{78}al.; i.et.

Amyl. For (normal) amyl derivatives see the parent compounds (e.g., for amylbenzene see *Benzene, amyl-*). For amyl esters of organic acids see the acids.

25 *pri-act*-**Amyl alcohol.** See 1-*Butanol*, 2-*methyl-**.

26 *pri-n*-**Amyl alcohol.** See 1-*Pentanol**.

27 *sec-act*-**Amyl alcohol.** See 2-*Pentanol**.

28 *tert*-**Amyl alcohol.** See 2-*Butanol*, 2-*methyl-**.

29 *n*-**Amyl aldehyde.** See *Valeraldehyde.*

30 **Amylamine** (*n-amylamine; pentylamine**; 1-*aminopentane*). $CH_3(CH_2)_4NH_2$, 87.11. Col.liq. **D.** 0.7614^{20}_{4}, **m.p.** −55, **b.p.** 104. **Soly.** s.w.; s.al.; ∞et.

* Name approved by the International Union of Chemistry.

31 Amylamine, α-methyl- (*2-aminohexane*). $CH_3(CH_2)_3CH(CH_3)NH_2$, 101.13. **D.** 0.767^{20}_{4}, **m.p.** −19, **b.p.** 130^{742}.

32 —, 4-methyl-. See *Isohexylamine.*

33 *sec-n*-Amylamine. See *Butylamine, α-methyl-; Propylamine, α-methyl-.*

34 *tert*-Amylamine (*(α, α-dimethylpropyl)amine; dimethylethylcarbinylamine*). $CH_3CH_2C(CH_3)_2NH_2$, 87.11. Col.liq. **D.** 0.7611^{2}_{4}, **m.p.** −105, **b.p.** 78.5. **Soly.** ∞w.; ∞al.; ∞et.

35 Amyl bromide (*1-bromopentane*; n-amyl bromide*). $CH_3(CH_2)_3CH_2Br$ 151.00. Col.liq., *n* 1.444. **D.** 1.246^{0}_{4} 1.218^{20}_{4}, **m.p.** −88.0, **b.p.** $128\text{–}9^{740}$ **Soly.** i.w.; s.al.; ∞et.

36 *pri-act*-Amyl bromide. See *Butane, 1-bromo-2-methyl-*.*

37 Amyl chloride (*1-chloropentane*; n-amyl chloride*). $CH_3(CH_2)_3CH_2Cl$, 106.54. Col.liq., *n* 1.4119^{18}. **D.** 0.883^{20}_{4}, **m.p.** −99, **b.p.** 108.2 (107^{740}). **Soly.** i.w.; ∞al.; ∞et.

38 *pri-act*-Amyl chloride. See *Butane, 1-chloro-2-methyl-*.*

39 *tert*-Amyl chloride. See *Butane, 2-chloro-2-methyl-*.*

40 *n*-Amyl cyanide. See *Capronitrile.*

41 α-*n*- Amylene. See *1-Pentene*.*

42 β-*n*-Amylene. See *2-Pentene*.*

43 α-*n*-Amylene glycol. See *1, 2-Pentanediol*.*

44 β-*n*-Amylene glycol. See *2, 3-Pentanediol*.*

45 Amyl ether (*pentyloxypentane*; di-n-amyl ether*). $[CH_3(CH_2)_3CH_2]_2O$. 158.17. Ylsh.liq. **D.** 0.774^{20}_{4}, **m.p.** −69.3, **b.p.** 190. **Soly.** i.w.; ∞al.; ∞et.

46 Amylin. See *Dextrin.*

47 Amyl iodide (*1-iodopentane*; n-amyl iodide*). $CH_3(CH_2)_3CH_2I$, 198.01. Col. liq., *n* 1.4955. **D.** 1.517^{20}_{4}, **m.p.** −85.6, **b.p.** 156. **Soly.** i.w.; s.al.; ∞et.

48 *pri-act*-Amyl iodide. See *Butane, 1-iodo-2-methyl-*.*

49 *tert*-Amyl iodide. See *Butane, 2-iodo-2-methyl-*.*

50 Amyl isocyanide (*n-amylcarbylamine**). $CH_3(CH_2)_4NC$, 97.09. Liq. **D.** 0.806^{20}_{4}, **m.p.** −51.1, **b.p.** 155.5. **Soly.** i.w.; s.al.

51 Amyl mercaptan. See *1-Pentanethiol*.*

52 *pri-act*-Amyl mercaptan. See *1-Butanethiol, 2-methyl-*.*

53 *tert*-Amyl mercaptan. See *2-Butanethiol, 2-methyl-*.*

54 *n*-Amyl mustard oil. See *Isothiocyanic acid, amyl ester.*

55 Amyl nitrite(*n*) (*pentyl nitrite**). $CH_3(CH_2)_4NO_2$, 117.09. Pa.yel.liq., *n* 1.38506. **D.** 0.8528^{20}_{4}, **b.p.** 104 **Soly.** sl.s.w.; ∞al.; ∞et.

56 Amyl sulfate (*di-n-amyl sulfate; pentyl sulfate*). $[CH_3(CH_2)_4]_2SO_4$, 238.23. *n* 1.4270^{25}. **D.** 1.0265^{25}_{25}, **b.p.** $117.0^{2.5}$.

57 Amytal. See *Barbituric acid, 5-ethyl-5-isoamyl-.*

58 *l*-Anabasine (*l-2-(3-pyridyl)piperidine*). $C_{10}H_{14}N_2$, 162.13. Col.liq., *n* 1.5430, $[\alpha]$ − $82.20°^{20}_{D}$. **D.** 1.0481^{20}_{20}, **b.p.** 28.09. **Soly.** ∞w.; s.al.; s.et.; s.bz.

59 Anacardic acid. $C_{22}H_{32}O_3$, 344.25. Cr. **m.p.** 26. **Soly.** i.w.; s.al.; s.et.

60 Anaesthesin. See *Benzocaine.*

61 Analgen (1) (*5-benzamido-8-ethoxyquinoline; quinalgen; chinalgen, labordin; benzanalgen*). $C_9H_5N(NHCOC_6H_5)OC_2H_5$, 292.14. Col. yel.need. **m.p.** 210. **Soly.** i.w. v.sl.s.al.; v.sl.s.et.; s.a.

Analgen (2). Formerly, 5-acetamido 8-ethoxyquinoline.

62 Analgesine. See *Antipyrine.*

63 Anethole (*p-propenylanisole; anise camphor; 1-methoxy-4-propenyl benzene*). $CH_3CH{:}CHC_6H_4OCH_3$, 148.09 Col.leaf.f.al., *n* 1.5624^{12}. **D.** 0.9936^{15}_{15}, **m.p.** 22.5, frz. 20–1, **b.p.** 235.3. **Soly.** v.sl.s.w.; 20 96% al.; s.et.; s.chl., bz., acet., CS_2.

64 Angelic acid (*cis-2-methyl-2-butenoic acid*; α-methylisocrotonic acid*). $CH_3CH{:}C(CH_3)COOH$, 100.06. Col. monocl.pr., *n* 1.4434^{47} liq. **D.** liq. 0.983^{47}_{4}, **m.p.** 45, **b.p.** 185. **Soly.** sl.s.w.; s.al.; v.s.et.

65 Anhalonidine. $C_{12}H_{17}NO_3$, 223.14. **m.p.** 160. **Soly.** s.w., s.al.; sl.s.et.; s.chl.

66 Anhalonine (*1, 2, 3, 4-tetrahydro-6-methoxy-1-methyl-7, 8-methylenedioxy-isoquinoline*). $C_{12}H_{15}NO_3$, 221.13. Need. **m.p.** 85. **Soly.** s.w.; s.al; s.et.; s.chl.

67 —, hydrochloride. $C_{12}H_{15}NO_3{\cdot}HCl$, 257.59. Wh.cr. powd. $[\alpha]$ $-41.9°^{17}_{D}$ in w. **m.p.** >230 d. **Soly.** sl.s.c., v.s.h.w.; sl.s.al.; sl.s.et.; sl.s.chl.

For explanations and abbreviations see beginning of table.

68 ***dl*-Anhydroecgonine** (*ecgonidine*) $C_9H_{13}NO_2$, 167.11. Wh.cr. f.w. **m.p.** 226–30 d.; (*l*, 235 d.). **Soly.** s.w.; sl.s.c.al.; v.sl.s.et.

69 —, hydrochloride. $C_9H_{13}NO_2 \cdot HCl$, 203.57. Rhomb. need.f.al., $[\alpha]$ $-61.5°_D$. **m.p.** 240–1. **Soly.** s.w.; s.al.

70 **Anhydroformaldehydeaniline.** See *s-Triazine, hexahydro-*1, 3, 5-*triphenyl-*.

71 **Aniline** (*phenylamine; aminobenzene*). $C_6H_5NH_2$, 93.06. Col. oily liq., *n* 1.5863^{20}. **D.** 1.022^{20}_{4}. **m.p.** -6.2, **b.p.** 184.4. **Soly.** 3.4^{20}, 6.4^{90} w.; ∞al.; ∞et.; ∞bz.

72 —, hydrochloride. $C_6H_5NH_2 \cdot HCl$, 129.53. Wh. leaf. or need. **D.** 1.222^{4}_{4}, **m.p.** 198, **b.p.** 245. **Soly.** 18^{16}, 107^{25} w.; s.al.; i.et.

73 —, sulfate $(C_6H_5NH_2)_2H_2SO_4$, 284.20. Leaf.f.al. **D.** 1.377^{4}_{4}, **m.p.** d. **Soly.** 6.6^{15}w.; sl.s.al.; i.et.

74 —, ***o*-acetyl-.** See *Acetophenone, o-amino-*.

75 —, ***N*-acetyl-.** See *Acetanilide.*

76 —, ***N*-allyl-** (*N-(2-propenyl)aniline*). $CH_2{:}CHCH_2NHC_6H_5$, 133.09. Yel. oil. **D.** 0.982^{25}_{4}, **b.p.** $217\text{–}8^{736}$ (209). **Soly.** sl.s.w.; s.al.; ∞et.

77 —, ***o*-amino-.** See *o-Phenylenediamine.*

78 —, ***m*-amino-.** See *m-Phenylenediamine.*

79 —, ***p*-amino-.** See *p-Phenylenediamine.*

80 —, **azodi-.** See *Azobenzene, diamino-.*

81 —, ***N*-benzal-** (*benzylideneaniline*). $C_6H_5CH{:}NC_6H_5$, 181.09. Yel. need. f.CS_2. **D.** 1.07^{50}, **m.p.** 54 (51–2), **b.p.** 300. **Soly.** i.w.; s.al.; s.et.

82 —, ***p, p'*-benzalbis-*N, N*-dimethyl-** (4, 4'-*bisdimethylaminotriphenylmethane; leuco malachite green*). $C_6H_5CH\text{-}[C_6H_4N(CH_3)_2]_2$, 330.22. Monocl. need.f.bz. **m.p.** 93; 102, **b.p.** d. **Soly.** i.w.; s.al.; v.s.et.; s.bz.; sl.s.lgr.

83 —, ***p, p'*-benzaldi-.** See *Methane, p, p'-diaminotriphenyl-*.

84 —, ***N*-benzal-*p*-hydroxy-.** See *Phenol, p-(benzalamino)-*.

85 —, ***m*-benzohydryl-** (*m-aminotriphenylmethane; m-aminotritan*). $(C_6H_5)_2CHC_6H_4NH_2$, 259.14. Need. f.et. **m.p.** 120.

86 —, ***p*-benzohydryl-** (*p-aminotriphenylmethane*) $(C_6H_5)_2CHC_6H_4NH_2$, 259.14. Pr.f.et. **m.p.** 84, **b.p.** 248^{12}. **Soly.** i.w.; s.et.; s.bz., lgr.

87 —, ***o, m* or *p*-benzoyl-.** See *Benzophenone, amino-*.

88 —, ***N*-benzoyl-.** See *Benzanilide.*

89 —, ***m*-benzyl-** (*m-aminodiphenylmethane*). $NH_2C_6H_4CH_2C_6H_5$, 183.11. Cr. **m.p.** 46. **Soly.** s.lgr.

90 —, ***p*-benzyl-** (*p-aminodiphenylmethane*). $NH_2C_6H_4CH_2C_6H_5$, 183.11. Col. monocl. f.lgr. **D.** 1.038^{55}, **m.p.** 34–5 (37), **b.p.** 300. **Soly.** i.w.; v.s.al.; v.s.et.; s.lgr.

91 —, ***N*-benzyl-.** See *Benzylamine, N-phenyl-*.

92 —, **benzylidene-.** See *Aniline, N-benzal-*.

93 —, ***o*-bromo-** (*1-amino-2-bromobenzene*). $BrC_6H_4NH_2$, 171.97. Cr. **m.p.** 32, frz. 28.7, **b.p.** 229. **Soly.** sl.s.w.; s.al.; s.et.

94 —, ***m*-bromo-** (*1-amino-3-bromobenzene*). $BrC_6H_4NH_2$, 171.97. *n* $1.62604^{20.4}$. **D.** $1.5793^{20.4}_{4}$, **m.p.** 18.5; frz. 16.7, **b.p.** 251. **Soly.** v.sl.s.w.; s.al.; s.et.

95 —, ***p*-bromo-** (*1-amino-4-bromobenzene*). $BrC_6H_4NH_2$, 171.97. Rhomb. **D.** 1.799, **m.p.** 66.4, **b.p.** d. **Soly.** i.w.; v.s.al.; v.s.et.

96 —, ***p*-bromo-*N, N*-diethyl-.** $BrC_6H_4\text{-}N(C_2H_5)_2$, 228.03. Need. or pr. **m.p.** 33, **b.p.** 270. **Soly.** i.w.; v.s.al.; v.s.et.

97 —, ***p*-bromo-*N, N*-dimethyl-.** $BrC_6\text{-}H_4N(CH_3)_2$, 200.00. **m.p.** 55, **b.p.** 264. **Soly.** i.w.; v.s.al.; v.s.et.

98 —, ***N*-butyl-.** $C_6H_5NHC_4H_9$, 149.13. Col.liq. **b.p.** 240.9. **Soly.** sl.s.w.; v.s.al.; v.s.et.

99 —, ***p-tert*-butyl-** (*1-amino-4-tert-butylbenzene*). $(CH_3)_3CC_6H_4NH_2$, 149.13. Oil. **D.** 0.9525^{15}_{4}, **m.p.** 17, **b.p.** 240.9. **Soly.** i.w.; ∞al.; ∞et.

00 —, ***o*-chloro-** (*2-chlorophenylamine*). $ClC_6H_4NH_2$, 127.51. Liq., *n* 1.5895. **D.** 1.213^{20}_{4}, **m.p.** $\alpha - 14$; $\beta - 3.5$; mixt. 0, **b.p.** 208.8. **Soly.** i.w.; ∞al.; s.et.; s. most org.solv., a.

01 —, ***m*-chloro-** (*3-chlorophenylamine*). $ClC_6H_4NH_2$, 127.51. Liq., *n* $1.59424^{20.7}$. **D.** 1.216^{20}_{4}, **m.p.** -10.4, **b.p.** 229.8 ($99\text{–}100^{10}$). **Soly.** ∞al.; ∞et.; s. most org.solv., a.

02 —, ***p*-chloro-** (*4-chlorophenylamine*). $ClC_6H_4NH_2$, 127.51. Rhomb.pr. **D.** 1.427^{19}_{4}; liq. 1.170^{70}_{4}, **m.p.** 70–2, **b.p.** 231. **Soly.** s.h.w.; s.al.; s.et.; s.a., most org.solv.

03 —, ***N*-cyano-.** See *Cyananilide.*

04 —, ***N, N*-diacetyl-.** See *Diacetanilide.*

* Name approved by the International Union of Chemistry.

05 **Aniline, *N*, *N*-dibenzyl-.** See *Dibenzylamine, N-phenyl-.*

06 —, **2, 4-dibromo-6-nitro-.** $Br_2(NO_2)C_6H_2NH_2$, 295.88. Yel.cr. **m.p.** 127.

07 —, **2, 6-dibromo-4-nitro-.** $Br_2(NO_2)C_6H_2NH_2$, 295.88. Yel.need. **m.p.** 203. **Soly.** sl.s.w.

08 —, ***N*, *N*-dibutyl-** (*N-phenyldibutylamine*). $C_6H_5N(C_4H_9)_2$, 205.19. Col. liq. **D.** 0.907, **b.p.** 262.8 (271). **Soly.** i.w.; s.al.; s.et.

09 —, **2, 3-dichloro-.** $Cl_2C_6H_3NH_2$, 161.96. Need.f.lgr. **m.p.** 24, **b.p.** 252. **Soly.** s.al.; v.sl.s.et.; sl.s.bz., lgr.

10 —, **2, 4-dichloro-.** $Cl_2C_6H_3NH_2$, 161.96. Need.f.dil.me.al. **D.** 1.567^{20}_{4}, **m.p.** 63, **b.p.** 245. **Soly.** sl.s.w.; s.al.; s.et.

11 —, **2, 5-dichloro-.** $Cl_2C_6H_3NH_2$, 161.96. Need.f.lgr. **m.p.** 50, **b.p.** 251. **Soly.** sl.s.w.; s.al.; s.et.; s.bz., CS_2; sl.s.lgr.

12 —, **3, 4-dichloro-.** $Cl_2C_6H_3NH_2$, 161.96. Need.f.lgr. **m.p.** 71.5, **b.p.** 272. **Soly.** s.al.; s.et.; sl.s.lgr.

13 —, **3, 5-dichloro-.** $Cl_2C_6H_3NH_2$, 161.96. Need. **m.p.** 50.5, **b.p.** 260. **Soly.** i.w.; s.al.; s.et.

14 —, ***N*-(dichloromethylene)-** (*phenyliminophosgene; phenylcarbylamine chloride*). $C_6H_5NCCl_2$, 173.96. Col.oil. **b.p.** 209.

15 —, **2, 6-dichloro-4-nitro-.** $Cl_2(NO_2)C_6H_2NH_2$, 206.96. Yel.need.f.al. **m.p.** 189–90(195). **Soly.** s.al.

16 —, ***N*, *N*-diethyl-** (*N-phenyldiethylamine*). $C_6H_5N(C_2H_5)_2$, 149.13. Col. inflam.oil, *n* $1.54105^{22.3}$. **D.** 0.93507^{20}_{4}, **m.p.** −34.5, **b.p.** 215.5(215–7). **Soly.** 1.44^{12}w.; s.al.; s.et.

17 —, ***N*, *N*-diethyl-*m*-nitro-.** $NO_2C_6H_4N(C_2H_5)_2$, 194.13. Yel.oil. **b.p.** 288–90.

18 —, ***N*, *N*-diethyl-*p*-nitro-.** $NO_2C_6H_4N(C_2H_5)_2$, 194.13. yel.monocl. need.f.al. **D.** 1.225, **m.p.** 77–8. **Soly.** v.s.h.al.; sl.s.lgr.

19 —, ***N*, *N*-diethyl-*p*-nitroso-.** $NOC_6H_4N(C_2H_5)_2$, 178.13. Grn.monocl. **D.** 1.24^{15}, **m.p.** 84. **Soly.** sl.s.w.; v.s.al.; v.s.et.

20 —, ***ar*-dimethyl-.** See *Xylidine.*

21 —, ***N*, *N*-dimethyl-.** $C_6H_5N(CH_3)_2$, 121.09. Yel.liq., *n* 1.55819. **D.** 0.9557^{20}_{4}, **m.p.** 2.5, **b.p.** 192.5–3.5, **Soly.** v.sl.s.w.; s.al.; s.et.; s. most ord.org.solv.

22 —, ***N*, *N*-dimethyl-*o*-nitro-.** $NO_2C_6H_4N(CH_3)_2$, 166.09. Red. monocl. **D.** 1.179, **m.p.** 60–1, **b.p.** 154^{24}. **Soly.** sl.s.w.; s.al.; s.et.

23 —, ***N*, *N*-dimethyl-*m*-nitro-.** $NO_2C_6H_4N(CH_3)_2$, 166.09. Red monocl. pr.f.et. **D.** 1.313^{17}, **m.p.** 66 (59–60), **b.p.** 285. **Soly.** i.w.; s.al.; s.et.

24 —, ***N*, *N*-dimethyl-*p*-nitro-.** $NO_2C_6H_4N(CH_3)_2$, 166.09. Yel.fluores. need.f.al. **m.p.** 163. **Soly.** i.w.; s.al.; s.conc.HCl, h.ac.a.

25 —, ***N*, *N*-dimethyl-*p*-nitroso-.** $NOC_6H_4N(CH_3)_2$, 150.09. Grn. tricl. leaf. **m.p.** 85. **Soly.** i.w.; s.al.; s.et.

26 —, ***N*, *N*-dimethyl-*p*-phenylazo-.** See *Azobenzene, p-dimethylamino-.*

27 —, **2, 4-dinitro-** (*2, 4-dinitrophenylamine*). $(NO_2)_2C_6H_3NH_2$, 183.06. Yel.monocl.f.dil.acet. **D.** 1.615, **m.p.** 176 (188). **Soly.** sl.s.h.w.; 0.7^{21}al.; sl.s.h.HCl.

28 —, **2, 6-dinitro-** (*2, 6-dinitrophenylamine*). $(NO_2)_2C_6H_3NH_2$, 183.06. Yel.need.f.al. **m.p.** 138 (141–2). **Soly.** i.w.; 0.40c.al.; s.et.; s.h.bz.; i.lgr.

29 —, ***N*, *N*-dipropyl-.** $C_6H_5N(C_3H_7)_2$, 177.16. Yel.oil. **D.** 0.9104^{20}_{4}, **b.p.** 245–6 (238–41). **Soly.** i.w.; s.al.; s.et.

30 —, **ethoxy-.** See *Phenetidine.*

31 —, **ethoxyl-.** See *Ethanol, 2-anilino-.*

32 —, ***o*-ethyl-** (*o-aminoethylbenzene*). $C_2H_5C_6H_4NH_2$, 121.09. Liq. **D.** 0.983^{22}_{4}, **m.p.** −43, **b.p.** 215–6. **Soly.** sl.s.w.; v.s.al.; v.s.et.

33 —, ***m*-ethyl-** (*m-aminoethylbenzene*). $C_2H_5C_6H_4NH_2$, 121.09. Col.liq. **D.** 0.990^{0}_{4}; 0.9631^{20}_{4}, **m.p.** −64, **b.p.** 214–5 (205). **Soly.** sl.s.w.; v.s.al.; v.s.et.

34 —, ***p*-ethyl-** (*p-aminoethylbenzene*). $C_2H_5C_6H_4NH_2$, 121.09. Glit.leaf. or col.oil. **D.** 0.975^{22}_{4}, **m.p.** −5, **b.p.** 216.5. **Soly.** sl.s.w.; v.s.al.; v.s.et.

35 —, ***N*-ethyl-** (*N-ethylphenylamine*). $C_6H_5NHC_2H_5$, 121.09. Col.liq., *n* $1.55558^{20.3}$. **D.** 0.9631^{20}_{4}, **m.p.** −63.5, **b.p.** 204.72. **Soly.** i.(v.sl.s.)w.; ∞al.; ∞et.

36 —, ***N*-ethyl-*o*, *m* or *p*-hydroxy-.** See *Phenol, ethylamino-.*

37 —, ***N*-ethyl-*N*-methyl-.** $C_6H_5N(CH_3)C_2H_5$, 135.11. Col.liq. **D.** 0.9193^{55}, **b.p.** 201. **Soly.** i.w.; ∞al.; ∞et.

38 —, **hexahydro-.** See *Cyclohexylamine*.*

For explanations and abbreviations see beginning of table.

39 **Aniline, *p, p'*-hydrazodi-.** See *Hydrazobenzene, 4, 4'-diamino-.*

40 —, **hydroxy-.** See *Phenol, amino-.*

41 —, ***m*-hydroxy-*N, N*-dimethyl-.** See *Phenol, m-dimethylamino-*.*

42 —, **β-hydroxyethyl-.** See *Ethanol, 2-anilino-.*

43 —, ***p, p'*-iminodi-.** See *Diphenylamine, 4, 4'-diamino-.*

44 —, ***o*-iodo-.** $IC_6H_4NH_2$, 218.97. Need. **m.p.** 56.5. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

45 —, ***m*-iodo-.** $IC_6H_4NH_2$, 218.97. Leaf. or need. **m.p.** 33 (27). **Soly.** i.w.; s.al.; s.chl.

46 —, ***p*-iodo-.** $IC_6H_4NH_2$, 218.97. Need.f.w. **m.p.** 62.75 (67–8). **Soly.** i.w.; s.al.; s.et.; s.chl.

47 —, ***N*-isoamyl-** (*N-isoamylphenylamine*). $C_5H_{11}NHC_6H_5$, 163.14. Liq. **D.** 0.928^{15}_{4}, **b.p.** 254.5. **Soly.** i.w.; ∞al.; ∞et.

48 —, ***p*-isopropyl-.** See *Cumidine.*

49 —, **2-isopropyl-5-methyl-.** See *Thymylamine.*

50 —, **5-isopropyl-2-methyl-.** See *Carvacrylamine.*

51 —, **mercapto-.** See *Phenol, aminothio-.*

52 —, **methenyltri-.** See *Leucaniline.*

53 —, **methoxy-.** See *Anisidine.*

54 —, ***o, m* or *p*-methyl-.** See *Toluidine.*

55 —, ***N*-methyl-.** $C_6H_5NHCH_3$, 107.08. Yel.liq., *n* $1.57021^{21.2}$. **D.** 0.986^{20}_{4}, **m.p.** −57.0, **b.p.** 195.7. **Soly.** v.sl.s.w.; s.al.; ∞et.; s.chl.

56 —, ***p*-methylamino-.** See *p-Phenylenediamine, N-methyl-.*

57 —, ***N*-methyl-*o*-nitro-.** $NO_2C_6H_4NHCH_3$, 152.08. Red need.f.pet.eth. **m.p.** 36–7 (34), **b.p.** d. **Soly.** sl.s.h.w.; s.al.; s.et.

58 —, ***N*-methyl-*m*-nitro-.** $NO_2C_6H_4NHCH_3$, 152.08. Red.-yel.need.f.al. **m.p.** 66.0. **Soly.** i.w.; s.al.; s.et.

59 —, ***N*-methyl-*p*-nitro-.** $NO_2C_6H_4NHCH_3$, 152.08. Yel.need.f.al. **D.** 1.201^{155}, **m.p.** 152, **b.p.** d. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.bz.; v.sl.s.lgr.

60 —, ***N*-methyl-*p*-nitroso-.** $NOC_6H_4NHCH_3$, 136.08. Bl.fl. **m.p.** 118.

61 —, ***N*-methyl-*N*-nitroso-** (*methylphenylnitrosamine*). $C_6H_5N(CH_3)NO$, 136.08. Yel.liq., *n* $1.57602^{22.7}$. **D.** 1.1277^{20}_{4}, **m.p.** 15, **b.p.** 225 d. **Soly.** i.(sl.s.)w.; s.al.; s.et.

62 —, ***N*-methyl-*N*, 2, 4, 6-tetranitro-.** See *Tetryl.*

63 —, **methylene-.** See *s-Triazine, hexahydro-1, 3, 5-triphenyl-.*

64 —, ***p, p'*-methylenebis[*N, N*-dimethyl-** (*p, p'-tetramethyldiaminodiphenylmethane*). $CH_2[C_6H_4N(CH_3)_2]_2$, 254.19. Leaf. or tab. **m.p.** 91–2. **Soly.** i.w.; sl.s.c., s.h.al.; v.s.et.; v.s.bz., CS_2.

66 —, ***p, p'*-methylenedi-** (*4, 4'-diaminodiphenylmethane*). $NH_2C_6H_4CH_2C_6H_4NH_2$, 198.13. Pearly leaf.f.bz. **m.p.** 93 (77–84), **b.p.** 232^{11}. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

67 —, ***N*-methyl-*N*-nitroso-** (*methylphenylnitrosamine*). $C_6H_5N(CH_3)NO$, 136.08. Yel.oil. **D.** 1.124^{20}_{4}, **m.p.** 12–5, **b.p.** 225; 121^{13}. **Soly.** s.al.; s.et.

68 —, ***o*-nitro-** (*1-amino-2-nitrobenzene*). $NO_2C_6H_4NH_2$, 138.06. Or.rhomb. need.f.al. **D.** 1.442^{20}_{4}, **m.p.** 71.5, **b.p.** 284.11 (270 d.). **Soly.** 0.126^{25}w.; 15.8^{15}, 27.87^{25}al.; v.s.et.

69 —, ***m*-nitro-** (*1-amino-3-nitrobenzene*). $NO_2C_6H_4NH_2$, 138.06. Yel.rhomb. need.f.al. **D.** 1.430^{20}_{4}, **m.p.** 111.8, **b.p.** 286; 306.35 (270 d.). **Soly.** 0.089^{25}w.; 6.10^{25}al.; 5.67^{20}et.

70 —, ***p*-nitro-** (*1-amino-4-nitrobenzene*). $NO_2C_6H_4NH_2$, 138.06. Yel.monocl. need.f.al. **D.** 1.424, **m.p.** 147.5, **b.p.** 331.73 (260 d.). **Soly.** 0.08^{19}, 2.2^{100}w.; 4.61^{20}al.; 4.39^{20}et.

71 —, ***N*-nitro-** (*phenylnitramine; nitranilide; diazobenzolic acid*). $C_6H_5NHNO_2$ or $C_6H_5N{:}NOOH$, 138.06. Leaf.f.lgr. **m.p.** 46, **b.p.** exp. 98. **Soly.** s.w.; v.s.al.; sl.s.lgr.

72 —, ***p*-nitroso-.** $NOC_6H_4NH_2$, 122.06. Steel bl.need.f.bz. **m.p.** 174. **Soly.** s.w.; s.al.; s.bz.

73 —, ***ar*-pentabromo-.** $C_6Br_5NH_2$, 487.60. Need. **m.p.** 222, **b.p.** 261–2. **Soly.** s.al.

74 —, ***ar*-pentachloro-.** $C_6Cl_5NH_2$, 265.31. Need.f.al. **m.p.** 232. **Soly.** v.s.al.; v.s.et.; sl.s.lgr.

75 —, ***ar*-pentamethyl-** (*aminopentamethylbenzene*). $C_6(CH_3)_5NH_2$, 163.14. Monocl.f.al. **m.p.** 152, **b.p.** 278. **Soly.** i.w.; s.al.; s.et.

76 —, ***p*-phenyl-.** See *Xenylamine.*

77 —, ***N*-phenyl-.** See *Diphenylamine*.*

78 —, **phenylazo-.** See *Azobenzene, amino-.*

* Name approved by the International Union of Chemistry.

79 **Aniline, *N*-(2-propenyl)-.** See *Aniline, N-allyl-.*

80 **—, *o*-propyl-.** (*1-amino-2-propylbenzene*). $CH_3CH_2CH_2C_6H_4NH_2$, 135.11. Liq. **D.** 0.949^{18}, **b.p.** 222–4. **Soly.** i.w.; s.al.; s.et.

81 **—, *p*-propyl-.** (*1-amino-4-propylbenzene*). $CH_3CH_2CH_2C_6H_4NH_2$, 135.11. Liq. **b.p.** 224–6. **Soly.** sl.s.w.

82 **—, *N*-propyl-.** $C_6H_5NHC_3H_7$, 135.11. Liq. **D.** 0.949^{18}_{4}, **b.p.** 222. **Soly.** i.w.; v.s.al.; v.s.et.

83 **—, 2, 3, 4, 5-tetrachloro-.** $C_6HCl_4NH_2$, 230.86. Need.f.al. **m.p.** 118. **Soly.** v.s.al.; v.s.et.; s.bz., ac.a.

84 **—, 2, 3, 5, 6-tetrachloro-.** $C_6HCl_4NH_2$, 230.86. Cr.f.lgr. **m.p.** 90. **Soly.** i.w.; s.al.; v.s.et.

85 **—, 2, 3, 4, 5-tetramethyl-.** $(CH_3)_4C_6HNH_2$, 149.13. Leaf.f.w., **m.p.** 64–6, **b.p.** 259–60. **Soly.** s.h.w.; v.s.al.; v.s.et.; s.pet.eth.

86 **—, 2, 3, 4, 6-tetramethyl-.** See *Isoduridine.*

87 **—, *p*, *p'*-thiodi-** (*4, 4'-diaminodiphenyl sulfide; thioaniline*). $S(C_6H_4NH_2)_2$, 216.17. Need.f.w. **m.p.** 108–9 (105). **Soly.** v.sl.s.w; s.al.; s.et.; s.h.bz.

88 **—, 2, 4, 6-tribromo-.** $Br_3C_6H_2NH_2$, 329.79. Col.rhomb.bi-pyr.need. f.bz. **D.** 2.35^{20}_{20}, **m.p.** 119, **b.p.** 300. **Soly.** i.w.; sl.s.al.; s.et.; s.chl.

89 **—, 3, 4, 5-tribromo-.** $Br_3C_6H_2NH_2$, 329.79. Need. **m.p.** 118–9. **Soly.** i.w.; s.al.; s.et.

90 **—, 2, 3, 4-trichloro-.** $Cl_3C_6H_2NH_2$, 196.41. Need.f.lgr. **m.p.** 67.5, **b.p.** 291.5. **Soly.** v.s.al.; s.lgr.

91 **—, 2, 4, 5-trichloro-.** $Cl_3C_6H_2NH_2$, 196.41. Need.f.lgr. **m.p.** 96, **b.p.** 270. **Soly.** v.s.al.; s.CS_2; sl.s.lgr.

92 **—, 2, 4, 6-trichloro-** (*sym-trichloroaniline*). $Cl_3C_6H_2NH_2$, 196.41. Lng. need.f.lgr. **m.p.** 77.5, **b.p.** 262.4 **Soly.** i.w.; v.s.al.; s.et.; v.s.lgr.

93 **—, 2, 4, 5-trimethyl-.** See *Pseudocumidine.*

94 **—, 2, 4, 6-trimethyl-.** See *Mesidine.*

95 **—, 2, 4, 6-trinitro-** (*picramide; "T.N.A."*). $(NO_2)_3C_6H_2NH_2$, 228.06. Yel.monocl.need.f.ac.a. **D.** 1.762, **m.p.** 188, **b.p.** exp. **Soly.** 0.106w.; 0.127al.; 0.121^{17}et.; s.ac.a.

96 ***o*-Anilinesulfonic acid.** See *Orthanilic acid.*

97 ***m*-Anilinesulfonic acid.** See *Metanilic acid.*

98 ***p*-Anilinesulfonic acid.** See *Sulfanilic acid.*

99 **Animal starch.** See *Glycogen.*

00 **Anisalcohol.** See *Anisyl alcohol.*

01 **Anisaldehyde** (*anisic aldehyde; p-methoxybenzaldehyde; p-anisaldehyde; aubepine*). $CH_3OC_6H_4CHO$, 136.06. Col.liq., *n* $1.57641^{12.7}$. **D.** 1.123^{20}_{4}, **m.p.** 2.5, **b.p.** 247. **Soly.** 0.2c.w.; ∞al.; ∞et.

02 **—, 3-hydroxy-.** See *Isovanillin.*

03 ***o*-Anisaldehyde.** See *Benzaldehyde, o-methoxy-.*

04 **Anise camphor.** See *Anethole.*

05 **Anisic acid** (*p-methoxybenzoic acid; p-anisic acid*). $CH_3OC_6H_4COOH$ 152.06. Col.monocl.need. or pr. **D.** 1.385^{4}_{4}, **m.p.** 184.2, **b.p.** 280. **Soly.** 0.04^{18}w.; 89^{25}al.; s.et.; s.chl., ac.a.et.

06 —, ethyl ester. $CH_3OC_6H_4COOC_2H_5$, 180.09. **D.** 1.1028^{15}_{15}, **m.p.** 7, **b.p.** 269; 134–5^{20}. **Soly.** i.w.; s.al.; s.et.

07 —, methyl ester (*methyl anisate*). $CH_3OC_6H_4COOCH_3$, 166.08. Col.sc. f.al. **m.p.** 48, **b.p.** 256. **Soly.** i.w.; s.al.; s.et.

08 —, piperazinium salt. $C_4H_{10}N_2 \cdot 2C_8H_8O_3$, 390.22. Wh.cr. **m.p.** 172–4. **Soly.** sl.s.w.; s.h.al.; i.et.

09 **—, 2-hydroxy-6-methyl-.** See *Everninic acid.*

10 **Anisic aldehyde.** See *Anisaldehyde.*

11 **Anisidine, *N*-acetyl-.** See *Acetaniside.*

12 ***o*-Anisidine** (*o-methoxyaniline*). $CH_3OC_6H_4NH_2$, 123.08. Col.liq., *n* 1.57536. **D.** 1.0923^{20}_{4}. **m.p.** 5.2 (3–4), **b.p.** 225 (218). **Soly.** sl.s.w.; s.al.; s.et.; s.dil.min.a.

13 ***m*-Anisidine** (*m-methoxyaniline*). $CH_3OC_6H_4NH_2$, 123.08. Col.liq. **D.** 1.096^{20}_{4}, **m.p.** < -12, **b.p.** 251. **Soly.** sl.s.w.; s.al.; s.et.

14 ***p*-Anisidine** (*p-methoxyaniline*). $CH_3OC_6H_4NH_2$, 123.08. Rhomb.pl., *n*. 1.55592^{67}. **D.** 1.071^{55}_{4}, **m.p.** 57.7, **b.p.** 245. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

15 **Anisole** (*methoxybenzene*; methyl phenyl ether*). $C_6H_5OCH_3$, 108.06. Col.liq., *n* 1.51503^{22}. **D.** 0.9944^{20}_{4}, **m.p.** −37.5, **b.p.** 155. **Soly.** i.w.; s.al; s.et.

16 **—, *p*-acetamido-.** See *p-Acetaniside.*

17 **—, *p*-acetyl-.** See *Acetophenone, p-methoxy-.*

18 **—, *p*-allyl-.** See *Estragole.*

For explanations and abbreviations see beginning of table.

19 **Anisole, *o*-bromo-** (*1-bromo-2-methoxybenzene*; o-bromophenyl methyl ether*). $BrC_6H_4OCH_3$, 186.97. Oil, *n* 1.57245. **b.p.** 221–3. **Soly.** i.w.; v.s.al.; v.s.et.

20 —, ***p*-bromo-** (*1-bromo-4-methoxybenzene*; p-bromophenyl methyl ether*). $BrC_6H_4OCH_3$, 186.97. Cr.f.et., *n* 1.56051. **D.** 1.494$^{9}_{4}$, **m.p.** 11, **b.p.** 215 (223). **Soly.** 7.1w.; v.s.al.; v.s.et.; v.s.chl.

21 —, **2, 4-dinitro-** (2, *4-dinitrophenyl methyl ether*). $(NO_2)_2C_6H_3OCH_3$, 198.06. Col.-yel.monocl.need.f.w. or al. **D.** 1.341$^{20}_{4}$, **m.p.** 88–9 (95.2), **b.p.** subl. **Soly.** sl.s.w.; 1.5^{20}al.; s.et.

22 —, ***o*-hydroxy-.** See *Guaiacol.*

23 —, ***o*-nitro-** (*1-methoxy-2-nitrobenzene*). $NO_2C_6H_4OCH_3$, 153.06. Col. liq., *n* 1.5620^{20}. **D.** 1.2540$^{20}_{4}$, **m.p.** 9.4 (10), **b.p.** 277; 273. **Soly.** 0.169^{30}w.; ∞al.; ∞et.

24 —, ***m*-nitro-** (*1-methoxy-3-nitrobenzene*). $NO_2C_6H_4OCH_3$, 153.06. Need.f.al. **D.** 1.373^{18}, **m.p.** 38, **b.p.** 258. **Soly.** i.w.; s.al.; v.s.et.

25 —, ***p*-nitro-** (*1-methoxy-4-nitrobenzene*). $NO_2C_6H_4OCH_3$, 153.06. Col. monocl.pr.f.al., *n* 1.57072^{60}. **D.** 1.233$^{20}_{4}$, **m.p.** 54, **b.p.** 260 (274). **Soly.** 0.007^{15}, 0.0589^{30}w.; s.al.; v.s.et.

26 —, ***p*-propenyl-.** See *Anethole.*

27 —, **2, 4, 6-trinitro-** (*picric acid methyl ether; methyl picrate*). $(NO_2)_3$-$C_6H_2OCH_3$, 243.06. Col.monocl.pl.f.al. **D.** 1.408$^{20}_{4}$, **m.p.** 68.4. **Soly.** i.w.; s.al.; s.et.; s.bz., ac.a.

28 —, ***o*-vinyl-** (*o-methoxystyrene*). $CH_2{:}CHC_6H_4OCH_3$, 134.08. Arom. liq., *n* 1.556. **D.** 1.0095$^{15}_{4}$, **b.p.** 195–200. **Soly.** i.w.; s.al.; s.et.

29 —, ***m*-vinyl-** (*m-methoxystyrene*). $CH_2{:}CHC_6H_4OCH_3$, 134.08. Oil. **b.p.** 89–90. **Soly.** i.w.; s.al.; s.et.

30 —, ***p*-vinyl-** (*p-methoxystyrene*). $CH_2{:}CHC_6H_4OCH_3$, 134.08. Arom. liq. **D.** 1.0029$^{15}_{4}$, **b.p.** 204^{756}; 90–1^{13}. **Soly.** i.w.; s.al.; s.et.

31 **Anisoyl chloride** (*p-methoxybenzoyl chloride; anisyl chloride*). CH_3OC_6-H_4COCl, 170.51. Need. **m.p.** 27 (22–3), **b.p.** 145^{14}. **Soly.** i.w.; s.d. al.; s.et.; s.acet.

32 **Anisyl alcohol** (*p-methoxybenzyl alcohol; anisalcohol*). $CH_3OC_6H_4CH_2OH$, 138.08. Need. **D.** 1.109$^{26}_{4}$, **m.p.** 25 (19–21), **b.p.** 258.8. **Soly.** i.w.; v.s.al.; v.s.et.

33 **Anisyl chloride.** See *Anisoyl chloride.*

34 **Anol** (*p-propenylphenol*). $CH_3CH{:}$-CHC_6H_4OH, 134.08. Col.leaf.f.h.w. **m.p.** 93, **b.p.** 250 d. **Soly.** sl.s.h.w.; s.al.; s.et.; s.alk., ord.org.solv.

35 **Anthracene.** $C_6H_4{:}(CH)_2{:}C_6H_4$, 178.08. Col.monocl. **D.** 1.25$^{27}_{4}$, **m.p.** 217 (213), **b.p.** 354–5. **Soly.** i.w.; 0.076^{16}, 0.83^{355}al.; 1.189et.; 1.767chl.; 1.500CS_2; 7.5^{80}bz.

36 —, *α*-hexahydride. See *Anthracene, α-hexahydro-.*

37 —, **amino-.** See *Anthrylamine.*

38 —, **diamino-.** See *Anthradiamine.*

39 —, **9, 10-dibromo-*.** $C_6H_4(CBr)_2$-C_6H_4, 335.89. Yel.need.f.xylene. **m.p.** 221 (226), **b.p.** subl. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.chl., h.bz., h.tol.

40 —, **9, 10-dichloro-*** (*ms-dichloroanthracene*). $C_6H_4(CCl)_2C_6H_4$, 246.98. Yel.need.f.CCl_4. **m.p.** 209–10. **Soly.** sl.s.al.; sl.s.et.; s.bz.

41 —, **9, 10-dihydro-*** (*anthracene 9, 10-dihydride*). $C_6H_4{:}(CH_2)_2{:}C_6H_4$, 180.09. Col.tricl. or monocl.f.al. **D.** 0.8976$^{14}_{4}$, **m.p.** 108.5, **b.p.** 305 (313) subl. **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

42 —, **9, 10-dihydro-9-keto-.** See *Anthrone.*

43 —, **dihydroxy-.** See *Anthracenediol.*

44 —, **9, 10-dihydroxy-9, 10-diketo-.** See *Anthraquinone.*

45 —, **2, 3-dimethyl-*.** $C_{14}H_8(CH_3)_2$, 206.11. Col.fluores.leaf.f.bz. **m.p.** 252 (246). **Soly.** s.al.; v.s.bz.

46 —, **2, 4-dimethyl-*.** $C_{14}H_8(CH_3)_2$, 206.11. Need.f.al.; **m.p.** 71. **Soly.** s.al.; v.s.bz.

47 —, **9-ethyl-*.** $C_6H_4CHC(C_2H_5)C_6H_4$, 206.11. Leaf.f.al., *n* 1.6762$^{99.2}$. **D.** 1.041$^{99}_{4}$, **m.p.** 59. **Soly.** i.w.; s.al.; s.et.

48 —, **9-ethyl-9, 10-dihydro-.** C_6H_4-$C_2H_3(C_2H_5)C_6H_4$, 208.12. Oil. **D.** 1.049$^{15}_{4}$, **b.p.** 320 sl.d. **Soly.** i.w.; s.al.; s.et.; ∞bz.

49 —, ***α*-hexahydro-** (*anthracene α-hexahydride*). $C_{14}H_{16}$, 184.12. Col. leaf. **m.p.** 63. **b.p.** 290. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.bz.

50 —, **hydroxy-.** See *Anthrol.*

51 —, **9-hydroxy-.** See *Anthranol.*

52 —, **1-methyl-** (*α-methylanthracene*). $C_6H_4(CH)_2C_6H_3CH_3$, 192.09. Col. leaf. f.al., *n* 1.6803$^{99.4}$. **D.** 1.047$^{99}_{4}$, **m.p.** 86, **b.p.** 200. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.bz., CS_2.

53 —, **2-methyl-** (*β-methylanthracene*). $C_6H_4(CH_2)C_6H_3CH_3$, 192.09. Col.sc. **m.p.** 207, **b.p.** subl. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.bz., CS_2.

* Name approved by the International Union of Chemistry.

54 **Anthracene, 9-methyl-.** $C_6H_4C(CH_3)CHC_6H_4$, 192.09. **D.** 1.066^{99}_{4}, **m.p.** 80.

55 —, **9-nitro-.** $C_{14}H_9NO_2$, 223.08. Yel.need.f.al. **m.p.** 146, **b.p.** >360. **Soly.** sl.s.al.; v.s.bz., CS_2.

56 —, **9-phenyl-.** $C_{14}H_9C_6H_5$, 254.11. Leaf.f.al. **m.p.** 153, **b.p.** 417. **Soly.** v.s.al.; v.s.et.; s.h.bz.

56_1 **Anthracenecarboxylic acid.** See *Anthroic acid.*

57 **Anthracenediamine*.** See *Anthradiamine.*

58 **1, 2-Anthracenediol*** (*1, 2-anthradiol; 1, 2-dihydroxyanthracene*). $C_6H_4(CH)_2C_6H_2(OH)_2$, 210.08. Grnsh.leaf. **m.p.** 160–2 (131 d.). **Soly.** v.s.al.; v.s.et.; s.ac.a., alk.

59 **1, 5-Anthracenediol*.** See *Rufol.*

60 **1, 8-Anthracenediol*.** See *Chrysazol.*

61 **2, 6-Anthracenediol*.** See *Flavol.*

62 **9, 10-Anthracenediol*.** See *Oxanthranol.*

63 **Anthrachrysazin.** See *Anthrachrysone.*

64 **Anthrachrysone** (*1, 3, 5, 7-tetrahydroxyanthraquinone; anthrachrysazin*). $C_{14}H_4O_2{\cdot}(OH)_4$, 272.06. Silky yel. need. $(+2H_2O)$. **m.p.** >360, **b.p.** $-H_2O$, 150, subl. **Soly.** i.w.; s.al.; v.sl.s.et.; s.ac.a., acet., chl., CS_2, bz., lgr.

65 **9, 10-Anthradiamine** (*9, 10-anthracenediamine*; 9, 10-diaminoanthracene*). $C_{14}H_8(NH_2)_2$, 208.11. Pa.yel. leaf. **m.p.** 160–6. **Soly.** i.w.

66 **Anthradiol.** See *Anthracenediol.*

67 **Anthraflavic acid** (*2, 6-dihydroxyanthraquinone*). $HOC_6H_3(CO)_2C_6H_3OH$, 240.06. Yel.need.f.al. **m.p.** 330, **b.p.** subl. **Soly.** i.w.; 1.10^{17}al.; i.et.; s.conc.H_2SO_4; sl.s.ac.a.; i.bz., chl.

68 **Anthragallol** (*1, 2, 3-trihydroxyanthraquinone*). $C_6H_4(CO)_2C_6H(OH)_3$, 256.06. Or.red need.f.dil.ac.a. **m.p.** 310 d., **b.p.** subl. 290. **Soly.** v.sl.s.w.; s.al.; s.et.; s.ac.a.; sl.s.chl., CS_2.

69 **Anthrahydroquinone.** See *Oxanthranol.*

70 **Anthramine.** See *Anthrylamine.*

71 **Anthranil.** C_7H_5NO, 119.05. Col. oil., *n* 1.5861. **D.** 1.187^{15}_{4}, **m.p.** <−18, **b.p.** 215. **Soly.** sl.s.h.w.; s.al.; s.ord.org.solv.

72 **Anthranilaldehyde** (*o-aminobenzaldehyde*). $NH_2C_6H_4CHO$, 121.06. Silv.leaf. **m.p.** 39–40, **b.p.** d. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.chl., bz.; i.lgr.

73 **Anthranilic acid** (*o-aminobenzoic acid*). $NH_2C_6H_4COOH$, 137.06. Col. trim.rhomb.leaf. **m.p.** 145, **b.p.** subl. **Soly.** 0.35^{14}w.; $10.7^{9.6}$al.; 16.0^{7}et.

74 —, ethyl ester (*ethyl anthranilate; ethyl o-aminobenzoate*). $NH_2C_6H_4COOC_2H_5$, 165.09. Cr. **D.** 1.1174, **m.p.** 13, **b.p.** 260 (266–8); $135–6^{12}$. **Soly.** v.sl.s.w.; s.al.; s.et.

75 —, methyl ester (*methyl anthranilate*). $NH_2C_6H_4COOCH_3$, 151.08. Col.liq. **D.** 1.168^{15}_{4}, **m.p.** 8.2; 24.5, **b.p.** 135.5^{15}. **Soly.** s.w.; v.s.al.; v.s.et.

76 —, ***N*-acetyl-** (*o-acetamidobenzoic acid*). $CH_3CONHC_6H_4COOH$, 179.08. Rhomb.f.ac.a. **m.p.** 185. **Soly.** sl.s.c., s.h.w.; s.h.al.; s.et.; s.bz., h.ac.a.

77 —, ***N*-benzoyl-** (*o-benzamidobenzoic acid*). $C_6H_5CONHC_6H_4COOH$, 241.09. Lng.need.f.al. **m.p.** 181. **Soly.** i.w.; s.al.; s.et.

78 —, ***N*-carboxy-,** anhydride. See *Isatoic anhydride.*

79 —, ***N*-(carboxymethyl)-** (*phenylglycine-o-carboxylic acid; anthranilidoacetic acid*). $HOOCCH_2NHC_6H_4COOH$, 195.08. Need.f.me.al. **m.p.** 215 (218–20). **Soly.** sl.s.w.; s.al.; s.et.; i.bz.

80 —, ***N*-ethyl-** (*o-ethylaminobenzoic acid; 2-ethylaminobenzenecarboxylic acid*). $C_2H_5NHC_6H_4COOH$, 165.09. Pr. **m.p.** 152–3. **Soly.** s.al.; s.et.

81 —, ***N*-methyl-,** methyl ester. $CH_3NHC_6H_4COOCH_3$, 165.09. **b.p.** 256. **Soly.** i.w.; s.al.; s.et.

82 —, **3-nitro-** (*2-amino-3-nitrobenzoic acid*). $NO_2(NH_2)C_6H_3COOH$, 182.06. Yel.need.f.w. **D.** 1.558^{15}_{4}, **m.p.** 204. **Soly.** i.w.; v.s.al.; v.s.et.

83 —, **4-nitro-** (*2-amino-4-nitrobenzoic acid*). $NO_2(NH_2)C_6H_3COOH$, 182.06. Red need. **m.p.** 264 (269.5). **Soly.** sl.s.h.w.; v.s.al.; v.s.et.; s.xylene.

84 —, **5-nitro-** (*2-amino-5-nitrobenzoic acid*). $NO_2(NH_2)C_6H_3COOH$, 182.06. Yel.need. **m.p.** 263 (270–80 d.). **Soly.** s.h.w.; s.al.; s.et.

85 —, **6-nitro-** (*2-amino-6-nitrobenzoic acid*). $NO_2(NH_2)C_6H_3COOH$, 182.06. Yel.leaf.f.w. **m.p.** 183–4 d. **Soly.** s.h.w.; v.s.al.; v.s.et.

86 —, ***N*-phenyl-** (*o-anilinobenzoic acid*). $C_6H_5NHC_6H_4COOH$, 213.09. Need.f.al. **m.p.** 181 (182–3), **b.p.** >184 d. **Soly.** v.sl.s.h.w.; v.s.h.al.; s.et.

87 **Anthranilonitrile** (*o-aminobenzonitrile; o-aminophenyl cyanide*). $NH_2C_6H_4CN$, 118.06. Col.-ylsh.pr. **m.p.** 50, **b.p.** 264–6. **Soly.** s.al.; s.et.

For explanations and abbreviations see beginning of table.

88 **Anthranol** (9-*anthrol;* 9-*hydroxyanthracene*). $C_{14}H_9{\cdot}OH$, 194.08. Pa.yel. need. **m.p.** 170 d. (120). **Soly.** i.w.; s.al.; v.s.h.bz.; s.alk., ac.a.

89 —, **9, 10-dihydro-** (*hydroanthranol*). $C_6H_4CHOHC_6H_4CH_2$, 196.09. Need. f.pet.eth. **m.p.** 76. **Soly.** s.h.w.; s.al.; s.et.

90 **Anthranylamine.** See 9-*Anthrylamine.*

91 **Anthrapurpurin** (1, 2, 7-*trihydroxyanthraquinone; isopurpurin*). HOC_6H_3-$(CO)_2C_6H_2(OH)_2$, 256.06. Or.need. f.al. **m.p.** 369, **b.p.** 462 d. **Soly.** sl.s.h.w.; v.s.al.; sl.s.et.; s.h.ac.a.; v.sl.s.chl., bz.

92 α-**Anthraquinoline.** See *Naphtho*-[2, 3-*f*] *quinoline.*

93 **Anthraquinonazine,** *N, N′*-**dihydro-.** See *Indanthrene.*

94 **Anthraquinone** (9, 10-*dihydroxy*-9, 10-*diketoanthracene*). $C_6H_4{:}(CO)_2{:}C_6H_4$, 208.06. Ylsh.rhomb. **D.** 1.419_4^{20}, **m.p.** 286 subl., **b.p.** 379–81. **Soly.** i.w.; 0.05^{10}, 2.3^{70}al.; v.sl.s.et.; 6.4^{100}tol.; sl.s.bz.

95 —, **1-amino-** (α-*anthraquinonylamine*). $C_6H_4(CO)_2C_6H_3NH_2$, 223.08. Red need. **m.p.** 252 (243), **b.p.** subl. **Soly.** i.w.; s.al.; s.et.; s.chl., bz., acet.

96 —, **2-amino-** (β-*anthraquinonylamine*). $NH_2C_6H_3(CO)_2C_6H_4$, 223.08. Red need.f.al. **m.p.** 302, **b.p.** subl. **Soly.** i.w.; s.al.; sl.s.et.; s.chl., bz., acet.

97 —, **2-amino-1-hydroxy-** (β-*alizarin amide*). $C_{14}H_6O_2{\cdot}(OH)NH_2$, 239.08. Br.need. f.al. **m.p.** 226–7, **b.p.** subl. **Soly.** i.w.; s.al.; s.et.; sl.s.NH_4OH.

98 —, **1-bromo-.** $C_6H_4(CO)_2C_6H_3Br$, 286.97. Yel.need.f.bz. **m.p.** 188, **b.p.** subl. **Soly.** s.al.; s.conc.H_2SO_4.

99 —, **2-bromo-.** $C_6H_4(CO)_2C_6H_3Br$. 286.97. Yel.need.f.amyl al. **m.p.** 204–5, **b.p.** subl. **Soly.** sl.s.al.; s.h.bz.

00 —, **1-chloro-.** $C_6H_4(CO)_2C_6H_3Cl$, 242.51. Yel.need. **m.p.** 162, **b.p.** subl. **Soly.** i.w.; sl.s.al.; i.et.; s.ac.a., nitro-bz., amyl al., h.bz.

01 —, **2-chloro-.** $C_6H_4(CO)_2C_6H_3Cl$, 242.51. Pa.yel.need.f.ac.a. or al. **m.p.** 211 (203–5), **b.p.** subl. **Soly.** i.w.; sl.s.al.; i.et.; s.h.bz., nitro-bz., conc. H_2SO_4.

05 —, **1, 2-diamino-.** $C_6H_4(CO)_2C_6H_2$-$(NH_2)_2$, 238.09. Vlt.cr., grn.cast. **m.p.** 303 (242–4). **Soly.** s.pyr., aniline; sl.s.chl., xylene.

06 —, **1, 3-diamino-.** $C_6H_4(CO)_2C_6$-$H_2(NH_2)_2$, 238.09. Brick red cr.f. $PbNO_2$. **m.p.** 290. **Soly.** s.h.$PhNO_2$.

07 —, **1, 4-diamino-.** $C_6H_4(CO)_2C_6H_2$-$(NH_2)_2$, 238.09. Dk.vlt.cr.f.al. **m.p.** 268. **Soly.** sl.s.h.w.; v.s.al.; s.bz., pyr., nitro-bz., aniline.

08 —, **1, 5-diamino-.** $NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$, 238.09. Red.need.f.al. or ac.a. **m.p.** 319, **b.p.** subl. **Soly.** v.sl.s.w.; sl.s.al.; sl.s.et.; s.h.nitro-bz.; sl.s.bz., chl., acet.

09 —, **1, 6-diamino-.** $NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$, 238.09. Red cr. **m.p.** 292. **Soly.** s.h.$PhNO_2$.

10 —, **1, 7-diamino-.** $NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$, 238.09. Red cr. **m.p.** 290. **Soly.** s.h.$PhNO_2$.

11 —, **1, 8-diamino-.** $NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$, 238.09. Red.cr.f.al. **m.p.** 262. **Soly.** i.w.; v.s.al.; sl.s.et.; s.ac.a., nitro-bz., pyr.

12 —, **2, 3-diamino-.** $C_6H_4(CO)_2C_6H_2$-$(NH_2)_2$, 238.09. Red.cr. **m.p.** >320. **Soly.** s.nitro-bz., pyr., H_2SO_4; sl.s.chl.

13 —, **2, 6-diamino-.** $NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$, 238.09. Redsh.-br.pr.f.h. pyr. **m.p.** 310–20 d. **Soly.** s.h.al.; i.chl., xylene.

14 —, **2, 7-diamino-.** $NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$, 238.09. Or.cr.f.al. or nitro-bz. **m.p.** > 330, **b.p.** subl. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.conc.a.

15 —, **2, 3-dibromo-** (β-*dibromoanthraquinone*). $C_6H_4(CO)_2C_6H_2Br_2$, 365.88. Yel.need. **m.p.** 281 (269–70), **b.p.** subl. **Soly.** v.sl.s.al.; s.chl., bz.

16 —, **2, 7-dibromo-.** $C_6H_3Br(CO)_2$-C_6H_3Br, 365.88. Yel.need. or pl. **m.p.** 236.5, **b.p.** subl. **Soly.** v.sl.s.h.al. s.bz., h.ac.a.

17 —, **1, 2-dihydroxy-.** See *Alizarin.*

18 —, **1, 3-dihydroxy-.** See *Purpuroxanthin.*

19 —, **1, 4-dihydroxy-.** See *Quinizarin*

20 —, **1, 5-dihydroxy-.** See *Anthrarufin.*

21 —, **1, 8-dihydroxy-.** See *Chrysazin.*

22 —, **2, 3-dihydroxy-.** See *Hystazarin*

23 —, **2, 6-dihydroxy-.** See *Anthraflavic acid.*

24 —, **2, 7-dihydroxy-.** See *Isoanthraflavic acid.*

25 —, **1, 3-dinitro-*.** $C_6H_4(CO)_2C_6H$-$(NO_2)_2$, 298.06. Yel.need. **m.p.** 24 (246–50).

* Name approved by the International Union of Chemistry.

26 **Anthraquinone, 1, 5-dinitro-*.** $NO_2C_6H_3(CO)_2C_6H_3NO_2$, 298.06. Pa.-yel.need.f.nitro-bz. or xylene. **m.p.** 384–5, **b.p.** subl. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; s.h.nitro-bz., h.xylene; sl.s.-ac.a.; v.sl.s.bz.

27 **—, 1, 2, 3, 5, 6, 7-hexahydroxy-.** See *Rufigallic acid.*

28 **—, 1**(or α)**-hydroxy-** (*erythrohydroxyanthraquinone*), $C_6H_4(CO)_2C_6H_3OH$, 224.06. Or.cr.f.al. **m.p.** 190, **b.p.** subl. **Soly.** i.w.; s.al.; s.et.

29 **—, 2**(or β)**-hydroxy-.** $C_6H_4(CO)_2$-C_6H_3OH, 224.06. Yel.leaf. or need.f.al. **m.p.** 302, **b.p.** subl. **Soly.** v.sl.s.w.; s.al.; s.et.

30 **—, 2-methyl-.** $C_6H_4(CO)_2C_6H_3CH_3$, 222.08. Col-ylsh.need.f.al. **m.p.** 175–7, **b.p.** subl. **Soly.** v.sl.s.al.; s.et.; v.s.bz.; s.conc.H_2SO_4.

31 **—, 1-nitro-.** $NO_2C_6H_3(CO)_2C_6H_4$, 253.06. Yel.need.f.ac.a. **m.p.** 230, **b.p.** 270^7 subl. **Soly.** i.w.; sl.s.al.; sl.s.et.

32 **—, 2-nitro-.** $NO_2C_6H_3(CO)_2C_6H_4$, 253.06. Yel.need.f.al. **m.p.** 181, **b.p.** subl. **Soly.** i.w.; sl.s.al.; sl.s.et.; v.s.chl.; s.H_2SO_4.

33 **—, 1, 2, 5, 6-tetrahydroxy-.** See *Rufiopin.*

34 **—, 1, 2, 5, 8-tetrahydroxy-.** See *Quinalizarin.*

35 **—, 1, 3, 5, 7-tetrahydroxy-.** See *Anthrachrysone.*

36 **—, 1, 2, 3-trihydroxy-.** See *Anthragallol.*

37 **—, 1, 2, 4-trihydroxy-.** See *Purpurin.*

38 **—, 1, 2, 5-trihydroxy-** (*2-hydroxyanthrarufin*). $HOC_6H_3(CO)_2C_6H_2(OH)_2$, 256.06. Red need. **m.p.** 273–4, **b.p.** subl. **Soly.** i.w.; s.et.

39 **—, 1, 2, 6-trihydroxy-.** See *Flavopurpurin.*

40 **—, 1, 2, 7-trihydroxy-.** See *Anthrapurpurin.*

41 **—, 1, 2, 8-trihydroxy-** (*2-hydroxychrysazin*). $HOC_6H_3(CO)_2C_6H_2(OH)_2$, 256.06. Or.need., **m.p.** 230, **b.p.** subl. **Soly.** i.w.; v.sl.s.al.

42 **—, 1, 3, 8-trihydroxy-6-methyl-.** See *Emodin.*

43 **2-Anthraquinonecarboxylic acid, 5, 6** (or **7, 8**)**-dihydroxy-.** See 6 (or 7)-*Alizarincarboxylic acid.*

44 α-**Anthraquinonylamine.** See *Anthraquinone, 1-amino-.*

45 β-**Anthraquinonylamine.** See *Anthraquinone, 2-amino-.*

46 **Anthrarufin** (*1, 5-dihydroxyanthraquinone*). $HOC_6H_3(CO)_2C_6H_3OH$, 240.06. Pa.yel.leaf.f.ac.a. **m.p.** 280, **b.p.** subl. **Soly.** v.sl.s.w.; sl.s.al.; sl.s.et.; s.bz., alk.; sl.s.acet.

47 **—, 2-hydroxy-.** See *Anthraquinone, 1, 2, 5-trihydroxy-.*

48 **1-Anthroic acid** (*1-anthracenecarboxylic acid*; α-anthroic acid*). $C_{14}H_9$COOH, 222.08. Yel.need. **m.p.** 24[illegible] **b.p.** subl. **Soly.** i.w.; sl.s.al.; sl.s.et.; sl.s.bz., chl.

49 **2-Anthroic acid** (*2-anthracenecarboxylic acid*; β-anthroic acid*). $C_{14}H_9$-COOH, 222.08. Yel.leaf. **m.p.** 281, **b.p.** subl. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.ac.a.; sl.s.chl.; i.bz., CS_2.

50 **9-Anthroic acid** (*9-anthracenecarboxylic acid*; ms-anthroic acid*). $C_{14}H_9COOH$, 222.08. Pa.yel.need.f.al. **m.p.** 217 d. (206), **b.p.** d. **Soly.** sl.s.h.w.; s.al.

51 **1-Anthrol** (*1-hydroxyanthracene*). $C_{14}H_9{\cdot}OH$, 194.08. Br.need. or leaf f. a. **m.p.** d. 150–3, **b.p.** 200 d. **Soly.** i.w.; v.s.al.; v.s.et.; s.NaOH, org.solv.

52 **2-Anthrol** (*2-hydroxyanthracene*). $C_{14}H_9{\cdot}OH$, 194.08. Brnsh.need. **m.p.** d. 200. **Soly.** i.w.; v.s.al.; v.s.et.; s.acet.

53 **9-Anthrol.** See *Anthranol.*

54 **Anthrone** (*9, 10-dihydro-9-ketoanthracene*). $C_{14}H_{10}O$, 194.08. Col.need. **m.p.** 154–5. **Soly.** i.w.; s.al.; s.bz., h.NaOH.

55 **—, 10-hydroxy-.** See *Oxanthranol.*

56 **1-Anthrylamine** (*α-anthramine; 1-aminoanthracene*). $C_{14}H_{11}N$, 193.09. **m.p.** 119 (130).

56_1 **2-Anthrylamine** (*β-anthramine; 2-aminoanthracene*). $C_{14}H_{11}N$, 193.09. Yel.need. **m.p.** 236–7. **Soly.** i.w.; sl.s.al.; sl.s.et.

56_2 **9-Anthrylamine** (*9-aminoanthracene; meso-anthramine; anthranylamine*).

$$C_6H_4\left\langle\begin{array}{c}C(NH_2)\\ \\ CH\end{array}\right\rangle C_6H_4$$

193.09 Yel. cr. **m.p.** 145–50. **Soly.** s.al.; s.et.; s.chl., bz.

57 **Antifebrin.** See *Acetanilide.*

58 **Antimony, pentamethyl-*.** Sb-$(CH_3)_5$, 196.88. **b.p.** 96–100. **Soly.** i.w., s.al.; ∞ et.

59 **—, triethyl-*.** See *Stibine, triethyl-.*

60 **—, trimethyl-*.** See *Stibine, trimethyl-.*

61 Antipyrine (1, 5-*dimethyl-2-phenyl-3-pyrazolone; analgesine; phenazone*) $N(CH_3)N(C_6H_5)COCH{:}C(CH_3)$, 188.11. Leaf. or sc.f.et., bz. or w., *n* 1.5697, 1.6935, 1.7324. **D.** 1.19^{20}_{4}, **m.p.** 114 (109), **b.p.** 319^{174}. **Soly.** 100w.; 100al.; 2.6et.; sl.s.lgr.

62 —, salicylate, See *Salipyrine.*

63 Antipyrine chloral hydrate. See *Hypnal.*

64 Antiscorbutin. See *l-Ascorbic acid.*

65 Antisepsin. See *Acetanilide, p-bromo-.*

66 Aphrodine. See *Yohimbine.*

67 Apiole (2, 5-*dimethoxysafrole; apiol; parsley camphor*). $CH_2{:}CHCH_2C_6H(OCH_3)_2(CH_2O_2)$, 222.11. Col.need., *n* 1.5380^{14}liq.; *α* 1.583, *β* 1.73sol. **D.** 1.015^{20}_{4}, **m.p.** 29.5, **b.p.** 294. **Soly.** v.sl.s.w.; s.al.; s.et.

68 Apoatropine (*atropamine*). $C_{17}H_{21}NO_2$, 271.17. Wh.pr. **m.p.** 62. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.chl., CS_2, bz.

69 —, hydrochloride. $C_{17}H_{21}NO_2{\cdot}HCl$, 307.64. Col.cr. **m.p.** 237–9. **Soly.** s.w.; s.al.; s.et.

70 Apocodeine. $C_{18}H_{19}NO_2$, 281.16. Pl.f.al. **m.p.** 100–10 d. **Soly.** v.sl.s. w.; s.al.; s.et.

71 Apomorphine. $C_{17}H_{17}NO_2$, 267.14. Wh.pr.f.et., turns grn. in air. **m.p.** 170 d. **Soly.** sl.s.w.; s.al.; s.et; v.s.chl.; s.bz.; sl.s.HCl.

72 —, hydrochloride. $C_{17}H_{17}NO_2{\cdot}HCl$, 303.61. Monocl.pr., grn. on expos. to lt. **m.p.** 200–10 d. **Soly.** 2^{25}w.; 2.47^{25}al.; 0.0536^{25}et.; v.sl.s.chl.

73 Apoquinine. $C_{19}H_{22}N_2O_2{\cdot}2H_2O$, 346.22. Need.f.et. **m.p.** 210 d. **Soly.** s.h.w.; s.al.; v.s.et.; s.chl., bz., CS_2, KOH.

74 Aposafranone (10-*phenyl*-2(10)-*phenazinone; benzeneindone*). $C_6H_4(NC_6H_5)(N)C_6H_3{:}O$, 272.11. Dk. red met.cr. **m.p.** 242 (248–9). **Soly.** sl.s.w.; s.al.; s.bz.; i.alk.

76 Arabinose, diphenylhydrazone. $C_5H_{10}O_4NN(C_6H_5)_2$, 316.17. Col.need., $[\alpha]$ $+18.5°^{20}_{D}$ in pyr. **m.p.** 197–204. **Soly.** v.sl. s.w.; s.h.al.

77 *dl*-Arabinose (*pectinose*). $C_5H_{10}O_5$, 150.08. Col.rhomb. **D.** 1.585^{20}_{4}, **m.p.** 164.5. **Soly.** 16.9^{10}w.; 0.35h.al.; i.et.

78 *α*-Arabinose (*d* or *l*). $C_5H_{10}O_5$, 150.08. Rhomb.pr.; *l*, $[\alpha]$ $-105°^{20}_{D}$ in w. **D.** 1.585^{20}_{4}, **m.p.** 159.5. **Soly.** 58.9^{10}w., 0.5 90 % al.; i.et.

79 *d*-Arabitol (*arabite*; 1, 2, 3, 4, 5-*pentanepentol** (*one form*)). $C_5H_7(OH)_5$, 152.09. Col.warts. or pr. **m.p.** 103. **Soly.** v.s.w.; 2.08^{12} 90 % al.; i.et.

80 Arabonic acid (*α, β, γ, δ-tetrahydroxyvaleric acid* (*one form*)). $CH_2OH(CHOH)_3COOH$, 166.08. Cr. or syrup. **m.p.** 89. **b.p.** d., $-H_2O$. **Soly.** v.v.s.w.

81 Arachic alcohol. See 1-*Eicosanol**.

82 Arachidic acid (*eicosanoic acid*; arachic acid; n-eicosoic acid*). $CH_3(CH_2)_{18}COOH$, 312.31. Lust.sc. **D.** 0.824^{100}_{4}, **m.p.** 76.3, **b.p.** 328. **Soly.** i.w.; 0.45^{20}al.; v.s.et.

83 —, ethyl ester. $C_{19}H_{39}COOC_2H_5$, 340.34. Cr. **m.p.** 50, **b.p.** $295–7^{100}$. **Soly.** i.w.; s.al.; s.et.

84 —, methyl ester, $C_{19}H_{39}COOCH_3$, 326.33. Cr. **m.p.** 54.5, **b.p.** 286^{100}. **Soly.** i.w.; s.al.; s.et.

85 Arbutin (*arbutoside*). $C_{12}H_{16}O_7$, 272.12. Col. silky need. **m.p.** 195. **Soly.** 12.5w.; 6.67al.; i.et.; i.chl., CS_2.

86 Arecaidine, Arecaine (1-*methylguvacine*; 1, 2, 5, 6-*tetrahydro*-1-*methylnicotinic acid*). $C_7H_{11}NO_2{\cdot}H_2O$, 159.11. **m.p.** 224 d. **Soly.** v.s.w.; i.al.; i.et.

87 —, methyl ester. See *Arecoline.*

88 Arecoline (*arecaidine methyl ester; methyl* 1, 2, 5, 6-*tetrahydro*-1-*methylnicotinate*). $C_8H_{13}NO_2$, 155.11. Oily alk.liq. **b.p.** 220. **Soly.** ∞w.; ∞al.; ∞et.; s.chl.

89 —, hydrobromide. $C_8H_{13}NO_2{\cdot}HBr$, 236.03. Pr.f.al. **m.p.** 168. **Soly.** s.w.; s.h.al.; sl.s.et.; sl.s.chl.

90 —, hydrochloride. $C_8H_{13}NO_2{\cdot}HCl$, 191.57. Wh.cr. **m.p.** 158. **Soly.** s.w.; s.al.

91 *dl*-Arginine (*dl-α-amino-δ-guanidovaleric acid; dl-Nδ-guanylornithine*). $NH_2C({:}NH)NH(CH_2)_3CH(NH_2)COOH$, 174.14. **m.p.** 217–8 d.

92 *d*-Arginine (*d-α-amino-δ-guanidovaleric acid*). $NH_2C({:}NH)NH(CH_2)_3CH(NH_2)COOH$, 174.14. Pr.f.w.; pl.f.al. **m.p.** 238 d. **Soly.** 15^{21}w.; i.al.; i.et.

93 —, flavianate. $C_6H_{14}N_4O_2{\cdot}C_{10}H_6N_2O_8S$, 488.26. Or.pl. **m.p.** 258–60 d. **Soly.** 0.0177^{19}w.; 0.002al.; i.et.

94 —, picrate. $C_6H_{14}N_4O_2{\cdot}C_6H_3N_3O_7{\cdot}2H_2O$, 439.22. Yel.need. **m.p.** 217–8 d. **Soly.** 0.5^{16}w.; i.al.; i.et.

95 Arsanilic acid (*p-aminobenzenearsonic acid; p-aminophenylarsinic acid*). $NH_2C_6H_4AsO(OH)_2$, 217.00 Wh.need. **m.p.** 232. **Soly.** sl.s.w. sl.s.al.; s.et.; sl.s.ac.a.; i.bz., chl., acet.

* Name approved by the International Union of Chemistry.

97 **Arsenic, bisdiethyl-.** See *Biarsine, tetraethyl-.*

98 —, **dimethyl-.** See *Cacodyl.*

99 —, **triethyl-.** See *Arsine, triethyl-.*

00 **Arsenic dichloride, methyl-.** See *Arsine, dichloromethyl-.*

01 **Arsenic oxide, bisdimethyl-.** See *Cacodyl oxide.*

02 —, **methyl-** (*methyl arsinoxide*). CH_3AsO, 105.95. Pr.f.CS_2. **m.p.** 95, **b.p.** d. **Soly.** s.al.; s.bz.

03 **Arsenic sulfide, bisdimethyl-.** See *Cacodyl sulfide.*

04 **Arsenic trichloride, dimethyl-.** See *Cacodyl trichloride.*

05 **Arsenious chloride, diphenyl-.** See *Arsine, chlorodiphenyl-.*

06 **Arsenobenzene, 3, 3′-diamino-4, 4′-dihydroxy-,** dihydrochloride. See *Arsphenamine.*

07 **Arsenobenzol.** See *Arsphenamine.*

08 **Arsine, chlorodimethyl-.** See *Cacodyl chloride.*

09 —, **chlorodiphenyl-.** (*diphenylchloroarsine; diphenylarsenious chloride; blue cross; sneezing gas*). $(C_6H_5)_2AsCl$, 264.47. Rhomb.pl. **D.** 1.583^{40}, **m.p.** 44 (39), **b.p.** 333 d. **Soly.** 0.2w.; 20al.; v.s.et.; s.bz.

10 —, **dichloromethyl-** (*methylarsenic dichloride; methyldichloroarsine*). CH_3AsCl_2, 160.87. Col.liq. **D.** 1.838^{20}_{4}, **m.p.** −59, **b.p.** 133 (136). **Soly.** 29w.; v.s.al ; v.s.et.

11 —, **dimethyl-** (*cacodyl hydride*). $(CH_3)_2AsH$, 105.98. Col.liq., ign.in air. **D.** 1.213^{29}_{4}, **b.p.** 36. **Soly.** ∞al.; ∞et.; ∞chl., bz., CS_2.

12 —, **ethyl-** (*arsinoethane*). $C_2H_5AsH_2$, 105.98. Col.liq. **D.** 1.217^{22}_{4}, **b.p.** 36. **Soly.** 0.00013^{19}w.; s.al.; s.et.

13 —, **methyl-.** CH_3AsH_2, 91.97. Col.liq. or gas. **b.p.** 2. **Soly.** 0.0085w.; v.s.al.; v.s.et.

14 —, **methyldichloro-.** See *Arsine, dichloromethyl-.*

15 —, **triethyl-** (*arsenic triethyl*). $(C_2H_5)_3As$, 162.05. Col.liq., n 1.467. **D.** 1.150^{20}_{4}, **b.p.** 141 d. **Soly.** i.w.; s.al.; s.et.

16 —, **trimethyl-.** $(CH_3)_3As$, 120.00. Col.liq. **D.** 1.124^{22}_{4}, **b.p.** 52.8. **Soly.** sl.s.w.; s.al.; ∞et.

17 **Arsinic acid, *p*-aminophenyl-.** See *Arsanilic acid.*

18 —, **dimethyl-.** See *Cacodylic acid.*

19 —, **methyl-.** See *Methanearsonic acid.*

20 **Arsinoxide, methyl-.** See *Arsenic oxide, methyl-.*

21 **Arsphenamine** (3, 3′-*diamino-4, 4′-dihydroxy-arsenobenzene dihydrochloride; salvarsan; arsenobenzol;* "606"). $C_{12}H_{12}As_2N_2O_2 \cdot 2HCl \cdot 2H_2O$, 474.93. Hgr.yel.powd. **Soly.** v.v.s.w.; sl.s.al.; v.sl.s.et.

22 **Asaron.** See *Benzene,* 1, 2, 4-*trimethoxy-5-propenyl-.*

23 **Asaronic acid** (2, 4, 5-*trimethoxybenzoic acid*). $(CH_3O)_3C_6H_2COOH$, 212.09. Need.f.al. **m.p.** 144, **b.p.** *ca.* 300. **Soly.** sl.s.c., s.h.w.; s.al.; s.bz., lgr.

24 *l*-**Ascorbic acid** (*vitamin C; antiscorbutin*). $C_6H_8O_6$, 176.06. Wh.cr. powd. **m.p.** 190–2. **Soly.** s.w.; s.al.

25 **Asepsin.** See *Acetanilide, p-bromo-.*

26 **Aseptol.** See 1-*Phenol-2-sulfonic acid.*

27 **Asparacemic acid.** See *dl-Aspartic acid.*

28 *l*-**Asparagine.** (*l-α-aminosuccinamic acid; l-β-asparagine*). $NH_2COCH_2CH(NH_2)COOH$, 132.08. Col. rhomb., n 1.549, 1.583, 1.625. **D.** 1.543^{15}_{4}, **m.p.** 236 d.cl.tube (226), **b.p.** 235 d. **Soly.** 2.46^{25}, 86.6^{100}w.; 0.0003^{25}al.; i.et.; s.NH_3.

29 *dl*-**Aspartic acid** (*dl-aminosuccinic acid; asparacemic acid*). $COOHCH_2CH(NH_2)COOH$, 133.06. Monocl. pr. **D.** 1.663^{12}_{12}, **m.p.** 278–80 d. **Soly.** 0.82^{25}, 4.79^{75}w.; 0.032^{25} 75% al.

30 *d*-**Aspartic acid** (*d-aminosuccinic acid*). $COOHCH_2CH(NH_2)COOH$, 133.06. **m.p.** 251.

31 *l*-**Aspartic acid** (*l-aminosuccinic acid*). $COOHCH_2CH(NH_2)COOH$, 133.06. Col.rhomb.leaf. **D.** 1.6613^{12}_{12}, **m.p.** 269–71. **Soly.** 0.39^{10}, 0.54^{25}, 2.71^{75}w.; i.al.; i.et.; s.dil.HCl.

32 **Aspidospermine.** $C_{22}H_{30}N_2O_2$, 354.25. Need.f.al. or pet.eth. **m.p.** 208. **Soly.** 1.7^{25}w.; 2.1^{25}al.; 0.95^{25}et.; s.chl., bz.

33 **Aspirin** (*acetylsalicylic acid; salicylic acid acetate; o-acetoxybenzoic acid*). $CH_3COOC_6H_4COOH$, 180.06. Col. need.f.w., n 1.505, 1.645, 1.655. **m.p.** 133–5, **b.p.** d. 140. **Soly.** 0.25w.; 20 90% al.; 3.57et.; 5.9chl.; v.sl.s.bz.

34 **Atisine.** $C_{22}H_{31}NO_2$, 341.25. Col. varnish. **m.p.** 85. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.chl.

35 —, hydrochloride. $C_{22}H_{31}NO_2 \cdot HCl$, 377.71. pr. **m.p.** 296. **Soly.** v.s.w.; v.s.al.; i.et.

For explanations and abbreviations see beginning of table.

36 ***dl*-Atrolactic acid** (*dl-α-phenyllactic acid; dl-α-hydroxyhydratropic acid; dl-atrolactinic acid*). $CH_3C(C_6H_5)(OH)COOH$, 166.08. Rhomb. **m.p.** ½H_2O 90; anh. 93. **Soly.** s.w.

37 **Atropamine.** See *Apoatropine.*

38 **Atropic acid** (*α-phenylacrylic acid; α-methylene-α-toluic acid*). $CH_2:C(C_6H_5)COOH$, 148.06. Col.monocl. **m.p.** 106–7, **b.p.** 267 d. **Soly.** 0.14^{19}w.; s.al.; s.et.; s.bz., chl., CS_2, glac.ac.a.

39 **Atropine** (*dl-hyoscyamine; dl-daturine, tropic acid tropine ester*). $C_{17}H_{23}NO_3$, 298.19. Col.rhomb.pr. or need. **m.p.** 115.5; 118, subl. **Soly.** 0.11^{25}w.; 68.5al.; 5.6et.; 64chl.; 3.7glyc.

40 —, chloroaurate. $C_{17}H_{23}NO_3H \cdot AuCl_4$, 629.22. Leaf. or glist.powd. **m.p.** 135–7. **Soly.** sl.s.w.

41 —, sulfate. $(C_{17}H_{23}NO_3)_2 \cdot H_2SO_4$, 676.45. Col.need. or wh.cr.powd. **m.p.** 183–4.5 anh. **Soly.** 260w.; 27al.; 0.05et.; 0.16chl.; s.glyc.

42 —, valerate. $C_{17}H_{23}NO_3 \cdot C_5H_{10}O_2 \cdot H_2O$, 409.28. Wh.crusts. **m.p.** 42. **Soly.** v.s.w.; sl.s.al.; sl.s.et.

43 **Atroscine.** See *i-Scopolamine.*

44 **Aubepine.** See *Anisaldehyde.*

45 **Auramine (base)** (*bis(p-dimethylaminophenyl)-methylenimine*). $[(CH_3)_2NC_6H_4]_2C:NH$, 267.19. Yel. leaf.f.al. **m.p.** 136. **Soly.** i.w.; 7^{20} 96% al.; 2.31^{20}et.

46 —, hydrochloride. See *Auramine (dye).*

47 —, ***N*-methyl-.** $[(CH_3)_2NC_6H_4]_2C:NCH_3$, 281.20. Yel.cr.f.al. **m.p.** 130–3. **Soly.** v.sl.s.w.; v.s.al.; v.s. ac.a.

48 **Auramine (dye)** (*auramine(base) hydrochloride*). $[(CH_3)_2NC_6H_4]_2C:NH_2Cl \cdot H_2O$, 321.67. Yel.fl. **Soly.** s.w.; s.al.

49 **Aurin, Aurine** (*rosolic acid; pararosolic acid*). $C_{19}H_{14}O_3$, 290.11. Red rhomb.need. **m.p.** 308–10 d. **Soly.** 0.12^{25}w.; s.al.; s.et.; s.ac.a., alk.; sl.s.chl.; i.bz., CS_2.

50 —, **hexamethoxy-.** See *Eupittone.*

51 **Azelaic acid** (*nonanedioic acid*; 1, 7-heptanedicarboxylic acid*). $COOH(CH_2)_7COOH$, 188.12. Col.leaf. or need., n $1.4303^{110.6}$. **D.** 1.029^{20}_{4}, **m.p.** 106.5, **b.p.** 360 d.; 226^{10}. **Soly.** 0.24^{20}, 2.2^{65}w.; v.s.al.; 2.7et.

52 —, diethyl ester (*ethyl azelate*). $CH_2[(CH_2)_3COOC_2H_5]_2$, 244.19. **b.p.** 291; $151–3^{14}$. **Soly.** i.w.; s.al.; s.et.

53 **Azete, tetrahydro-.** See *Trimethylenimine.*

54 **Azetidine.** See *Trimethylenimine.*

55 **Azimethylene.** See *Methane, diazo-*.*

56 **Azirine, dihydro-.** See *Ethylenimine.*

57 **Azoaniline.** See *Azobenzene, diamino-.*

58 **Azobenzene** (*diphenyldiimide; azobenzide*). $C_6H_5N:NC_6H_5$, 182.09. Or.-red monocl.leaf. **D.** 1.203^{20}_{4}, **m.p.** 68, **b.p.** 297.4. **Soly.** i.w.; 8.5^{16} al.; s.et.; 8.57^{20}lgr.; 3.95^{10}me.al.

59 —, ***p*-acetamido-** (*p-phenylazoacetanilide*). $CH_3CONHC_6H_4N:NC_6H_5$, 239.13. **m.p.** 144.

60 —, ***o*-amino-** (*o-phenylazoaniline; 2-benzeneazoaniline*). $NH_2C_6H_4N:NC_6H_5$, 197.11. Golden need. **m.p.** 123. **Soly.** i.w.; v.s.al.; s.et.

61 —, ***m*-amino-** (*m-phenylazoaniline; 3-benzeneazoaniline*). $NH_2C_6H_4N:NC_6H_5$, 197.11. Or.need. **m.p.** 57. **Soly.** i.w.; s.al.; s.et.; s.bz., chl.

62 —, ***p*-amino-** (*p-phenylazoaniline*); *4-benzeneazoaniline*). $NH_2C_6H_4N:NC_6H_5$, 197.11. Yel.monocl. **m.p.** 126 (122–3), **b.p.** >360. **Soly.** sl.s.h.w.; s.h.al.; s.et.; s.bz., chl.

63 —, **4-amino-2, 3′-dimethyl-.** See *m-Toluidine, 4-m-tolylazo-.*

64 —, **4-amino-3, 4′-dimethyl-.** See *o-Toluidine, 4-p-tolylazo-.*

65 —, **4′-amino-2, 3′-dimethyl-.** See *o-Toluidine, 4-o-tolylazo-.*

66 —, **2, 2′-diamino-** (*2, 2′-azodianiline*). $H_2NC_6H_4N:NC_6H_4NH_2$, 212.13. Redsh.pl.f.al. or bz. **m.p.** 134. **Soly.** v.sl.s.w.; s.al.; s.et.; v.s.acet.

67, —, **2, 4-diamino-.** See *Chrysoidine (base).*

68 —, **4,4′-diamino-** (*4,4′-azodianiline*). $H_2NC_6H_4N_2C_6H_4NH_2$, 212.13. Yel. need.f.al. **m.p.** 241. **Soly.** sl.s.w.; s.al.; s.et.; s.bz., chl.; sl.s.lgr.

69 —, **diethoxy-.** See *o-Azophenetole.*

70 —, **dihydroxy-.** See *Azophenol.*

71 —, **dimethyl-.** See *Azotoluene.*

72 —, ***p*-dimethylamino-** (*N, N-dimethyl-p-phenylazoaniline*). $(CH_3)_2NC_6H_4N:NC_6H_5$, 225.14. Yel.leaf.f.al. **m.p.** 117(115), **b.p.** d. **Soly.** i.w.; v.s.al.; s.et.; s.conc.min.a.

73 —, **4, 4′-diphenyl-.** See *p, p′-Azobiphenyl.*

* Name approved by the International Union of Chemistry.

74 Azobenzene, o-hydroxy- (*o-phenylazophenol*). $HOC_6H_4N:NC_6H_5$, 198.09. Or.need. f.et. **m.p.** 82.5–3.0. **Soly.** sl.s.w.; s.al., s.et.; s.alk.

75 —, m-hydroxy- (*m-phenylazophenol*). $HOC_6H_4N:NC_6H_5$, 198.09. Yel.pr.f. bz. **m.p.** 114–7. **Soly.** 0.08 h.w.; s.al.; s.et.

76 —, p-hydroxy- (*p-phenylazophenol*). $HOC_6H_4N:NC_6H_5$, 198.09. Rhomb. pr.f.al. **m.p.** 152 (155–6), **b.p.** 220–30^{20} sl.d. **Soly.** 0.002^{25}w.; v.s.al.; v.s.et.

77 —, p-nitro-. $NO_2C_6H_4N:NC_6H_5$, 227.09. Or. red leaf. or need. **m.p.** 134. **Soly.** v.sl.s.h.al.

78 —, 2,4,3′-triamino-. See *m-Phenylenediamine, 4-(3-aminophenylazo)-*.

79 Azobenzenedicarboxylic acid. See *Azobenzoic acid.*

80 Azobenzil. See *Oxazole, triphenyl-.*

81 o-Azobenzoic acid (*o, o′-azobenzenedicarboxylic acid*). $COOHC_6H_4N:NC_6H_4COOH$, 270.09. Dk.yel.need. f.al. **m.p.** 245 d (237). **Soly.** v.sl.s.w.; s.al.; v.s.et.; i.bz.

82 m-Azobenzoic acid (*m, m′-azobenzenedicarboxylic acid*). $COOHC_6H_4N:NC_6H_4COOH$, 270.09. Amor.powd. or yel.need. **m.p.** 340, **b.p.** d. **Soly.** sl.s.w.; 0.24^{78} 88% al.; sl.s.et.

83 p-Azobenzoic acid (*p, p′-azobenzenedicarboxylic acid*). $COOHC_6H_4N:NC_6H_4COOH$, 270.09. Red.need. **m.p.** *ca.* 330, **b.p.** d. **Soly.** v.sl.s.w.; v.sl.s.al.; v.sl.s.et.

84 p, p′-Azobiphenyl (4, 4′-*diphenylazobenzene; p-azodiphenyl; di-p-xenyldiimide*). $C_6H_5C_6H_4N:NC_6H_4C_6H_5$, 334.16. Or.-red pl.f.bz. **m.p.** 249–50. **Soly.** i.w.; i.al.; s.et.

85 Azodicarbonamide (*azoformamide*). $NH_2CON:NCONH_2$, 116.06. Or.-red cr. **m.p.** 180 d. **Soly.** s.h.w.; i.al.; sl.s.et.; d.h. HCl.

86 p-Azodiphenyl. See *p, p′-Azobiphenyl.*

87 Azoformamide. See *Azodicarbonamide.*

88 Azoimide, phenyl-. See *Benzene, triazo-.*

89 Azole. See *Pyrrole.*

90 1, 1′-Azonaphthalene (*di-1-naphthyldiimide; α, α′-azonaphthalene*). $C_{10}H_7N:NC_{10}H_7$, 282.13. Red need.f. ac.a. **m.p.** 190, **b.p.** subl. **Soly.** i.w.; sl.s.al.; s.bz., ac.a., acet.

91 —, 4-amino-. See 1-*Naphthylamine, 4-(1-naphthylazo)-*.

92 1, 2′-Azonaphthalene (*α-naphthyl-β-naphthyldiimide.* $C_{10}H_7N:NC_{10}H_7$, 282.13. Br.leaf.f. ac.a. **m.p.** 136. **Soly.** i.w.; s.al.; s.bz., ac.a., conc. H_2SO_4.

93 2, 2′-Azonaphthalene (*di-β-naphthyldiimide*). $C_{10}H_7N:NC_{10}H_7$, 282.13. Red. leaf.f.bz. or chl. **m.p.** 208, **b.p.** subl. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.bz., chl.; sl.s.me.al.

94 o-Azophenetole (*o, o′-azodiphenetole; o, o′-diethoxyazobenzene*). $(C_2H_5OC_6H_4)_2N_2$, 270.16. Red pr.f.al. **m.p.** 131, **b.p.** 240 d. **Soly.** i.w.; s.al.; s.et.; s.HCl.

95 p-Azophenetole (*p, p′-azodiphenetole; p, p′-diethoxyazobenzene*). $(C_2H_5OC_6H_4)_2N_2$, 270.16. Yel.leaf. **m.p.** 160.2, **b.p.** d. **Soly.** i.w.; s.h.al.; v.s.et.

96 o-Azophenol (*o, o′-azodiphenol;* 2, 2′-*dihydroxyazobenzene*). $HOC_6H_4N:NC_6H_4OH$, 214.09. Yel.leaf.f.bz. or al. **m.p.** 172, **b.p.** subl. **Soly.** i.w.; 0.33al.; v.s. et.; 1.67bz.; s.conc.alk.

97 m-Azophenol (*m, m′-azodiphenol;* 3, 3′-*dihydroxyazobenzene*). $HOC_6H_4N:NC_6H_4OH$, 214.09. Yel.leaf.f. dil.al. **m.p.** 205. **Soly.** v.sl.s.w.; s.h.al.; sl.s. et.; s.h.alk.

98 p-Azophenol (*p, p′-azodiphenol;* 4, 4′-*dihydroxyazobenzene*). $HOC_6H_4N:NC_6H_4OH$, 214.09. Cr. $(+1H_2O)$ f. dil.al.; α anh.grn.powd.; β anh.dk.red powd. **m.p.** 216. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

99 o-Azotoluene (2, 2′-*dimethylazobenzene; di-o-tolyldiimide*). $CH_3C_6H_4N:NC_6H_4CH_3$, 210.13. Red monocl. pr.f.et. **m.p.** 55. **Soly.** i.w.; 6$^{14.5}$al.; 147.7$^{18.5}$et.; s.bz.

00 m-Azotoluene (3, 3′-*dimethylazobenzene; di-m-tolyldiimide*). $CH_3C_6H_4N:NC_6H_4CH_3$, 210.13. Or.red rhomb.cr. **m.p.** 54–5. **Soly.** i.w.; v.s.al.; v.s.et.

01 p-Azotoluene (4, 4′-*dimethylazobenzene; di-p-tolyldiimide*). $CH_3C_6H_4N:NC_6H_4CH_3$, 210.13. Or.yel.monocl. need.f.lgr. **m.p.** 144. **Soly.** i.w.; s.al.; v.s.et.; s.lgr.

02 Azoxybenzene (ordinary) (*azoxybenzide*). $C_6H_5(NON)C_6H_5$, 198.09. Yel.rhomb.need.f.h.al., *n* 1.6644^{26}. **D.** 1.246$^{26}_{4}$, **m.p.** 36, **b.p.** d. **Soly.** i.w.; 17.5^{16}al.; v.s.et.; 43^{15}lgr.

03 Azoxybenzenedicarboxylic acid. See *Azoxybenzoic acid.*

04 o-Azoxybenzoic acid (*o, o′-azoxydibenzoic acid; azoxybenzene-2, 2′-dicarboxylic acid*). $C_6H_4COOH(NON)C_6H_4COOH$, 286.09. Pa.yel.tricl.leaf.f. al. **m.p.** 250 d., **b.p.** d. **Soly.** i.w.; sl.s.al.; sl.s.et.

For explanations and abbreviations see beginning of table.

05 ***m*-Azoxybenzoic acid** (*m, m'-azoxydibenzoic acid*). $C_6H_4COOH(NON)$-C_6H_4COOH, 286.09. Pa.yel.need. or leaf. **m.p.** 345 d. (320). **Soly.** i.w.; sl.s.al.; sl.s.et.

06 ***p*-Azoxybenzoic acid** (*p, p'-azoxydibenzoic acid*). $C_6H_4COOH(NON)C_6$-H_4COOH, 286.09. Yel.amor. **m.p.** 240 d., **b.p.** d. **Soly.** i.w.; i.al.; i.et.; s.pyr.

07 **1, 1'-Azoxynaphthalene** (1, *1'-azoxydinaphthalene; α, α'-azoxynaphthalene*). $C_{10}H_7(NON)C_{10}H_7$, 298.13. Yel.-red rhomb.f.al. **m.p.** 127. **Soly.** i.w.; s.al.; sl.s.et.; s.conc.H_2SO_4.

08 **2, 2'-Azoxynaphthalene** (*β, β'-azoxynaphthalene*). $C_{10}H_7(NON)C_{10}H_7$, 298.13. Yel.rhomb.need.f.al. **m.p.** 167–8. **Soly.** i.w.; s.h.al.; sl.s.et.; s.bz., chl.

09 **Baeyer's acid.** See *Croceic acid.*

10 **Baphiin.** $C_{12}H_{10}O_4$ or $C_{24}H_{20}O_8$, 218.08 or 436.16. Leaf. **m.p.** d. **Soly.** i.w.; s.al.; s.et.

11 **Baptitoxine.** See *Cytisine.*

12 **Barbital** (5, 5-*diethylbarbituric acid; veronal; barbitone; malourea*).
NHCONHCOC(C_2H_5)$_2$CO,
184.11. Wh.cr.powd. **m.p.** 191. **Soly.** 0.69^{20}, 8.3^{100}w.; s.al.; v.s.et.; s.acet., alk., pet.eth., ac.a.; sl.s.chl.

13 **Barbituric acid** (*malonylurea; pyrimidinetrione*). NHCONHCOCH$_2$CO,
128.05. Wh.rhomb.pr. **m.p.** 245., **b.p.** 260 d. **Soly.** sl.s.w.; sl.s.al.; s.et.

14 —, **5-amino-.** See *Uramil.*

15 —, **5, 5-diallyl-** (*dial*).
NHCONHCOC(C_3H_5)$_2$CO,
208.11. Col.sc. **m.p.** 170. **Soly.** sl. s.w.; s.al.; s.et.

16 —, **5, 5-diethyl-.** See *Barbital.*

17 —, **5, 5-dipropyl-** (*proponal; propytal*). NHCONHCOC(C_3H_7)$_2$CO,
212.14. Col.cr. **m.p.** 145. **Soly.** 0.06c., 1.4^{100}w.; v.s.al.; v.s.et.; s.dil.alk.

18 —, **5-ethyl-5-isoamyl-** (*amytal*)
NHCONHCOC(C_2H_5)(C_5H_{11})CO,
226.16. Col. **m.p.** 135. **Soly.** sl.s.w.; s.al.; s.et.

19 —, **5-ethyl-5-α-methylbutyl-.**
NHCONHCOC(C_2H_5)(C_5H_{11})CO,
226.16. Col. **m.p.** 128.5–130. **Soly.** sl.s.w.; s.al.; s.et.

20 —, **5-ethyl-5-phenyl-.** See *Phenobarbital.*

21 —, **5-(2-fural)-2-thio-** (*furfuralmalonylthiourea*). C_4H_3OCH:-CCONHCSNHCO, 222.12. Yel.flocks. **Soly.** i.w.

22 —, **5-hydroxy-.** See *Dialuric acid.*

23 —, **5-isonitroso-.** See *Violuric acid.*

25 **Bassorin** (*tragacanthin*). $C_{16}H_{10}O_5$ (?), 282.08. Amor., a mucilage. **Soly.** sl.s.w.; i.al.; s.alk.; d.h.a.

26 **Bebeerine.** $C_{18}H_{21}NO_3$, 299.17. Mixture(?), pr.f.me.al., $[\alpha] - 298°_D$, **m.p.** 214. **Soly.** 0.016c.w.; 20al.; s.et.; s.chl., a.

27 —, hydrochloride. $C_{18}H_{19}NO_3 \cdot HCl$, 333.62. Hyg.need. or sc. **m.p.** 259–60. **Soly.** s.w.; s.al.

28 **Behenic acid** (*docosanoic acid*; n-docosoic acid*). $CH_3(CH_2)_{20}COOH$, 340.34. Col.need. **m.p.** 80.7 (84), **b.p.** 306^{60}. **Soly.** 0.10c.w.; 0.10^{17}al.; 1.92^{16}et.

29 —, ethyl ester. $C_{21}H_{43}COOC_2H_5$, 368.37. Need.f.al. **m.p.** 54–4.5, **b.p.** 230–1^5. **Soly.** i.w.; s.al.; s.et.

30 —, methyl ester. $C_{21}H_{43}COOCH_3$, 354.36. Cr. **m.p.** 54–4.5, **b.p.** 224–5^{16}. **Soly.** i.w.; s al.; s.et.

31 **Behenolic acid** (13-*docosynoic acid**). $CH_3(CH_2)_7C{:}C(CH_2)_{11}COOH$, 336.31. Col.need.f.al. **m.p.** 57.5. **Soly.** i.w.; v.s.al.; v.s.et.; s.chl.

32 **Belladonnine.** $C_{17}H_{21}NO_2$, 271.17. Amor.resin. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.chl.

33 **Benzaconine** (*benzoylaconine; napelline; picraconitine*). $C_{32}H_{43}NO_{10}$, 601.34. Amor. **m.p.** 130.

Benzal-. For benzal derivatives see the parent compounds (e.g., for benzalmalonic acid see *Malonic acid, benzal-*).

34 **Benzalazine.** See *Benzaldehyde, azine.*

35 **Benzal bromide** (*α, α-dibromotoluene; benzylidene bromide*). $C_6H_5CHBr_2$, 249.88. Fum. oily liq., *n* 1.541. **D.** 1.51^{15}, **b.p.** 140^{20}. **Soly.** i.w.; ∞al.; ∞et.

36 **Benzal chloride** (*α, α-dichlorotoluene; benzylidene chloride*). $C_6H_5CHCl_2$, 160.96. Col. oily liq. **D.** 1.2557^{14}, **m.p.** −16; frz. −17, **b.p.** 207 (203.5^{756}). **Soly.** i.w.; ∞al.; ∞et.

* Name approved by the International Union of Chemistry.

37 Benzaldehyde (*benzenecarbonal**). C_6H_5CHO, 106.05. Col.liq., *n* $1.54629^{17.6}$. **D.** 1.0504^{15}_{4}, **m.p.** −26; frz. −56, **b.p.** 179.5; $112.5–131^{100}$. **Soly.** 0.33w.; ∞al.; ∞et.; ∞ fixed and vol. oils.

38 —, azine (*benzalazine; benzylideneazine; dibenzalhydrazine*). $C_6H_5CH:NN:CHC_6H_5$, 208.11. Lng.yel.lust.pr. **m.p.** 93, **b.p.** d. **Soly.** i.w.; v.s.h.al.; v.s.et.; s.chl., bz.

39 —, cyanohydrin. See *Mandelonitrile.*

40 —, hydrazone (*benzalhydrazine; benzylidenehydrazine*). $C_6H_5CH:NNH_2$, 120.08. Col.leaf. or liq. **m.p.** 16, **b.p.** 140^{14}. **Soly.** d.w.; s.al.; d.a., alk.

41 —, α-, *trans*-, or *anti*-oxime (*trans-benzaldoxime*). $C_6H_5CH:NOH$, 121.06. Col.leaf., *n* $1.5637^{21.4}$. **D.** 1.111^{20}_{4}, **m.p.** 35, **b.p.** 200, 134^{20}. **Soly.** sl.s.w.; v.s.al.; v.s.et.; v.s.bz.

42 —, β-, *cis*-, or *syn*-oxime (*cis-benzaldoxime*). $C_6H_5CH:NOH$, 121.06. Col.rhomb.tab. or need. **m.p.** 130. **Soly.** s.h.w.; 15.5^{20}, 53.6^{70}al.; v.s.et.; sl.s.bz.

43 —, phenylhydrazone (*benzalphenylhydrazine; benzylidenephenylhydrazine*). $C_6H_5CH:NNHC_6H_5$, 196.11. Col.-pink monocl.pr. **m.p.** 156. **Soly.** s.h.al.; sl.s.et.; s.bz.

44 —, **4-acetoxy-3-methoxy-.** See *Vanillin, acetate.*

45 —, *o*-**amino-.** See *Anthranilaldehyde.*

46 —, ***m*-amino-.** $NH_2C_6H_4CHO$, 121.06. In solution only.

47 —, ***p*-amino-.** $NH_2C_6H_4CHO$, 121.06. Pl. or leaf.f.w. **m.p.** 71. **Soly.** v.sl.s.w.; s.al.; s.et.

48 —, ***o*-chloro-** (*2-chlorobenzenecarbonal**). ClC_6H_4CHO, 140.50. Liq., *n* $1.56564^{21.7}$. **D.** 1.252^{20}_{4}, **m.p.** 11 (8–9), **b.p.** 208^{748}. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

49 —, ***m*-chloro-** (*3-chlorobenzenecarbonal**). ClC_6H_4CHO, 140.50. Liq. or pr., *n* $1.56500^{20.2}$. **D.** 1.2497^{15}_{4}, **m.p.** 17–8, **b.p.** 213–4 (204). **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

50 —, ***p*-chloro-** (*4-chlorobenzenecarbonal**). ClC_6H_4CHO, 140.50. Leaf., *n* 1.55525^{61}. **D.** 1.196^{61}_{4}, **m.p.** 47.5, **b.p.** 214 ($144–4.5^{100}$). **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.CS_2, ac.a., bz.

51 —, **diacetyl-.** See *Benzal diacetate.*

52 —, **2, 4-dihydroxy-.** See *β-Resorcylaldehyde.*

53 —, **3, 4-dihydroxy-.** See *Protocatechualdehyde.*

54 —, **2, 4-dimethoxy-** (*2, 4-dimethoxybenzenecarbonal*; β-resorcylaldehyde dimethyl ether*). $(CH_3O)_2C_6H_3CHO$, 166.08. Need.f.dil.al. **m.p.** 69–70, **b.p.** 165^{10}. **Soly.** i.w.; v.s.al.; v.s.et.

55 —, **3, 4-dimethoxy-.** See *Veratraldehyde.*

56 —, ***p*-dimethylamino-** (*4-dimethylaminobenzenecarbonal**). $(CH_3)_2NC_6H_4CHO$, 149.09. Leaf.f.w. **m.p.** 74, **b.p.** $176–7^{17}$. **Soly.** sl.s.w.; s.al.; s.et.; s.ac.a., ord.org.solv.

57 —, **2, 4-dinitro-** (*2, 4-dinitrobenzenecarbonal**). $(NO_2)_2C_6H_3CHO$, 196.05. Pa.yel.cr.f.al. **m.p.** 72, **b.p.** $190–210^{10-20}$. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

58 —, **2, 6-dinitro-** (*2, 6-dinitrobenzenecarbonal**). $(NO_2)_2C_6H_3CHO$, 196.05. Leaf.f.dil.ac.a. **m.p.** 123. **Soly.** s.h.w.; s.al.; s.et.; s.bz., ac.a., chl.; sl.s.CS_2, lgr.

59 —, **4-ethoxy-3-methoxy-** (*vanillin ethyl ether; protocatechualdehyde 4-ethyl 3-methyl ether*). $C_2H_5O(CH_3O)C_6H_3CHO$, 180.09. Monocl.pr. **m.p.** 64–5 (73–4), **b.p.** subl. **Soly.** sl.s.h.w.; sl.s.al.; s.et.

60 —, ***o*-hydroxy-.** See *Salicylaldehyde.*

61 —, ***m*-hydroxy-.** HOC_6H_4CHO, 122.05. Col.need.f.w. **m.p.** 106 (101–3), **b.p.** 240. **Soly.** 2.78^{43}w.; v.s.al.; s.et.; 6.31^{61}bz.

62 —, ***p*-hydroxy-.** HOC_6H_4CHO, 122.05. Col.need.f.w. **D.** 1.129^{130}_{4}, **m.p.** 116, **b.p.** subl. **Soly.** $1.38^{30.5}$w.; v.s.al.; v.s.et.; 3.68^{65}bz.

63 —, **4-hydroxy-3-methoxy-.** See *Vanillin.*

64 —, ***p*-isopropyl-.** See *Cumaldehyde.*

65 ***o*-methoxy-** (*salicylaldehyde methyl ether; o-anisaldehyde*). $CH_3OC_6H_4CHO$, 136.06. Pr., *n* 1.5597. **D.** 1.133^{20}_{4}, **m.p.** 35, **b.p.** 243. **Soly.** i.w.; s.al.; v.s.et.

66 —, ***p*-methoxy-.** See *Anisaldehyde.*

67 —, **methyl-.** See *Tolualdehyde.*

68 —, **3, 4-methylenedioxy-.** See *Piperonal.*

69 —, ***o*-nitro-.** $NO_2C_6H_4CHO$, 151.05. Yel.need.f.w. **m.p.** α 40; β 37.9, **b.p.** 156^{15}. **Soly.** 0.23^{25}, 1.53^{103}w.; v.s.al.; v.s.et.; s.bz.

70 —, ***m*-nitro-.** $NO_2C_6H_4CHO$, 151.05. Lt.yel.need.f.w. **m.p.** 58, **b.p.** 164^{23}. **Soly.** 0.16^{25}, 1.95^{112}w.; s.al.; v.s.et.; s.chl.

For explanations and abbreviations see beginning of table.

71 Benzaldehyde, *p*-nitro-. $NO_2C_6H_4CHO$, 151.05. Col.pr.f.w. **D.** 1.496^{9}_{4}, **m.p.** 106.5, **b.p.** subl. **Soly.** 0.97^{93}w.; v.s.al.; sl.s.et.; 5.01^{13}bz.

72 —, 2, 4, 6-trinitro-. $(NO_2)_3C_6H_2CHO$, 241.05. Pl.f.bz. **m.p.** 119. **Soly.** i.w.; s.al.; s.et.

73 —, trithio-. See *s-Trithiane, triphenyl-*.

74 *o*-Benzaldehydesulfonic acid. See *Benzenesulfonic acid, o-formyl-*.

75 Benzal diacetate (*benzylidene diacetate; diacetylbenzaldehyde; α, α-diacetoxytoluene*). $C_6H_5CH(OOCCH_3)_2$, 208.09. **D.** 1.11^{20}_{4}, **m.p.** 44–6, **b.p.** 220; 154^{20}. **Soly.** s.al.; s.et.

75 Benzaldoxime. See *Benzaldehyde, oxime.*

76 Benzaldoximecarboxylic anhydride. See 2, 3, 1-*Benzoxaz*-1-*one.*

77 Benzalimine, *N*-ethyl-. See *Ethylamine, N-benzal-*.

78 Benzamarone (1, 2, 3, 4, 5-*pentaphenyl*-1, 5-*pentanedione* (*one form*); *α, α′-benzalbisdesoxybenzoin*). $C_6H_5CH[CH(C_6H_5)COC_6H_5]_2$, 480.22. Col.cr. **m.p.** 217–8. **Soly.** 0.63h.w.; sl.s.al.; 1.6^{12}bz.

79 Benzamide (*benzenecarbonamide; benzoic amide*). $C_6H_5CONH_2$, 121.06. Col. monocl. **D.** 1.341^{4}_{4}, **m.p.** 130 (125–6), **b.p.** 290. **Soly.** 0.58^{12}, 1.35^{25}w.; 17^{25}al.; v.s.et.

80 —, oxime (*benzamidoxime; benzenylaminoxide*). $C_6H_5C(:NOH)NH_2$, 136.08. Monocl.pr.f.w. **m.p.** 79–80. **Soly.** sl.s.c.w.; v.s.al.; v.s.et.; s.chl., bz.; i.lgr.

81 —, *o*-amino-. $NH_2C_6H_4CONH_2$, 136.08. Leaf.f.chl. **m.p.** 109–11.5 (108), **b.p.** 300 d. **Soly.** s.h.w.; v.s.al.; sl.s.et.; sl.s.bz.

82 —, *m*-amino-. $NH_2C_6H_4CONH_2$, 136.08. Yel.need. $(+1H_2O)$ f.w. **m.p.** 113–4 anh.; $+H_2O$ 79, **b.p.** d. 300.; $-H_2O$, 100–20. **Soly.** sl.s.w.; s.al.; s.et.; sl.s.c.chl., c.bz.

83 —, *p*-amino-. $NH_2C_6H_4CONH_2$, 136.08. Yel.cr. **m.p.** 183 (anh.) **Soly.** sl.s.w.; s.al.; sl.s.et.

84 —, *o*-chloro- (2-*chlorobenzenecarbonamide**). $ClC_6H_4CONH_2$, 155.51. Lng. rhomb.need.f.w. **D.** 1.34^{19}_{4}, **m.p.** 142 (139). **Soly.** sl.s.w.; v.s.al.; v.s.et.

85 —, *m*-chloro- (3-*chlorobenzenecarbonamide**). $ClC_6H_4CONH_2$, 155.51. Need. **m.p.** 134.5. **Soly.** sl.s.w.; v.s.al.; s.et.

86 —, *p*-chloro- (4-*chlorobenzenecarbonamide**). $ClC_6H_4CONH_2$, 155.51. Need.f.et. **m.p.** 179(170). **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

87 —, *o*-hydroxy-. See *Salicylamide.*

88 —, *m*-hydroxy-. $HOC_6H_4CONH_2$, 137.06. Col.leaf.f.w. **m.p.** 170.5. **Soly.** sl.s.c., s.h.w.; v.s.al.; v.s.et.; i.chl., CS_2.

89 —, *p*-hydroxy-. $HOC_6H_4CONH_2$, 137.06. Need.f.w. **m.p.** 162 anh., **b.p.** $-H_2O$, 100. **Soly.** sl.s.w.; v.s.al.; sl.s.et.; i.chl., CS_2.

90 —, *o, m* or *p*-methyl-. See *Toluamide.*

91 —, *o*-nitro-. $NO_2C_6H_4CONH_2$, 166.06. Need.f.dil.al. **D.** 1.462^{32}_{4}, **m.p.** 176.6, **b.p.** 317. **Soly.** s.h.w.; s.al.; s.et.

92 —, *m*-nitro-. $NO_2C_6H_4CONH_2$, 166.06. Yel.monocl.need.f.w. **m.p.** 142.7, **b.p.** 315. **Soly.** s.h.w.; s.al.; s.et

93 —, *p*-nitro-. $NO_2C_6H_4CONH_2$, 166.06. Need.f.w. **m.p.** 201.4. **Soly.** v.sl.s.w.; s.al.; s.et.

94 —, *N*-phenyl-. See *Benzanilide.*

95 Benzamidine (*benzenecarbonamidine*; benzenylamidine*). $C_6H_5C(:NH)NH_2$, 120.08. Col.cr. **m.p.** 80, **b.p.** d. **Soly.** s.w.; v.s.al.; sl.s.et.

96 —, *N*-1-naphthyl- (*benzenylnaphthylamidine*). $C_6H_5C(:NH)NHC_{10}H_7$ or $C_6H_5C(NH_2):NC_{10}H_7$, 246.13. Pl.f.al. **m.p.** 141. **Soly.** i.w.; s.al.; s.et.

97 Benzamidoxime. See *Benzamide, oxime.*

98 Benzamine. See *β-Eucaine.*

99 Benzanalgen. See *Analgen.*

00 Benzanilide (*N-phenylbenzamide; N-benzoylaniline*). $C_6H_5CONHC_6H_5$, 197.09. Col.leaf.f.al. **D.** 1.321^{4}_{4}, **m.p.** 161, **b.p.** $117–9^{10}$. **Soly.** v.sl.s.w.; 3.16^{30}al.; sl.s.et.

01 —, *o*-nitro-. $NO_2C_6H_4CONHC_6H_5$, 242.09. Wh.need.f.al. **m.p.** 155. **Soly.** v.sl.s.w.; v.s.al.; sl.s.et.

02 —, *o′*-nitro-. $C_6H_5CONHC_6H_4NO_2$, 242.09. Yel.need.f.al. **m.p.** 94–8. **Soly.** sl.s.h.w.; s.al.; v.s.et.

03 —, *m*-nitro-. $NO_2C_6H_4CONHC_6H_5$, 242.09. Leaf.f.w. or al. **m.p.,** 153–4, **b.p.** subl. **Soly.** v.sl.s.c.w.; s.al.; s.et.; s.bz.

04 —, *m′*-nitro-. $C_6H_5CONHC_6H_4NO_2$, 242.09. Leaf.f. amyl al. **m.p.** 157. **Soly.** i.w.; sl.s.al.; v.s.chl.

05 —, *p*-nitro-. $NO_2C_6H_4CONHC_6H_5$, 242.09. Leaf.f.et. **m.p.** 210–11. **Soly.** v.sl.s.w.; s.al.; s.et.

06 —, *p′*-nitro-. $C_6H_5CONHC_6H_4NO_2$, 242.09. Yel.need., **m.p.** 199. **Soly.** i.w.; sl.s.h.al.

* Name approved by the International Union of Chemistry.

07 Benzanilide, thio-. $C_6H_5CSNHC_6H_5$, 213.15. Yel.pr.f.al. **m.p.** 100–2, **b.p.** d. **Soly.** i.w.; s.al.; v.s.et.

08 —. **3, 4, 5-trihydroxy-.** See *Gallanilide.*

09 Benzaurin (*p, p'-dihydroxytriphenylcarbinol*). $C_6H_5(C_6H_4OH)_2COH$ or $C_6H_5(OHC_6H_4)C{:}C_6H_4{:}O$, 292.12 or 274.11. Brick red powd. **m.p.** 100. **Soly.** v.sl.s.w.; s.al.; s.et.; sl.s.h.bz.

10 Benzazide. See *Benzoyl azide.*

11 1-Benzazine. See *Quinoline.*

12 2-Benzazine. See *Isoquinoline.*

13 Benzene* (*benzol; benzole; phene**). C_6H_6, 78.05. Col.rhomb.pr. or inflam. liq., *n* 1.50165. **D.** 0.8941^{0}_{4}, **m.p.** 5.48, **b.p.** 80.08. **Soly.** 0.082^{22}w.; ∞al.; ∞et.; ∞ac.a., acet., tol.; s.chl.

14 —, hexabromide. See *Cyclohexane,* 1, 2, 3, 4, 5, 6-*hexabromo-**.

15 —, hexachloride. See *Cyclohexane,* 1, 2, 3, 4, 5, 6-*hexachloro-**.

16 —, **acetyl-.** See *Acetophenone.*

17 —, **acetylenyl-.** See *Benzene, ethynyl-.*

18 —, **1-allyl-3, 4-methylenedioxy-.** See *Safrole.*

19 —, **amino-.** See *Aniline.*

20 —, **aminodimethylamino-.** See *Phenylenediamine, N, N-dimethyl-.*

21 —, **amoxy-.** See *Ether, amyl phenyl.*

22 —, **amyl-** (1-*phenylpentane*). $C_6H_5(CH_2)_4CH_3$, 148.12. Col.liq., *n* 1.4751^{15}. **D.** 0.860^{22}_{4}, **m.p.** −78.25, **b.p.** 202.1. **Soly.** i.w.; s.al.; ∞et.

23 —, ***sec-n*-amyl-.** See *Benzene, (α-methylbutyl)-.*

24 —, ***tert*-amyl-.** (*2-methyl-2-phenylbutane*). $C_6H_5C(CH_3)_2C_2H_5$, 148.12. Liq., *n* 1.49154^{23}. **D.** 0.8736^{15}, **b.p.** 189–91. **Soly.** i.w.; ∞al.; ∞et.

25 —, **1-amyl-2, 4-dihydroxy-.** See *Resorcinol, 4-amyl-.*

26 —, **anilino-.** See *Diphenylamine**.

27 —, **azimino-.** See 1, 2, 3-*Benzotriazole.*

28 —, **benzoyl-.** See *Benzophenone.*

29 —, **benzyl-.** See *Methane, diphenyl-.*

30 —, **1-benzyl-4-ethyl-** (*p-ethyldiphenylmethane*). $C_6H_5CH_2C_6H_4C_2H_5$, 196.12. Liq. **D.** 0.985^{19}, **b.p.** 294.5. **Soly.** s.al.; s.et.; s.chl.

30₁ —, **1-benzyloxy-2-methoxy-4-propenyl-.** See *Isoeugenol, benzyl ether.*

31 —, **benzylphenyl-.** See *Biphenyl, benzyl-.*

32 —, **bromo-*** (*phenyl bromide*). C_6H_5Br, 156.96. Col. oily liq., *n* 1.55977. **D.** 1.4991^{15}_{15}, **m.p.** −30.6, **b.p.** 155–6. **Soly.** 0.0446^{30}w.; 10.4^{25}al.; 71.3et.; s.bz.

33 —, **1-bromo-4-(4-bromophenoxy)-.** See *Ether, bis-p-bromophenyl.*

34 —, **1-bromo-3-chloro-*** (*m-bromochlorobenzene*). BrC_6H_4Cl, 191.40. **D.** 1.6302^{20}_{4}, **m.p.** −21.2, **b.p.** 196. **Soly.** i.w.; v.s.al.; v.s.et.

35 —, **1-bromo-4-chloro-*** (*p-bromochlorobenzene*). BrC_6H_4Cl, 191.40. Col.rhomb. or monocl.pr. **m.p.** 67.4, **b.p.** 196.3. **Soly.** i.w.; s.al.; s.et.

36 —, **(α-bromoethyl)-** (*1-bromo-1-phenylethane*). $CH_3CHBrC_6H_5$, 184.99. Liq. **D.** 1.3108^{23}_{4}, **b.p.** 200–10 d.; $105–7^{30}$. **Soly.** i.w.; s.al.; s.et.

37 —, **1-bromo-4-fluoro-*** (*p-fluorobromobenzene*). BrC_6H_4F, 174.95. Col.liq. **b.p.** 152.5. **Soly.** i.w.; v.s.al.; v.s.et.

38 —, **1-bromo-2-iodo-*.** BrC_6H_4I, 282.87. Col.liq. **D.** 2.257^{25}_{4}, **m.p.** 2.1, **b.p.** 257^{754} ($124–7^{17}$). **Soly.** i.w.; v.sl.s.al.; v.sl.s.ac.a.

39 —, **1-bromo-3-iodo-*.** BrC_6H_4I, 282.87. Col.oily liq. **m.p.** −9.3, **b.p.** 252^{754}. **Soly.** i.w.; v.sl.s.al.; v.sl.s.ac.a.

40 —, **1-bromo-4-iodo-*.** BrC_6H_4I, 282.87. Col.need. or pl. **m.p.** 92, **b.p.** 251.5^{754}. **Soly.** i.w.; sl.s.al.; s.et.

41 —, **1-bromo-2-nitro-*.** $BrC_6H_4NO_2$, 201.96. Pa.yel.cr.f.al. **D.** 1.6245^{80}_{4}, **m.p.** 42 (36–9), **b.p.** 261. **Soly.** i.w.; v.s.al.; s.et.; s.bz.

42 —, **1-bromo-3-nitro-*.** $BrC_6H_4NO_2$, 201.96. Rhomb.cr., *n* 1.5979. **D.** 1.7036^{20}_{4}, **m.p.** 56, **b.p.** 256.5. **Soly.** v.sl.s.w.; s.al.; s.et.; s.bz.

43 —, **1-bromo-4-nitro-*.** $BrC_6H_4NO_2$, 201.96. Col.rhomb.pr. **D.** 1.934^{22}_{4}, **m.p.** 127, **b.p.** 256. **Soly.** i.w.; 1.38c.al.; s.et.; s.bz.

44 —, **(β-bromovinyl)-.** See *Styrene, β-bromo-.*

45 —, **butoxy-*.** See *Ether, butyl phenyl.*

46 —, **butyl-** (*1-phenylbutane*). $C_6H_5CH_2CH_2CH_2CH_3$, 134.11. Col.liq., *n* 1.494^{13}. **D.** 0.862, **m.p.** −81.2, **b.p.** 180 (181–3). **Soly.** i.w.; ∞al.; ∞et.

47 —, ***sec*-butyl-** (*2-phenylbutane*). $C_6H_5CH(CH_3)C_2H_5$, 134.11. Col.liq., *n* 1.4894^{21}. **D.** 0.8634^{21}_{4}, **m.p.** −82.7, **b.p.** 173.5. **Soly.** i.w.; ∞al.; ∞et.

48 —, ***tert*-butyl-** (*2-methyl-2-phenylpropane*). $C_6H_5C(CH_3)_3$, 134.11. Col.liq., *n* 1.49724^{18}. **D.** 0.867^{20}_{4}, **m.p.** −58.1, **b.p.** 168.7. **Soly.** i.w.; v.s.al.; v.s.et.

49 Benzene*, 1-*tert*-butyl-3,5-dimethyl-2,4,6-trinitro- (*musk xylene*). $(NO_2)_3C_6C(CH_3)_3(CH_3)_2$, 297.14. **m.p.** 113. **Soly.** i.w.; sl.s.al.; s.et.

50 —, butylmethyl-. See *Toluene, butyl-*.

51 —, 1-butynyl- (*1-phenyl-1-butyne; ethylphenylacetylene*). $C_6H_5C:CCH_2CH_3$, 130.08. **D.** 0.923^{21}, **b.p.** 203. **Soly.** i.w.; s.al.; s.et.

52 —, chloro-* (*phenyl chloride*). C_6H_5Cl, 112.50. Col.liq., n 1.52479. **D.** 1.1066^{20}_{4}, **m.p.** −45, frz. −55, **b.p.** 132. **Soly.** 0.0488^{30}w.; ∞al.; ∞et.; s.chl., CS_2, bz.

53 —, 1-chloro-2,4-dinitro-* (*4-chloro-1,3-dinitrobenzene*). $(NO_2)_2C_6H_3Cl$, 202.50. Yel.rhomb.f.et. **D.** $\alpha 1.697^{22}$; $\beta 1.680^{20}_{4}$, **m.p.** α53.4 (51); β43; γ27, **b.p.** 315. **Soly.** i.w.; s.al.; s.et.

54 —, 1-chloro-3,5-dinitro-* (*5-chloro-1,3-dinitrobenzene*). $(NO_2)_2C_6H_3Cl$, 202.50. Col.need.f.al. **m.p.** 55 (59), **b.p.** volat. in steam. **Soly.** i.w.; s.al.; s.et.

55 —, 2-chloro-1,3-dinitro-*. $(NO_2)_2C_6H_3Cl$, 202.50. Yel.need.f.al. **D.** $1.6867^{16.5}$, **m.p.** 87, **b.p.** 315. **Soly.** i.w.; v.s.al.; s.et.

56 —, 3-chloro-1,2-dinitro-*. $(NO_2)_2C_6H_3Cl$, 202.50. Pr.f.et.al. **m.p.** 78 (86.8). **Soly.** i.w.; s.al.; s.et.

57 —, 4-chloro-1,2-dinitro-*. $(NO_2)_2C_6H_3Cl$, 202.50. Yel.monocl.rhomb. f.et. **D.** $\alpha 1.697^{22}_{4}$; $\beta 1.6867^{20}_{4}$, **m.p.** α36.3; β37.1; γ38.8; δ28, **b.p.** 315 d. **Soly.** i.w.; s.al.; v.s.et.; s.bz., CS_2.

58 —, 1-chloro-4-iodo-*. ClC_6H_4I, 238.41., Col.leaf.f.al. **m.p.** 57, **b.p.** 226–7. **Soly.** i.w.; s.al.

59 —, chloromercuri-. See *Mercury chloride, phenyl-**.

60 —, 1-chloro-2-nitro-* (*o-chloronitrobenzene*). $ClC_6H_4NO_2$, 157.50. Monocl.need. **D.** 1.368^{22}_{4}; 1.305^{80}_{4}, **m.p** 32.5, **b.p.** 245.7. **Soly.** i.w.; s.al.; s.et.; s.bz.

61 —, 1-chloro-3-nitro-* (*m-chloronitrobenzene*). $ClC_6H_4NO_2$, 157.50. Pa.yel.rhomb.pr.f.al. **D.** 1.534^{22}_{4}, **m.p.** unst. 23.7; stab. 44.4 (46), **b.p.** 235–6. **Soly.** i.w.; v.s.h.al.; s.et.; s.bz., ac.a., chl., CS_2.

62 —, 1-chloro-4-nitro-* (*p-chloronitrobenzene*). $ClC_6H_4NO_2$, 157.50. Monocl.pr. **D.** 1.520^{18}_{4}, **m.p.** 83.5, **b.p.** 242. **Soly.** i.w.; s.al.; s.et.; s.CS_2.

63 —, 1-chloro-2,4,5-trinitro-*. $(NO_2)_3C_6H_2Cl$, 247.50. Yel.cr.f.al. **m.p.** 116. **Soly.** i.w.; v.s.h.al.; s.h.bz.

64 —, 1-chloro-2,4,6-trinitro-*. See *Picryl chloride*.

65 —, 2-chloro-1,3,5-trinitro-*. See *Picryl chloride*.

66 —, cyclohexyl-. See *Cyclohexane, phenyl-*.

67 —, 1,4-diacetamido-. See *o-Phenylenediamine, N, N′-diacetyl-*.

68 —, diamino-. See *Phenylenediamine*.

69 —, diazoamino-. See *Diazoaminobenzene*.

70 —, 1,2-dibromo-* (*o-dibromobenzene*). $C_6H_4Br_2$, 235.86. Col.liq., n $1.6117^{17.5}$. **D.** $1.9557^{20.5}_{4}$, **m.p.** 1.8 (5.6); frz. 6–7, **b.p.** 221 (224). **Soly.** i.w.; s.al.; ∞et.

71 —, 1,3-dibromo-* (*m-dibromobenzene*). $C_6H_4Br_2$, 235.86. Col.liq., n $1.6083^{17.5}$. **D.** $1.9523^{20.5}_{4}$, **m.p.** −6.9, **b.p.** 219.5 (217). **Soly.** i.w.; s.al.; s.et.

72 —, 1,4-dibromo-* (*p-dibromobenzene*). $C_6H_4Br_2$, 235.86. Col.monocl. f.al., n 1.57425. **D.** 2.261^{17}_{4}; liq 1.841^{89}, **m.p.** 86.9, **b.p.** 218–19. **Soly.** i.w.; 10^{25}al; 71^{25}et.; $90CS_2$; s.acet. lgr.

73 —, 1,2-dibutoxy-* (*pyrocatechol dibutyl ether*). $C_6H_4[O(CH_2)_3CH_3]_2$, 222.17. Pa.yel.liq. **b.p.** $135–8^{12}$.

74 —, 1,2-dichloro-* (*o-dichlorobenzene*). $C_6H_4Cl_2$, 146.95. Col.liq. n 1.5518^{22}. **D.** 1.3048^{20}_{4}, **m.p.** −17.5 **b.p.** 180–3. **Soly.** 0.0145^{25}w.; s.al. s.et.

75 —, 1,3-dichloro-* (*m-dichlorobenzene*). $C_6H_4Cl_2$, 146.95. Col.liq., n $1.54570^{20.9}$. **D.** 1.288^{20}_{4}, **m.p.** −24.8 **b.p.** 172. **Soly.** 0.0123^{25}w.; s.al. s.et.; s.bz.

76 —, 1,4-dichloro-* (*p-dichlorobenzene*). $C_6H_4Cl_2$, 146.95. Monocl lf.f.al., n $1.52104^{80.3}$. **D.** $1.4581^{20.5}_{4}$ **m.p.** 53, **b.p.** 173.4. **Soly.** 0.0079 w.; sl.s.c., v.s.h.al.; v.s.et.; s.bz., chl CS_2.

77 —, 1,3-dicyano-. See *Isophthalonitrile*.

78 —, 1,2-diethoxy-* (*pyrocatechol diethyl ether; catechol diethyl ether*). $C_6H_4(OC_2H_5)_2$, 166.11. Cr.f.pet.eth **m.p.** 43–5.

79 —, 1,3-diethoxy-* (*resorcinol diethyl ether*). $C_6H_4(OC_2H_5)_2$, 166.11 Pr. **m.p.** 12.4, **b.p.** 234–5. **Soly** i.w.; s.al.; s.et.

80 —, 1,4-diethoxy-* (*hydroquinone diethyl ether*). $C_6H_4(OC_2H_5)_2$, 166.11 Leaf. 71–2, **b.p.** 246. **Soly.** v.s.al v.s.et.; v.s.chl.

* Name approved by the International Union of Chemistry.

81 **Benzene*, 1, 2-diethyl-*** (*o-diethylbenzene*). $C_6H_4(C_2H_5)_2$, 134.11. Col.-liq. **D.** 0.8662^{19}_{4}, **m.p.** < −20, **b.p.** 184.5. **Soly.** i.w.; s.al.; s.et.

82 —, **1, 3-diethyl-*** (*m-diethylbenzene*). $C_6H_4(C_2H_5)_2$, 134.11. Col.liq., *n* 1.4955. **D.** 0.8602^{20}_{4}, **m.p.** < −20, **b.p.** 182. **Soly.** i.w.; s.al.; s.et.

83 —, **1, 4-diethyl-*** (*p-diethylbenzene*). $C_6H_4(C_2H_5)_2$, 134.11. Col.liq., *n* $49897^{16.2}$. **D.** 0.865^{20}_{4}, **m.p.** −35, **b.p.** 183. **Soly.** i.w.; s.al.; s.et.

84 —, **(diethylamino)methyl-.** See *Toluidine, N, N-diethyl-.*

85 —, **1, 3-diethyl-5-methyl-*.** See *Toluene, 3, 5-diethyl-.*

86 —, **dihydro-.** See *Cyclohexadiene*.*

87 —, **1, 2-dihydroxy-.** See *Pyrocatechol.*

88 —, **1, 3-dihydroxy-.** See *Resorcinol.*

89 —, **1, 4-dihydroxy-.** See *Hydroquinone.*

90 —, **1, 2-diiodo-*** (*o-diiodobenzene*). $C_6H_4I_2$, 329.87. Monocl.pl. or pr.f. lgr. **m.p.** 27; frz. 23.4, **b.p.** 286–7. **Soly.** v.sl.s.w.; s.al.; v.s.et.

91 —, **1, 3-diiodo-*** (*m-diiodobenzene*). $C_6H_4I_2$, 329.87. Rhomb.pl.f.al.-et. **m.p.** 40; frz. 34.2, **b.p.** 284.8. **Soly.** i.w.; s.al.; s.et.; s.chl.

92 —, **1, 4-diiodo-*** (*p-diiodobenzene*). $C_6H_4I_2$, 329.87. Rhomb.lf.f.al. **m.p.** 129.4, **b.p.** 285, subl. **Soly.** i.w.; s.al.; v.s.et.

93 —, **1, 3-diisoamoxy-** (*resorcinol diisoamyl ether*). $C_6H_4[OCH_2CH_2CH(CH_3)_2]_2$, 250.20. Cr.f.w. **m.p.** 47.

94 —, **1, 2-dimethoxy-*.** See *Veratrole.*

95 —, **1, 3-dimethoxy-*** (*resorcinol dimethyl ether*). $C_6H_4(OCH_3)_2$, 138.08. Col.liq. **D.** 1.0803^{0}_{4}, **m.p.** −52, **b.p.** 216.5–217.7. **Soly.** v.sl.s.w.; s.al.; s.et.

96 —, **1, 4-dimethoxy-*** (*hydroquinone dimethyl ether*). $C_6H_4(OCH_3)_2$, 138.08. Col.leaf.f.w. **D.** 1.053^{55}_{55}, **m.p.** 56, **b.p.** 212.6; 109^{20}. **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

97 —, **1, 2-dimethyl-*.** See *o-Xylene.*

98 —, **1, 3-dimethyl-*.** See *m-Xylene.*

99 —, **1, 4-dimethyl-*.** See *p-Xylene.*

00 —, **1, 2-dinitro-*** (*o-dinitrobenzene*). $C_6H_4(NO_2)_2$, 168.05. Col.-yel.monocl. pl.f.al. **D.** 1.565^{17}_{4}, **m.p.** 118 (116–7). **b.p.** 319^{773}. **Soly.** 0.01c., 0.38^{100}w.; 3.8^{25}al.; 27.1^{18}chl.; 5.0^{18}bz.; s.me.al.

01 —, **1, 3-dinitro-*.** (*m-dinitrobenzene*). $C_6H_4(NO_2)_2$, 168.05. Col.-yelsh. rhomb.need. or pl.f.al. **D.** 1.571^{0}_{4}; 1.5656^{20}_{4}, **m.p.** 89.57, **b.p.** 302.8^{770} (291). **Soly.** 0.0469^{15}, 0.32^{100}w.; 2.60^{20} al.; 6.7^{15}et.; 34.7^{18} bz.; s.tol., chl., ethyl acet.

02 —, **1, 4-dinitro-*** (*p-dinitrobenzene*). $C_6H_4(NO_2)_2$, 168.05. Col.-yel. monocl. need.f.al. **D.** 1.625^{18}_{4}, **m.p.** 173–4, **b.p.** 299^{777}, subl. **Soly.** 0.18^{100}w.; 0.4^{20}al.; 1.82^{18}chl.; 2.3^{18}bz., s.ac.a.

03 —, **1, 3-diphenyl-** (*m-phenylbiphenyl; m-terphenyl*). $(C_6H_5)_2C_6H_4$, 230.11. Need.f.al. **m.p.** 86–7, **b.p.** 363. **Soly.** i.w.; s.al.; s.et.; s.ac.a., bz.

04 —, **1, 4-diphenyl-.** See *Terphenyl.*

05 —, **1, 2-dipropoxy-*** (*pyrocatechol dipropyl ether*). $C_6H_4(OCH_2CH_2CH_3)_2$, 194.14. **b.p.** $117–20^{12}$.

06 —, **1, 3-dipropoxy-*** (*resorcinol dipropyl ether*). $C_6H_4(OCH_2CH_2CH_3)_2$, 194.14. Liq., *n* 1.5138^{33}. **D.** 1.035^{22}_{21}, **b.p.** 251; $127–8^{12}$.

07 —, **ethenoxy-*.** See *Ether, phenyl vinyl.*

08 —, **ethoxy-*.** See *Phenetole.*

09 —, **1-ethoxy-2-methoxy-4-propenyl-.** See *Isoeugenol, ethyl ether.*

10 —, **ethyl-** (*phenylethane*). $C_2H_5C_6H_5$, 106.08. Col.liq., *n* $1.49828^{14.5}$. **D.** 0.8669^{20}_{4}, **m.p.** −93.9 (−92.8). **b.p.** 136.15 (134–6). **Soly.** 0.014^{15}w.; ∞al.; ∞et.

11 —, **1-ethyl-4-isobutyl-.** $C_2H_5C_6H_4CH_2CH(CH_3)_2$, 162.14. Liq. **b.p.** 209–13. **Soly.** i.w.; s.et.

12 —, **1-ethyl-3-isopropyl-.** $C_2H_5C_6H_4CH(CH_3)_2$, 148.12. Liq. **m.p.** < −20, **b.p.** 190–2. **Soly.** i.w.; s.et.

13 —, **1-ethyl-4-isopropyl-.** $C_2H_5C_6H_4CH(CH_3)_2$, 148.12. Liq. **D.** 0.8606^{15}_{4}, **m.p.** < −20, **b.p.** 197–8. **Soly.** i.w.; s.et.

14 —, **ethylmethyl-.** See *Toluene, ethyl-.*

15 —, **1-ethyl-2-nitro-.** $NO_2C_6H_4C_2H_5$, 151.08. Col.liq. **D.** $1.126^{24.5}_{4}$, **m.p.** −23, **b.p.** 223–4. **Soly.** i.w.; v.s.al.; v.s.et.

16 —, **1-ethyl-3-nitro-.** $NO_2C_6H_4C_2H_5$, 151.08. Col.liq. **D.** 1.135^{20}_{4}, **b.p.** 242–3. **Soly.** i.w.; v.s.al.; v.s.et.

17 —, **1-ethyl-4-nitro-.** $NO_2C_6H_4C_2H_5$, 151.08. Col.liq. **D.** 1.124^{25}_{4}, **m.p.** −32, **b.p.** 241–2. **Soly.** i.w.; v.s.al.; v.s.et.

18 —, **1-ethyl-4-propyl-.** $C_2H_5C_6H_4(CH_2)_2CH_3$, 148.12. Liq. **D.** 0.867^{14}_{4}, **b.p.** $202–5^{765}$. **Soly.** i.w.; s.et.

19 —, **ethylsulfonyl-*.** See *Sulfone, ethyl phenyl.*

For explanations and abbreviations see beginning of table.

20 **Benzene, ethynyl-** (*phenylacetylene; acetylenylbenzene*). $C_6H_5C\vdots CH$,102.05. Col.liq., *n* $1.5524^{12.5}$. **D.** 0.9295^{20}_{4}, **m.p.** −40 to −48 (−56), **b.p.** 143. **Soly.** i.w.; ∞al.; ∞et.

21 —, **fluoro-***. C_6H_5F, 96.04. Col. liq., *n* $1.4646^{22.8}$. **D.** 1.024^{20}_{4}, **m.p.** −41.2, **b.p.** 86 (84–5). **Soly.** 0.154^{30}w.; ∞al.; ∞et.

22 —, ***p*-fluorobromo-.** See *Benzene, 1-bromo-4-fluoro-**.

23 —, **1-fluoro-4-iodo-***. FC_6H_4I, 221.95. Col.liq. **b.p.** 182.4. **Soly.** i.w.; s.al.; s.et

24 —, **hexabromo-***. (*perbromobenzene*). C_6Br_6, 551.50. Monocl.need.f.bz. **m.p.** 306. **Soly.** i.w.; i.al.; i.et.; sl.s.bz.

25 —, **hexachloro-*** (*perchlorobenzene*). C_6Cl_6, 284.74. Monocl. or rhomb.pr. **D.** 1.569^{236}; 2.044^{23}, **m.p.** 227 (224–6), **b.p.** 326. **Soly.** i.w.; i.c., v.sl.s.h.al.; v.sl.s.et.; s.h.bz.

26 —, **hexaethyl-.** $C_6(C_2H_5)_6$, 246.23. Col.monocl.f.al., *n* $1.480^{130.4}$. **D.** 0.831^{130}, **m.p.** 129, **b.p.** 298. **Soly.** i.w.; s.al.; v.s.et.; v.s.bz.

27 —, **hexahydro-.** See *Cyclohexane.*

28 —, **hexahydroxy-** (*benzenehexol*). $C_6(OH)_6$, 174.05. Need.f.HCl **m.p.** d. 200. **Soly.** sl.s.w.; sl.s.al.; sl.s.et.; sl.s.bz.

29 —, **hexaiodo-*** (*periodobenzene*). C_6I_6, 833.52. Red-br.need.f.bz. **m.p.** 350 d. **Soly.** i.w.; i.al.; i.et.

30 —, **hexamethyl-.** $C_6(CH_3)_6$, 162.14. Col.rhomb.pl.f.al., *n* 1.8012, 1.745, 1.5032 (587 mμ). **m.p.** 166 (159–62), **b.p.** 265. **Soly.** i.w.; 0.16^{0}al.; v.s.bz.

31 —, **hexyloxy-.** See *Ether, hexyl phenyl.*

32 —, **hydroxy-.** See *Phenol.*

33 —, **iodo-** (*phenyl iodide*). C_6H_5I, 203.96. Col.liq., *n* $1.62145^{18.5}$. **D.** 1.832^{20}_{4}, **m.p.** −31.4, **b.p.** 188.6. **Soly.** 0.034^{30}w.; s.al.; ∞et.; s.chl.

34 —, **1-iodo-2-nitro-***. $NO_2C_6H_4I$, 248.96. Yel.rhomb.need. **D.** 1.810^{16}_{4}, **m.p.** 49.4, **b.p.** 290. **Soly.** i.w.; sl.s.al.; sl.s.et.

35 —, **1-iodo-3-nitro-***. $NO_2C_6H_4I$, 248.96. Col.cr. **D.** 1.804^{16}_{4}, **m.p.** 36, **b.p.** 280. **Soly.** i.w.; sl.s.al.; sl.s.et.

36 —, **1-iodo-4-nitro-***. $NO_2C_6H_4I$, 248.96. Col.need. **D.** $1.8090^{1.5}_{4}{}^{.5}$, **m.p.** 171.5, **b.p.** 288.1. **Soly.** i.w.; sl.s.al.; sl.s.et.

37 —, **iodoso-.** C_6H_5IO, 219.96. Yel. powd. **m.p.** exp.abt. 210. . **Soly.** s.w.; s.al.; i.c., s.h.et.; s.h.chl.

38 —, **iodoxy-.** $C_6H_5IO_2$, 235.96. Need. f.w. **m.p.** exp. 236–7. **Soly.** v.sl. s.w.; i.al.; v.s.bz., chl.; s.h.ac.a.

39 —, **isoallyl-.** See *Benzene, propenyl-.*

40 —, **isoamoxy-.** See *Ether, isoamyl phenyl.*

41 —, **isoamyl-** (*3-methyl-1-phenylbutane*). $C_6H_5(CH_2)_2CH(CH_3)_2$, 148.12. Col.liq. **D.** 0.885^{20}_{4}, **b.p.** 194 (198–9). **Soly.** i.w.; ∞al.; ∞et.

42 —, **isobutoxy-.** See *Ether, isobutyl phenyl.*

43 —, **isobutyl-** (*2-methyl-1-phenylpropane*). $C_6H_5CH_2CH(CH_3)_2$, 134.11. Col.liq., *n* $1.4957^{14.6}$. **D.** 0.8673^{20}_{4}, **b.p.** 171.4. **Soly.** i.w.; ∞al.; ∞et.

44 —, **isohexyl-** (*4-methyl-1-phenylpentane*). $C_6H_5(CH_2)_3CH(CH_3)_2$, 162.14. Liq. **D.** 0.857, **b.p.** 214–5. **Soly.** i.w.; sl.s.al.; s.et.

45 —, **isopropenyl-** (*2-phenylpropene; uns-methylphenylethylene*). $CH_3C(C_6H_5){:}CH_2$, 118.08. Col.liq. **D.** 0.9139^{20}_{4}, **b.p.** 160.5–1.5. **Soly.** i.w.; s.al.; s.et.

46 —, **isopropoxy-***. See *Ether, isopropyl phenyl.*

47 —, **isopropyl-.** See *Cumene.*

48 —, **isopropylmethyl-.** See *Cymene.*

49 —, **methoxy-***. See *Anisole.*

50 —, **1-methoxy-4-propenyl-.** See *Anethole.*

51 —, **methyl-.** See *Toluene.*

52 —, **(α-methylbutyl)-** (*2-phenylpentane; sec-n-amylbenzene*). $C_6H_5CH(CH_3)CH_2CH_2CH_3$, 148.12. Liq. **D.** 0.874^{15}_{4}, **b.p.** 189.3 (191–3). **Soly.** i.w.; s.al.; s.et.

53 —, **3, 4-methylenedioxy-1-propenyl-.** See *Isosafrole.*

54 —, **(β-methylpropoxy)-***. See *Ether, isobutyl phenyl.*

55 —, **methylpropyl-.** See *Toluene, propyl-.*

56 —, **nitro-.** $C_6H_5NO_2$, 123.05. Yel liq., *n* 1.55291. **D.** 1.19867^{25}_{4}, **m.p.** 5.7, **b.p.** 210.9. **Soly.** 0.19^{20}; 0.8^{80}w. v.s.c.al.; v.s.et.; s.bz., oils.

57 —, **nitroso-***. C_6H_5NO, 107.05. Col rhomb. or monocl.f.et. **m.p.** 68, **b.p** 59^{18}. **Soly.** i.w.; s.al.; s.et.; s.chl. sl.s.lgr.

58 —, **pentaamino-.** See *Benzenepentamine**.

* Name approved by the International Union of Chemistry.

59 Benzene, pentabromo-*. C_6HBr_5, 472.59. Need.f.al. **m.p.** 293, **b.p.** subl. **Soly.** sl.s.al.; sl.s.et.; s.bz.

60 —, **pentachloro-*.** C_6HCl_5, 250.29. Need.f.al. **D.** 1.8342^{16}_{4}, **m.p.** 86, **b.p.** 277. **Soly.** i.w.; v.sl.s.al.; v.s.et.; s.bz., CS_2.

61 —, **pentaethyl-*.** $(C_2H_5)_5C_6H$, 218.20 Col.liq., *n* 1.516. **D.** 0.896, **m.p.** < −20, **b.p.** 277. **Soly.** i.w.

62 —, **pentaiodo-*.** C_6HI_5, 707.61. Need.f.al. **m.p.** 172, **b.p.** subl. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; s.chl., h.ac.a.

63 —, **pentamethyl-*.** $(CH_3)_5C_6H$, 148.12. Col.pr.f.dil.al., *n* $1.50489^{72.8}$. **D.** liq. 0.847^{107}, **m.p.** 53, **b.p.** 230. **Soly.** i.w.; v.s.al.

64 —, **perbromo-.** See *Benzene, hexabromo-**.

65 —, **perchloro-.** See *Benzene, hexachloro-**.

66 —, **periodo-.** See *Benzene, hexaiodo-**.

67 —, **phenoxy-*.** See *Phenyl ether*.

68 —, **phenyl-.** See *Biphenyl*.

69 —, **phenyldithio-*.** See *Phenyl disulfide*.

70 —, **phenylsulfonyl-*.** See *Phenyl sulfone*.

71 —, **phenylthio-*.** See *Phenyl sulfide*.

72 —, **(2-propenoxy)-*.** See *Ether, allyl phenyl*.

73 —, **propenyl-** (*1-phenylpropene; 1-propenylbenzene; isoallylbenzene*). CH_3-$CH:CHC_6H_5$, 118.08. Col.liq. **D.** 0.914^{20}_{4}; 0.924^{15}_{4}, **b.p.** 175, (176–7). **Soly.** i.w.; s.al.; ∞ et.

75 —, **propoxy-*.** See *Ether, phenyl propyl*.

76 —, **propyl-** (*1-phenylpropane*). $C_6H_5CH_2CH_2CH_3$, 120.09. Col.liq., *n* $1.49549^{12.25}$. **D.** 0.862^{20}_{4}, **m.p.** −101.6, **b.p.** 159.45 (153–7). **Soly.** 0.006^{15}w.; s.al.; s.et.

77 —, **1-propynyl-.** See *Propyne, 1-phenyl-*.

78 —, **1, 2, 3, 5-tetrabromo-*.** $C_6H_2Br_4$, 393.68. Need.f.al. **m.p.** 98.5, **b.p.** 329. **Soly.** i.w.; v.sl.s.al.; v.s.et.; v.s.bz.

79 —, **1, 2, 4, 5-tetrabromo-*.** $C_6H_2Br_4$, 393.68. Monocl.pr.f.CS_2. **D.** 3.027^{20}_{4}, **m.p.** 178. **Soly.** i.w.; v.sl.s.al.; v.s.et.

80 —, **1, 2, 3, 4-tetrachloro-*.** $C_6H_2Cl_4$, 215.84. Need. **m.p.** 47.5, **b.p.** 254. **Soly.** i.w.; sl.s.al.; v.s.et.; v.s.CS_2.

81 —, **1, 2, 3, 5-tetrachloro-*.** $C_6H_2Cl_4$, 215.84. Need.f.al. **m.p.** 51, **b.p.** 246. **Soly.** sl.s.c., s.h.w.; v.sl.s.al.; s.et.; v.s.CS_2.

82 —, **1, 2, 4, 5-tetrachloro-*.** $C_6H_2Cl_4$, 215.84. Monocl.need.f.et. **D.** 1.734^{10}_{4}; 1.858^{21}_{4}, **m.p.** 138, **b.p.** 246. **Soly.** i.w.; sl.s.h.al.; s.et.; s.bz., CS_2.

83 —, **1, 2, 3, 4-tetraethyl-.** $(C_2H_5)_4$-C_6H_2, 190.17. Liq., *n* 1.5083. **D.** 0.887, **b.p.** 254. **Soly.** i.w.; sl.s.al.; s.et.

84 —, **1, 2, 4, 5-tetraethyl-.** $(C_2H_5)_4$-C_6H_2, 190.17. Col.liq. or cr., *n* 1.5025. **D.** 0.888^{16}_{4}, **m.p.** 13, **b.p.** 250. **Soly.** i.w.; v.s.al.; v.s.et.

85 —, **tetrahydro-.** See *Cyclohexene*.

86 —, **tetrahydroxy-.** See *Benzenetetrol*.

87 —, **1, 2, 3, 4-tetraiodo-.** $C_6H_2I_4$, 581.70. Pr.f.CS_2. **m.p.** 136, **b.p.** subl. **Soly.** v.s.al.; v.s.et.; s.chl.

88 —, **1, 2, 3, 5-tetraiodo-.** $C_6H_2I_4$, 581.70. Pr.f.et. **m.p.** 148, **b.p.** subl. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; v.s.h.ac.a.

89 —, **1, 2, 4, 5-tetraiodo-.** $C_6H_2I_4$, 581.70. Need.f.et. **m.p.** 254, **b.p.** subl. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; v.s.CS_2.

90 —, **1, 2, 3, 4-tetramethyl-.** See *Prehnitene*.

91 —, **1, 2, 3, 5-tetramethyl-.** See *Isodurene*.

92 —, **1, 2, 4, 5-tetramethyl-.** See *Durene*.

93 —, **triamino-.** See *Benzenetriamine*.

94 —, **triazo-** (*diazobenzene imide; phenyl azoimide*). $C_6H_5N_3$, 119.06. Yel. oil, *n* $1.56421^{22.5}$. **D.** $1.078^{22.5}$, **b.p.** 59^{12}; exp. **Soly.** i.w.; sl.s.al.; sl.s.et.

95 —, **1, 2, 3-tribromo-*** (*v-tribromobenzene*). $C_6H_3Br_3$, 314.77. Col. monocl.pr.f.al. **D.** 2.658, **m.p.** 87.4. **Soly.** i.w.; sl.s.h.al.; v.s.et.

96 —, **1, 2, 4-tribromo-*.** (*as-tribromobenzene*). $C_6H_3Br_3$, 314.77. Need.f. al. **m.p.** 44, **b.p.** 276. **Soly.** i.w.; sl.s.al.; s.et.; v.s.bz.; s.CS_2.

97 —, **1, 3, 5-tribromo-*** (*sym-tribromobenzene*). $C_6H_3Br_3$, 314.77. Need.f. al. **m.p.** 119–21, **b.p.** 278. **Soly.** i.w.; sl.s.h.al.; s.et.; s.bz., chl.

98 —, **1, 2, 3-trichloro-*** (*v-trichlorobenzene*). $C_6H_3Cl_3$, 181.39. Pl.f.al. **m.p.** 52, **b.p.** 219. **Soly.** i.w.; sl.s.al.; v.s.et.

99 —, **1, 2, 4-trichloro-*** (*as-trichlorobenzene*). $C_6H_3Cl_3$, 181.39. Col.rhomb., *n* 1.5671. **D.** 1.574^{10}_{4}, **m.p.** 17, **b.p.** 213. **Soly.** i.w.; sl.s.al.; v.s.et.

00 —, **1, 3, 5-trichloro-*** (*sym-trichlorobenzene*). $C_6H_3Cl_3$, 181.39. Lng.need. **m.p.** 63, **b.p.** 208.5. **Soly.** i.w.; s.al.; v.s.et.

For explanations and abbreviations see beginning of table.

01 Benzene, 1, 3, 5-triethoxy-* (*phloroglucinol triethyl ether*). $C_6H_3(OC_2H_5)_3$, 210.14. Col.cr. **m.p.** 43, **b.p.** 175^{24}. **Soly.** i.w.; v.s.al.; v.s.et.

02 —, 1, 2, 4-triethyl- (*as-triethylbenzene*). $(C_2H_5)_3C_6H_3$, 162.14. Arom. liq., *n* 1.4972. **D.** 0.8819^{19}_{4}, **b.p.** 218. **Soly.** i.w.; s.al.; s.et.

03 —, 1, 3, 5-triethyl- (*sym-triethylbenzene*). $(C_2H_5)_3C_6H_3$, 162.14. Col.liq., *n* 1.4939. **D.** 0.863^{20}_{4}, **b.p.** 218. **Soly.** i.w.; v.s.al.; v.s.et.

04 —, 1, 3, 5-trihydroxamino-. See 1, 3, 5-*Cyclohexanetrione, trioxime.*

05 —, 1, 2, 3-trihydroxy-. See *Pyrogallol.*

06 —, 1, 2, 4-trihydroxy-. See **1, 2, 4-***Benzenetriol.*

07 —, 1, 3, 5-trihydroxy-. See *Phloroglucinol.*

08 —, 1, 2, 3-triiodo-* (*v-triiodobenzene*). $C_6H_3I_3$, 455.78. Need.f.al. **m.p.** 116, **b.p.** subl. **Soly.** i.w.; v.s.al.; v.s.et.

09 —, 1, 2, 4-triiodo-* (*as-triiodobenzene*). $C_6H_3I_3$, 455.78. Need.f.al. **m.p.** 91 (84), **b.p.** subl. **Soly.** i.w.; s.al.; s.et.; s.chl.

10 —, 1, 3, 5-triiodo-* (*sym-triiodobenzene*). $C_6H_3I_3$, 455.78. Need.f.ac.a. **m.p.** 184 (180), **b.p.** subl. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; s.ac.a.

11 —, 1, 2, 3-trimethoxy-* (*pyrogallol trimethyl ether*). $(CH_3O)_3C_6H_3$, 168.09. Col.rhomb.need.f.dil.al. **D.** 1.099^{76}_{78}, **m.p.** 47, **b.p.** 241 (235–6). **Soly.** v.s.al.; v.s.et.

12 —, 1, 3, 5-trimethoxy-* (*phloroglucinol trimethyl ether*). $C_6H_3(OCH_3)_3$, 168.09. Col.pr.f.al. **m.p.** 54–5 (52); **b.p.** 255.5. **Soly.** i.w.; v.s.al.; v.s.et., v.s.bz.

13 —, 1, 2, 4-trimethoxy-5-propenyl- (*asaron*). $CH_3CH{:}CHC_6H_2(OCH_3)_3$, 208.12. Monocl.need.f.w., *n* 1.5719^{11}. **D.** 1.165, **m.p.** 67, **b.p.** 296, subl.d. **Soly.** sl.s.h.w.; v.s.al.; v.s.et.; s.ac.a., chl., CCl_4.

14 —, 1, 2, 3-trimethyl-. See *Hemimellitene.*

15 —, 1, 2, 4-trimethyl-. See *Pseudocumene.*

16 —, 1, 3, 5-trimethyl-. See *Mesitylene.*

17 —, 1, 2, 3-trinitro- (*v-trinitrobenzene*). $C_6H_3(NO_2)_3$, 213.05. Lt.grn. pr.f.al. **m.p.** 127.5. **Soly.** i.w.; 10h.al.

18 —, 1, 2, 4-trinitro- (*as-trinitrobenzene*). $C_6H_3(NO_2)_3$, 213.05. Col.-yel. cr. **D.** 1.73^{16}_{4}, **m.p.** 61.0. **Soly.** sl. s.w.; 5.45^{15}al.; 7.13^{15}et.

19 —, 1, 3, 5-trinitro- (*sym-trinitrobenzene*). $C_6H_3(NO_2)_3$, 213.05.Col.yel. rhomb.pl.f.bz. **D.** 1.688^{20}_{4}, **m.p.** 61; 121, **b.p.** d. **Soly.** 0.04^{16}w.; 1.9^{16}al.; $1.07^{17.5}$et.; v.s.bz.

20 —, 1, 3, 5-triphenyl- (*sym-triphenylbenzene*). $(C_6H_5)_3C_6H_3$, 306.14. Rhomb.tab.f.et., *n* 1.524, 1.867, 1.873. **D.** 1.206^{20}_{4}, **m.p.** 170. **Soly.** sl.s.al.; sl.s.et.; s.bz.

21 —, vinyl-. See *Styrene.*

22 Benzenearsonic acid, *p*-amino-. See *Arsanilic acid.*

23 Benzene azimide. See 1, 2, 3-*Benzotriazole.*

24 Benzeneazoaniline. See *Azobenzene, amino-.*

25 Benzeneazoethane (*ethaneazobenzene; ethylphenyldiimide*). $C_6H_5N{:}NC_2H_5$, 134.09. Lt.yel.oil. **b.p.** 175–85 d. **Soly.** sl.s.w.; v.s.al.; v.s.et.

26 Benzeneazomethane (*methaneazobenzene; methylphenyldiimide*). $C_6H_5N{:}NCH_3$, 120.08. Yel.oil. **b.p.** 150. **Soly.** s.al.; s.et.

27 Benzeneazo-β-naphthol, *p*-nitro-. See 2-*Naphthol, 1-p-phenylazo-.*

28 4 - Benzeneazo-α-naphthylamine. See 1-*Naphthylamine*, 4-*phenylazo.*

29 Benzenecarbonal.* See *Benzaldehyde.*

30 Benzenecarbonamide. See *Benzamide.*

31 Benzenecarbonamidine.* See *Benzamidine.*

32 Benzenecarbonitrile.* See *Benzonitrile.*

33 Benzenecarbonyl bromide*, etc. See *Benzoyl bromide*, etc.

34 Benzenecarbothioic acid*. See *Benzoic acid, thio-.*

35 Benzenecarboxylic acid*. See *Benzoic acid.*

36 1, 2-Benzenediacetonitrile (*o-xylylene cyanide*). $C_6H_4(CH_2CN)_2$, 156.08. Col.cr.f.et. **m.p.** 59–60. **Soly.** s.al.; s.et.

37 1, 3-Benzenediacetonitrile (*m-xylylene cyanide*). $C_6H_4(CH_2CN)_2$, 156.08. Cr. **m.p.** 28–9, **b.p.** 305–10^{300}sl.d. **Soly.** i.w.; s.al.; s.et.; s.chl.

38 1, 4-Benzenediacetonitrile (*p-xylylene cyanide*) $C_6H_4(CH_2CN)_2$, 156.08. Lng.pr.f.et. or need.f.w. **m.p.** 98. **Soly.** sl.s h.w.; s.al.; s.et.; s.chl.

39 Benzenediamine. See *Phenylenediamine.*

* Name approved by the International Union of Chemistry.

40 Benzenediazoanilide. See *Diazoaminobenzene**.

41 Benzenediazonium chloride* (*diazobenzene chloride*). $C_6H_5N(\vdots$ 1, 140.51. Col.need. **m.p.** d., **b.p.** exp. **Soly.** v.s.w.; s.al.; i.et.; s.acet.; i.bz., lgr.

42 Benzenediazonium cyanide* (*diazobenzene cyanide*). $C_6H_5N(\vdots N)CN$, 131.06. Yel.pr. **m.p.** 69. **Soly.** sl.s.w.

43 Benzenediazonium nitrate* (*diazobenzene nitrate*). $C_6H_5N(\vdots N)NO_3$, 167.06. Col.need. **D.** 1.37^{20}_{4}, **m.p.** exp. at 90. **Soly.** v.s.w.; s.al.; i.et.; i.chl., bz.

44 Benzenediazonium tribromide* (*diazobenzene perbromide*). $C_6H_5N(\vdots N)Br_3$, 344.80. Or.yel.tab.f.al. **m.p.** 63.5 d. **Soly.** i.w.; sl.s.al.; i.et.

45 Benzenedicarbinol. See *Xylylene glycol*.

46 1, 2-Benzenedicarbonal*. See *Phthalaldehyde*.

47 1, 3-Benzenedicarbonal*. See *Isophthalaldehyde*.

48 1, 4-Benzenedicarbonal.* See *Terephthalaldehyde*.

49 1, 3-Benzenedicarbonitrile*. See *Isophthalonitrile**.

50 1, 4-Benzenedicarbonitrile*. See *Terephthalonitrile*.

51 1, 2-Benzenedicarbonyl chloride*. See *Phthalyl chloride*.

52 1, 3-Benzenedicarbonyl chloride*. See *Isophthalyl chloride*.

53 1, 4-Benzenedicarbonyl chloride*. See *Terephthalyl chloride*.

54 1, 2-Benzenedicarboxylic acid*. See *Phthalic acid*.

55 1, 3-Benzenedicarboxylic acid*. See *Isophthalic acid*.

56 1, 4-Benzenedicarboxylic acid. See *Terephthalic acid*.

57 1, 2-Benzenediol*. See *Pyrocatechol*.

58 1, 3-Benzenediol*. See *Resorcinol*.

59 1, 4-Benzenediol*. See *Hydroquinone*.

60 1, 3-Benzenedithiol*. See *Resorcinol, dithio-*.

61 1, 4-Benzenedithiol*. See *Hydroquinone, dithio-*.

62 Benzenehexacarboxylic acid*. See *Mellitic acid*.

63 Benzenehexol*. See *Benzene, hexahydroxy-*.

64 Benzeneindone. See *Aposafranone*.

65 Benzenepentacarboxylic acid.* $C_6H(COOH)_5$, 298.05. Rhomb. **m.p.** 238; $+5H_2O$ d. 238. **Soly.** s.w.; s.al.; sl.s.et.; i.bz.

66 Benzenepentamine* (*pentaaminobenzene*). $C_6H(NH_2)_5$, 153.13. Need. **Soly.** v.s.w.; i.al.; i.et.

67 Benzenepropionic acid. See *Hydrocinnamic acid*.

68 Benzenesiliconic acid (*silicobenzoic acid*). C_6H_5SiOOH, 138.11. Glassy f.et. **m.p.** 92. **Soly.** i.w.; v.s.et.; s.KOH.

69 Benzenesulfanilide. See *Benzenesulfonanilide*.

70 Benzene sulfide. See *Phenyl sulfide*.

71 Benzenesulfinic acid*. $C_6H_5SO_2H$, 142.11. Pr.f.w. **m.p.** 84, **b.p.** 100 d. **Soly.** sl.s.w.; v.s.al.; v.s.et.

72 Benzenesulfonamide (*benzenesulfonic amide*). $C_6H_5SO_2NH_2$, 157.12. Monocl.need.f.w. or pl.f.al. **m.p.** 156. **Soly.** 0.43^{16}w.; v.s.h.al.; v.s.et.

73 Benzenesulfonanilide (*benzenesulfanilide*). $C_6H_5SO_2NHC_6H_5$, 233.15. Tetr.pr., n 1.600, 1.649. **m.p.** 110. **Soly.** 4.3^{16}w.; v.s.al.; v.s.et.

74 Benzene sulfone. See *Phenyl sulfone*.

75 Benzenesulfone chloride. See *Benzenesulfonyl chloride**.

76 Benzenesulfonic acid*. $C_6H_5SO_3H$, 158.11. Col.leaf. or need. **m.p.** $+1.5H_2O$ 43–4; anh. 50–1, **b.p.** 137. **Soly.** v.s.w.; v.s.al.; i.et.; sl.s.bz.

77 —, sodium salt. $C_6H_5SO_3Na$, 180.10. Need.f.w. **m.p.** 450 d. **Soly.** 47w.; sl.s.h.al.

78 —, *o*-amino-. See *Orthanilic acid*.

79 —, *m*-amino-. See *Metanilic acid*.

80 —, *p*-amino-. See *Sulfanilic acid*.

81 —, *p*-(4-amino-1-naphthylazo)-. $SO_3HC_6H_4N{:}NC_{10}H_6NH_2$, 327.19. Vlt.need. **Soly.** i.w.; v.sl.s.al.

82 —, *o*-bromo-. $BrC_6H_4SO_3H$, 237.02. Deliq.need. **Soly.** v.s.w.; s.al.

83 —, *p*-bromo-. $BrC_6H_4SO_3H$, 237.02. Deliq.need. **m.p.** 102–3, **b.p.** 155^{25}. **Soly.** s.w.; s.al.

84 —, *p*-chloro-. $ClC_6H_4SO_3H$, 192.56. Deliq.need. **m.p.** 68, **b.p.** $147–8^{25}$. **Soly.** s.w.; s.al.; i.et.; i.bz.

85 —, *p*-(*p*-dimethylaminophenylazo)-, sodium salt. See *Methyl orange*.

86 —, *o*-formyl- (*o-benzaldehydesulfonic acid*). $C_6H_5(CHO)SO_3H$, 187.11. **m.p.** 114. **Soly.** s.w.

For explanations and abbreviations see beginning of table.

87 **Benzenesulfonic acid, methyl-.** See *Toluenesulfonic acid.*

88 **—, o-nitro-.** $NO_2C_6H_4SO_3H$, 203.11. Leaf. **m.p.** 70, **b.p.** d. **Soly.** v.s.w.; s.al.; i.et.; s.alk.

89 **Benzenesulfonic amide.** See *Benzenesulfonamide**.

90 **Benzenesulfonyl chloride*** (*benzenesulfonic chloride; benzenesulfone chloride*). $C_6H_5SO_2Cl$, 176.56. Rhomb.cr.or col. oily liq. **D.** 1.378^{23}, **m.p.** 14.5; frz. 0, **b.p.** 246–7 d. **Soly.** i.w.; v.s.al.; s.et.

91 **—, p-bromo-.** $BrC_6H_4SO_2Cl$, 255.46. Tricl. or monocl.f.et. **m.p.** 75, **b.p.** 153^{15}. **Soly.** i.w.; d.al.; v.s.et.

92 **1, 2, 3, 4-Benzenetetracarboxylic acid*.** See *Mellophanic acid.*

93 **1, 2, 3, 5-Benzenetetracarboxylic acid*.** See *Prehnitic acid.*

94 **1, 2, 4, 5-Benzenetetracarboxylic acid*.** See *Pyromellitic acid.*

95 **1, 2, 3, 5-Benzenetetrol*** (*1, 2, 3, 5-tetrahydroxybenzene*). $C_6H_2(OH)_4$, 142.05. Need.f.w. **m.p.** 165. **Soly.** v.s.w.; v.s.al.; i.chl., bz.

96 **1, 2, 4, 5-Benzenetetrol*.** C_6H_2-$(OH)_4$, 142.05. Leaf.f.ac.a. **m.p.** 220. **Soly.** v.s.w.; v.s.al.; v.s.et.; sl.s.HCl.

97 **Benzenethiol*.** See *Phenol, thio-.*

98 **1, 2, 3-Benzenetriamine*** (*vic-triaminobenzene*). $C_6H_3(NH_2)_3$, 123.09. Cr. **m.p.** 103, **b.p.** 336. **Soly.** v.s.w.; v.s.al.; v.s.et.

99 **1, 2, 4-Benzenetriamine*** (*asym-triaminobenzene*). $C_6H_3(NH_2)_3$, 123.09. Leaf.f.chl. **m.p.** 100, **b.p.** 340. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.; s.chl.

00 **1, 2, 3-Benzenetricarboxylic acid*.** See *Hemimellitic acid.*

01 **1, 2, 4-Benzenetricarboxylic acid*.** See *Trimellitic acid.*

02 **1, 3, 5-Benzenetricarboxylic acid*.** See *Trimesic acid.*

03 **1, 2, 3-Benzenetriol*.** See *Pyrogallol.*

04 **1, 2, 4-Benzenetriol*** (*hydroxyquinol; hydroxyhydroquinone*). $C_6H_3(OH)_3$, 126.05. Col.monocl.leaf.f.w. or et. **m.p.** 140.5. **Soly.** v.s.w.; v.s.al.; v.s.et.; sl.s.bz.

05 **1, 3, 5-Benzenetriol*.** See *Phloroglucinol.*

06 **1, 3, 5-Benzenetrisulfonic acid*.** $C_6H_3(SO_3H)_3$, 318.23. Deliq.cr. $+3H_2O$. **m.p.** d. >100. **Soly.** s.w.

07 **Benzenyl amidine.** See *Benzamidine.*

08 **Benzenyl aminoxime.** See *Benzamide, oxime.*

09 **Benzenylphenyleneamidine.** See *Benzimidazole, 2-phenyl-.*

10 **Benzhydrol.** See *Benzohydrol.*

11 **Benzidine** (*p, p'-bianiline; 4, 4'-diaminobiphenyl*). $NH_2C_6H_4C_6H_4NH_2$, 184.11. Wh. or sltly.redsh.cr.powd. or leaf.f.H_2O. **D.** 1.250^{20}_{4}, **m.p.** 128, **b.p.** 401.7. **Soly.** 0.04^{12}, 0.94^{100}w.; s.al.; 2.2et.

12 **—, 3-amino-** (NH_2 = 1) (*o-amino-p, p'-diaminobiphenyl*). $(NH_2)_2C_6H_3C_6H_4NH_2$, 199.13. Need. **m.p.** 134.

13 **—, *N, N'*-diacetyl-** (*p, p'-biacetanilide*). $(CH_3CONHC_6H_4)_2$, 268.14. Need. f.ac.a. **m.p.** 331 (314–6), **b.p.** subl.d. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.

14 **—, 2, 2'-dimethoxy-.** See 4, 4'-*Bi-o anisidine.*

15 **—, 2, 2'-dimethyl-.** See *o-Tolidine.*

16 **—, *N, N'*-diphenyl-.** $[C_6H_4NHC_6H_5]_2$, 336.17. Leaf.f.tol. **m.p.** 242. **Soly.** i.w.; sl.s.al.; s.h.tol.; sl.s.bz., acet.

17 **—, 2-ethoxy-** (NH_2 = 1)(*3-ethoxybenzidine* (NH_2 = 4); *4, 4'-diamino-3-ethoxybiphenyl*). $NH_2C_6H_4C_6H_3$-$(OC_2H_5)NH_2$, 228.14. Glit.flat need. **m.p.** 134 (139). **Soly.** v.sl.s.w. v.s.h.al.; v.sl.s.et.

18 **3, 3'-Benzidinedisulfonic acid** (NH_2 = 1) (*4, 4'-diamino-2-2'-biphenyldisulfonic acid*). $(NH_2)_2C_{12}H_6(SO_3H)_2$, 344.23. Monocl.pr.f.w. **m.p.** d. >175. **Soly.** 0.0791^{22}w.; v.sl.s.al.; v.sl.s.et.

19 **Benzidine sulfone** (*dibenzothiophene-2, 7-diamine 9-dioxide; 2, 7-diaminobiphenylene sulfone*). $(NH_2C_6H_3)_2SO_2$, 246.15. Yel.pl. **m.p.** >350. **Soly.** i.w.; i.al.; i.et.; i.h.bz.

20 **Benzil** (*diphenylglyoxal; bibenzoyl; dibenzoyl; diphenyl diketone*). C_6H_5-$COCOC_6H_5$, 210.08. Yel. rhomb.need. f.al. **D.** 1.521^{13}_{4}, **m.p.** 95, **b.p.** 346–8 d. **Soly.** i.w.; v.s.al.; v.s.et.

21 —, α- or *anti*-dioxime. $(C_6H_5C{:}NOH)_2$, 240.11. Leaf. **m.p.** 237 d. **Soly**; i.w.; 0.05^{17}al.; v.sl.s.et.; s.conc.NaOH. v.sl.s.ac.a.

22 —, β- or *syn*-dioxime. $(C_6H_5C{:}NOH)_2$, 240.11. Need. ($+C_2H_6O$) f.al. **m.p.** 206–7 d. **Soly.** sl.s.h.w.; 15.26^{17}al.; s.et.; s.ac.a., NH_3, conc.NaOH.

23 —, γ- or *amphi*-dioxime. $(C_6H_5C{:}NOH)_2$, 240.11. Need. (+al.) f.al. **m.p.** -al. 100; 164–5. **Soly.** i.w.; >15.3^{17}al.; s.conc.alk.; i.lgr.

* Name approved by the International Union of Chemistry.

24 **Benzil,** α-mono-oxime. $C_6H_5COC(:NOH)C_6H_5$, 225.09. Lust.pl.f.al. **m.p.** 137–8, **b.p.** d. 200. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.chl., ac.a.; sl.s.c.bz.,lgr.

25 —, β-mono-oxime. $C_6H_5COC(:NOH)C_6H_5$, 225.09. Need.f.bz. **m.p.** 113–4. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.most org.solv.; i.lgr.

26 —, *syn* (or α)-osazone (*benzil synbisphenylhydrazone*) $(C_6H_5C:NNHC_6H_5)_2$, 390.20. Yel.need. **m.p.** 208. **Soly.** sl.s.c.al.; s.et.; 1.7^{19}acet.

27 —, *anti* (or β)-osazone) (*benzil bisphenylhydrazone*) $(C_6H_5C:NNHC_6H_5)_2$, 390.20. Need. **m.p.** 225, **b.p.** d. **Soly.** i.w.; sl.s.al.; sl.s.et.; 2.4^{19}acet.; v.s.h.chl., bz.

28 **Benzilam.** See *Oxazole, triphenyl-*.

29 **Benzilic acid** (*diphenylglycolic acid*). $(C_6H_5)_2COHCOOH$, 228.09. Monocl. need.f.w. **m.p.** 150, **b.p.** d. 180. **Soly.** v.s.h.w.; v.s.al.; v.s.et.; s.H_2SO_4

30 **Benzimidazole** (*benzoglyoxaline*). $C_6H_4NHCH:N$, 118.06. Rhomb.pl.f. al. **m.p.** 170, **b.p.** <360. **Soly.** s.w.; s.al.; s.et.; s.a., alk.

31 —, **2-phenyl-** (*2-phenylbenzoglyoxaline; benzenylphenyleneamidine*). $C_6H_4NHC(C_6H_5):N$, 194.09. Tab.f. ac.a.; need.f.w. **m.p.** 280 (291). **Soly.** sl.s.w.; v.s.al.; sl.s.bz., chl.

32 **2(3)-Benzimidazolone** (*phenyleneurea*). $C_6H_4NHCONH$, 134.06. Plates. **m.p.** 305. **Soly.** sl.s.w.; s.al.; sl.s.bz.; i.dil.a.

33 **Benzocaine** (*ethyl p-aminobenzoate; anaesthesin*). $NH_2C_6H_4COOC_2H_5$, 165.09. Col.pr.f.al. or rhomb.f.et. **m.p.** 91–2 (88–90). **Soly.** 0.04w.; 20al.; 14.3et;. s.chl.

34 **1, 3-Benzodiazine.** See *Quinazoline.*

35 **1, 4-Benzodiazine.** See *Quinoxaline.*

36 **Benzodifluorochloride.** See *Toluene, α-chloro-α, α-difluoro-.*

37 **Benzofuran** (*coumarone; benzfuran*). $C_6H_4OCH:CH$, 118.05. Liq., *n* $1.56450^{23.7}$. **D.** 1.0776^{18}_{18}, **m.p.** < −18, **b.p.** 174 (169). **Soly.** i.w.; s.al.; s.et.; i.alk.

38 **2-Benzofurancarboxylic acid.** See *Coumarilic acid.*

39 **Benzoglyoxaline.** See *Benzimidazole.*

40 **Benzohydrazide.** See *Benzoic acid, hydrazide.*

41 **Benzohydrol** (*diphenylcarbinol; benzhydrol*). $(C_6H_5)_2CHOH$, 184.09. Silky need.f.lgr. **m.p.** 68–9, **b.p.** 298.5. **Soly.** 0.05 c.w.; v.s.al.; v.s.et.; s.ac.a., chl., CCl_4.

42 —, ***p*-amino-** (*p-aminodiphenylcarbinol*). $C_6H_5CHOHC_6H_4NH_2$, 199.11. Need.f.bz. or h.w. **m.p.** 121. **Soly.** s.w.; v.s.al.; sl.s.et.; s.me.al., acet., glac.ac.a.; sl.s.pet.eth., lgr.

43 —, ***p, p′*-bisdimethylamino-** (*Michler's hydrol; tetramethyl-4, 4′-diaminobenzohydrol*). $HOCH[C_6H_4N(CH_3)_2]_2$, 270.19. Col.tricl.pr.f.bz. **m.p.** 96. **Soly.** i.w.; s.al.; s.et.; s.bz.

44 ***p*-Benzohydrolcarboxylic acid.** See *Benzoic acid, p-(α-hydroxybenzyl)-.*

45 **Benzohydrol ether.** See *Benzohydryl ether.*

46 **Benzohydroxamic acid.** $C_6H_5C(:NOH)OH$, 137.06. Rhomb.lvs. **m.p.** 125, **b.p.** exp. **Soly.** 2.25^{6}w.; s.al.; sl.s.et.; i.bz.

47 **Benzohydrylamine** (*α-aminodiphenylmethane*). $(C_6H_5)_2CHNH_2$, 183.11. Hex.pl. or liq., *n* 1.5963^{22}. **D.** 1.0635^{22}_{0}, **m.p.** 34, **b.p.** 288 (301^{746}). **Soly.** sl.s.w.

48 **Benzohydryl ether** (*benzohydrol ether*). $[(C_6H_5)_2CH]_2O$, 350.17. Monocl. f.bz. **m.p.** 109–11, **b.p.** 315^{745} d. **Soly.** sl.s.al.; sl.s.et.; s.bz.

49 **Benzoic acid** (*benzenecarboxylic acid*; phenylformic acid*). C_6H_5COOH, 122.05. Col.monocl.leaf. or need. *n* 1.53974^{15}. **D.** 1.2659^{15}_{4}, **m.p** 122, **b.p.** 249. **Soly.** 0.18^{4}, 0.27^{18} 2.2^{75}w.; 47.1^{15}al.; 40^{15}et.; s.chl., CCl_4 acet., me.al., bz., CS_2.

50 —, allyl ester (*allyl benzoate*). $C_6H_5COOC_3H_5$, 162.08. Yel.liq. **D** 1.058^{15}_{15}, **b.p.** 230. **Soly.** i.w.; s.al. ∞et.

51 —, anhydride. See *Benzoic anhydride.*

52 —, benzyl ester (*benzyl benzoate; benzyl benzenecarboxylate*). $C_6H_5COOCH_2C_6H_5$, 212.09. Col. oily liq., or need. or leaf., *n* 1.5681^{21}. **D.** 1.114^{18}, **m.p.** 21 (18.5), **b.p.** 323–4 (316–7). **Soly.** i.w.; s.al.; s.et.; s.chl.; i.glyc.

53 —, butyl ester (*butyl benzoate; butyl benzenecarboxylate**). $C_6H_5COOC_4H_9$, 178.11. Thick col.oil. **D.** 1.000^{20}_{0}, **m.p.** −22.4, **b.p.** 250.3. **Soly.** i.w.; ∞al.; ∞et.

For explanations and abbreviations see beginning of table.

54 **Benzoic acid,** ethyl ester (*ethyl benzoate; ethyl benzenecarboxylate**). C_6H_5-$COOC_2H_5$, 150.08. Col.liq., *n* $1.50682^{17.3}$. **D.** 1.0509^{15}_{4}; 1.047^{20}_{4}, **m.p.** −34.6, **b.p.** 212.6. **Soly.** 0.08^{20}w.; s.al.; ∞et.; s.chl., pet.eth.

55 —, ethylene ester. See *Glycol, dibenzoate.*

56 —, hydrazide (*benz(o)hydrazide; benzoylhydrazine*). $C_6H_5CONHNH_2$, 136.08. Pl.f.w. **m.p.** 112.5, **b.p.** 267 d. **Soly.** s.w.; s.al.; sl.s.et.; sl.s.chl., bz.

57 —, isoamyl ester (*3-methyl-1-butanol benzoate*). $C_6H_5COOC_5H_{11}$, 192.13. Col. liq. **D.** 0.9925^{19}, **b.p.** 262. **Soly.** i.w.; s.al.; ∞et.

58 —, isobutyl ester (*isobutyl benzoate; β-methylpropyl benzenecarboxylate**). C_6-$H_5COOCH_2CH(CH_3)_2$, 178.11. Col. liq. **D.** 1.002^{15}_{4}, **b.p.** 237. **Soly.** i.w.; ∞al.; ∞et.

59 —, isopropyl ester. C_6H_5COOCH-$(CH_3)_2$, 164.09. Col.liq. **D.** 1.0162^{15}_{4}, **b.p.** 218.5. **Soly.** i.w.; s.al.; s.et.

60 —, methylene diester (*methylene dibenzoate; methylene benzoate; methanediol dibenzoate*). $(C_6H_5COO)_2CH_2$, 256.09. Need. **m.p.** 97.8. **Soly.** sl.s.w.; s.al.; s.et.

61 —, methyl ester (*methyl benzoate; niobe oil*). $C_6H_5COOCH_3$, 136.06. Col.liq., *n* $1.51810^{16.0}$. **D.** 1.0937^{15}_{4}; 1.088^{20}_{4}, **m.p.** −12.5, **b.p.** 199.6. **Soly.** 0.0157^{20}w.; ∞al.; ∞et.

62 —, phenyl ester (*phenyl benzoate*). $C_6H_5COOC_6H_5$, 198.08. Col.monocl. **D.** 1.235^{15}_{4}, **m.p.** 70, **b.p.** 314. **Soly.** v.sl.s.w.; s.al.; s.et.

63 —, phenylhydrazide (*1-benzoyl-2-phenylhydrazine*). $C_6H_5CONHNHC_6H_5$, 212.11. Col.pl.f.al. **m.p.** 168. **Soly.** sl.s.h.w.; s.h.al.; sl.s.et.

64 —, propyl ester (*n-propyl benzoate*). $C_6H_5COOC_3H_7$, 164.09. Col.liq. **D.** 1.0274^{15}_{4}, **m.p.** −51.6, **b.p.** 231.2. **Soly.** v.sl.s.w.; ∞al.; ∞et.

65 —, **o-acetamido-.** See *Anthranilic acid, N-acetyl-.*

66 —, ***m*-acetamido-.** $CH_3CONHC_6H_4$-$COOH$, 179.08. Need.f.al. **m.p.** 249–50, **b.p.** subl. **Soly.** v.sl.s.w.; sl.s.h.al.; sl.s.et.

67 —, ***p*-acetamido-.** $CH_3CONHC_6H_4$-$COOH$, 179.08. Need. **m.p.** 250–2. **Soly.** sl.s.w.; s.al.; sl.s.et.

68 —, **o-acetoxy-.** See *Aspirin.*

69 —, **o-acetyl-** (*o-acetophenonecarboxylic acid*). $CH_3COC_6H_4COOH$, 164.06. Cr. f.w. **m.p.** 114–5. **Soly.** s.h.w.

70 —, ***p*-acetyl-.** $CH_3COC_6H_4COOH$, 164.06. Need.f.h.w. **m.p.** 200, **b.p.** subl. **Soly.** sl.s.w.; sl.s.al.; sl.s.et.; i.lgr.

71 —, **o-amino-.** See *Anthranilic acid.*

72 —, ***m*-amino-.** $NH_2C_6H_4COOH$, 137.06. Yel.need. **D.** 1.511^{20}_{4}, **m.p.** 174 (179.5), **b.p.** subl. **Soly.** 0.59^{15}w.; 2.2^{10}al.; $1.81^{5.6}$et.

73 —, ***p*-amino-.** $NH_2C_6H_4COOH$, 137.06. Yelsh.-red monocl. **m.p.** 187. **Soly.** $0.34^{9.6}$w.; $11.3^{9.6}$al.; $8.21^{5.8}$et.

74 —, —, butyl ester. See *Butesin.*

75 —, —, β-diethylaminoethyl ester, hydrochloride. See *Procaine, hydrochloride.*

76 —, —, ethyl ester. See *Benzocaine.*

77 —, —, methyl ester. $NH_2C_6H_4COO$-CH_3, 151.08. Col.leaf. **m.p.** 112.

78 —, **3-amino-2-nitro-.** $NH_2(NO_2)$-C_6H_3COOH, 182.06. Yel.need.f.w. **m.p.** 156–7, **b.p.** 195 d. **Soly.** v.s.h.w.; v.s.al.; v.s.et.

79 —, **3-amino-4-nitro-.** $NH_2(NO_2)$-C_6H_3COOH, 182.06. Red.leaf.f.al. **m.p.** 298 d. **Soly.** sl.s.w.; s.al.; s.et.

80 —, **3-amino-5-nitro-.** $NH_2(NO_2)$-C_6H_3COOH, 182.06. Yel.pr.f.w. **m.p.** 208. **Soly.** sl.s.w.; v.s.h.al.; s.ac.a.

81 —, **4-amino-2-nitro-.** $NH_2(NO_2)$-C_6H_3COOH, 182.06. Red.need.f.w. **m.p.** 239.5 d. **Soly.** s.h.w.; v.s.al.

82 —, **4-amino-3-nitro-.** $NH_2(NO_2)$-C_6H_3COOH, 182.06. Red-yel.need.f. al. **m.p.** 284. **Soly.** i.w.; sl.s.h.al.

83 —, **5-amino-2-nitro-** (*3-amino-6-nitrobenzoic acid*). $NH_2(NO_2)C_6H_3$-$COOH$, 182.06. Yel.need. or pr. **m.p.** 235 d. **Soly.** sl.s.h.w.; s.h.al.; sl.s.et.

84 —, **o-anilino-.** See *Anthranilic acid, N-phenyl-.*

85 —, **azodi-.** See *Azobenzoic acid.*

86 —, **azoxydi-.** See *Azoxybenzoic acid.*

87 —, **o-benzamido-.** See *Anthranilic acid, N-benzoyl-.*

88 —, ***m*-benzamido-** (*m-benzoylaminobenzoic acid*). $C_6H_5CONHC_6H_4COOH$, 241.09. Red.pr.f.al. **D.** 1.5105^{4}_{4}, **m.p.** 248 (174), **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.

89 —, ***p*-benzamido-** (*p-benzoylaminobenzoic acid*). $C_6H_5CONHC_6H_4COOH$, 241.09. Sm.need.f.al. **m.p.** 278. **Soly.** sl.s.w.; s.al.; s.et.; s.ac.a.

90 —, **o-benzohydryl-** (*triphenylmethane o-carboxylic acid*). $(C_6H_5)_2$-CHC_6H_4COOH, 288.12. Need.f.al. **m.p.** 161–2, **b.p.** subl. **Soly.** i.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

91 Benzoic acid, o-benzoyl- (*benzophenone-o-carboxylic acid*). $C_6H_5COC_6H_4$-COOH, 226.08. Tricl.need. (+1H_2O) f.h.w. **m.p.** +H_2O, 93; anh. 217. **Soly.** s.h.w.; v.s.al.; v.s.et.

92 —, **m-benzoyl-** (*benzophenone-m-carboxylic acid*). $C_6H_5COC_6H_4COOH$. 226.08. Need.f.dil.al. **m.p.** 161–2, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.

93 —, **p-benzoyl-** (*benzophenone-p-carboxylic acid*). $C_6H_5COC_6H_4COOH$, 226.08. Monocl.leaf.f.w. **m.p.** 194, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; s.ac.a.; sl.s.chl., bz.

94 —, **benzoylamino-**. See *Benzoic acid, benzamido-*.

95 —, **o-benzyl-** (*diphenylmethane-o-carboxylic acid*). $C_6H_5CH_2C_6H_4COOH$, 212.09. Need.f.dil.al. **m.p.** 114, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; s.chl., bz.

96 —, **m-benzyl-**. $C_6H_5CH_2C_6H_4COOH$, 212.09. Need. or leaf.f.dil.al. **m.p.** 107–8, **b.p.** subl. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl.

97 —, **p-benzyl-**. $C_6H_5CH_2C_6H_4COOH$, 212.09. Need.f.w. or leaf.f.dil.al. **m.p.** 157–8, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; s.chl., bz.

98 —, **o-bromo-**. BrC_6H_4COOH, 200.96. Col.monocl.need.f.w. **D.** 1.929^{25}_{4}, **m.p.** 147–50, **b.p.** subl. **Soly.** 0.18^{25}w.; s.al.; s.et.; s.chl.

99 —, **m-bromo-**. BrC_6H_4COOH, 200.96. Col.monocl.need. **D.** 1.845^{25}_{4}, **m.p.** 155, **b.p.** 280. **Soly.** 0.04^{25}w.; s.al.; s.et.

00 —, **p-bromo-**. BrC_6H_4COOH, 200.96. Col.monocl.need. or leaf.f.w. **D.** 1.894^{25}_{4}, **m.p.** 251–3. **Soly.** 0.0056^{25}w.; s.al.; s.et.

01 —, **p, p'-carbonyldi-** (*p, p'-benzophenonedicarboxylic acid*. CO-($C_6H_4COOH)_2$, 270.08. Gel. **m.p.** subl. <360. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.ac.a.; sl.s.bz., acet.

02 —, **o-(carboxymethoxy)-** (*salicylic-O-acetic acid; salicylacetic acid*). $HOOCCH_2OC_6H_4COOH$, 196.06. Need.f.w. **m.p.** 190. **Soly.** s.w.; s.al.; s.et.; s.ac.a., acet.

03 —, **o-chloro-**. ClC_6H_4COOH, 156.50. Col.monocl. **D.** 1.544^{20}_{4}, **m.p.** 142, **b.p.** subl. **Soly.** 0.21^{25}w.; v.s.al.; v.s.et.

04 —, **m-chloro-**. ClC_6H_4COOH, 156.50. Col.pr. **D.** 1.496^{25}_{4}, **m.p.** 158 (154–5), **b.p.** subl. **Soly.** 0.04^{0}w.; s.al.; s.et.

05 —, **p-chloro-**. ClC_6H_4COOH, 156.50. Col.tricl. **D.** 1.541^{24}_{4}, **m.p.** 243 (235), **b.p.** subl. **Soly.** 0.0077^{25}w.; v.s.al.; v.s.et.

06 —, **p-cyano-** (*terephthalic mononitrile*). CNC_6H_4COOH. 147.05. Leaf.f.w. **m.p.** 213–4(219). **Soly.** v.sl.s.c., s.h.w.; v.s.al.; v.s.et.; s.h.ac.a.

07 —, **2, 3-diamino-**. $C_6H_3(NH_2)_2$-COOH, 152.08. Lng.need. **m.p.** 190–1, **b.p.** d. **Soly.** sl.s.w.; v.v.s.al.; v.s.ac.a.

08 —, **2, 4-diamino-**. $C_6H_3(NH_2)_2$-COOH, 152.08. Cr. **m.p.** *ca* 140. **Soly.** s.h.w.; s.al.; v.s.ac.a.

09 —, **2, 5-diamino-**. $C_6H_3(NH_2)_2$-COOH, 152.08. Sm.pr. **b.p.** d. **Soly.** v.sl.s.w.; v.sl.s.al.; v.sl.s.et.

10 —, **3, 4-diamino-**. $C_6H_3(NH_2)_2$-COOH, 152.08. Leaf. **m.p.** 210–1 d. **Soly.** sl.s.c., s.h.w.

11 —, **3, 5-diamino-**. $C_6H_3(NH_2)_2$-COOH, 152.08. Need.(+1H_2O)f.w. **m.p.** (−H_2O, 110) anh. 228–36, **b.p.** d. **Soly.** 1.1^{8}w.; v.s.al.; v.s.et.

12 —, **2, 3-dibromo-**. $C_6H_3Br_2COOH$, 279.86. Need.f.w. **m.p.** 149–50 **Soly.** sl.s.h.w.; s.h.lgr.

13 —, **2, 4-dibromo-**. $C_6H_3Br_2COOH$, 279.86. Leaf.f.w. **m.p.** 172–3, **b.p.** subl. **Soly.** sl.s.h.w.; s.al.; s.et.

14 —, **2, 5-dibromo-**. $C_6H_3Br_2COOH$, 279.86. Need.f.w. or al. **m.p.** 153. **Soly.** 0.084^{11}w.; s.al.; s.et.; s.ac.a.

15 —, **2, 6-dibromo-**. $C_6H_3Br_2COOH$, 279.86. Need.f.w. **m.p.** 146.5 (151–2), **b.p.** $209–10^{16}$. **Soly.** s.h.w.; s.al.; s.et.; s.chl.

16 —, **3, 4-dibromo-**. $C_6H_3Br_2COOH$ 279.86. Need.f.w. **m.p.** 232–3, **b.p.** subl. **Soly.** sl.s.h.w.; s.al.; s.et.

17 —, **2, 3-dichloro-**. $Cl_2C_6H_3COOH$, 190.95. Need. **m.p.** 164(160). **Soly.** sl.s.h.w.; s.al.; s.et.

18 —, **2, 4-dichloro-**. $Cl_2C_6H_3COOH$, 190.95. Need.f.w. or bz. **m.p.** 164 (160, 158), **b.p.** subl. **Soly.** s.h.w.; s.al.; s.et.; s.chl., bz.

19 —, **2, 5-dichloro-**. $Cl_2C_6H_3COOH$, 190.95. Col.need.f.w. **m.p.** 154.4, **b.p.** 301. **Soly.** 0.084^{11}w.; s.al.; s.et.; s.alk.

20 —, **2, 6-dichloro-**. $Cl_2C_6H_3COOH$, 190.95. Col.need.f.al. **m.p.** 139 (132), **b.p.** subl. **Soly.** i.w.; s.al.; s.et.; s.bz., alk.

21 —, **3, 4-dichloro-**. $Cl_2C_6H_3COOH$, 190.95. Col.need.f.al. or bz. **m.p.** 208–9 (201–2), **b.p.** subl. **Soly.** sl.s.w.; v.sl.s.al.; s.et.; s.alk.

22 —, **3, 5-dichloro-**. $Cl_2C_6H_3COOH$, 190.95. Need.f.al. **m.p.** 182–3, **b.p.** subl. **Soly.** s.al.; s.et.

For explanations and abbreviations see beginning of table.

23 Benzoic acid, 2, 3-dihydroxy- (*o-pyrocatechuic acid; pyrocatechol-o-acid*). $(HO)_2C_6H_3COOH$, 154.05. Col.need. f.w. **m.p.** anh.204, **b.p.** d. **Soly.** s.w.; s.al.; s.et.

24 —, **2, 4-dihydroxy-.** See *β-Resorcylic acid.*

25 —, **2, 5-dihydroxy-.** See *Gentisic acid.*

26 —, **2, 6-dihydroxy-.** See *γ-Resorcylic acid.*

27 —, **3, 4-dihydroxy-.** See *Protocatechuic acid.*

28 —, **3, 5-dihydroxy-.** See *α-Resorcylic acid.*

29 —, **3, 4-dimethoxy-.** See *Veratric acid.*

30 —, **2, 3-dimethyl-.** See *Hemellitic acid.*

31 —, **2, 4-dimethyl-.** See 2, 4-*Xylic acid.*

32 —, **2, 5-dimethyl-.** See *Isoxylic acid.*

33 —, **2, 6-dimethyl-.** See 2, 6-*Xylic acid.*

34 —, **3, 4-dimethyl-.** See 3, 4-*Xylic acid.*

35 —, **3, 5-dimethyl-.** See *Mesitylenic acid.*

36 —, **2, 4-dinitro-.** $(NO_2)_2C_6H_3COOH$, 212.05. Col.rhomb.pr.f.w. **m.p.** 182–3; frz. 180.9, **b.p.** subl. **Soly.** 1.85^{25} w.; v.s.al.; 0.71^{30}bz.

37 —, **2, 5-dinitro-.** $(NO_2)_2C_6H_3COOH$, 212.05. Col.need. or monocl.pr.f.w. **m.p.** 177. **Soly.** sl.s.h.w.; s.al.; s.et.

38 —, **2, 6-dinitro-.** $(NO_2)_2C_6H_3COOH$, 212.05. Col.need.f.w. **m.p.** 202–3, **b.p.** d. **Soly.** s.h.w.; s.al.; s.et.

39 —, **3, 4-dinitro-.** $(NO_2)_2C_6H_3COOH$, 212.05. Col.need. **m.p.** 163, **b.p.** 165 subl. **Soly.** 0.67^{25}w.; v.s.al.; v.s.et.

40 —, **3, 5-dinitro-.** $(NO_2)_2C_6H_3COOH$, 212.05. Yel.monocl.tab.f.w. **m.p.** 204–5, **b.p.** subl. **Soly.** 1.9^{100}w.; v.s.al.; sl.s.et.; s.ac.a.; sl.s.bz., CS_2.

41 —, **o-ethoxy-** (*salicylic acid ethyl ether*). $C_2H_5OC_6H_4COOH$, 166.08. Col. oil, **m.p.** 19.3–19.5 (22), **b.p.** d. 300 ±. **Soly.** sl.s.c., s.h.w.

42 —, ***m*-ethoxy-.** $C_2H_5OC_6H_4COOH$, 166.08. Col.need.f.w. **m.p.** 137, **b.p.** subl. **Soly.** sl.s.h.w.; s.al.; s.et.

43 —, ***p*-ethoxy-.** $C_2H_5OC_6H_4COOH$, 166.08. Col.need. **m.p.** 195. **Soly.** v.sl.s.h.w.

44 —, ***o*-ethyl-.** $C_2H_5C_6H_4COOH$, 150.08. Col.need.f.h.w., n $1.51012^{99.6}$. **m.p.** 68, **b.p.** 259. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

45 —, ***m*-ethyl-.** $C_2H_5C_6H_4COOH$, 150.08. Col.need.f.dil.al., n 1.5345^{100}. **D.** 1.042^{100}, **m.p.** 47. **Soly.** v.sl.s.w.; s.al.; v.s.et.

46 —, ***p*-ethyl-.** $C_2H_5C_6H_4COOH$, 150.08. Col.leaf.or pr.f.al. **m.p.** 113. **Soly.** s.h.w.; v.s.al.; v.s.et.

47 —, ***o*-ethylamino-.** See *Anthranilic acid, N-ethyl-.*

48 —, ***m*-ethylamino-.** $C_2H_5NHC_6H_4$-COOH, 165.09. Pr. **m.p.** 101, **b.p.** subl. **Soly.** v.sl.s.w.; s.al.; s.et.

49 —, ***p*-ethylamino-.** $C_2H_5NHC_6H_4$-COOH, 165.09. **m.p.** 178. **Soly.** s.al.; s.et.

50 —, ***o*-fluoro-.** FC_6H_4COOH, 140.04. Need.f.w. **D.** 1.460^{25}_{4}, **m.p.** 122. **Soly.** 0.722^{25}w.; v.s.al.; v.s.et.

51 —, ***m*-fluoro-.** FC_6H_4COOH, 140.04. Leaf.f.w. **D.** 1.474^{25}_{4}, **m.p.** 124. **Soly.** 0.150^{25}w.

52 —, ***p*-fluoro-.** FC_6H_4COOH, 140.04. Monocl.pr.f.w. **D.** 1.479^{25}_{4}, **m.p.** 182 (184–6). **Soly.** 0.127^{25}w.; s.al.; s.et.

53 —, ***o*-formyl-.** See *Phthalaldehydic acid.*

54 —, ***m*-formyl-.** See *Isophthalaldehydic acid.*

55 —, ***p*-formyl-.** See *Terephthalaldehydic acid.*

56 —, **hexahydro-.** See *Cyclohexanecarboxylic acid*.*

57 —, **hydrazodi-.** See *Hydrazobenzoic acid.*

58 —, ***o*-hydroxy-.** See *Salicylic acid.*

59 —, ***m*-hydroxy-.** HOC_6H_4COOH, 138.05. Col.rhomb.f.w. or al. **D.** 1.473^{4}_{4}, **m.p.** 201.3 (199–200). **Soly.** 0.92^{18}w.; s.h.al.; 9.7^{17}et.; 0.01^{25}bz.

60 —, ***p*-hydroxy-.** HOC_6H_4COOH, 138.05. Col.monocl.f.w. **D.** 1.443^{20}_{4}, **m.p.** 213 (214.5–5.5), **b.p.** subl. 76. **Soly.** 0.79^{15}, 2.6^{75}w.; 39.34^{15}al.; 9.4^{17}et.; 0.01^{11}bz.

61 —, **p-(α-hydroxybenzyl)-** (*p-benzohydrolcarboxylic acid*). $C_6H_5CH(OH)$-C_6H_4COOH, 228.09. Need.f.w. **m.p.** 164–5, **b.p.** d. **Soly.** s.h.w.; s.al.; s.et.; sl.s.chl.

62 —, **4-hydroxy-3-methoxy-.** See *Vanillic acid.*

63 —, *o-β*-**hydroxyvinyl-, lactone.** See *Isocoumarin.*

* Name approved by the International Union of Chemistry.

64 Benzoic acid, *o*-iodo-. IC_6H_4COOH, 247.96. Col.need.f.w. **D.** 2.249^{25}_{4}, **m.p.** 162. **Soly.** 0.095^{25}w.; sl.s.al.; sl.s.et.

65 —, ***m*-iodo-.** IC_6H_4COOH, 247.96. Need.f.acet. **D.** 2.171^{25}_{4}, **m.p.** 185–7, **b.p.** subl. d. **Soly.** 0.0117^{25}w.; sl.s.al.; sl.s.et.

66 —, ***p*-iodo-.** IC_6H_4COOH, 247.96. Pl. or leaf. **D.** 2.184^{25}_{4}, **m.p.** 269–70, **b.p.** subl. d. **Soly.** 0.0035^{25}w.; sl.s.al.; sl.s.et.

67 —, ***o*-isopropyl-.** $(CH_3)_2CHC_6H_4$-COOH, 164.09. Col.pr.f.w. **m.p.** 51. **Soly.** s.h.w.; s.al.; s.et.; s.bz.

68 —, ***p*-isopropyl-.** See *Cumic acid.*

69 —, ***o*-mercapto-** (*thiosalicylic acid; o-sulfhydrylbenzoic acid*). HSC_6H_4-COOH, 154.11. Lt.yel.need.f.al. **m.p.** 164, **b.p.** subl. **Soly.** v.sl.s.w.; v.s.al.; s.et.; s.ac.a.

70 —, ***o*-methoxy-** (*salicylic acid methyl ether*). $CH_3OC_6H_4COOH$, 152.06. Monocl.tab.f.w. **D.** 1.180, **m.p.** 98 (100–1), **b.p.** 200. **Soly.** 0.5^{30}w.; v.s.al.; v.s.et.

71 —, ***m*-methoxy-.** $CH_3OC_6H_4COOH$, 152.06. Col.need.f.w. **m.p.** 107–8, **b.p.** $170–2^{10}$ subl. **Soly.** sl.s.c.,v.s.h.w.; v.s.al.; v.s.et.

72 —, ***p*-methoxy-.** See *Anisic acid.*

73 —, **methyl-.** See *Toluic acid.*

74 —, **3, 4-methylenedioxy-.** See *Piperonylic acid.*

75 —, ***o*-nitro-.** $NO_2C_6H_4COOH$, 167.05. Tricl.need.f.w. **D.** 1.575^{4}_{4}, **m.p.** 147.5 (144–5). **Soly.** 0.68^{20}w.; 2.8^{10}al.; 2.16^{11}et.; s.alk.; v.sl.s.bz., chl.; i.lgr.

76 —, —, ethyl ester. $NO_2C_6H_4COOC_2$-H_5, 195.08. Col.tricl. **m.p.** 30, **b.p.** $148–50^{10}$. **Soly.** i.w.; s.al.; s.et.

77 —, —, methyl ester. $NO_2C_6H_4$-$COOCH_3$, 181.06. Yel. oil. **D.** 1.286^{20}_{4}; 1.284^{25}_{25}, **m.p.** −8, **b.p.** 275 (269). **Soly.** i.w.; ∞al.; ∞et.; i.pet.eth.

78 —, ***m*-nitro-.** $NO_2C_6H_4COOH$, 167.05. Monocl.leaf.f.w. **D.** 1.494^{4}_{4}, **m.p.** 141.4. **Soly.** 0.31^{20}w.; 3.3^{10}al.; 2.51^{11}et.; s.alk.; v.sl.s.bz., chl.; i.lgr.

79 —, —, ethyl ester. $NO_2C_6H_4COOC_2$-H_5, 195.08. Monocl.pr. **m.p.** 47 (40–1), **b.p.** 298; 171^{25}. **Soly.** i.w.; v.s.al.; v.s.et.

80 —, —, methyl ester. $NO_2C_6H_4$-$COOCH_3$, 181.06. Col.need. **m.p.** 78.5 (70), **b.p.** 279. **Soly.** i.w.; sl.s.al.; s.et.; sl.s.me.al.

81 —, ***p*-nitro-.** $NO_2C_6H_4COOH$, 167.05. Monocl.leaf.f.w. **D.** 1.550^{32}_{4}, **m.p.** 242.4, **b.p.** subl. **Soly.** 0.024^{25}w.; 0.09^{10}al.; 0.22^{11}et.; s.acet., alk.; v.sl.s.c.bz., chl.; i.lgr.

82 —, —, ethyl ester, $NO_2C_6H_4COOC_2H_5$, 195.08. Col.tricl.leaf.f.al. **m.p.** 57. **Soly.** i.w.; s.al.; s.et.

83 —, —, methyl ester. $NO_2C_6H_4$-$COOCH_3$, 181.06. Yel.monocl.leaf. **m.p.** 96. **Soly.** i.w.; s.al.; s.et.

84 —, ***o*-nitroso-.** NOC_6H_4COOH, 151.05. Col.f.al. **m.p.** 210 d. **Soly.** s.al.; v.sl.s.et.; s.ac.a.; v.sl.s.bz.

85 —, ***m*-nitroso-.** NOC_6H_4COOH, 151.05. Col.cr. **m.p.** 230 d. **Soly.** s.al.; v.sl.s.et.; v.sl.s.bz.

86 —, ***p*-nitroso-.** NOC_6H_4COOH, 151.05. Yel.powd. **m.p.** 250 d. **Soly.** s.al.; v.sl.s.et.; sl.s.ac.a.; v.sl.s.bz.

87 —, **pentamethyl-.** $(CH_3)_5C_6COOH$, 192.12. Need.f.w. **m.p.** 210.5, **b.p.** subl. **Soly.** v.sl.s.w.; s.al.

88 —, ***o*-phenoxy-** (*salicylic acid phenyl ether*). $C_6H_5OC_6H_4COOH$, 214.08. Rhomb.leaf.f.dil.al. **m.p.** 114.5, **b.p.** 355 d. **Soly.** 0.01w.; v.s.al.; v.s.et.; s.chl., glyc.

89 —, ***o*-phenyl-** (*o-biphenylcarboxylic acid*). $C_6H_5C_6H_4COOH$, 198.08. Col.monocl.need.f.al. **D.** 1.458^{20}_{4}, **m.p.** 114 (111), **b.p.** 343–4. **Soly.** sl.s.h., i.c.w.; v.s.al.; v.s.bz.; s.ac.a.

90 —, ***m*-phenyl-** (*m-biphenylcarboxylic acid*). $C_6H_5C_6H_4COOH$, 198.08. Col.leaf.f.al. **m.p.** 160–2. **Soly.** i. (sl.s.) w.; v.s.al.; v.s.et.; v.s.bz., ac.a., lgr.

91 —, ***p*-phenyl-** (*p-biphenylcarboxylic acid*). $C_6H_5C_6H_4COOH$, 198.08. Col.need.f.al. or bz. **m.p.** 219 (224), **b.p.** subl. **Soly.** v.sl.s.h.w.; v.s.al.; v.s.et.

92 —, ***p*-phosphono-** (*p-benzophosphinic acid*). $(HO)_2POC_6H_4COOH$, 202.07. Need f.w. **m.p.** >300. **Soly.** s.w.; s.al.; sl.s.HCl.

93 —, ***o*-propyl-.** $C_3H_7C_6H_4COOH$, 164.09. Leaf.f.al. **m.p.** 58, **b.p.** 273. **Soly.** s.w.; v.s.al.; v.s.et.

94 —, ***p*-propyl-.** $C_3H_7C_6H_4COOH$, 164.09. Col.leaf.f.w. **m.p.** 141. **Soly.** sl.s.h.w.; v.s.al.; v.s.et.; s.bz.

95 —, **silico-.** See *Benzenesiliconic acid.*

96 —, ***o*-sulfamyl-** (*o-sulfamidobenzoic acid*). $NH_2O_2SC_6H_4COOH$, 201.12. Rhomb.f.al. **m.p.** 165–7. **Soly.** v.s.w.; v.s.al.; v.s.et.

For explanations and abbreviations see beginning of table.

97 Benzoic acid, *m*-sulfamyl-. $NH_2O_2SC_6H_4COOH$, 201.12. Need. or pl.f.w. **m.p.** 238. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

98 —, ***p*-sulfamyl-.** $NH_2O_2SC_6H_4COOH$, 201.12. Need. or pr.f.w. **m.p.** 280 d. **Soly.** v.v.sl.s.w.; v.s.al.; sl.s.et.; v.sl.s.bz.

99 —, ***o*-sulfhydryl-.** See *Benzoic acid, o-mercapto-.*

00 —, ***o*-sulfo-.** $HO_3SC_6H_4COOH·3H_2O$, 256.15. Rhomb.need.f.w. **m.p.** 68–9; $-3H_2O$, 105; anh. 141. **Soly.** 50w.; v.s.al.; i.et.

01 —, —, imide. See *Saccharin.*

02 —, ***m*-sulfo-.** $HO_3SC_6H_4COOH·2H_2O$, 238.14. Deliq.cr. **m.p.** 98; anh. 141. **Soly.** s.w.; s.al.; v.s.et.; i.bz.

03 —, ***p*-sulfo-.** $HO_3SC_6H_4COOH·3H_2O$, 256.15. Need.f.w. **m.p.** 94; anh. 260. **Soly.** v.s.w.; v.s.al.; v.s.et.

04 —, **2, 3, 4, 5-tetrahydro-.** See 1-*Cyclohexene*-1-*carboxylic acid**.

05 —, **2, 3, 4, 5-tetrahydroxy-.** $(HO)_4C_6HCOOH$, 186.05. Cr. **m.p.** 148. **Soly.** v.s.w.; i.lgr.

06 —, **thio-** (*benzenecarbothioic acid**). C_6H_5COSH or C_6H_5CSOH, 138.11. Yel. oil or cr. **m.p.** 24, **b.p.** d. **Soly.** i.w.; ∞al.; ∞et.

07 —, ***p*-(*p*-toluyl)-.** $CH_3C_6H_4COC_6H_4COOH$, 240.09. Need.f.acet. **m.p.** 130 (224). **Soly.** v.sl.s.w.; v.s.al.; v.s.acet.; sl.s.bz.

08 —, **2, 3, 5-triamino-.** $(NH_2)_3C_6H_2COOH$, 167.09. Cr.f.w. **Soly.** v.s.h.w.; v.sl.s.h.al.; i.et.

09 —, **3, 4, 5-triamino-.** $(NH_2)_3C_6H_2COOH$, 167.09. Need.f.w. **m.p.** $-H_2O$, >100, **b.p.** d. **Soly.** s.h.w.; i.al.; i.et.

10 —, **2, 3, 4-trichloro-.** $Cl_3C_6H_2COOH$, 225.39. Need.f.al. **m.p.** 186–7 (129). **Soly.** sl.s.w.; s.al.; s.et.

11 —, **2, 4, 5-trichloro-.** $Cl_3C_6H_2COOH$, 225.39. Sm.need.f.w. **m.p.** 163, **b.p.** subl. **Soly.** s.h.w.; s.al.; s.et.

12 —, **3, 4, 5-trichloro-.** $Cl_3C_6H_2COOH$, 225.39. Need.f.al. **m.p.** 203, **b.p.** subl. **Soly.** s.h.w.; v.s.al.; v.s.et.

13 —, **2, 3, 4-trihydroxy-** (4-*pyrogallolcarboxylic acid*). $(HO)_3C_6H_2COOH$, 170.05. Need.f.w. **m.p.** 200 d. **b.p.** subl. **Soly.** 0.13^{12}w.; s.al.; v.s.et.

14 —, **2, 4, 5-trihydroxy-** (4-*hydroxygentisic acid*). $(HO)_3C_6H_2COOH$, 170.05. Need.f.w. **m.p.** 217–8. **Soly.** v.s.h.w.; v.s.al.

15 —, **2, 4, 6-trihydroxy-** (*phloroglucinolcarboxylic acid*). $(HO)_3C_6H_2COOH$, 170.05. Cr.f.w. **m.p.** 100 d. **Soly.** s.h.w.; s.al.; v.s.et.; i.bz.

16 —, **3, 4, 5-trihydroxy-.** See *Gallic acid.*

17 —, **2, 3, 4-trimethoxy-.** $(CH_3O)_3C_6H_2COOH$, 212.09. Cr.f.et. **m.p.** 97–9. **Soly.** s.w.; s.al.; s.et.

18 —, **2, 4, 5-trimethoxy-.** See *Asaronic acid.*

19 —, **3, 4, 5-trimethoxy-** (*gallic acid trimethyl ether*). $(CH_3O)_3C_6H_2COOH$, 212.09. Monocl.need.f.w. **m.p.** 168, **b.p.** $225–7^{10}$. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; v.s.chl.

20 —, **2, 3, 4-trimethyl-.** See *Prehnitylic acid.*

21 —, **2, 3, 5-trimethyl-.** See *γ-Isodurylic acid.*

22 —, **2, 3, 6-trimethyl-.** $(CH_3)_3C_6H_2COOH$, 164.09. Need.f.w. **m.p.** 84; 105–6. **Soly.** s.w.; s.al.; s.et.

23 —, **2, 4, 5-trimethyl-.** See *Durylic acid.*

24 —, **2, 4, 6-trimethyl-.** See *β-Isodurylic acid.*

25 —, **3, 4, 5-trimethyl-.** See *α-Isodurylic acid.*

26 —, **2, 4, 6-trinitro-** (*sym-trinitrobenzoic acid*). $(NO_2)_3C_6H_2COOH$, 243.04. Yel.rhomb.need.f.w. **m.p.** 228.7 (220–3), **b.p.** subl. d. **Soly.** 2.05^{23}w.; 26.6^{25}al.; 14.7^{25}et.

27 Benzoic amide. See *Benzamide.*

28 Benzoic anhydride (*benzoic acid anhydride*). $(C_6H_5CO_2)O$, 226.08. Col.rhomb.pr., *n* 1.57665^{15}. **D.** 1.1989^{15}_{4}, **m.p.** 42, **b.p.** 360. **Soly.** i.w.; s.al.; s.et.

29 Benzoic sulfinide. See *Saccharin.*

30 Benzoin (*benzoylphenylcarbinol; α-hydroxy α-phenylacetophenone*). $C_6H_5CHOHCOC_6H_5$, 212.09. Col.hex.pr. f.al. **D.** 1.310^{20}_{4}, **m.p.** 137, **b.p.** 344; 194^{12}. **Soly.** 0.03^{25}w.; s.al.; sl.s.et.

31 —, ethyl ether (*α-ethoxy-α-phenylacetophenone; 2-ethoxy-1, 2-diphenyl-1-ethanone*). $C_6H_5CH(OC_2H_5)COC_6H_5$, 240.12. Need.f.lgr. **m.p.** 62, **b.p.** 184–6. **Soly.** s.al.; s.et.; v.s.bz.

32 —, imide. See *Amaron.*

33 —, *l*-oxime. $C_6H_5CH(OH)C(:NOH)C_6H_5$, 227.11. Wh.amor.powd. or pr.f.bz. **m.p.** 163–4 (149–51). **Soly.** i.w.; s.al.; s.et.; s.acet.

* Name approved by the International Union of Chemistry.

34 **Benzol, Benzole.** See *Benzene**.

35 **Benzonitrile** (*benzenecarbonitrile*; phenyl cyanide*). C_6H_5CN, 103.05. Col.liq., *n* 1.52892. **D.** 1.0102^{15}_{15}, **m.p.** −13, **b.p.** 190.7. **Soly.** 1^{100}w.; ∞ al.; ∞ et.

36 —, *o*-**amino-.** See *Anthranilonitrile.*

37 —, *m*-**amino-.** (*m-aminophenyl cyanide*). $NH_2C_6H_4CN$, 118.06. Need. **m.p.** 53–4, **b.p.** 288–90. **Soly.** sl.s.w.; s.al.; s.et.

38 —, *p*-**amino-** (*p-aminophenyl cyanide*). $NH_2C_6H_4CN$, 118.06. Col.monocl.pr. **m.p.** 86, **b.p.** d. **Soly.** v.s.h.w.; v.s.al.; v.s.et.; i.HCl.

39 —, *p*-**bromo-** (*p-bromophenyl cyanide*). BrC_6H_4CN, 181.96. Need. f.w. **m.p.** 113, **b.p.** 235–7. **Soly.** s.h.w.; s.al.; v.s.et.

40 —, *p*-**chloro-** (*4-chlorobenzenecarbonitrile*; p-chlorophenyl cyanide*). ClC_6H_4CN, 137.50. Need.f.al. **m.p.** 92 (93–4), **b.p.** 223. **Soly.** sl.s.w.; s.al.; s.et.; s.bz.

41 —, **methyl-.** See *Tolunitrile.*

42 —, *o*-**nitro-** (*2-nitrobenzenecarbonitrile*; o-nitrophenyl cyanide*). $NO_2C_6H_4CN$, 148.05. Silky need.f.w. **m.p.** 109. **Soly.** s.h.w.; s.al.; s.et.; s.ac.a.

43 —, *m*-**nitro-.** $NO_2C_6H_4CN$, 148.05. Need.f.w. **m.p.** 118 (115–6), **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.

44 —, *p*-**nitro-.** $NO_2C_6H_4CN$, 148.05. Yel.leaf.f.al. **m.p.** 147. **Soly.** sl.s.c.w.; sl.s.c., s.h.al.; s.chl., ac.a.

45 **Benzo[*a*]phenanthrene.** See *Chrysene.*

46 **Benzo[*def*]phenanthrene.** See *Pyrene.*

47 **Benzo[*l*]phenanthrene.** See *Triphenylene.*

48 **Benzo[*a*]phenazine** (*α-benzophenazine; αβ-naphthophenazine*). $C_{10}H_6{:}N_2{:}C_6H_4$, 230.09. Yel.need.f.bz. **m.p.** 142.5, **b.p.** >360. **Soly.** i.w.; v.sl. s.al.; v.sl.s.et.; sl.s.c.bz.

49 **Benzo[*b*]phenazine, 5, 8-dihydro-8-imino-5-phenyl-.** See *Rosinduline.*

50 **Benzophenone** (*phenyl ketone; diphenyl ketone; benzoylbenzene; α-oxodiphenylmethane*). $(C_6H_5)_2CO$, 182.08. α(stab.) col.rhomb.pr.; β col.monocl. pr. **D.** $α1.0976^{50}_{50}$; $β1.108^{23}_{4}$, **m.p.** α49; β26; γ45–8; δ−51, **b.p.** 306. **Soly.** i.w.; 13.5^{18}al.; 17.5^{13}; s.chl.

51 —, oxime. $(C_6H_5)_2C{:}NOH$, 197.09. Need. **m.p.** 144 (141–2.5). **Soly.** v.sl.s.w.; s.al.; v.s.et.; v.s.acet; s.alk.

52 —, phenylhydrazone. $(C_6H_5)_2C{:}NNHC_6H_5$, 272.14. Need. **m.p.** 137 (105).

53 —, **2-amino-** (*o-aminophenyl phenyl ketone; o-benzoylaniline*). $C_6H_5COC_6H_4NH_2$, 197.09. Pa.yel.leaf. **m.p.** 108. **Soly.** s.al.; s.et.

54 —, **3-amino-** (*m-aminophenyl phenyl ketone; m-benzoylaniline*). $C_6H_5COC_6H_4NH_2$, 197.09. Yel.need. **m.p.** 86. **Soly.** sl.s.w.; s.al.; s.et.

55 —, **4-amino-** (*p-aminophenyl phenyl ketone; p-benzoylaniline*). $C_6H_5COC_6H_4NH_2$, 197.09. Leaf.f.dil.al. **m.p.** 124 (110–5). **Soly.** sl.s.w.; s.al.; s.et.

56 —, **4, 4′-bisdimethylamino-** (*Michler's ketone; tetramethyl-4, 4′-diaminobenzophenone*). $CO[C_6H_4N(CH_3)_2]_2$, 268.17. Glit.leaf.f.al. **m.p.** 174, **b.p.** >360 sl.d. **Soly.** 0.04^{25}w.; v.s.al.; v.s.et.; v.s.bz.

57 —, **2, 2′-diamino-** (*bis-o-aminophenyl ketone*). $NH_2C_6H_4COC_6H_4NH_2$, 212.11. Pa.yel.leaf.f.dil.al. **m.p.** 132–3. **Soly.** i.w.; s.al.

58 —, **3, 3′-diamino-** (*bis-m-aminophenyl ketone*). $NH_2C_6H_4COC_6H_4NH_2$, 212.11. Yel.need.f.al. **m.p.** 173–4 (171), **b.p.** 285^{11}. **Soly.** s.h.w.; s.al.; s.et.

59 —, **4, 4′-diamino-** (*bis-p-aminophenyl ketone*). $NH_2C_6H_4COC_6H_4NH_2$, 212.11. Hex. or rhomb.need.f.dil.al. **m.p.** 244 (237). **Soly.** s.h.w., d. by boil.w.; s.al.; s.et.

60 —, **2, 2′-dihydroxy-** (*bis-o-hydroxyphenyl ketone*). $HOC_6H_4COC_6H_4OH$, 214.08. Leaf. or pr.f.lgr. **m.p.** 59–60, **b.p.** 340. **Soly.** i.w.; s.al.; s.et.; s.chl.

61 —, **2, 3′-dihydroxy-** (*m-hydroxyphenyl o-hydroxyphenyl ketone*). $HOC_6H_4COC_6H_4OH$, 214.08. Need.f.w. **m.p.** 126. **Soly.** s.al.; s.et.

62 —, **2, 4-dihydroxy-** (*4-benzoylresorcinol; 4-benzoresorcin*). $C_6H_5COC_6H_3(OH)_2$, 214.08. **m.p.** 144. **Soly.** i.w.; s.al.; s.et.

63 —, **2, 4′-dihydroxy-** (*o-hydroxyphenyl p-hydroxyphenyl ketone; p-salicylylphenol*). $HOC_6H_4COC_6H_4OH$, 214.08. Yel.pyram.f.bz. or pl.f.h.w. **m.p.** 150–1 (147–8). **Soly.** s.h.w.; s.h.al.; v.s.et.; s.bz., alk.

64 —, **2, 5-dihydroxy-** (*2, 5-dihydroxyphenyl phenyl ketone*). $(HO)_2C_6H_3COC_6H_5$, 214.08. Yel.need.f.dil.al. **m.p.** 125. **Soly.** s.h.w.; s.al.; s.et.; s.bz.

For explanations and abbreviations see beginning of table.

65 **Benzophenone, 3, 3′-dihydroxy-** (*bis-m-hydroxyphenyl ketone*). $HOC_6H_4COC_6H_4OH$, 214.08. Sm.need.f.w. **m.p.** 170 (162–3). **Soly.** s.w.; s.al.; s.alk.

66 **—, 3, 4′-dihydroxy-** (*m-hydroxyphenyl p-hydroxyphenyl ketone*). $HOC_6H_4COC_6H_4OH$, 214.08. Need.f.w. **m.p.** 206 (197–200). **Soly.** s.h.w.; s.al.; s.et.

67 **—, 4, 4′-dihydroxy-** (*bis-p-hydroxyphenyl ketone*). $HOC_6H_4COC_6H_4OH$, 214.08. Yel.need.f.lgr. **m.p.** 210, **b.p.** subl. **Soly.** v.s.h.w.; v.s.al.; v.s.et.; s.me.al., acet.; i.bz., chl., CS_2.

68 **—, 2, 4-dihydroxy-6-methoxy-.** See *Isocotoin.*

69 **—, 2, 6-dihydroxy-4-methoxy-.** See *Cotoin.*

70 **—, 4, 4′-dimethyl-** (*di-p-tolyl ketone*). $CH_3C_6H_4COC_6H_4CH_3$, 210.11. Rhomb.f.al. **m.p.** 95 (91–2), **b.p.** $333\text{–}4^{725}$. **Soly.** i.w.; v.s.al.; v.s.et.; s.chl., CS_2.

71 **—, p-hydroxy-.** $HOC_6H_4COC_6H_5$, 198.08. Rhomb.leaf.f.dil.al. **m.p.** 134. **Soly.** s.h.w.; v.s.al.; v.s.et.

72 **—, o-nitro-** (*o-nitrophenyl phenyl ketone*). $NO_2C_6H_4COC_6H_5$, 227.08. Col.monocl.f.al. **m.p.** 105. **Soly.** sl.s.al.

73 **—, m-nitro-.** $NO_2C_6H_4COC_6H_5$, 227.08. Col.need.f.al. **m.p.** 94–5, **b.p.** 234^{18}. **Soly.** s.al.

74 **—, p-nitro-.** $NO_2C_6H_4COC_6H_5$, 227.08. Col.leaf.f.al. **m.p.** 138. **Soly.** v.sl.s.w.; s.al.; sl.s.bz., CS_2.

75 **—, 2, 4, 6, 3′, 4′-pentahydroxy-.** See *Maclurin.*

76 **—, 2, 2′, 6-trihydroxy-** (*2-salicylylresorcinol*). $(HO)_2C_6H_3COC_6H_4OH$, 230.08. Yel.leaf.f.al. **m.p.** 133. **Soly.** sl.s.h.w.; s.h.al.; s.et.; s.bz., alk.

77 **—, 2, 3, 4-trihydroxy-** (*4-benzoylpyrogallol; alizarin yellow A*). $C_6H_5COC_6H_2(OH)_3$, 230.08. Yel.need.f.dil. al. **m.p.** 140. **Soly.** sl.s.w.; s.al.; s.et.; s.alk., H_2SO_4; sl.s.bz.

78 **Benzophenonecarboxylic acid.** See *Benzoic acid, benzoyl-.*

79 **p, p′-Benzophenonedicarboxylic acid.** See *Benzoic acid, p, p′-carbonyldi-.*

80 **2, 3-Benzophenonedicarboxylic acid.** See *Phthalic acid, 3-benzoyl-.*

81 **2, 5-Benzophenonedicarboxylic acid.** See *Terephthalic acid, benzoyl-.*

82 **3, 4-Benzophenonedicarboxylic acid.** See *Phthalic acid, 4-benzoyl-.*

83 **p-Benzophosphinic acid.** See *Benzoic acid, p-phosphono-.*

84 **Benzopinacol** (*1, 1, 2, 2-tetraphenyl-1, 2-ethanediol*; tetraphenylethylene glycol; benz(o)pinacone*). $(C_6H_5)_2COHCOH(C_6H_5)_2$, 366.17. Pr. **m.p.** 186 d. **Soly.** 2.02h.al.; s.et.

85 **β-Benzopinacolin** (*α-triphenylacetophenone; benzoyltriphenylmethane; phenyl trityl ketone*). $(C_6H_5)_3CCOC_6H_5$, 348.16. Need. **m.p.** 182.5. **Soly.** i.w.; v.sl.s.c., s.h.al.; s.et.; v.s.bz., chl., CS_2.

86 **Benzopinacone.** See *Benzopinacol.*

87 **Benzopyrazine.** See *Quinoxaline.*

88 **Benzo[b]pyridine.** See *Quinoline.*

89 **Benzo[c]pyridine.** See *Isoquinoline.*

90 **Benzo[a]pyrimidine.** See *Quinazoline.*

91 **1, 2-Benzopyrone.** See *Coumarin.*

92 **1, 4-Benzopyrone, γ-Benzopyrone** See *Chromone.*

93 **2, 1-Benzopyrone.** See *Isocoumarin.*

94 **Benzol[b]pyrrole.** See *Indole.*

95 **Benzoquinhydrone.** See *Quinhydrone.*

96 **Benzo[f]quinoline** (*5, 6-benzoquinoline; β-naphthoquinoline*). $C_{13}H_9N$, 179.08. Sm.leaf.f.h.w. **m.p.** 93, **b.p.** 351. **Soly.** s.h.w.; v.s.al.; v.s.et.; v.s.bz.

97 **—, 3-methyl-** (*3-methyl-5, 6-benzoquinoline; β-naphthoquinaldine*). $C_{13}H_8NCH_3$, 193.09. Need.f.dil.al. **m.p.** 82, **b.p.** >300. **Soly.** sl.s.w.; s.al.; s.et.

98 **Benzo[h]quinoline** (*7, 8-benzoquinoline; α-naphthoquinoline*). $C_{13}H_9N$, 179.08. Monocl.f.et. **m.p.** 52, **b.p.** 351 (223^{47}). **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.bz.

99 **—, 2-methyl-** (*2-methyl-7, 8-benzoquinoline; α-naphthoquinaldine*). $C_{13}H_8NCH_3$, 193.09. Liq. **b.p.** >300. **Soly.** i.w.; s.al.

00 **p-Benzoquinone.** See *Quinone.*

01 **4-Benzoresorcin.** See *Benzophenone, 2, 4-dihydroxy-.*

Benzothiazole. (Numbered beginning S = 1).

02 **Benzothiazole, 2-(2, 4-dinitrophenylthio)-** (*2-benzothiazyl 2, 4-dinitrophenyl sulfide*). $C_6H_4SC[SC_6H_3(NO_2)_2]:N$, 333.20. Yel.cr. **D.** 1.24_4^{20}, **m.p.** 160–2. **Soly.** i.w.; sl.s.c., s.h.al.; sl.s.et.

* Name approved by the International Union of Chemistry.

03 **Benzothiazole, 2, 2′-dithiobis-** (*2, 2′-dibenzothiazyl disulfide*). $C_{14}H_8N_2S_4$, 332.32. Lt.yel.cr. **D.** 1.50^{20}_{4}, **m.p.** 180.0, **b.p.** d. **Soly.** i.w.; v.sl.s.h.al.; v.sl.s.chl.

04 —, **mercapto-.** See *Benzothiazolethiol.*

05 —, **2-methyl-** (*μ-methylbenzothiazole; ethenylaminothiophenol*). $SC(CH_3){:}NC_6H_4$, 149.12. Liq. **b.p.** 238. **Soly.** i.w.; s.al.

06 —, **2-phenyl-** (*benzenylaminothiophenol*). $C_6H_4SC(C_6H_5){:}N$, 211.14. Need.f.al. **m.p.** 115, **b.p.** 360. **Soly.** i.w.; s.al.; s.et.; s.CS_2, dil.HCl.

07 **2-Benzothiazolethiol** (*2-mercaptobenzothiazole; o-thiocarbamidothiophenol*). $C_6H_4SC(SH){:}N$, 167.17. Lt.yel.cr. **D.** 1.42^{20}_{4}, **m.p.** 179.5, **b.p.** d. **Soly.** i.w.; s.h.al.; v.sl.s.et.; s.alk.

08 —, benzoate. $C_{14}H_9NOS_2$, 271.20. Yel.cr. **m.p.** 132. **Soly.** i.w.; sl.s.c., s.h.al.; sl.s.et.

09 —, mercaptide with α, β-diphenylguanidine. $C_{20}H_{18}N_4S_2$, 378.29. Yel. cr. **D.** 1.00, **m.p.** 173. **Soly.** i.w.; s.al.; i.et.

10 —, **6-nitro-,** diethylthiolthionocarbamic ester. $C_{12}H_{13}N_3O_2S_3$, 327.31. Fine yel.cr. **m.p.** 122. **Soly.** i.w.; s.h.al.; s.et.; s.bz.

11 **Benzothiofuran.** See *Thionaphthene.*

12 **Benzothiophene.** See *Thionaphthene.*

13 ***o*-Benzotoluide** (*N-benzoyl-o-toluidine*). $C_6H_5CONHC_6H_4CH_3$, 211.11. Rhomb.need., *n* 1.621, 1.654, 1.691. **D.** 1.205^{15}_{4}, **m.p.** 146 (135–6.5). **Soly.** sl.s.h.w.; s.al.; s.et.

14 ***m*-Benzotoluide** (*N-benzoyl-m-toluidine; m-benzotoluidide*). $C_6H_5CONHC_6H_4CH_3$, 211.11. Monocl.pr. f.dil.al. **D.** 1.170^{15}_{4}, **m.p.** 125. **Soly.** 10.02^{15}al.

15 ***p*-Benzotoluide** (*N-benzoyl-p-toluidine*). $C_6H_5CONHC_6H_4CH_3$, 211.11. Rhomb.need.f.al. **D.** 1.202^{15}_{4}, **m.p.** 158, **b.p.** 232. **Soly.** i.w.; 3.3^{15}al.; s.et.

16 **1, 2, 3-Benzotriazole** (*aziminobenzene; benzene azimide*). $C_6H_4NHN{:}N$, 119.06. Need.f.bz. **m.p.** 100, **b.p.** 73.5. **Soly.** i.w.; s.al.; s.bz.

17 **Benzotrichloride.** See *Toluene, α-trichloro-.*

18 **Benzotrifluoride.** See *Toluene, α-trifluoro-.*

19 **Benzoxazole, 2-methyl-** (O = 1) (*μ-methylbenzoxazole; ethenylaminophenol*). $OC(CH_3){:}NC_6H_4$, 133.06. Liq. **D.** 1.136^{0}_{4}, **b.p.** 201. **Soly.** i.w.; s.al.; ∞et.

20 **2(3)-Benzoxazolone** (O = 1) (*o-hydroxycarbanilic acid lactone*). C_6H_4OCONH or $C_6H_4OC(OH){:}N$, 133.05. Col.need.f.h.dil.HCl, **m.p.** 141–2 (138). **Soly.** sl.s.c.w.; v.s.al.; v.s.et.

21 **2, 3, 1-Benzoxaz-1-one** (*benzaldoximecarboxylic anhydride*). $C_6H_4COON{:}CH$, 147.05. Cr.f.bz. **m.p.** d. 120.

Benzoyl-. For benzoyl derivatives see the parent compounds (e.g., for benzoylacetic acid see *Acetic acid, benzoyl-*). See also "benzoate" under names of alcohols and phenols.

22 **Benzoyl azide** (*benzazide*). $C_6H_5CON_3$, 147.06. Col.pl.f.acet. **m.p.** 32, **b.p.** exp. **Soly.** i.w.; s.al.; s.et.

23 **Benzoyl bromide** (*benzenecarbonyl bromide**). C_6H_5COBr, 184.96. Col. fum.liq. **D.** 1.570^{15}_{4}, **m.p.** 0; frz. −24, **b.p.** 218–19. **Soly.** d.w.; s.d.al.; ∞et.

24 **Benzoyl chloride** (*benzenecarbonyl chloride**). C_6H_5COCl, 140.50. Col. fum.liq., *n* 1.55369. **D.** 1.2187^{15}_{15}. **m.p.** −1, **b.p.** 197 (194^{742}). **Soly.** d.w.; s.d.al.; ∞et.; s.bz., CS_2, oils.

25 —, ***p*-bromo-.** BrC_6H_4COCl, 219.40. Col.need. **m.p.** 42, **b.p.** 245–7 sl.d. **Soly.** d.w.; v.s.al.; v.s.et.; s.bz., lgr.

26 —, **3, 5-dinitro-.** $(NO_2)_2C_6H_3COCl$, 230.50. Yel.need.f.bz. **m.p.** 68–9, **b.p.** 196^{12}. **Soly.** d.w.; d.al.; s.et.

27 —, ***p*-methoxy-.** See *Anisoyl chloride.*

28 —, ***m*-nitro-.** $NO_2C_6H_4COCl$, 185.50. Yel.pr. **m.p.** 34, **b.p.** 278. **Soly.** d.w.; d.al.; s.et.

29 —, ***p*-nitro-.** $NO_2C_6H_4COCl$. 185.50. Yel.need.f.lgr. **m.p.** 72, **b.p.** 154^{15}. **Soly.** d.w.; d.al.; s.et.

30 **Benzoyl cyanide** (*α-keto-α-tolunitrile; 2-oxo-2-phenylethanenitrile*). C_6H_5COCN, 131.05. Col.tab. **m.p.** 32–3, **b.p.** 206–8. **Soly.** i.w.; v.s.al.; v.s.et.

For explanations and abbreviations see beginning of table.

31 **Benzoyl disulfide** (*dibenzoyl disulfide*). $(C_6H_5CO)_2S_2$, 274.20. Pr. f.h.al., et. or CS_2, **m.p.** 133 (128), **b.p** d. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.CS_2; i.NH_4OH.

32 **Benzoyl fluoride** (*benzenecarbonyl fluoride**). C_6H_5COF, 124.04. Fum. liq. **D.** >1, **b.p.** 154–5 (145). **Soly.** hyd.h.w.; v.s.al.; v.s.et.

34 **Benzoyl hydroperoxide.** See *Perbenzoic acid.*

35 **Benzoyl iodide** (*benzenecarbonyl iodide**). C_6H_5COI, 231.96. Need. or leaf. **m.p.** 3, **b.p.** 135^{25}. **Soly.** d. w.; s.al.; ∞ et.

36 **Benzoyl peroxide** (*dibenzoyl peroxide*). $(C_6H_5CO)_2O_2$, 242.08. Col. rhomb.f.et., *n* 1.545, 1.546, 1.837. **m.p.** 103.5 (106–8), **b.p.** exp. **Soly.** sl.s.w.; s.al.; s.et.; $2.53^{15}CS_2$; s.bz., olive oil.

37 **Benzpinacone.** See *Benzopinacol.*

Benzyl-. For benzyl derivatives see the parent compounds (e.g., for benzylbenzoic acid see *Benzoic acid, benzyl-*).

38 **Benzyl alcohol** (*phenylcarbinol; α-hydroxytoluene*). $C_6H_5CH_2OH$, 108.06. Col.liq., *n* 1.53955. **D.** 1.050^{15}_{15}, **m.p.** −15.3, **b.p.** 205.2; 93^{10}. **Soly.** 4^{17}w.; 66.7 50%, ∞ abs.al.; ∞ et.; ∞ chl., me.al.; s.acet.

39 —, esters. See "benzyl ester" under the corresponding acids.

40 —, ***o*-chloro-.** $ClC_6H_4CH_2OH$, 142.51. Need. or leaf.f.dil.al. **m.p.** 72, **b.p.** 230. **Soly.** sl.s.w.; s.al.; s.et.

41 —, **3, 4-dihydroxy-α-(methylaminomethyl)-.** See *Adrenaline.*

42 —, **α, α-dimethyl-.** See *2-Propanol, 2-phenyl-.*

43 —, ***o*-hydroxy-.** See *Saligenin.*

44 —, ***m*-hydroxy-** (*α, 3-toluenediol*). $HOC_6H_4CH_2OH$, 124.06. Need.f.bz. **m.p.** 67, **b.p.** 300 d. **Soly.** v.s.h.w.; v.s.al.; v.s.et.

45 —, ***p*-hydroxy-** (*α, 4-toluenediol*). $HOC_6H_4CH_2OH$, 124.06. Col.need. f.w. **m.p.** 124 (110), **b.p.** 252. **Soly.** s.w.; v.s.al.; v.s.et.

46 —, **4-hydroxy-3-methoxy-.** See *Vanillyl alcohol.*

47 —, ***p*-isopropyl-.** See *Cumic alcohol.*

48 —, ***o*-methoxy-** (*saligenin 2-methyl ether*). $CH_3OC_6H_4CH_2OH$, 138.08. Liq., *n* 1.549^{17}. **D.** 1.0495^{15}_{15}, **b.p.** 248–50; $131–2^{15}$. **Soly.** v.sl.s.w.; s.al.; ∞ et.

49 —, ***p*-methoxy-.** See *Anisyl alcohol.*

50 —, ***o*, *m* or *p*-methyl-.** See *Carbinol, tolyl-.*

51 —, **α-methyl-** (*methylphenylcarbinol; 1-phenylethanol*). $C_6H_5CH(CH_3)OH$, 122.08. Col.liq. **D.** 1.013^{20}_{4}; 1.000^{25}_{4}, **b.p.** 205 ($105–7^{12}$). **Soly.** i.w.; ∞ al.; ∞ et.

52 —, **3, 4-methylenedioxy-.** See *Piperonyl alcohol.*

53 —, ***o*-nitro-.** $NO_2C_6H_4CH_2OH$, 153.06. Need.f.w. **m.p.** 74, **b.p.** 168^{20}. **Soly.** sl.s.c.w.; s.al.; s.et.

54 —, ***m*-nitro-.** $NO_2C_6H_4CH_2OH$, 153.06. Rhomb. **m.p.** 27, **b.p.** 180^{3}. **Soly.** sl.s.w.; s.al.; v.s.et.

55 —, —, benzoate (*m-nitrobenzyl benzoate*). $C_6H_5COOCH_2C_6H_4NO_2$, 257.09. **m.p.** 69.0–.5. **Soly.** i.w.; s.al.; s.et.

56 —, ***p*-nitro-.** $NO_2C_6H_4CH_2OH$, 153.06. Need.f.w. **m.p.** 93, **b.p.** 185^{12}. **Soly.** sl.s.c., s.h.w.; v.s.al.; v.s.et.

57 —, **thio-.** See *α-Toluenethiol.*

58 **Benzylamine** (*α-aminotoluene*). $C_6H_5CH_2NH_2$, 107.08. Col.liq., *n* 1.5401. **D.** 0.9826^{19}_{4}, **b.p.** 185. **Soly.** ∞ w.; ∞ al.; ∞ et.

59 —, ***N*-acetyl-.** See *Acetamide, N-benzyl-.*

60 —, ***N, N*-diphenyl-.** See *Diphenylamine, N-benzyl-.*

61 —, **α-methyl-** (*α-phenylethylamine; 1-amino-1-phenylethane*). $C_6H_5CH(CH_3)NH_2$, 121.09. Arom.oil. **D.** 0.9395^{15}, **b.p.** 187.4. **Soly.** 4.2^{20}w.; ∞ al.; ∞ et.

62 —, ***N*-methyl-*N*-phenyl-** (*N-benzyl-N-methylaniline*). $C_6H_5CH_2N(CH_3)C_6H_5$, 197.13. Liq. **m.p.** 9.2, **b.p.** 306. **Soly.** i.w.; v.s.al.; v.s.et.

63 —, ***N*-nitroso-*N*-phenyl-** (*N-phenylbenzylnitrosamine*). $C_6H_5CH_2N(NO)C_6H_5$, 212.11. Yel.need.f.al. **m.p.** 57–8. **Soly.** i.w.; s.al.; s.et.; s.chl., lgr.

64 —, ***N*-phenyl-** (*N-benzylaniline*). $C_6H_5CH_2NHC_6H_5$, 183.11. Col.monocl. pr.f.al. **D.** 1.0618^{24}_{4}; 1.038^{54}_{4}, **m.p.** 37–8 (32), **b.p.** 306–7. **Soly.** i.w.; s.al.; s.et.; s.h.me.al.

65 **Benzyl azide.** See *Toluene, α-triazo-.*

66 **Benzyl bromide** (*α-bromotoluene*). $C_6H_5CH_2Br$, 170.97. Col.pois.liq. **D.** 1.438^{22}_{0}, **m.p.** −4.0, **b.p.** 198. **Soly.** i.w.; ∞ al.; ∞ et.

67 **Benzyl chloride** (*α-chlorotoluene*). $C_6H_5CH_2Cl$, 126.51. Col.liq., *n* 1.5415^{15}. **D.** 1.1026^{18}_{4}, **m.p.** −43 (−48), **b.p.** 179. **Soly.** i.c., d.h.w.; ∞ al.; ∞ et.

* Name approved by the International Union of Chemistry.

68 **Benzyl chloride, *o*-bromo-** (*o-bromo-α-chlorotoluene*). $BrC_6H_4CH_2Cl$, 205.42. **b.p.** $124–6^{20}$. **Soly.** i.w.; v.s.al.; v.s.et.

69 **—, *p*-bromo-** (*p-bromo-α-chlorotoluene*). $BrC_6H_4CH_2Cl$, Need.f.al. or pet.eth. **m.p.** 41, **b.p.** 236. **Soly.** i.w.; v.s.h.al.; v.s.et.

70 **—, *p*-chloro-** (*α, 4-dichlorotoluene*). $ClC_6H_4CH_2Cl$, 160.96. Need. **m.p.** 29, **b.p.** 222 (214) d. **Soly.** i.w.; s.c., v.s.h.al.; s.et.; s.ac.a., CS_2, bz.

71 **Benzyl cyanide.** See *α-Tolunitrile.*

72 **Benzyl disulfide** (*dibenzyl disulfide; α-(benzyldithio)toluene*). $(C_6H_5CH_2)_2S_2$, 246.23. Leaf.f.al. **m.p.** (1) 71–2; (2) 69–70. **Soly.** v.sl.s.w.; s.h.al.; s.et.; s.bz., h.me.al.

73 **Benzyl ether** (*dibenzyl ether*). $(C_6H_5CH_2)_2O$, 198.11. Col.oil. **D.** 1.0428^{20}_{4}, **m.p.** 4–5, **b.p.** 295–8 ($157–60^{15}$). **Soly.** i.w.; v.s.h.al.; s.et.

74 **Benzyl hydrosulfide.** See *α-Toluenethiol.*

Benzylidene. See *Benzal.*

75 **Benzyl iodide** (*α-iodotoluene*). $C_6H_5CH_2I$, 217.97. Col.cr. **D.** 1.733^{25}_{4}, **m.p.** 24, **b.p.** 93^{10}. **Soly.** i.w.; s.al.; s.et.; s.CS_2.

76 **Benzyl mercaptan.** See *α-Toluenethiol.*

77 **Benzyl mustard oil.** See *Isothiocyanic acid, benzyl ester.*

78 **Benzylnitrosamine, *N*-phenyl-.** See *Benzylamine, N-nitroso-N-phenyl-.*

79 **Benzyloxyamine*** (*α(or O)-benzylhydroxylamine*). $C_6H_5CH_2NHOH$, 123.08. Oil. **b.p.** $118–9^{30}$. **Soly.** s.w.

80 **Benzyl sulfide** (*dibenzyl sulfide*). $(C_6H_5CH_2)_2S$, 214.17. Col.rhomb.pl. f.et. or chl. **D.** 1.0712^{50}_{50}, **m.p.** 49. **Soly.** i.w.; s.al.; s.et.

81 **Benzyl sulfone** (*dibenzyl sulfone*). $(C_6H_5CH_2)_2SO_2$, 246.17. Need.f.al. +bz. **m.p.** 151, **b.p.** 290sl.d. **Soly.** s.h.w.; sl.s.al.; v.s.acet.; s.bz., ac.a.

82 **Benzyl sulfoxide** (*dibenzyl sulfoxide*). $(C_6H_5CH_2)_2SO$, 230.17. Leaf.f.al. or w. **m.p.** 134 (130), **b.p.** d. 210. **Soly.** i.c., s.h.w.; s.al.; s.et.

83 **Berbamine.** $C_{18}H_{19}NO_3{\cdot}2H_2O$, 333.19. Leaf.f.al., $[\alpha]$ $108.6°^{5}_{D}$. **m.p.** anh. 200. **Soly.** s.al.; s.et.

84 **Berberine.** $C_{20}H_{17}NO_4{\cdot}6H_2O$, 443.23. Yel.anh.need.f.et.; cr.($+6H_2O$)f.w. **m.p.** anh. 145. **Soly.** 22^{21}w.; 1c.al.; v.sl.s.et.; sl.s.chl., bz.

85 —, compd. with chloroform. $C_{20}H_{19}NO_5{\cdot}CHCl_3$, 472.54. Tricl.tab.f.chl. **m.p.** 179.

86 —, hydrochloride. $C_{20}H_{19}NO_5{\cdot}HCl{\cdot}2H_2O$, 425.65. Or.need. or yel.powd. **Soly.** s.w.; s.al.

87 —, nitrate. $C_{20}H_{19}NO_5{\cdot}HNO_3$, 416.17. Yel.need. **Soly.** sl.s.w.

88 —, sulfate. $C_{20}H_{19}NO_5{\cdot}H_2SO_4$, 451.23. Yel.need. **Soly.** 1^{21}w.; sl.s.al.

89 **—, tetrahydro-.** See *Canadine; Hydroberberine.*

90 **Berberonic acid** (*2, 4, 5-pyridinetricarboxylic acid**). $C_5H_2N(COOH)_3{\cdot}1\frac{1}{2}H_2O$, 238.07. Tricl.pr. **m.p.** 235; anh. 243. **Soly.** v.sl.s.w.; v.sl.s.al.; i.et.; s.dil.a.; i.bz., chl.

91 **Betacaine.** See *β-Eucaine.*

92 **Betaine** (*lycine; oxyneurine; trimethylglycocoll; (carboxymethyl)trimethylammonium hydroxide anhydride*). $COCH_2N(CH_3)_3O$, 117.09. Col. monocl.pr. or leaf. **m.p.** 293 d. **Soly.** 157^{19}w.; 8.6^{18}al.; v.sl.s.et.

93 **Betel phenol.** See *Chavibetol.*

94 **Betol** (*2-naphthyl salicylate; β-naphthyl salicylate*). $HOC_6H_4COOC_{10}H_7$, 264.09. Cr.f.al. **m.p.** 95. **Soly.** i.w.; s.al.; s.h.et.; s.h.bz.

95 **Betorcinol.** See *Resorcinol, 2, 5-dimethyl-.*

96 **Betulinic acid.** $C_{36}H_{64}O_6$, 582.42. Wh.powd. **m.p.** 195. **Soly.** sl.s.w.; v.s.al.

97 **Betulinol** (*betulin; betula camphor; birch camphor*). $C_{36}H_{60}O_3$(?), 540.47. Need.f.al., $[\alpha]+19.96°^{15}_{D}$ in pyr. **m.p.** 251, **b.p.** subl., d. **Soly.** i.w.; 0.85c., 4.27h.al.; 0.4c., 3.07h.et.

98 ***p, p′*-Biacetanilide.** See *Benzidine, N, N′-diacetyl-.*

99 **Biacetyl.** See 2, 3-*Butanedione**.

00 **Biacetylene.** See *Butadiyne.*

01 **Biallyl.** See 1, 5-*Hexadiene**.

02 ***o, p′*-Bianiline.** See 2, 4′-*Biphenyldiamine.*

03 ***p, p′*-Bianiline.** See *Benzidine.*

04 **4, 4′-Bi-*o*-anisidine** (*2, 2′-dimethoxybenzidine*(NH_2 = 1)). $[CH_3O(NH_2)C_6H_3]_2$, 244.14. Col.need. or leaf. **m.p.** 137–8 (131.5). **Soly.** sl.s.h.w.; s.al.; sl.s.et.; s.acet., chl., bz.

05 **Biarsine, tetraethyl-** (*ethyl cacodyl; bis(diethylarsenic)*). $(C_2H_5)_2AsAs(C_2H_5)_2$, 266.02. Liq., ign. in air, *n* 1.4709. **D.** $1.1388^{23.7}_{4}$, **b.p.** 185–90. **Soly.** i.w.; s.al.; s.et.

For explanations and abbreviations see beginning of table.

06 **Biarsine, tetramethyl-.** See *Cacodyl.*

07 *o, o′*-**Bibenzoic acid.** See *Diphenic acid.*

08 **Bibenzoyl.** See *Benzil.*

09 **Bibenzyl** (*sym- or* 1, 2-*diphenylethane; dibenzyl*). $C_6H_5CH_2CH_2C_6H_5$, 182.11. Col.monocl.need.f.al. **D.** $0.995^{0°}_{4}$; $0.942^{60°}_{4}$; **m.p.** 52.5, **b.p.** 284. **Soly.** i.w.; s.al.; v.s.et.; s.CS_2.

10 —, **4, 4′-diamino-.** See *α, α′-Bi-p-toluidine.*

11 **Bi-*sec*-butyl.** See *Hexane,* 3, 4-*dimethyl-*.*

12 **Bi-*tert*-butyl.** See *Butane,* 2, 2, 3, 3-*tetramethyl-*.*

13 **2, 2′-Bicamphane-2, 2′-diol.** See *Camphor pinacol.*

14 **Bicyclo[4, 4, 0]decane.** See *Naphthalene, decahydro-*.*

15 **Bicyclo[2, 2, 1]heptane.** See *Norcamphane.*

16 **Bicyclo-[2, 2, 1]hept-2-ene, 1, 7, 7-trimethyl-.** See *Bornylene.*

17 **Bicyclo[3, 1, 1]hept-2-ene, 2, 6, 6-trimethyl-.** See *Pinene.*

18 **Bicyclo[3, 1, 0]hexane, 1-isopropyl-4-methylene-.** See *Sabinene.*

19 **Biethylene.** See 1, 3-*Butadiene*.*

20 **Biformyl.** See *Glyoxal.*

21 **Biguanide** (*guanylguanidine; diguanide*). $NH_2C(:NH)NHC(:NH)-NH_2$, 101.09. Amor. or pr.f.al. **m.p.** 130. **Soly.** s.w.; s.al.

22 —, ***α-o*-tolyl-.** $C_7H_7NHC(:NH)-NHC(:NH)NH_2 \cdot \frac{1}{2}H_2O$, 200.15. Wh. cr. **m.p.** $\frac{1}{2}H_2O$ 140–4; anh. 145–6. **Soly.** s.h.w.; s.al.; s.et.

23 **Bihexyl.** See *Dodecane*.*

24 **Biisoamyl.** See *Octane,* 2, 7-*dimethyl-*.*

25 **Biisobutyl.** See *Hexane,* 2, 5-*dimethyl-*.*

26 **Biisopropenyl.** See 1, 3-*Butadiene,* 2, 3-*dimethyl-*.*

27 **Biisopropyl.** See *Butane,* 2, 3-*dimethyl-*.*

28 **Bikhaconine, acetylveratryl-.** See *Bikhaconitine.*

29 **Bikhaconitine** (*acetylveratrylbikhaconine*). $C_{36}H_{51}NO_{11}$, 673.41. Cr. **m.p.** 113. **Soly.** s.al.; s.et.

30 **Bilifuscin.** $C_{16}H_{20}N_2O_4$, 304.17. Br.powd. **m.p.** 183. **Soly.** sl.s.w.; s.al.; sl.s.et.; s.glac.ac.a., alk.

31 **Bilineurine.** See *Choline.*

32 **Bilirubin.** $C_{32}H_{36}N_4O_6$, 572.31. Br. rhomb.cr. **m.p.** 192–2.5. **Soly.** i.w.; sl.s.al.; v.sl.s.et.; s.CS_2, chl., bz., a., alk.

33 **Biliverdin.** $C_{32}H_{36}N_4O_8$, 604.31. Grn.-blk.powd. **Soly.** i.w.; s.al.; sl.s.et.; s.bz., alk.; i.chl.

34 **1, 1′-Bi-2-naphthol** (*β-dinaphthol;* 2, 2′-*dihydroxy*-1, 1′-*binaphthyl*). $HOC_{10}H_6C_{10}H_6OH$, 286.11. Need.f.al. or tol. **m.p.** 218, **b.p.** subl. **Soly.** i.w.; s.al.; v.s.et.; sl.s.chl.

35 **4, 4′-Bi-1-naphthol** (*α-dinaphthol;* 4, 4′-*dihydroxy*-1, 1′-*binaphthyl*). $HOC_{10}H_6C_{10}H_6OH$, 286.11. Rhomb. f.al. **m.p.** 300, **b.p.** subl. **Soly.** i.w.; s.al.; v.s.et.; s.alk.; sl.s.chl., bz.

36 **1, 1′-Binaphthyl*** (*α, α′-dinaphthyl*). $C_{10}H_7C_{10}H_7$, 254.11. Col.rhomb.leaf. f.al. **m.p.** 160.5 (156), **b.p.** *ca.* 360; $240–4^{12}$. **Soly.** i.w.; s.h.al.; s.et.; s.bz., CS_2.

37 —, **2, 2′-dihydroxy-.** See 1, 1′-*Bi*-2-*naphthol.*

38 —, **4, 4′-dihydroxy-.** See 4, 4′-*Bi*-1-*naphthol.*

39 **2, 2′-Binaphthyl*** (*β, β′-dinaphthyl*). $C_{10}H_7C_{10}H_7$, 254.11. Col.pl. **m.p.** 187–8 (181), **b.p.** 452. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.h.bz., CS_2.

40 **Bindschedler green,** leuco base. See *Diphenylamine, p, p′-bisdimethylamino-.*

41 **Bioctyl.** See *Hexadecane*.*

42 **Bioxirane.** See *i-Erythritol, anhydride.*

43 ***o, o′*-Biphenol** (2, 2′-*dihydroxybiphenyl*). $HOC_6H_4C_6H_4OH$, 186.08. Pr.f.tol.; leaf.(hyd.)f.w. **m.p.** hyd. 73–5; anh. 109–10, **b.p.** 326. **Soly.** s.h.w.; s.al.; s.et.; s.ac.a., bz., alk.

44 ***o, p′*-Biphenol** (2, 4′-*dihydroxybiphenyl*). $HOC_6H_4C_6H_4OH$, 186.08. Monocl.pr. or need. **m.p.** 162–3, **b.p.** 342. **Soly.** sl.s.h.w.; s.al.; s.et.

45 ***m, m′*-Biphenol** (3, 3′-*dihydroxybiphenyl*). $HOC_6H_4C_6H_4OH$, 186.08. Need.f.w. **m.p.** 123–4, **b.p.** 247^{18}. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl., bz., alk.

46 ***p, p′*-Biphenol** (4, 4′-*dihydroxybiphenyl*). $HOC_6H_4C_6H_4OH$, 186.08. Rhomb.need. or pl.f.al. **D.** $1.25^{0°}_{4}$, **m.p.** 274–5 (270–2), **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; sl.s.bz.

47 ***p, p′*-Biphenol, 2, 2′, 6, 6′-tetramethoxy-.** See *Hydrocerulignone.*

* Name approved by the International Union of Chemistry.

48 *p, p'*-**Biphenol, 3, 3', 5, 5'-tetranitro-.** $[C_6H_2(NO_2)_2OH]_2$, 366.08. Yel.need. **m.p.** 222–5. **Soly.** i.w.; s.al.

49 Biphenyl (*diphenyl; phenylbenzene*). $C_6H_5C_6H_5$, 154.08. Col.monocl., *n* α1.56841, β1.59441, γ1.61158; $1.58822^{77.1}$. **D.** 1.180^{0}_{4}; 0.9919^{73}_{4}, **m.p.** 69–71, **b.p.** 254–5. **Soly.** i.w.; 10c.al.; s.et.; $6.57^{19.5}$me.al.

50 —, **2-amino-.** See *o-Biphenylamine.*

51 —, **3-amino-.** See *m-Biphenylamine.*

52 —, **4-amino-.** See *Xenylamine.*

53 —, **2-amino-4, 4'-diamino-.** See *Benzidine, 3-amino-.*

54 —, **2-benzyl-** (*1-benzyl-2-phenylbenzene*). $C_6H_5CH_2C_6H_4C_6H_5$, 244.12. Monocl.need. **m.p.** 54, **b.p.** $283–7^{110}$. **Soly.** i.w.; s.al.; s.et.; v.s.bz.

55 —, **4-benzyl-** (*1-benzyl-4-phenylbenzene*). $C_6H_5CH_2C_6H_4C_6H_5$, 244.12. Leaf. **m.p.** 85, **b.p.** $285–6^{100}$. **Soly.** i.w.; s.al.; s.et.; v.s.bz.

56 —, **2-bromo-** (*2-bromodiphenyl*). $C_6H_5C_6H_4Br$, 232.99. Liq. **m.p.** < -20, **b.p.** 296–8. **Soly.** i.w.; s.al.; s.et.

57 —, **4-bromo-** (*4-bromodiphenyl*). $C_6H_5C_6H_4Br$, 232.99. Col.pl.f.al. **m.p.** 89–90, **b.p.** 310. **Soly.** i.w.; s.al.; s.et.

58 —, **2-chloro-** (*o-chlorodiphenyl*). $ClC_6H_4C_6H_5$, 188.53. Monocl. **m.p.** 32, **b.p.** 273–4. **Soly.** i.w.; s.al.; v.s.et.; s.lgr., CCl_4.

59 —, **3-chloro-** (*m-chlorodiphenyl*). $ClC_6H_4C_6H_5$, 188.53. Cr. **m.p.** 89, **b.p.** 284–5. **Soly.** i.w.; s.al.; s.et.

60 —, **4-chloro-** (*p-chlorodiphenyl*). $ClC_6H_4C_6H_5$, 188.53. Leaf.f.lgr. or al. **m.p.** 77 (66–75), **b.p.** 291.2^{745} (282). **Soly.** i.w.; s.al.; s.et.; s.lgr.

61 —, **2, 4'-diamino-.** See *2, 4'-Biphenyldiamine.*

62 —, **4, 4'-diamino-.** See *Benzidine.*

63 —, **4, 4'-dibromo-*** (*p, p'-dibromodiphenyl*). $BrC_6H_4C_6H_4Br$, 311.89. Monocl.pr. **D.** 1.897^{20}_{4}, **m.p.** 164, **b.p.** 355–60. **Soly.** i.w.; v.sl.s.h.al.; s.bz.

64 —, **4, 4'-dichloro-*** (*4, 4'-dichlorodiphenyl*). $ClC_6H_4C_6H_4Cl$, 222.98. Monocl.pr. or need.f.tol. **D.** 1.439^{20}_{4}, **m.p.** 148–9 (130–43), **b.p.** 315–9. **Soly.** i.w.

65 —, **4, 4' dichloro-2, 2'-dinitro-.** $Cl(NO_2)C_6H_3C_6H_3(NO_2)Cl$, 312.98. Yel.need.f.al. **m.p.** 138. **Soly.** i.w.; sl.s.c., s.h.al.

66 —, **2, 2'-dihydroxy-.** See *o, o'-Biphenol.*

67 —, **2, 4'-dihydroxy-.** See *o, p'-Biphenol.*

68 —, **3, 3'-dihydroxy-.** See *m, m'-Biphenol.*

69 —, **4, 4'-dihydroxy-.** See *p, p'-Biphenol.*

70 —, **2, 2'-dimethyl-.** See *o, o'-Bitolyl.*

71 —, **2, 3'-dimethyl-.** See *o, m'-Bitolyl.*

72 —, **3, 3'-dimethyl-.** See *m, m'-Bitolyl.*

73 —, **4, 4'-dimethyl-.** See *p, p'-Bitolyl.*

74 —, **2, 2'-dinitro-*** (*o, o'-dinitrodiphenyl*). $NO_2C_6H_4C_6H_4NO_2$, 244.08. Yelsh.monocl.need. **D.** 1.45^{20}_{4}, **m.p.** 124. **Soly.** i.w.; s.h.al.; s.et.; s.h.ac.a., h. bz.; sl.s.lgr.

75 —, **2, 4'-dinitro-*** (*o, p'-dinitrodiphenyl*). $NO_2C_6H_4C_6H_4NO_2$, 244.08. Col.monocl.need. or pr. **D.** 1.474^{20}_{4}, **m.p.** 93.5. **Soly.** i.w.; s.h.al.; s.et.; s.h.ac. a., h.bz.

76 —, **3, 3'-dinitro-*** (*m, m'-dinitrodiphenyl*). $NO_2C_6H_4C_6H_4NO_2$, 244.08. Or.-yel.need. **m.p.** 200. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.h.ac.a., h.bz.

77 —, **4, 4'-dinitro-*** (*p, p'-dinitrodiphenyl*). $NO_2C_6H_4C_6H_4NO_2$, 244.08. Need.f.al. **D.** 1.445^{20}_{4}, **m.p.** 233 (237–43). **Soly.** i.w.; v.sl.s.c., s.h.al.; v.s.et.; s.h.bz., h.ac.a.

78 —, **2-ethoxy-*.** $C_6H_5C_6H_4OC_2H_5$, 198.11. Pr. **m.p.** 34, **b.p.** 276. **Soly.** v.s.al.; v.s.et.

79 —, **3-ethoxy-*.** $C_6H_5C_6H_4OC_2H_5$, 198.11. Cr. **m.p.** 34, **b.p.** 305. **Soly.** s.al.; s.et.

80 —, **1, 2, 3, 4, 5, 6-hexahydro-.** See *Cyclohexane, phenyl-.*

81 —, **hydroxy-.** See *Phenol, phenyl-.*

82 —, **4-iodo-*.** $C_6H_5C_6H_4I$, 279.99. Col.cr.f.ac.a. **m.p.** 113–4 (109–11), **b.p.** 320 d. **Soly.** i.w.; s.h.al.; s.et.; s.bz., ac.a.

83 —, **2-methoxy-*.** $C_6H_5C_6H_4OCH_3$, 184.09. Pr. **m.p.** 29, **b.p.** 274; $159–60^{18}$.

84 —, **4-methoxy-*.** $C_6H_5C_6H_4OCH_3$, 184.09. Leaf. **m.p.** 90 (84–5). **Soly.** s.h.al.

85 —, **2-methyl-** (*o-phenyltoluene*). $C_6H_5C_6H_4CH_3$, 168.09. Col.liq. **D.** 1.010^{20}_{4}, **b.p.** 260. **Soly.** i.w.; s.al.; s.et.

For explanations and abbreviations see beginning of table.

86 Biphenyl, 3-methyl- (*m-phenyltoluene*). $C_6H_5C_6H_4CH_3$, 168.09. Col. liq. **D.** 1.031$^{0}_{4}$, **b.p.** 277. **Soly.** i.w.; s.al.; s.et.

87 —, **4-methyl-** (*p-phenyltoluene*). $C_6H_5C_6H_4CH_3$, 168.09. Col.liq. **D.** 1.015^{27}, **m.p.** −3, **b.p.** 267. **Soly.** i.w.; s.al.; s.et.

88 —, **2-nitro-.** $C_6H_5C_6H_4NO_2$, 199.08. Rhomb.bipy.leaf.f.al. **D.** 1.44$^{20}_{4}$, **m.p.** 37 (31–3), **b.p.** 320. **Soly.** i.w.; v.s.al.; v.s.et.

89 —, **3-nitro-.** $C_6H_5C_6H_4NO_2$, 199.08. Yel.leaf.f.w.+al. **m.p.** 58.5–61. **Soly.** i.w.; v.s.al.; v.s.ac.a.; s.lgr.

90 —, **4-nitro-.** $C_6H_5C_6H_4NO_2$, 199.08. Col.rhomb.bipy.need.f.al. **D.** 1.328$^{20}_{4}$, **m.p.** 113, **b.p.** 340. **Soly.** i.w.; sl.s.c.al.; s.et.; v.s.chl.

91 —, **3-phenyl-.** See *Benzene*, 1, 3-*diphenyl-*.

92 —, **4-phenyl-.** See *Terphenyl*.

93 —, **3, 3′, 3, 5′-tetrahydroxy-.** See 5, 5′-*Biresorcinol*.

94 —, **2, 2′, 4, 4′-tetranitro-.** $(NO_2)_2C_6H_3C_6H_3(NO_2)_2$, 334.08. Yel.pr.f.bz. **m.p.** 164–5, **b.p.** d. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.bz., ac.a.

95 ***o*-Biphenylamine** (*2-aminobiphenyl*). $NH_2C_6H_4C_6H_5$, 169.09. Col.leaf. **m.p.** 49.3 (45.5), **b.p.** 299. **Soly.** i.w.; s.al.

96 ***m*-Biphenylamine** (*3-aminobiphenyl*). $NH_2C_6H_4C_6H_5$, 169.09. Col. leaf. or need. **m.p.** 30, **b.p.** 254^{135}. **Soly.** sl.s.w.; s.al.; s.et.

97 ***p*-Biphenylamine.** See *Xenylamine*.

98 Biphenylcarboxylic acid. See *Benzoic acid, phenyl-*.

99 2, 4′-Biphenyldiamine (*o, p′-bianiline; diphenyline; 2, 4′-diaminobiphenyl*). $NH_2C_6H_4C_6H_4NH_2$, 184.11. Need.f.dil.al. **m.p.** 45, **b.p.** 363. **Soly.** v.sl.s.w.; s.al.; s.et.

00 2, 2′-Biphenyldicarbonyl chloride. See *Diphenoyl chloride*.

01 2, 2′-Biphenyldicarboxylic acid. See *Diphenic acid*.

02 2, 2′-Biphenyldisulfonic acid, 4, 4′-diamino-. See 3, 3′-*Benzidinedisulfonic acid*.

03 Biphenylene oxide. See *Dibenzofuran*.

04 Biphenylene sulfone, 2, 7-diamino-. See *Benzidine sulfone*.

05 *p*-Biphenylyl mustard oil. See *Isothiocyanic acid, xenyl ester*.

06 Bipropargyl. See 1, 5-*Hexadiyne**.

07 Bipropenyl. See 2, 4-*Hexadiene**.

08 4, 4′-Bipyridyl (4, 4′- or *γ, γ′-dipyridyl*). $(C_5H_4N)_2$, 156.08. Need. ($+2H_2O$)f.w. **m.p.** $2H_2O$, 73; anh. 114, **b.p.** 304.8. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.chl., bz.

09 Bipyromucyl. See *Furil*.

10 2, 3′-Biquinoline (2, 3′-*biquinolyl*; 2, 3′-*diquinolyl*). $(C_9H_6N)_2$, 256.11. Yel.pl. or need.f.bz. **m.p.** 176–7, **b.p.** >400. **Soly.** i.w.; v.s.al.; s.et.; s.h.chl., h.bz.

11 2, 7′-Biquinoline (2, 7′-*diquinolyl*). $(C_9H_6N)_2$, 256.11. Monocl.pl.f.al. **m.p.** 193, **b.p.** subl. **Soly.** i.w.; v.sl.s.al.; sl.s.et.; s.chl., h.bz.

12 6, 6′-Biquinoline (6, 6′-*diquinolyl*). $(C_9H_6N)_2$, 256.11. Monocl.leaf.f.al. **m.p.** 181 (178), **b.p.** dist. **Soly.** v.sl.s.h.w.; v.sl.s.al.; s.et.; s.bz.

13 Birch camphor. See *Betulinol*.

14 5, 5′-Biresorcinol (3, 3′, 5, 5′-*tetrahydroxybiphenyl*). $(HO)_2C_6H_3C_6H_3(OH)_2 \cdot 2H_2O$, 254.11. Pl., need. or wh. cr.powd. **m.p.** anh. 310. **Soly.** s.h.w.; s.al.; s.et.; i.ac.a., acet.

15 Bismuth, triethyl-* (*triethylbismuthine; bismuth triethyl*). $Bi(C_2H_5)_3$, 296.12. Col.liq. **D.** 1.82$^{20}_{4}$, **b.p.** 107^{79} exp. **Soly.** i.w.; s.al.; s.et.

16 —, **trimethyl-*** (*trimethylbismuthine*). $(CH_3)_3Bi$, 254.07. **D.** 2.300$^{18}_{4}$, **b.p.** 110.

17 —, **triphenyl-*** (*triphenylbismuthine*). $(C_6H_5)_3Bi$, 440.12. Monocl. **D.** 1.585$^{20}_{4}$, **m.p.** 77–8, **b.p.** 242^{14}. **Soly.** i.w.; sl.s.al.; s.et.; v.s.chl., acet.

Bismuthine. For derivatives see under *Bismuth*.

18 2, 2′-Bithienyl. See 2, 2′-*Bithiophene*.

19 2, 2′-Bithiophene (2, 2′-*bithienyl*; *α, α-dithienyl*). $(C_4H_3S)_2$, 166.17. Col. leaf. **m.p.** 33, **b.p.** 260. **Soly.** i.w.; v.s.al.; v.s.et.; s.ac.a.

20 2, 2′-Bithiophene, hexabromo- (*perbromo-α, α-dithienyl*). $(C_4Br_3S)_2$, 639.62. Need. **m.p.** 255. **Soly.** i.al.; s.h.bz.

21 4, 4′-Bi-*o*-toluidine (NH_2 = 1). See *o-Tolidine*.

22 *α, α′*-Bi-*p*-toluidine (4, 4′-*diaminobibenzyl*; 4, 4′-*diamino-s-diphenylethane*). $H_2NC_6H_4C_2H_4C_6H_4NH_2$, 212.14. Lust. pl.f.w. **m.p.** 134–5 (132), **b.p.** subl. **Soly.** s.h.w.; v.s.al.

* Name approved by the International Union of Chemistry.

23 ***o, o'*-Bitolyl** (*2, 2'-dimethylbiphenyl*). $CH_3C_6H_4C_6H_4CH_3$, 182.11. Col.liq. or cr.f.al. **D.** 0.955^{20}_{4}, **m.p.** 17.8, **b.p.** 272; 258^{736}. **Soly.** i.w.; s.al.; s.et.; s.bz.

24 ***o, m'*-Bitolyl** (*2, 3'-dimethylbiphenyl*). $CH_3C_6H_4C_6H_4CH_3$, 182.11. Col.liq. **b.p.** 270 (287.5). **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

25 ***m, m'*-Bitolyl** (*3, 3'-dimethylbiphenyl; m, m'-ditolyl*). $CH_3C_6H_4C_6H_4CH_3$, 182.11. Col.visc.liq. **D.** 0.9993^{18}_{4}, **m.p.** 5–7, **b.p.** $286–7^{713}$. **Soly.** i.w.; s.al.; s.et.; s.bz.

26 ***p, p'*-Bitolyl** (*4, 4'-dimethylbiphenyl*). $CH_3C_6H_4C_6H_4CH_3$, 182.11. Col monocl.pr.f.et. **D.** 1.102^{20}_{4}; liq 0.917^{121}, **m.p.** 121, **b.p.** 273–6 (295). **Soly.** i.w.; s.al.; s.et.; s.bz.,CS_2.

27 **Biuret** (*allophanamide; carbamylurea; ureidoformamide*). $NHCONH_2$-$CONH_2 \cdot H_2O$, 121.08. Col.need. $(+1H_2O)$; anh.f.al. **m.p.** 190 (193) d. **Soly.** 1.54^{15}, 45.5^{100}w.; v.s.al.; v.sl.s.et.

28 —, **acetyl-** (*acetylallophanamide*). $CH_3CONHCONHCONH_2$, 145.08. Col.need. **m.p.** 193. **Soly.** s.w.; v.s.al.; sl.s.et.; s.bz.

29 **Bivinyl.** See 1, 3-*Butadiene**.

30 —, **α-methyl-.** See 1, 3-*Pentadiene**.

31 —, **β-methyl-.** See *Isoprene*.

32 **Blue cross.** See *Arsine, chlorodiphenyl-*.

33 **Boric acid, benzyl-** (*benzylboron dihydroxide*). $C_6H_5CH_2B(OH)_2$, 135.89. Cr. **m.p.** 161. **Soly.** s.et.

34 —, ***p*-bromophenyl.** $BrC_6H_4B(OH)_2$, 200.78. Need. **m.p.** 266. **Soly.** s.et.

35 —, ***p*-chlorophenyl-.** $ClC_6H_4B(OH)_2$, 156.32. Need. or sheafs. **m.p.** 275. **Soly.** s.et.

36 —, **ethyl-.** $C_2H_5B(OH)_2$, 73.87. Wh. cr. **m.p.** subl. 40 (?). **Soly.** s.w.; s.al.; s.et.

37 —, **isoamyl-.** $(CH_3)_2CHCH_2CH_2B(OH)_2$, 115.92. Rectangular tab. **m.p.** 169 (101). **Soly.** s.w.; s.al.; s.et.

38 —, **isobutyl-.** $(CH_3)_2CHCH_2B(OH)_2$, 101.91. Long pointed doubly refracting pl. **m.p.** 112 (104). **Soly.** s.w.; s.al.; s.et.

39 —, **phenyl-** (*phenylboron dihydroxide*). $C_6H_5B(OH)_2$, 121.87. Need. **m.p.** 216. **Soly.** sl.s.w.; s.al.; s.et.

40 —, **propyl-.** $CH_3CH_2CH_2B(OH)_2$, 87.89. Thick rectangular pl. **m.p.** 107 (74–5). **Soly.** s.w.; s.al.; s.et.

41 —, ***p*-tolyl-** (*p-tolylboron dihydroxide*). $CH_3C_6H_4B(OH)_2$, 135.89. Need. **m.p.** 240. **Soly.** s.et.

42 **Borine, difluorophenyl-** (*boron phenyl difluoride; phenylboron difluoride*). $C_6H_5BF_2$, 125.86. Oil. **b.p.** 70–5. **Soly.** s.et.

43 —, **difluoro-*p*-tolyl-** (*p-tolylboron difluoride; boron p-tolyl difluoride*). $CH_3C_6H_4BF_2$, 139.87. Oil. **b.p.** 95–7. **Soly.** s.et.

44 —, **triethyl-** (*triethylboron; boron triethyl*). $(C_2H_5)_3B$, 97.94. Col.fum. liq. **D.** 0.6961^{23}_{4}, **b.p.** 95. **Soly.** v.sl.s.w.; s.al.; s.et.

45 —, **triisoamyl-** (*triisoamylboron*). $(C_5H_{11})_3B$, 224.08. Liq., *n* 1.43207. **D.** $0.7600^{23.4}_{4}$, **b.p.** 119^{14}. **Soly.** s.et.

46 —, **triisobutyl-** (*triisobutylboron*). $(C_4H_9)_3B$, 182.03. Liq., *n* $1.42445^{22.8}$. **D.** 0.7380^{25}_{4}, **b.p.** 188; 86^{20}. **Soly.** s.et.

47 —, **trimethyl-** (*trimethylboron; boron trimethyl*). $(CH_3)_3B$, 55.89. Col.gas. **D.** 1.9108 g/l, **m.p.** −161.5, **b.p.** −20. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

48 —, **triphenyl-** (*triphenylboron; boron triphenyl*). $(C_6H_5)_3B$, 241.94. Hex. columns, d. in air. **m.p.** 136, **b.p.** 245–50 (203^{15}). **Soly.** d.al.; s.et.

49 —, **tripropyl-** (*tripropylboron*). $(C_3H_7)_3B$, 139.98. Liq., *n* $1.42354^{22.5}$. **D.** $0.7204^{24.7}_{4}$, **b.p.** 156 (60^{20}). **Soly.** s.et.

50 **Borneo camphor.** See *d-Borneol*.

51 ***dl*-Borneol** (*dl-exo-2-camphanol; dl-bornyl alcohol; dl-α-camphol*). $C_{10}H_{17}OH$, 154.14. Col.hex.leaf.f.lgr., $[\alpha]$ −44.2°D. **D.** 1.011^{20}_{4}, **m.p.** 210.5, **b.p.** subl. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; 25^{20}bz.

52 —, acetate (*dl-bornyl acetate*). $C_{10}H_{17}OOCCH_3$, 196.16. Col., *n* 1.4630. **D.** 0.985^{20}_{4}, **m.p.** 27–8, **b.p.** 114^{22}.

53 ***d*-Borneol** (*d-exo-2-camphanol; d-bornyl alcohol; Borneo camphor; Malay camphor; Sumatra camphor; d-α-camphol*). $C_{10}H_{17}OH$, 154.14. Col.hex.leaf., $[\alpha]$ $+37.44°^{20}_{D}$ in al. **D.** 1.011^{20}_{4}, **m.p.** 208, **b.p.** 212 subl. **Soly.** 0.074^{25}w.; s.al.; s.et.; 22.2^{20}bz.; s.lgr.

54 —, acetate. $CH_3COOC_{10}H_{17}$, 196.16. Col.rhomb., *n* 1.46635^{15}, liq. $[\alpha]$ $+44.45°^{20}_{D}$. **D.** liq. 0.9855^{20}_{4}, **m.p.** 29, **b.p.** 223–4 (225–6). **Soly.** v.sl.s.w.; v.s.al.; s.et.

For explanations and abbreviations see beginning of table.

55 ***l*-Borneol** (*l-exo-2-camphanol; ngai camphor*). $C_{10}H_{17}OH$, 154.14. Col. hex.pl., $[\alpha]$ 37.74°$^{20}_{D}$ in al. **D.** 1.011$^{20}_{4}$, **m.p.** 208.6, **b.p.** 210^{799} subl. **Soly.** 0.0740^{25}w.; s.al.; v.s.et.; 22.2^{20}bz.

56 —, acetate (*l-bornyl acetate*). $C_{10}H_{17}$-$OOCCH_3$, 196.16. Col., *n* 1.46635^{15}, **D.** 0.9855$^{20}_{4}$, **m.p.** 29, **b.p.** 223–4.

57 **Bornyl acetate.** See *Borneol, acetate.*

58 **Bornyl alcohol.** See *Borneol.*

59 **Bornylamine.** $C_{10}H_{17}NH_2$, 153.16. Col.cr., $[\alpha]$+47.2°$^{20}_{D}$ in al. **m.p.** 163, **b.p.** 200 subl. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

60 **Bornyl chloride** (*2-chlorocamphane* (one form); *pinene hydrochloride; artificial camphor*). $C_{10}H_{17}Cl$, 172.59. Col.cr. **m.p.** 131-2 (128), **b.p.** 207.4. **Soly.** i.w.; 26.04al.; s.et.

61 **Bornyl chloride.** See also *Isobornyl chloride.*

62 ***l*-Bornylene** (*l-1, 7, 7-trimethylbicyclo-*[2, 2, 1]-*2-heptene*). $C_{10}H_{16}$, 136.12. Col.cr.f.me.al., $[\alpha]$−22.27°$^{20}_{D}$ in bz. **m.p.** 113, **b.p.** 146^{750}. **Soly.** i,w.; s.al.; s.et.; s.tol., me.al.

63 **Bornyl esters.** See under *Borneol.*

64 **Boron.** (For other derivatives see under *Boric acid* and *Borine.*)

65 —, **triethoxy-.** See *Ethyl borate.*

66 —, **trimethoxy-.** See *Methyl borate.*

67 —, **tripropoxy-.** See *Propyl borate.*

68 **Brasilein.** See *Brazilein.*

69 **Brasilin.** See *Brazilin.*

70 **Brassidic acid, Brassic acid** (*trans-13-docosenoic acid*; isoerucic acid; trans-erucic acid*). $C_8H_{17}CH{:}CHC_{11}$-$H_{22}COOH$, 338.33. Col.leaf.f.al., *n* 1.4347^{100}. **D.** 0.8585$^{57}_{4}$, **m.p.** 61.5, **b.p.** 282^{30}. **Soly.** 0.74^{24}w.; v.sl.s.c.al.; s.et.

71 **Brassidic anhydride.** $(C_{21}H_{41}CO)_2$-O, 658.64. Need. **D.** 0.835$^{70}_{4}$, **m.p.** 64. **Soly.** i.w.; sl.s.al.; s.et.

72 **Brazileïn** (*brasileïn*). $C_{16}H_{12}O_5$, 284.09. Dk.red rhomb.leaf. **Soly.** sl.s.h.w.; s.al.; s.et.; s.alk.

73 **Brazilin** (*brasilin*). $C_{16}H_{14}O_5{\cdot}1\frac{1}{2}H_2O$, 313.13. Wh. or pa.yel.rhomb.need.f.al. **m.p.** 250. **Soly.** sl.s.w.; s.al.; s.et.; s.alk.

74 **British gum.** See *Dextrin.*

75 **Bromacetol.** See *Propane, 2, 2-dibromo-*.*

76 **Bromal** (*2, 2, 2-tribromoethanal*; tribromoacetaldehyde; tribromoaldehyde*). CBr_3CHO, 280.76. Yel.liq. **D.** 2.30^{15}. **b.p.** 174. **Soly.** d.w.; s.al.; s.et.

77 —, hydrate (*2, 2, 2-tribromo-1, 1-ethanediol*; tribromoethylidene glycol*). $CBr_3CH(OH)_2$, 298.77. Col. monocl.pr. **D.** 2.566$^{40}_{4}$, **m.p.** 53.5, **b.p.** d. **Soly.** s.w.; s.al.; s.et.

78 **Bromanilid.** See *Acetanilide, p-bromo-.*

79 **Bromelia.** See *Ether, ethyl 2-naphthyl.*

80 **Bromine cyanide.** See *Cyanogen bromide.*

Bromo-. See the parent compounds (e.g., for bromoacetic acid see *Acetic acid, bromo-.*)

81 **Bromoform** (*tribromomethane*). $CHBr_3$, 252.76. Col.liq. or hex.cr., *n* 1.5980$^{19.0}$. **D.** 2.890$^{20}_{4}$, **m.p.** 6–7, **b.p.** 149.5. **Soly.** 0.319^{30}w.; ∞al.; ∞et.; s.bz., chl., pet.eth. and oils.

82 **Bromoform, nitro-.** See *Bromopicrin.*

83 **Bromopicrin** (*tribromonitromethane*; nitrobromoform*). NO_2CBr_3, 297.76. Pr., *n* 1.5831^{13}. **D.** 2.811$^{12}_{4}$$^{.5}$, **m.p.** 10, **b.p.** 127^{118}. **Soly.** i.w.; s.al.; s.et.

84 **Brönner's acid.** See *2-Naphthylamine-6-sulfonic acid.*

85 **Brucine.** $C_{23}H_{26}N_2O_4{\cdot}4H_2O$, 466.28. Monocl.pr.f.al., $[\alpha]$ −119°D. **m.p.** $4H_2O$, 105; anh. 178. **Soly.** 0.1c., 0.67^{100}w.; 81.8^{25}al.; 0.75et.; 13.1^{25}chl.; s.bz.; i.alk.

86 —, hydrochloride. $C_{23}H_{26}N_2O_4{\cdot}HCl$, 430.68. Wh.need. **Soly.** s.w.; s.al.

87 —, nitrate. $C_{23}H_{26}N_2O_4{\cdot}HNO_3{\cdot}2H_2O$, 493.27. Wh.pr. **m.p.** anh. 230 d. **Soly.** s.w.; s.al.

88 —, sulfate. $(C_{23}H_{26}N_2O_4)_2{\cdot}H_2SO_4$-$7H_2O$, 1012.62. Lng.need. **Soly.** s.w.; s.al.

89 **Bulbocapnine.** $C_{19}H_{19}NO_4$, 325.16. Rhomb.pr.f.et., $[\alpha]$ +237.1°D. **m.p.** 199. **Soly.** i.w.; s.al.; s.et.; s.chl.

90 **1, 2-Butadiene*** (*methylallene*). $CH_2{:}C{:}CHCH_3$, 54.05. Col.liq. **b.p.** 19. **Soly.** i.w.; ∞al.; ∞et.

91 **1, 3-Butadiene*** (*bivinyl; erythrene; pyrrolylene; vinylethylene; divinyl; biethylene*). $CH_2{:}CHCH{:}CH_2$, 54.05. Gas. **D.** 0.650$^{-6}_{4}$, **m.p.** −5^{713}, **b.p.** −3. **Soly.** i.w.; v.s.al.; ∞et.

92 —, **2-chloro-*.** See *Chloroprene.*

* Name approved by the International Union of Chemistry.

93 1, 3-Butadiene, 2, 3-dimethyl-* (*biisopropenyl*). CH_2:C(CH_3)C(CH_3):-CH_2, 82.08. Col. liq., *n* 1.437717. **D.** 0.7446^{0}_{0}; 0.727^{28}_{28}. **m.p.** −65, **b.p.** 69.6.

94 —, 2-methyl-*. See *Isoprene.*

95 Butadiyne* (*butadiine; biacetylene*). CH⋮CC⋮CH, 50.02. Gas. **D.** 2.233, **m.p.** −36.4, **b.p.** 10.3 **Soly.** 460 cm^3w.; s.al.; v.s.et.

96 Butanal*. See *Butyraldehyde.*

97 Butanamide*. See *Butyramide.*

98 Butane (*n-butane; methylethylmethane*). $CH_3(CH_2)_2CH_3$, 58.08. Col. gas or hex. **D.** liq. 0.60^{0}_{4}, **m.p.** −135, **b.p.** −0.6 to −0.3. **Soly.** $15^{17}_{772}$$cm^3$w.; $1813^{17}_{775}$$cm^3$al.; $2980^{18}_{773}$$cm^3$et.

99 —, 1-amino-. See *Butylamine (n).*

00 —, 2-amino-. See *sec-Butylamine.*

01 —, 1-amino-3-methyl-. See *Isoamylamine.*

02 —, 1-benzyloxy-. See *Ether, benzyl butyl.*

03 —, 2, 2-bis(ethylsulfonyl)-*. See *Trional.*

04 —, 1-bromo-*. See *Butyl bromide (n).*

05 —, 2-bromo-*. See *sec-Butyl bromide.*

06 —, 1-bromo-2-methyl-* (*d*) (*d-pri-act-amyl bromide*). $CH_3CH_2CH(CH_3)$-CH_2Br, 151.00. Liq. **D.** 1.221^{20}_{4}, **b.p.** 120–1. **Soly.** i.w.; s.al.; s.et.

07 —, 1-bromo-3-methyl-*. See *Isoamyl bromide.*

08 —, 1-butoxy-*. See *Butyl ether.*

09 —, 1-butyldithio-*. See *Butyl disulfide.*

10 —, butylthio-*. See *Butyl sulfide (n).*

11 —, 1-chloro-*. See *Butyl chloride (n).*

12 —, 2-chloro-*. See *sec-Butyl chloride.*

13 —, 1-chloro-2-methyl-* (*pri-act-amyl chloride*). $CH_3CH_2CH(CH_3)$-CH_2Cl, 106.54. Liq. **D.** 0.881^{18}_{4}, **b.p.** 97–9. **Soly.** i.w.; s.al.; s.et.

14 —, 1-chloro-3-methyl-*. See *Isoamyl chloride.*

15 —, 2-chloro-2-methyl-* (*tert-amyl chloride*). $CH_3CH_2CCl(CH_3)CH_3$, 106.54. Liq., *n* 1.407^{18}, **D.** 0.871^{20}_{4}, **m.p.** −73, **b.p.** 86. **Soly.** i.w., s.al.; s.et.

16 —, 1, 2, 3, 4-diepoxy-. See *i-Erythritol, anhydride.*

17 —, 1, 4-dihydroxy-. See *1, 4-Butanediol**.

18 —, 2, 2-dimethyl-* (*ethyltrimethylmethane; neohexane*). $(CH_3)_3CCH_2$-CH_3, 86.11. Liq., *n* 1.3675. **D.** 0.6487^{20}_{4}, **m.p.** −98.2, **b.p.** 49.7. **Soly.** i.w.; s.al.; s.et.

19 —, 2, 3-dimethyl-* (*isopropyldimethylmethane; biisopropyl*). $(CH_3)_2$-$CHCH(CH_3)_2$, 86.11. Liq., *n*. 1.3783. **D.** 0.668^{17}_{4}, **m.p.** −135.1, **b.p.** 58.1. **Soly.** i.w.; s.al.; s.et.

20 —, 1-ethoxy-*. See *Ether, butyl ethyl.*

21 —, 1-ethoxy-3-methyl-*. See *Ether, ethyl isoamyl.*

22 —, 1-iodo-*. See *Butyl iodide.*

23 —, 2-iodo-*. See *sec-Butyl iodide.*

24 —, 1-iodo-2-methyl-* (*pri-act-amyl iodide*). $CH_3CH_2CH(CH_3)CH_2I$, 198.01. Liq., *n* 1.4981^{15}. **D.** 1.524, **b.p.** 148. **Soly.** i.w.; s.al.; s.et.

25 —, 1-iodo-3-methyl-*. See *Isoamyl iodide.*

26 —, 2-iodo-2-methyl-* (*tert–amyl iodide*). $CH_3CH_2CI(CH_3)CH_3$, 198.01. Liq. **D.** 1.497^{19}, **b.p.** 125–8. **Soly.** i.w.; ∞al.; ∞et.

27 —, 1-methoxy-*. See *Ether, butyl methyl.*

28 —, 2-methyl-* (*ethyldimethylmethane; isopentane*). $(CH_3)_2CHCH_2$-CH_3, 72.09. Col.liq., *n* 1.355. **D.** 0.621^{19}, **m.p.** −160.5, **b.p.** 28 (27–31). **Soly.** i.w.; ∞al.; ∞et.

29 —, 3-methyl-1-(γ-methylbutoxy)-*. See *Isoamyl ether.*

30 —, 2-methyl-1-(β-methylbutylthio)-*. See *Sulfide, bis(β-methylbutyl).*

31 —, 3-methyl-1-(γ-methylbutylthio)-*. See *Isoamyl sulfide.*

32 —, 3-methyl-1-phenoxy-. See *Ether, isoamyl phenyl.*

33 —, 2-methyl-2-phenyl-. See *Benzene, tert-amyl-.*

34 —, 3-methyl-1-phenyl-. See *Benzene, isoamyl-.*

35 —, 3-methyl-1-(2-propenoxy)-*. See *Ether, allyl isoamyl.*

36 —, (α-methylpropoxy)-*. See *sec-Butyl ether.*

37 —, 1-nitro-*. $CH_3CH_2CH_2CH_2NO_2$, 103.08. Liq. **b.p.** 151–2. **Soly.** v.sl. s.w.; ∞al.; ∞et.

38 —, 1-phenyl-. See *Benzene, butyl-.*

For explanations and abbreviations see beginning of table.

39 Butane, 2-phenyl-. See *Benzene, sec-butyl-.*

40 — 2, 2, 3, 3-tetramethyl-* (*tert-butyltrimethylmethane; bi-tert-butyl; hexamethylethane*). $CH_3C(CH_3)_2C(CH_3)_2CH_3$, 114.14. Leaf.f.et., **m.p.** 104 (98–9), **b.p.** 106.8. **Soly.** i.w.; s.et.

41 —, 2, 2, 3-trimethyl-* (*isopropyltrimethylmethane*). $CH_3C(CH_3)_2CH(CH_3)CH_3$, 100.12. Col.liq., *n* 1.390. **D.** 0.6900^{20}_{4}, **m.p.** −25.0, **b.p.** 80.9. **Soly.** i.w.; s.al.; s.et.

42 1-Butanearsonic acid (*n-butylarsonic acid*). $CH_3(CH_2)_3AsO(OH)_2$, 182.02. **m.p.** 158–9. **Soly.** v.s.w.; s.al.; s.et.

43 Butanedial*. See *Succinaldehyde.*

44 Butanediamide*. See *Succinamide.*

45 —, 2-hydroxy-*. See *Malamide.*

46 1, 4-Butanediamine*. See *Putrescine.*

47 1,1-Butanedicarboxylic acid*. See *Malonic acid, propyl-.*

48 1, 2-Butanedicarboxylic acid. See *Succinic acid, ethyl-.*

49 1, 4-Butanedicarboxylic acid. See *Adipic acid.*

50 2, 3-Butanedicarboxylic acid, 2, 3-dimethyl-. See *Succinic acid, tetramethyl-.*

51 Butanedinitrile*. See *Succinonitrile.*

52 Butanedioic acid*. See *Succinic acid.*

53 Butanedioic anhydride*. See *Succinic anhydride.*

54 1, 1-Butanediol, 2, 2, 3-trichloro-*. See *Butyraldehyde, α, α, β-trichloro-, hydrate.*

55 1, 2-Butanediol (*α-butylene glycol; ethylethylene glycol*). $CH_3CH_2CH(OH)CH_2OH$, 90.08. Liq. **D.** 1.019^{0}_{4}, **b.p.** 192. **Soly.** sl.s.w.; ∞al.

56 —, 3-methyl-* (*isopropylethylene glycol; α-isoamylene glycol*). $(CH_3)_2CHCH(OH)CH_2OH$, 104.09. Liq. **D.** 0.9987^{0}_{4}, **b.p.** 206. **Soly.** s.al.; s.et.

57 1, 3-Butanediol* (*β-butylene glycol; α-methyltrimethylene glycol*). $CH_3CH(OH)CH_2CH_2OH$, 90.08. Visc.liq. **D.** 1.0259^{20}_{4}, **b.p.** 204. **Soly.** s.w.; s.al.; i.et.

58 —, 3-methyl-* (*γ-isoamylene glycol*). $(CH_3)_2COHCH_2CH_2OH$, 104.09. Thick syrup. **D.** 0.9892^{20}_{4}, **b.p.** 202–3. **Soly.** s.w.; s.al.

59 1, 4-Butanediol* (*tetramethylene glycol; 1, 4-dihydroxybutane*). $CH_2OH(CH_2)_2CH_2OH$, 90.08. Need. or oil. **D.** 1.020^{20}_{4}, **m.p.** 16, **b.p.** 230. **Soly.** ∞w.; s.al.; sl.s.et.

60 2, 3-Butanediol* (*pseudobutylene glycol; sym-dimethylethylene glycol*). $CH_3CH(OH)CH(OH)CH_3$, 90.08. Liq. **D.** 1.048^{0}_{4}, **b.p.** 184. **Soly.** ∞w.; s.al.; ∞et.

61 —, 2, 3-dimethyl-*. See *Pinacol.*

62 —, 2, 3-diphenyl- (*α, α′-dimethylhydrobenzoin; acetophenone pinacol*). $CH_3COH(C_6H_5)COH(C_6H_5)CH_3$, 242.14. Need. **m.p.** 121–2; 116–7. **Soly.** i.w.; v.s.al.; v.s.et.; sl.s.pet.eth.

63 —, 2-methyl-* (*trimethylethylene glycol; β-isoamylene glycol*). $(CH_3)_2C(OH)CH(OH)CH_3$, 104.09. Thick oil. **D.** 0.9893^{0}_{0}, **b.p.** 177. **Soly.** ∞w.; ∞al.; ∞et.

64 1, 3-Butanedione, 1-phenyl-*. See *Acetone, benzoyl-.*

65 2, 3-Butanedione* (*dimethylglyoxal; biacetyl; dimethyl diketone; diacetyl*). $CH_3COCOCH_3$, 86.05. Grnsh.yel. liq., *n* 1.39331^{18}. **D.** 0.9904^{18}_{18}, **b.p.** 88. **Soly.** 25^{15}w.; ∞al.; ∞et.

66 —, dioxime*. See *Glyoxime, dimethyl-.*

67 —, mono-oxime (*biacetyl mono-oxime; α-isonitrosoethyl methyl ketone*). $CH_3COC(:NOH)CH_3$, 101.06. Pr.f. chl.; leaf.f.w. **m.p.** 74–5, **b.p.** 186. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.alk.

68 Butanedioyl chloride*. See *Succinyl chloride.*

69 Butanenitrile*. See *Butyronitrile.*

70 —, 3-methyl-*. See *Isovaleronitrile.*

71 1, 2, 3, 4-Butanetetrol* (*anti*). See *i-Erythritol.*

72 1-Butanethiol* (*butyl mercaptan*). $CH_3(CH_2)_2CH_2SH$, 90.14. Col.liq. **D.** 0.858^{0}_{4}; 0.8365^{20}_{4}, **m.p.** −115.9, **b.p.** 98. **Soly.** sl.s.w.; v.s.al.; v.s.et.

73 —, 2-methyl-* (*pri-act-amyl mercaptan*). $CH_3CH_2CH(CH_3)CH_2SH$, 104.15. Liq. **D.** 0.8415^{20}_{4}, **b.p.** 119–21.

74 —, 3-methyl-* (*isoamyl mercaptan*). $(CH_3)_2CH(CH_2)_2SH$, 104.15. Col.liq., *n* 1.44118. **D.** 0.835^{20}_{4}, **b.p.** 119. **Soly.** i.w.; ∞al.; ∞et.

75 2-Butanethiol, 2-methyl-* (*tert-amyl mercaptan*). $CH_3CH_2C(CH_3)_2SH$, 104.15.

76 1, 2, 3-Butanetricarboxylic acid, 1, 2, 3-dimethyl-*. See *l-Camphoronic acid.*

* Name approved by the International Union of Chemistry.

77 **Butanimide***. See *Succinimide.*

78 **Butanoic acid***. See *Butyric acid.*

79 —, **3-methyl-***. See *Isovaleric acid.*

80 **Butanoic anhydride***. See *Butyric anhydride.*

81 **1-Butanol.** See *Butyl alcohol* (*n*).

82 —, **2-ethyl-*** (*pseudohexyl alcohol*). $(C_2H_5)_2CHCH_2OH$, 102.11. Col.liq., *n* 1.421. **D.** 0.8328^{20}_{4}; 0.8192^{25}_{4}. **b.p.** 148.9. **Soly.** 0.63^{24}w.; s.al.; s.et.

83 —, —, acetate (*β-ethylbutyl acetate*). $(C_2H_5)_2CHCH_2OOCCH_3$, 144.12. Col.liq., *n* 1.410. **D.** 0.879^{20}_{4}, **m.p.** < −100, **b.p.** 162.4. **Soly.** 0.06w.

84 —, **2-methyl-*** (*d*) (*d-sec-butylcarbinol; d-pri-act-amyl alcohol*). CH_3-$CH_2CH(CH_3)CH_2OH$, 88.09. Col.liq., $[\alpha] -5.90°^{20}_{D}$. **D.** 0.816^{20}_{4}, **b.p.** 128. **Soly.** sl.s.w.; ∞al.; ∞et.

85 —, **3-methyl-**. See *Isoamyl alcohol.*

86 —, **3-methyl-1-phenyl-*** (*isobutylphenylcarbinol*). $(CH_3)_2CHCH_2$-$CHOHC_6H_5$, 164.12. Thick oil. **D.** 0.9537^{10}_{4}, **b.p.** $235\text{–}6^{746}$. **Soly.** i.w.; s.al.; s.et.

87 **2-Butanol.** See *sec-Butyl alcohol.*

88 —, **2, 3-dimethyl-*** (*isopropyldimethylcarbinol*). $(CH_3)_2COHCH(CH_3)_2$, 102.11. Col.liq.w. odor of camphor. **D.** 0.8232^{10}_{4}, **m.p.** −14, **b.p.** 120–1. **Soly.** v.sl.s.w.; s.al.; ∞et.

89 —, **3, 3-dimethyl-***. See *Pinacolyl alcohol.*

90 —, **2-methyl-*** (*dimethylethylcarbinol; tert-amyl alcohol*). $CH_3CH_2C(CH_3)$-$OHCH_3$ 88.09. Col.liq., *n* 1.4052. **D.** 0.809, **m.p.** −11.9, **b.p.** 101.8. **Soly.** 12.5; 14^{30}w.; ∞al.; ∞et.; s.bz., chl., glyc., oils.

91 —, **3-methyl-*** (*methylisopropylcarbinol; sec-isoamyl alcohol*). $(CH_3)_2$-$CHCHOHCH_3$, 88.09. Col.liq. **D.** 0.819^{20}_{4}, **b.p.** 114 (112). **Soly.** sl.s.w.; ∞al.; ∞et.

92 —, **2, 3, 3-trimethyl-*** (*tert-butyldimethylcarbinol; pentamethylethyl alcohol.* $(CH_3)_3CC(CH_3)_2OH$, 116.12. Col.liq.; $+1H_2O$ need. **m.p.** 17; frz. 15, **b.p.** 131–2. **Soly.** i.w.; s.al.; s.et.

93 **Butanolide.** See *Butyrolactone.*

94 **1-Butanone, 3-methyl-1-phenyl-.** See *Isovalerophenone.*

95 **2-Butanone*** (*ethyl methyl ketone*). $CH_3COC_2H_5$, 72.06. Col.liq., *n* $1.38071^{15.9}$. **D.** 0.805^{20}_{4}, **m.p.** −86.4, **b.p.** 79.6. **Soly.** 35.3^{10}, 19^{90}w.; ∞al.; s.et.

96 —, oxime (*methyl ethyl ketoxime*). CH_3-$C:NOH(C_2H_5)$, 87.08. Col.liq., *n* 1.4428. **D.** 0.923^{20}_{4}, **m.p.** −29.5, **b.p.** 152. **Soly.** 10w.; ∞al.; ∞et.

97 —, **3, 3-dimethyl-***. See *Pinacolin.*

98 —, **3, 3-diphenyl-** (*acetophenone pinacolin*). $CH_3COC(C_6H_5)_2CH_3$, 224.12. Pr. **m.p.** 41–1.5, **b.p.** 310–1. **Soly.** i.w.; s.c., v.s.h.al.; v.s.et.; v.s.bz., chl.

99 —, **3-hydroxy-***. See *Acetoin.*

00 —, **3-methyl-*** (*isopropyl methyl ketone*). $CH_3COCH(CH_3)_2$, 86.08. Col.liq., *n* 1.38788^{16}. **D.** 0.815^{15}_{4}, **m.p.** −92, **b.p.** 93. **Soly.** v.sl.s.w.; ∞al.; ∞et.

01 —, **3-methyl-,** oxime (*methylisopropyl ketoxime*). $CH_3C:NOHCH$-$(CH_3)_2$, 101.09. Col.liq. **b.p.** 157–8. **Soly.** s.w.; ∞al.; ∞et.

02 —, **1-phenyl-** (*benzyl ethyl ketone*). $C_2H_5COCH_2C_6H_5$, 148.09. Col.liq. **D.** 1.002^{0}_{4}, **b.p.** 230.2. **Soly.** i.w.; ∞al.; ∞et.

03 —, **4-phenyl-*** (*benzylacetone*). C_6-$H_5CH_2CH_2COCH_3$, 148.09. Liq. **D.** 0.989^{23}_{17}, **b.p.** 235; 115^{13}. **Soly.** s.al.; s.et.

05 **Butanoyl bromide***. See *Butyryl bromide.*

06 **Butanoyl chloride***. See *Butyryl chloride.*

07 —, **3-methyl-***. See *Isovaleryl chloride.*

08 **2-Butenal***. See *Crotonaldehyde.*

09 —, **2-methyl-***. See *Tiglaldehyde.*

10 **1-Butene** (*α-butylene; ethylethylene*). $CH_3CH_2CH:CH_2$, 56.06. Gas. **D.** 0.668^{0}_{4}, **m.p.** −130, **b.p.** −5. **Soly.** i.w.; v.s.al.; v.s.et.

11 —, **4-bromo-*** (*δ-bromo-α-butylene; vinylethyl bromide*). CH_2BrCH_2CH:-CH_2, 134.97. **D.** 1.33^{17}_{4}, **b.p.** 165–6 (99). **Soly.** s.al.; s.et.

12 —, **2, 3-dimethyl-*** (*1-isopropyl-1-methylethylene*). $CH_2:C(CH_3)CH$-$(CH_3)_2$, 84.09. **D.** 0.6803^{20}_{4}, **b.p.** 56.0–6.5.

13 —, **3, 3-dimethyl-*** (*tert-butylethylene; pseudobutylethylene*). $CH_2:CHC$-$(CH_3)_3$, 84.09. **D.** 0.6549^{10}_{4}, **b.p.** 41.2.

14 —, **2-ethyl-*** (*3-methylenepentane; uns-diethylethylene*). $CH_2:C(C_2H_5)$-CH_2CH_3, 84.09. **D.** 0.6914^{20}_{4}, **b.p.** 66.2–6.7.

15 —, **2-ethyl-3-methyl-*** (*1-ethyl-1-isobutylethylene; 2-methyl-3-methylenepentane**). $CH_2:C(C_2H_5)CH(CH_3)_2$, 98.11. **D.** 0.7186^{20}_{4}, **b.p.** 88.7–9.1.

For explanations and abbreviations see beginning of table.

16 **1-Butene, 2-methyl-*** (*uns-ethylmethylethylene*). $CH_2:C(CH_3)CH_2CH_3$, 70.08. Col. liq. **b.p.** 31.0.

17 —, **3-methyl-*** (*isopropylethylene; α-isoamylene*). $(CH_3)_2CHCH:CH_2$, 70.08. Col.liq. **D.** 0.648^{20}_{4}, **m.p.** −135, **b.p.** 25 (21). **Soly.** i.w.; ∞al.; ∞et.

18 **2-Butene*** (*sym-dimethylethylene; β-butylene; pseudobutylene*). $CH_3CH:$-$CHCH_3$, 56.06. Col.gas. **D.** 0.635, **b.p.** *cis* 1; *trans* 2.5. **Soly.** i.w.; v.s.al.; v.s.et.; i.H_2SO_4.

19 —, **2, 3-dimethyl-*** (*tetramethylethylene*). $(CH_3)_2C:C(CH_3)_2$, 84.09. Liq., *n* 1.4128. **D.** 0.712^{20}_{4}, **b.p.** 73.

20 —, **3-methyl-*** (*trimethylethylene; β-isoamylene*). $(CH_3)_2C:CHCH_3$, 70.08. Col.inflam.liq. **D.** 0.668^{13}_{4}, **m.p.** −124, **b.p.** 38.4. **Soly.** v.sl.s.w.; s.al.; ∞et.

21 **3-Butene-1, 1-dicarboxylic acid.** See *Malonic acid, allyl-*.

22 *cis*-**Butenedioic acid***. See *Maleic acid*.

23 *trans*-**Butenedioic acid***. See *Fumaric acid*.

24 **3-Butenenitrile***. See *Allyl cyanide*.

25 **2-Butenoic acid, *cis*(?)-***. See *Isocrotonic acid*.

26 —, *trans*(?)-*. See *Crotonic acid*.

27 —, **2-methyl-***. See *Tiglic acid*.

28 —, **4-oxo-4-phenyl-.** See *Acrylic acid, β-benzoyl*.

29 **3-Butenoic acid*** (*vinylacetic acid; β-butenic acid*). $CH_2:CHCH_2COOH$, 86.05. Col.liq., *n* 1.4257^{15}. **D.** 1.013^{15}_{15}, **m.p.** −39, **b.p.** 163. **Soly.** s.w.; ∞al.; ∞et.

30 —, **2-hydroxy-4-phenyl-** (*benzallactic acid; styrylglycolic acid*). C_6H_5-$CH:CHCHOHCOOH$, 178.08. Need. f.w. **m.p.** 46, **b.p.** 98. **Soly.** s.h.w.; sl.s.et.; i.bz., CS_2, lgr.

31 —, **4-phenyl-** (*β-benzalpropionic acid*). $C_6H_5CH:CHCH_2COOH$, 162.08. Need.f.w. **m.p.** 88 (83–4), **b.p.** 302 sl.d. **Soly.** sl.s.h.w.; v.s.al.; v.s.et.

32 **2-Buten-1-ol*** (*propenylcarbinol; crotyl alcohol; crotonyl alcohol; γ-methylallyl alcohol*). $CH_3CH:CHCH_2OH$, 72.06 Col.liq., *n* 1.4240. **D.** 0.8726^{0}_{4}; 0.854^{20}_{4}, **m.p.** < −30, **b.p.** 118 (117–20). **Soly.** 16.6 w.; ∞al.; ∞et.

33 —, acetate (*2-butenyl ethanoate*; crotyl acetate; crotonyl acetate*). CH_3-$COOC_4H_7$, 114.08. Col.liq. **D.** 0.934^{0}_{4}, **b.p.** 129. **Soly.** sl.s.w.; s.al.; s.et.

34 **3-Buten-1-ol*** (*allylcarbinol; 1-buten-4-ol*). $CH_2:CHCH_2CH_2OH$, 72.06. Col.liq., *n* $1.4146^{17.5}$. **D.** 0.864^{0}_{4}; 0.848^{17}_{0}, **b.p.** 113. **Soly.** s.w.; ∞al.; ∞et.

35 **3-Buten-2-ol*** (*methylvinylcarbinol*). $CH_2:CHCHOHCH_3$, 72.06. Col.liq. **b.p.** 96–7.

36 **3-Buten-2-one, 4-*p*-anisyl-** (*anisalacetone; p-methoxybenzalacetone*). $CH_3OC_6H_4CH:CHCOCH_3$, 176.09. Leaf. **m.p.** 72–4. **Soly.** i.w.; v.s.al.; v.s.et.

37 —, **4-(2-furyl)-*** (*2-furalacetone; furfurylideneacetone*). C_4H_3-$OCH:CHCOCH_3$, 136.06. Wh.need. **m.p.** 39–40, **b.p.** 229 d. **Soly.** i.w.; s.al.; s.et.

38 —, **4-phenyl-***. See *Acetone, benzal-*.

39 —, **4-(2, 6, 6-trimethyl-1-cyclohexenyl)-.** See *β-Ionone*.

40 —, **4-(2, 6, 6-trimethyl-2-cyclohexenyl)-.** See *α-Ionone*.

41 —, **4-(2, 2, 6-trimethyl-3-cyclohexenyl)-.** See *β-Irone*.

42 ***β*-Butenonitrile.** See *Allyl cyanide*.

43 **3-Buten-1-yne*** (*vinylacetylene*). $CH:CCH:CH_2$, 52.03. Col.liq. **D.** 0.6867^{20}_{0}, **b.p.** 5^{757}.

44 **Butesin** (*butyl p-aminobenzoate*). H_2-$NC_6H_4COO(CH_2)_3CH_3$, 193.13. Wh. cr.powd. **m.p.** 55–7, **b.p.** 147^{2}. **Soly.** 0.00014 w.; s.al.; s.et.; s.bz., chl., dil.a.

45 —, picrate. $(H_2NC_6H_4COOC_4H_9)_2$-$C_6H_2(NO_2)_3OH$, 615.30. Yel.amor. powd. **m.p.** 109.10. **Soly.** 0.07w.; s.al.; s.et.; s.bz., chl.

46 **Butine.** See *Butyne**.

Butyl-. For butyl derivatives see the parent compounds (e.g., for butylbenzene see *Benzene, butyl-*). For butyl esters of organic acids see the acids.

47 **Butyl acetate, α, γ-dimethyl-.** See *2-Pentanol, 4-methyl-*, acetate*.

48 —, **β-ethyl-.** See *1-Butanol, 2-ethyl-*, acetate*.

49 **Butyl alcohol** (*n*) (*1-butanol*; propylcarbinol*). $CH_3(CH_2)_2CH_2OH$, 74.08. Col.liq., *n* 1.39931. **D.** 0.80978^{20}_{4}, **m.p.** −89.2 to −89.8 (−79.9), **b.p.** 117.71. **Soly.** 7.9^{20}w.; ∞al.; ∞et.

50 *sec*-**Butyl alcohol** (*2-butanol*; ethylmethylcarbinol*). $CH_3CH_2CHOHCH_3$, 74.08. Col.liq., *n* 1.397. **D.** 0.808^{20}_{4}, **m.p.** −89, **b.p.** 99.5–100. **Soly.** 12.5^{20}w.; ∞al.; ∞et.

* Name approved by the International Union of Chemistry.

51 ***tert*-Butyl alcohol** (*2-methyl-2-propanol*; trimethylcarbinol*). $(CH_3)_3COH$, 74.08. Col.liq. or rhomb.pr. or pl., *n* 1.38779. **D.** 0.7887^{20}_{4}, **m.p.** 25.5, **b.p.** 82.8. **Soly.** ∞w.; ∞al.; ∞et.

52 **—, trichloro-.** See *Chloretone.*

53 **Butylamine** (*n*) (*1-aminobutane*). $CH_3(CH_2)_2CH_2NH_2$, 73.09. Col.liq., *n* 1.401. **D.** 0.7401^{20}_{4}, **m.p.** −50.5, **b.p.** 77.8 (76–8). **Soly.** ∞w.; s.al.; s.et.

54 **—, *N*-methyl-.** $CH_3NHC_4H_9$, 87.11. Col.liq., *n* $1.40180^{18.1}$. **D.** 0.737^{20}_{4}, **b.p.** 91.

55 **—, α-methyl-** (*methylpropylcarbinylamine; sec-n-amylamine; 2-aminopentane*). $CH_3(CH_2)_2CH(CH_3)NH_2$, 87.11. Col.liq. **D.** 0.73839^{20}_{0}, **b.p.** 92. **Soly.** ∞w.; ∞al.; ∞et.

56 **—, γ-methyl-*.** See *Isoamylamine.*

57 ***sec*-Butylamine** (*(α-methylpropyl)-amine; 2-aminobutane*). $CH_3CH(NH_2)CH_2CH_3$, 73.09. Col.liq., *n* $1.39501^{16.7}$, $[\alpha]$ 7.4^{20}_{D}. **D.** 0.724^{20}_{4} (0.718^{20}_{4}), **m.p.** −104.5, **b.p.** 63. **Soly.** ∞w.; ∞al.; ∞et.

58 ***tert*-Butylamine** (*(α, α-dimethylethyl)-amine; trimethylcarbinylamine*). $(CH_3)_3CNH_2$, 73.09. Col.liq., *n* 1.37940^{18}. **D.** 0.696^{20}_{4}, **m.p.** −67.5, **b.p.** 46.4 (43.8). **Soly.** ∞w.; ∞al.; ∞et.

59 ***n*-Butylarsonic acid.** See *1-Butanearsonic acid.*

60 **Butyl bromide** (*n*) (*1-bromobutane**). $CH_3(CH_2)_2CH_2Br$, 136.99. Col.liq., *n* 1.4398. **D.** 1.299^{20}_{4}, **m.p.** −112.4, **b.p.** 101.6. **Soly.** i.w.; ∞al.; ∞et.

61 ***sec*-Butyl bromide** (*2-bromobutane*; methylethylbromomethane*). $C_2H_5CH(CH_3)Br$, 136.99. Col.liq., *n* 1.4344^{25}. **D.** 1.2580^{20}_{4}, **b.p.** 91.3. **Soly.** i.w.

62 ***tert*-Butyl bromide** (*2-bromo-2-methylpropane*; trimethylbromomethane*). $(CH_3)_3CBr$, 136.99. Col.liq., *n* 1.428. **D.** 1.222^{20}_{4}, **m.p.** −20, **b.p.** 73.3. **Soly.** i.w.

63 **Butyl carbitol.** See *Diethylene glycol, monobutyl ether.*

64 **Butyl cellosolve.** See *Ethanol, 2-butoxy-*.*

65 **Butyl chloral.** See *Butyraldehyde, α, α, β-trichloro-.*

66 **Butyl chloride** (*n*) (*1-chlorobutane**). $CH_3(CH_2)_2CH_2Cl$, 92.53. Col.liq., *n* 1.4015. **D.** 0.884; 0.9074^{0}_{4}, **m.p.** −123.1, **b.p.** 78. **Soly.** $0.066^{12.5}$w.; ∞al.; ∞et.

67 ***sec*-Butyl chloride** (*2-chlorobutane*; methylethylchloromethane*). $C_2H_5CH(CH_3)Cl$, 92.53. Col.liq., *n* 1.3953^{25}. **D.** 0.8707^{20}_{4}, **m.p.** −131.3, **b.p.** 68. **Soly.** v.sl.s.w.; ∞al.; ∞et.

68 ***tert*-Butyl chloride** (*2-chloro-2-methylpropane*; trimethylchloromethane*). $(CH_3)_3CCl$, 92.53. Col.liq., *n* 1.38686^{18}. **D.** 0.847^{15}_{4}, **m.p.** −28.5, **b.p.** 51–2. **Soly.** v.sl.s.w.; ∞al.; ∞et.

69 **Butyl cyanide** (*n*). See *Valeronitrile.*

70 ***sec*-Butyl cyanide.** See *Butyronitrile, α-methyl-.*

71 ***tert*-Butyl cyanide.** See *Propionitrile, α, α-dimethyl-.*

72 **Butyl disulfide** (*n*) (*1-butyldithiobutane**). $[CH_3(CH_2)_3]_2S_2$, 178.26, **b.p.** $100–3^{15}$. **Soly.** i.w.; ∞al.; ∞et.

73 **α-Butylene.** See *1-Butene*.*

74 **β-Butylene.** See *2-Butene*.*

75 **γ-Butylene.** See *Propene, 2-methyl-*.*

76 **α-Butylene glycol.** See *1, 2-Butanediol*.*

77 **β-Butylene glycol.** See *1, 3-Butanediol*.*

78 **Butyl ether** (*n*) (*1-butoxybutane*; di-n-butyl ether*). $CH_3(CH_2)_3O(CH_2)_3CH_3$, 130.14. Col.liq. **D.** 0.7841^{0}_{4}; 0.769^{20}_{20}, **m.p.** −95.2 (−98), **b.p.** 142. **Soly.** sl.s.w.; ∞al.; ∞et.

79 ***sec*-Butyl ether** (*2-(α-methylpropoxy)-butane*; di-sec-butyl ether*). $[CH_3CH_2CH(CH_3)]_2O$, 130.14. **D.** 0.756^{21}_{4}, **b.p.** 121. **Soly.** sl.s.w.; ∞al.; ∞et.

80 **Butyl hydrogen sulfate.** See *Butylsulfuric acid.*

81 **Butyl iodide** (*n*) (*1-iodobutane**). $CH_3(CH_2)_2CH_2I$, 183.99. Liq., *n* 1.50006. **D.** 1.617^{20}_{4}, **m.p.** −103.5, **b.p.** 131. **Soly.** $0.0202^{17.5}$w.; ∞al.; ∞et.

82 ***sec*-Butyl iodide** (*2-iodobutane*; methylethyliodomethane*). $C_2H_5CH(CH_3)I$, 183.99. Col.liq. **D.** 1.595^{20}_{4}, **m.p.** −104.0, **b.p.** 117.5 (119–22). **Soly.** i.w.; s.al.; ∞et.

83 ***tert*-Butyl iodide** (*2-iodo-2-methylpropane*; trimethyliodomethane*). $(CH_3)_3CI$, 183.99. Liq. **D.** 1.571^{0}_{4}, **m.p.** −33.65, **b.p.** 100 d. **Soly.** i., d.w.; ∞al.; ∞et.

84 **Butyl isocyanide** (*n*) (*butylcarbylamine**). $CH_3(CH_2)_3NC$, 83.08. Liq. **b.p.** 118. **Soly.** i.w.; ∞al.; ∞et.

85 **Butyl isocyanide, γ-methyl-.** See *Isoamyl isocyanide.*

For explanations and abbreviations see beginning of table.

86 *tert*-**Butyl isocyanide** (*(α, α-dimethylethyl)carbylamine**). $(CH_3)_3CNC$, 83.08. Lt. oil, **b.p.** $91^{37.5}$. **Soly.** s.al.

87 **Butyl mercaptan** (*n*). See *1-Butanethiol**.

88 **Butyl mustard oils.** See the butyl esters under *Isothiocyanic acid.*

89 **Butyl nitrate*** (*n*). $CH_3(CH_2)_3ONO_2$, 119.08. Liq., *n* $1.40130^{23.2}$. **D.** 1.048^{0}_{4}, **b.p.** 136. **Soly.** i.w.; s.al.; s.et.

90 *sec*-**Butyl nitrate** (*α-methylpropyl nitrate**). $C_2H_5CH(CH_3)ONO_2$, 119.08. Liq. **D.** 1.0382^{0}_{4}, **b.p.** 124. **Soly.** ∞al.; ∞et.

91 **Butyl nitrite*** (*n*). $CH_3(CH_2)_3ONO$, 103.08. Liq. **D.** 0.9114^{0}_{4}, **b.p.** 75 (77–9). **Soly.** ∞al.; ∞et.

92 *sec*-**Butyl nitrite** (*α-methylpropyl nitrite**). $C_2H_5CH(CH_3)ONO$, 103.08. Liq. **D.** 0.8981^{0}_{4}, **b.p.** 68. **Soly.** ∞al.; ∞et.

93 *tert*-**Butyl nitrite** (*α, α-dimethylethyl nitrite**). $(CH_3)_3CONO$, 103.08. Lt. yel.liq. **D.** 0.8941^{0}_{4}, **b.p.** 63. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.chl., CS_2.

94 **Butyl sulfate** (*n*) (*di-n-butyl sulfate*). $(CH_3CH_2CH_2CH_2)_2SO_4$, 210.20. Col. liq., *n* 1.4210^{25}. **D.** 1.0591^{20}_{20}, **b.p.** 97.4^{3}. **Soly.** i.w.

95 **Butyl sulfide** (*n*) (*dibutyl sulfide; butylthiobutane**). $(CH_3CH_2CH_2CH_2)_2S$, 146.20. Liq. **D.** 0.852^{0}_{4}; 0.839^{10}_{0}, **m.p.** −79.7, **b.p.** 182 (186–9). **Soly.** i.w.; v.s.al.; v.s.et.

96 *sec*-**Butyl sulfide** (*di-sec-butyl sulfide; 1-methyl-1-(α-methylpropylthio)propane**). $[C_2H_5CH(CH_3)]_2S$, 146.20. Liq. **D.** 0.8317^{23}_{4}, **b.p.** 165. **Soly.** i.w.; v.s.al.; v.s.et.

97 **Butylsulfuric acid** (*n*) (*butyl hydrogen sulfate*). $C_4H_9OSO_2OH$, 154.14. Syrup. **b.p.** d. **Soly.** v.s.w.; s.al.; s.et.

98 **1-Butyne*** (*ethylacetylene; 1-butine*). $CH:CCH_2CH_3$, 54.05. Col.liq., *n* 1.3962. **D.** 0.668^{0}_{4}, **m.p.** −130, **b.p.** 18.5. **Soly.** i.w.; s.al.; s.et.

99 —, **3-methyl-***, (*isopropylacetylene*). $(CH_3)_2CHC:CH$, 68.06. Col.liq. **D.** 0.6854^{0}_{4}, **b.p.** 29.3. **Soly.** i.w.; ∞al.; ∞et.

00 **1-Butyne, 1-phenyl-.** See *Benzene, 1-butynyl-.*

01 **2-Butyne*** (*crotonylene; dimethylacetylene; 2-butine*). $CH_3C:CCH_3$, 54.05. Liq. **b.p.** 28.9. **Soly.** i.w.; s.al.; s.et.

02 **Butynedioic acid*.** See *Acetylenedicarboxylic acid.*

03 **2-Butynoic acid*.** See *Tetrolic acid.*

04 **Butyraldehyde** (*butanal*; butyric aldehyde*). $CH_3(CH_2)_2CHO$, 72.06. Col.liq., *n* 1.38433. **D.** 0.817^{20}_{4}, **m.p.** −99.0, **b.p.** 75.7. **Soly.** 3.7w.; ∞al.; ∞et.

05 —, oxime (*butanal oxime*; butyraldoxime*). $CH_3(CH_2)_2CH:NOH$, 87.08. Col.liq. **D.** 0.923^{20}_{4}, **m.p.** −29.5, **b.p.** 152^{715}. **Soly.** 10.8w.; ∞al.; ∞et.

06 —, phenylhydrazone (*N-butylidene-N′-phenylhydrazine*). $CH_3(CH_2)_2CH:NNHC_6H_5$, 162.13.

07 —, sodium bisulfite compound. $C_3H_7CHOHOSO_2Na$, 176.13. Leaf. **m.p.** d. **Soly.** v.s.w.; sl.s.al.; i.et.

08 —, *α*-**ethyl-** (*2-ethylbutanal**). $CH_3CH_2CH(C_2H_5)CHO$, 100.09. Col.liq. **D.** 0.814^{20}_{4}, **b.p.** 116–7. **Soly.** sl.s.w.; ∞al.; ∞et.

09 —, *β*-**hydroxy-.** See *Aldol.*

10 —, *β*-**methyl-.** See *Isovaleraldehyde.*

11 —, *α, α, β*-**trichloro-** (*2, 2, 3-trichlorobutanal*; butyl chloral*). $CH_3CHClCCl_2CHO$, 175.41. Col. oily liq., *n* 1.47554. **D.** 1.3956^{20}_{4}, **b.p.** $164–5^{750}$. **Soly.** s.w.; s.al.; s.et.

12 —, —, hydrate (*2, 2, 3-trichloro-1, 1-butanediol*; butyl chloral hydrate*). $CH_3CHClCCl_2CH(OH)_2$, 193.43. Rhomb.leaf.f.w. **D.** 1.693^{20}_{4}, **m.p.** 78, **b.p.** d. **Soly.** sl.s.w.; v.s.al.; s.et.

13 **Butyraldoxime.** See *Butyraldehyde, oxime.*

14 **Butyramide** (*butanamide*; butyric amide*). $CH_3CH_2CH_2CONH_2$, 87.08. Rhomb.f.bz. **D.** 1.032^{20}_{4}, **m.p.** 116 (108–10), **b.p.** 216. **Soly.** 16.28^{15}w.; s.al.; sl.s.et.

15 —, *β*-**bromo-*γ*-oxo-*N*-phenyl-.** See *Acetoacetanilide, α-bromo-.*

16 —, *β*-**methyl-.** See *Isovaleramide.*

17 —, *N*-**phenyl-.** See *Butyranilide.*

18 **Butyranilide** (*N-phenylbutyramide*). $CH_3(CH_2)_2CONHC_6H_5$, Monocl.leaf. **D.** 1.134^{20}_{4}, **m.p.** 91–2, **b.p.** 189^{15}. **Soly.** i.w.; v.s.al.; v.s.et.

19 —, *β*-**keto-.** See *Acetoacetanilide.*

20 **Butyric acid** (*butanoic acid*; ethylacetic acid*). $CH_3CH_2CH_2COOH$, 88.06. Col.liq., *n* 1.39906. **D.** 0.9587^{20}_{4}, **m.p.** −7.9; frz. −19, **b.p.** 163.5^{757}. **Soly.** $5.62^{-1.1}$w.; ∞al.; ∞et.

* Name approved by the International Union of Chemistry.

21 Butyric acid, allyl ester (*allyl butyrate; 2-propenyl butanoate**). $C_3H_7COOCH_2CH{:}CH_2$, 128.09. Liq. **b.p.** 143. **Soly.** i.w.; ∞al.; ∞et.

22 —, amyl ester (*amyl butyrate; pentyl butanoate**). $C_3H_7COO(CH_2)_4CH_3$, 158.14. Liq., *n* 1.4110. **D.** 0.8713^{15}_{4}, **m.p.** −73.2, **b.p.** 185. **Soly.** 0.054^{50} w.; v.s.al.; v.s.et.

23 —, benzyl ester. $CH_3(CH_2)_2CO_2CH_2C_6H_5$, 178.11. **D.** $1.016^{17.5}$, **b.p.** 240. **Soly.** i.w.; v.s.al.; v.s.et.

24 —, butyl ester (*butyl butyrate; butyl butanoate**). $CH_3CH_2CH_2COOC_4H_9$, 144.12. Col.liq., *n* 1.4049. **D.** 0.8721^{20}_{20}, **m.p.** −91.5, **b.p.** 166.4. **Soly.** sl.s.w.; ∞al.; ∞et.

25 —, ethyl ester (*ethyl butyrate; ethyl butanoate**). $CH_3CH_2CH_2COOC_2H_5$, 116.09. Col.liq., *n* 1.39302^{18}. **D.** 0.879^{20}_{4}, **m.p.** −93.3, **b.p.** 121.3 (119–21). **Soly.** 0.68^{25}w.; s.al.; s.et.

26 —, ethylene ester. See *Glycol, dibutyrate.*

27 —, furfuryl ester. See *Furfuryl alcohol, butyrate.*

28 —, geranyl ester. See *Geraniol, butyrate.*

29 —, glyceryl ester. See *Glycerol, tributyrate.*

30 —, isoamyl ester (*γ-methylbutyl butanoate**). $CH_3(CH_2)_2COOC_5H_{11}$, 158.14. Col.liq. **D.** 0.882^{0}_{4}; 0.860^{15}_{4}, **m.p.** −73.2, **b.p.** 159–79 (184.8). **Soly.** 0.054^{50}w.; v.s.al.; v.s.et.

31 —, isobutyl ester (*β-methylpropyl butanoate**). $CH_3(CH_2)_2COOCH_2CH(CH_3)_2$, 144.12. Col.liq., *n* 1.4035. **D.** 0.8606^{25}_{4}, **b.p.** 156.9. **Soly.** v.sl.s.w.; ∞al.; ∞et.

32 —, methyl ester (*methyl n-butyrate*). $CH_3CH_2CH_2COOCH_3$, 102.08. Col. liq., *n* 1.3879. **D.** 0.898, **m.p.** <−95, **b.p.** 102.3. **Soly.** 1.56^{21}w.; ∞al.; ∞et.

33 —, α-methylisoamyl ester. See *2-Pentanol, 4-methyl-, butyrate.*

34 —, *p*-phenylphenacyl ester. $CH_3(CH_2)_2COOCH_2COC_6H_4C_6H_5$, 282.14., **m.p.** 97.

35 —, propyl ester (*n-propyl butyrate*). $CH_3CH_2CH_2COOC_3H_7$, 130.11. Col. liq., *n* 1.4005. **D.** 0.879^{15}_{4}; 0.8710^{25}_{4}, **m.p.** −95.2, **b.p.** 143. **Soly.** 0.167^{17}w.; ∞al.; ∞et.

36 —, piperazinium salt. $C_4H_{10}N_2{\cdot}2C_3H_7COOH$, 262.22. Wh.cr. **m.p.** 89.5–90. **Soly.** s.w.; s.al.; i.et.; s.h. dioxane.

37 —, **α-amino-** (*2-aminobutanoic acid**). $CH_3CH_2CH(NH_2)COOH$, 103.08. Col. leaf. **m.p.** d. 285, **b.p.** subl. **Soly.** 28w.; 0.182^{78}al.; i.et.

38 —, **β-amino-** (*3-aminobutanoic acid**). $CH_3CH(NH_2)CH_2COOH$, 103.08. Need. **m.p.** 184. **Soly.** 100w.; i.al.; i.et.

39 —, **γ-amino-** (*4-aminobutanoic acid*; piperidic acid*). $NH_2CH_2CH_2CH_2COOH$, 103.08. Leaf. or need.f.dil. al. **m.p.** 193 (183–4, 202 d.). **Soly.** v.s.w.; i.al.; i.et.; i.bz.

40 —, **α-amino-α-methyl.** See *Isovaline.*

41 —, **α-amino-γ-methylmercapto-.** See *Methionine.*

42 —, **α-bromo-** (*2-bromobutanoic acid**). $CH_3CH_2CHBrCOOH$, 166.97. Col. oily liq. **D.** 1.567^{20}_{20}, **m.p.** −4, **b.p.** 212–7 d.; $181–2^{250}$. **Soly.** 6.7 c.w.; s.al.; s.et.

43 —, **α-bromo-,** ethyl ester (*ethyl 2-bromobutanoate**). $CH_3CH_2CHBrCOOC_2H_5$, 195.00. Col.liq. **D.** 1.321^{25}_{4}, **b.p.** 179 d. ($58–62^{10}$). **Soly.** i.w.; s.al.; s.et.

44 —, **α, β-dibromo-** (*2, 3-dibromobutanoic acid**). $CH_3CHBrCHBrCOOH$, 245.88. Long need., **m.p.** 86–7. **Soly.** sl.s.w.; v.s.al.; v.s.et.

45 —, **α, α-dimethyl-** (*2, 2-dimethylbutanoic acid*; ethyldimethylacetic acid.* $CH_3CH_2C(CH_3)_2COOH$, 116.09. Col. liq. **m.p.** −14, **b.p.** 187. **Soly.** v.sl.s.w.; s.al.; s.et.

46 —, **α, β-dimethyl-** (*2, 3-dimethylbutanoic acid*; isopropylmethylacetic acid.* $CH_3CH(CH_3)CH(CH_3)COOH$, 116.09. Liq. **D.** 0.928^{15}_{4}, **b.p.** 189–91. **Soly.** s.w.; s.al.; s.et.

47 —, **α-ethyl-** (*2-ethylbutanoic acid*; 3-pentanecarboxylic acid; diethylacetic acid*). $(C_2H_5)_2CHCOOH$, 116.09. Col. liq., *n* 1.41788^{10}. **D.** 0.9331^{10}_{4}; 0.9195^{18}_{4} **m.p.** <−15, **b.p.** 190 (195–7). **Soly.** sl.s.w.; ∞al.; ∞et.

48 —, **α-ethyl-α-methyl-** (*diethylmethylacetic acid.* $CH_3CH_2C(C_2H_5)(CH_3)COOH$, 130.11. Arom.oil. **m.p.** <−20, **b.p.** 203–4. **Soly.** i.w.; s.al.

49 —, **α-hydroxy-** (*2-hydroxybutanoic acid**). $CH_3CH_2CHOHCOOH$, 104.06. Col.hyg.cr. **m.p.** 42.5, **b.p.** 260 d., subl. 60–70. **Soly.** s.w.; s.al.; s.et.

50 Butyric acid, β-hydroxy- (*3-hydroxybutanoic acid**). $CH_3CHOHCH_2COOH$, 104.06. Monocl.; syrup. **m.p.** 48–50, **b.p.** 130^{12}. **Soly.** v.s.w.; v.s.al.; v.s.et.; i.bz.

51 —, **γ-hydroxy-** (*4-hydroxybutanoic acid*). $CH_2OHCH_2CH_2COOH$, 104.06. Liq. **m.p.** −17, **b.p.** sl.d.ord.temp.

52 —, **γ-hydroxy-,** lactone. See *Butyrolactone.*

53 —, **α-isonitroso-.** See *Butyric acid, α-keto-, oxime.*

54 —, **α-keto-** (*2-oxobutanoic acid**). $CH_3CH_2COCOOH$, 102.05. Hyg.pl. or oil. **D.** 1.200^{17}_{4}, **m.p.** 32, **b.p.** 85^{21}. **Soly.** v.s.w.; v.s.al.; sl.s.et.

55 —, —, oxime (*α-isonitrosobutyric acid*). $C_2H_5C(:NOH)COOH$, 117.06. Need. f.w. **m.p.** 151 (169–70). **Soly.** v.sl.s. w.; v.s.al.; v.sl.s.et.

56 —, **γ-keto-γ-phenyl-.** See *Propionic acid, β-benzoyl-.*

57 —, **α-methyl-** (*2-methylbutanoic acid*; ethylmethylacetic acid; active valeric acid*). $CH_3CH_2CH(CH_3)COOH$, 102.08. Col.liq., *n* 1.4051. **D.** 0.941^{20}_{4}, **m.p.** <-80, **b.p.** 174. **Soly.** sl.s. w.; ∞al.; ∞et.

58 Butyric aldehyde. See *Butyraldehyde.*

59 Butyric amide. See *Butyramide.*

60 Butyric anhydride (*butanoic anhydride**). $(CH_3CH_2CH_2CO)_2O$, 158.11. Col.liq. **D.** 0.9946^{20}_{4}. **m.p.** −75.0 (−56.1), **b.p.** 198. **Soly.** d.w.; d.al.; ∞et.

61 Butyrin. See *Glycerol, tributyrate.*

62 Butyrolactone (*4-hydroxybutanoic acid lactone*; γ-hydroxybutyric acid lactone; butanolide*). $\underbrace{CH_2CH_2CH_2COO}$, 86.05. Oil. **D.** 1.1286^{15}_{0}, **b.p.** 206. **Soly.** ∞w.; s.al.; s.et.

63 2-Butyronaphthone, 1-hydroxy- (*1-hydroxy-2-naphthyl propyl ketone; 2-butyryl-1-naphthol*). $CH_3(CH_2)_2COC_{10}H_6OH$, 214.10. Yel-grn.need. **m.p.** 78. **Soly.** i.w.; s.al.; s.et.

64 Butyrone. See *4-Heptanone**.

66 Butyronitrile (*butanenitrile*; n-propyl cyanide*). $CH_3(CH_2)_2CN$, 69.06. Col.liq., *n* 1.3816^{24}. **D.** 0.796^{15}, **m.p.** −112.6, **b.p.** 118. **Soly.** sl.s.w.; ∞al.; ∞et.

67 —, **β,γ-epoxy-.** See *Epicyanohydrin.*

68 —, **α-ethyl-** (*2-ethylbutanenitrile*; diethylacetonitrile*), $(C_2H_5)_2CHCN$, 97.09. Oil, **b.p.** 144–6. **Soly.** ∞al.; ∞et.

69 —, **α-methyl-** (*2-methylbutanenitrile*; sec-butyl cyanide; methylethylacetonitrile*). $CH_3CH_2CH(CH_3)CN$, 83.08. Liq. **D.** 0.8061^{0}_{4}, **b.p.** 125. **Soly.** s.al.; s.et.

70 Butyrophenone (*phenyl propyl ketone*). $CH_3CH_2CH_2COC_6H_5$, 148.09. Col.liq., *n* $1.52016^{18.25}$. **D.** 0.988^{20}_{4}, **m.p.** 11, **b.p.** 232.3. **Soly.** i.w.; s.al.; ∞et.

71 Butyryl bromide (*butanoyl bromide**). $CH_3(CH_2)_2COBr$, 150.97. Liq. **D.** 1.4162^{17}_{4}, **b.p.** 128.

72 Butyryl chloride (*butanoyl chloride**). $CH_3(CH_2)_2COCl$, 106.51. Col.liq., *n* 1.41209. **D.** 1.028^{20}_{4}, **m.p.** −89.0, **b.p.** 102 (99–102). **Soly.** d.w.; d.al.; ∞et.

73 C acid. See *2-Naphthylamine-4, 8-disulfonic acid.*

74 Cacodyl (*tetramethylbiarsine; diarsenic tetramethyl; arsenic dimethyl*). $(CH_3)_2AsAs(CH_3)_2$, 209.95. Col.oil. **D.** >1, **m.p.** −6, **b.p.** 170. **Soly.** sl.s.w.; s.al.; s.et.

75 —, **ethyl-.** See *Biarsine, tetraethyl-.*

76 Cacodyl chloride (*dimethylarsenic monochloride; chlorodimethylarsine*). $(CH_3)_2AsCl$, 140.43. Col.liq. **D.** >1, **m.p.** <-45, **b.p.** 106.5. **Soly.** i.w.; ∞al.; i.et.

77 Cacodyl hydride. See *Arsine, dimethyl-.*

78 Cacodylic acid (*dimethylarsinic acid; alkargen*). $(CH_3)_2AsOOH$, 137.98. Col. tricl. **m.p.** 200. **Soly.** 83^{22}w.; 28.5^{15} 90%al.; i.et.

79 Cacodyl oxide (*bisdimethylarsenic oxide; alkarsin, alkarsine*). $[(CH_3)_2As]_2O$, 225.95. Col.liq. **D.** 1.486^{15}, **m.p.** −25, **b.p.** 149–51. **Soly.** sl.s.w.; s.al.; s.et.

80 Cacodyl sulfide (*bisdimethylarsenic sulfide*). $[(CH_3)_2As]_2S$, 242.01. Oil. **m.p.** <-40 d. **b.p.** 211. **Soly.** sl.s.w.; s.al.; s.et.

81 Cacodyl trichloride (*dimethylarsenic trichloride*). $(CH_3)_2AsCl_3$, 211.35. Cr. f.et. **m.p.** d. 50. **Soly.** d.w.; d.al.; s.et.; s.CS_2.

82 Cadaverine (*1, 5-pentanediamine*; pentamethylenediamine*). $H_2N(CH_2)_5NH_2$, 102.13. Syrupy fum.liq. **D.** 0.9174^{0}_{4}, **m.p.** 9, **b.p.** 178–80. **Soly.** s.w.; s.al.; sl.s.et.

83 Cadmium, diethyl-* (*cadmium ethyl*). $(C_2H_5)_2Cd$, 170.49. Col.liq. **D.** 1.653^{22}_{4}, **m.p.** −21, **b.p.** $64^{19.5}$. **Soly.** ∞et.

* Name approved by the International Union of Chemistry.

84 **Cadmium, dimethyl-*.** $(CH_3)_2Cd$, 142.46. Col. liq. **D.** $1.9846^{17.9}$, **m.p.** −4.5, **b.p.** 105.5^{758}. **Soly.** d.w.; s.et.

85 **Caffeic acid** (3, 4-*dihydroxycinnamic acid*). $(HO)_2C_6H_3CH{:}CHCOOH$, 180.06. Yel.monocl.f.w. **m.p.** 195, **b.p.** d. **Soly.** s.w.; v.s.al.; sl.s.et.

86 **Caffeine** (1, 3, 7-*trimethylxanthine; theine*). $C_8H_{10}N_4O_2$, 194.11. Wh.need. f.al.; cr. $(+1H_2O)$ f.w. **D.** 1.23^{19}_{4}, **m.p.** anh. 235–7, **b.p.** subl. 180. **Soly.** 1.35^{16}, 45.5^{65}w.; 2.3^{16} 85%al.; 0.044^{16}et.; 14.2chl.; s.acet., bz.

87 —, benzoate. $C_8H_{10}N_4O_2{\cdot}C_7H_6O_2$, 316.16. Wh.cr. **Soly.** s.w.; s.al.

88 —, citrate. $C_8H_{10}N_4O_2{\cdot}C_6H_8O_7$, 386.17. Monocl. **Soly.** s.w.; s.d.al.

89 —, hydriodide diiodide. $C_8H_{10}N_4O_2{\cdot}HI{\cdot}I_2{\cdot}1\frac{1}{2}H_2O$, 602.90. Dk.grn.pr. **m.p.** 182–4. **Soly.** i.w.; s.al.; sl.s.chl.

90 —, hydrobromide. $C_8H_{10}N_4O_2{\cdot}HBr{\cdot}2H_2O$, 311.07. Col.trans.cr. **Soly.** s.w.; s.d.al.

91 —, hydrochloride. $C_8H_{10}N_4O_2{\cdot}HCl{\cdot}2H_2O$, 266.61. Monocl.col. **Soly.** s.d.w.; s.d.al.

92 —, isovalerate. $C_8H_{10}N_4O_2{\cdot}C_5H_{10}O_2$, 296.19. Fatty glist.need. **Soly.** s.w.

93 —, mercurichloride. $C_8H_{10}O_2N_4{\cdot}HgCl_2$, 465.63. Col.need. **m.p.** 246. **Soly.** s.w.

94 —, salicylate. $C_8H_{10}N_4O_2{\cdot}C_7H_6O_3$, 332.16. Cr.masses. **Soly.** s.w.; s.al.

95 —, sulfate. $C_8H_{10}N_4O_2{\cdot}H_2SO_4$, 292.19. Wh.need. **Soly.** s.d.w.; s.d.al.

96 **Cajeputole.** See *Cineole.*

97 **Camphane** (1, 7, 7-*trimethylnorcamphane; hydrocamphene;* 1, 7, 7-*trimethylbicyclo*[2, 2, 1] *heptane*). $C_{10}H_{18}$, 138.14. Hex.pl. or pr. **m.p.** 152–4, **b.p.** 160 subl. **Soly.** i.w.; s.h.al.; s.et.; s.et. acetate, h.me.al.

98 —, **2-chloro-.** See *Bornyl chloride; Isobornyl chloride.*

99 **2-Camphanol.** See *Borneol.*

00 **2-Camphanone.** See *Camphor.*

01 *dl*-**Camphene** (*dl*-2, 2-*dimethyl*-3-*methylenenorcamphane*). $C_{10}H_{16}$, 136.12. Feathery need., n 1.4402^{80}. **D.** 0.879^{20}_{4}; 0.822^{78}, **m.p.** 50, **b.p.** 159–60. **Soly.** i.w.; v.s.al.; v.s.et.

02 *d* **or** *l*-**Camphene.** $C_{10}H_{16}$, 136.12. *d:* Feath. need., $[\alpha]$ $+103.9°^{17}_{D}$ in et. **m.p.** 51(48), **b.p.** 160–2; 52^{17}. **Soly.** i.w.; sl.s.al.; s.et.
l: Cr., n 1.45514^{45}, $[\alpha]$ $-52°_{D}$. **m.p.** 42–52, **b.p.** 158–60. **Soly.** s.et.

03 α-**Camphol.** See *Borneol.*

04 *dl*-**Campholic acid** (*dl*-1, 2, 2, 3-*tetramethylcyclopentanecarboxylic acid**). $C_5H_5(CH_3)_4COOH$, 170.14. Col.tricl. pr. $(d)[\alpha]$ $+49.8°^{15}_{D}$ in al.; $(l)[\alpha]$ $-49.1°^{15}_{D}$ in al. **m.p.** (*dl*) 109; (*d*) 106; (*l*) 106–7, **b.p.** (*d*) 255; (*l*) 250. **Soly.** 0.016^{19}w.; 51.29 c.al.; s.et.

05 **Camphor, 3-amino-** (α-*aminocamphor; 3-camphorylamine*). $C_{10}H_{15}O{\cdot}NH_2$, 167.14. Waxy, **m.p.** 110, **b.p.** 244. **Soly.** i.w.; s.al.; s.et.; s.a.

06 —, **artificial.** See *Bornyl chloride.*

07 —, **Borneo.** See *d-Borneol.*

08 —, **parsley.** See *Apiole.*

09 *d*-**Camphor** (*d-2-camphanone; Japan camphor; laurel camphor; Formosa camphor; d-2-keto*-1, 7, 7-*trimethylnorcamphane*). $C_{11}H_{16}O$, 152.12. Col. trig., hex., n 1.532(1.5462), $[\alpha]44.26°^{20}_{D}$ in al. **D.** 1.000^{0}_{0}; 0.990^{25}_{4}, **m.p.** 176–7, **b.p.** 204 subl. **Soly.** 0.1w.; 100al.; 173et.; 300chl.; s.CS_2, bz., me.al., ac.a., acet.

10 —, oxime. $C_{10}H_{16}NOH$, 167.14. Monocl.need. or pr.f.dil.al., $[\alpha]$ $+42.4^{20}_{D}$ in al. **D.** 1.01^{118}_{4}, **m.p.** 118 (114–6), **b.p.** 249–54 d. **Soly.** i.w.; v.s.al.; s.et.; s.min.a.

11 —, α-**bromo-** (3-*bromo-d-camphor* (one form)). $C_{10}H_{15}BrO$, 231.03. Col. monocl., n 1.5535, 1.5787, 1.5912, $[\alpha]165°_{5461}$. **D.** 1.449^{20}_{4}, **m.p.** 78, **b.p.** 274 sl.d. **Soly.** i.w.; 12.1^{15}, 130^{50}al.; s.et.; s.chl., CCl_4, bz.

12 —, α' **(or** β**)-bromo-** (3-*bromo-d-camphor* (one form)). $C_{10}H_{15}BrO$, 231.03. **m.p.** 61, **b.p.** 130^{10}. **Soly.** i.w.; s.al.; s.et.

13 —, α-**chloro-** (3-*chloro-d-camphor* (one form)). $C_{10}H_{15}ClO$, 186.57. (α)Leaf., $[\alpha]$ $+97°^{20}_{D}$ in al. **m.p.** 93–4, **b.p.** 244–7 part.d. **Soly.** s.h.w.; s.h.al.; s.et.; s.chl., CS_2, bz.

14 —, **3-nitro-** (α-*nitrocamphor*). $C_{10}H_{15}O{\cdot}NO_2$, 197.13. Monocl.pr.f.bz. **m.p.** 100–1. **Soly.** i.w.; s.al.; s.et.; v.s.bz., s.chl.

15 α-**Camphoramic acid** (α-*camphoramidic acid; 3-carbamyl*-1, 2, 2-*trimethylcyclopentanecarboxylic acid; camphoric acid 3-monoamide*). $C_5H_4(CH_3)_3(CONH_2)COOH$, 198.13. **m.p.** 176–7. **Soly.** s.h.w.; s.h.al.; s.et.; s.h.me.al.

For explanations and abbreviations see beginning of table.

16 **β-Camphoramic acid** (*β-camphoramidic acid; 3-carbamyl-2, 2, 3-trimethylcyclopentanecarboxylic acid; camphoric acid 1-monoamide*). $C_5H_4(CH_3)_3(CONH_2)COOH$, 198.13. **m.p.** 182–3. **Soly.** s.h.w.; s.al.; s.et.; s.acet.; sl.s.bz.

17 **Camphoric acid,** 1-monoamide. See *β-Camphoramic acid.*

18 —, 3-monoamide. See *α-Camphoramic acid.*

19 ***dl*-Camphoric acid** (*dl-cis*-1, 2, 2-*trimethyl*-1, 3-*cyclopentanedicarboxylic acid*; paracamphoric acid*). $C_8H_{14}(COOH)_2$, 200.12. Col.monocl.need. **D.** 1.228^{20}_{4}, **m.p.** 202 (208). **Soly.** 0.76^{25}, 10^{100}w.; s.al.; v.s.et.

20 ***d*-Camphoric acid.** $C_8H_{14}(COOH)_2$, 200.12. Col.monocl.pr. or leaf., $[\alpha]$ $47.7°^{20}_{D}$ in al. **D.** 1.186^{20}_{4}, **m.p.** 187. **Soly.** 0.62^{12}, 8.3^{100}w.; 112 al.; 91.4^{25}et.; s.acet.; i.chl.

21 ***l*-Camphoric acid** (*l-cis*-1, 2, 2-*trimethyl*-1, 3-*cyclopentanedicarboxylic acid*). $C_{10}H_{14}(COOH)_2$, 200.12. **m.p.** 187. **Soly.** sl.s.w.; s.al.; s.et.; s.me.al.

22 ***dl*-Camphoric anhydride** (*dl-cis*-1, 2, 2-*trimethyl*-1, 3-*cyclopentanedicarboxylic anhydride**). $C_8H_{14}(CO)_2O$, 182.11. Rhomb.f.al. **D.** 1.194^{20}_{4}, **m.p.** 221 (216–7), **b.p.** 270. **Soly.** v.sl.s.w.; 0.63 c.al.; 1.00et.; v.s.chl., ethyl acetate; s.bz., CS_2.

23 ***d*-Camphoric anhydride.** $C_{10}H_{14}O_3$, 182.11. Rhomb.pr.f.al. **D.** 1.194^{20}_{4}, **m.p.** 221, **b.p.** 270 d. **Soly.** v.sl.s.w.; v.s.al.; 37.5^{5}bz.

24 ***l*-Camphoronic acid** (*l*-2, 3-*dimethyl*-1, 2, 3-*butanetricarboxylic acid*; l-α, α, β-trimethyltricarballylic acid*). $(CH_3)_2C(COOH)C(CH_3)(COOH)CH_2COOH$, 218.11. Hyg.need.f.w., $[\alpha]$ $-26.9°^{15}_{D}$ in w. **m.p.** 164–5 (158), **b.p.** $195–210^{13}$. **Soly.** 12.5^{16}w.; 59.8^{16}al.; 5.28^{16}et.; 42.9chl.; s.acet.; v.sl.s.bz., CS_2.

25 **Camphor pinacol** (*l*) (*l*-2, 2′-*bicamphane*-2, 2′-*diol*). $C_9H_{16}COHCOHC_9H_{16}$, 306.27. Rhomb.bisphenoidal. **m.p.** 157.8. **Soly.** i.w.; s.al.; s.et.

26 **3-Camphorylamine.** See *Camphor, 3-amino-.*

27 **β-Camphylamine** (2, 3, 3-*trimethyl*-1-*cyclopentene*-1-*ethylamine*). $C_8H_{13}CH_2CH_2NH_2$, 153.16. Liq., *n* 1.47284^{18}, $[\alpha]$ $+6°_D$, **D.** 0.8736^{18}_{0}, **b.p.** 194–6.

28 **Canadine** (*l-tetrahydroberberine*). $C_{20}H_{21}NO_4$, 339.17. Silky need.f.al., $[\alpha]$ $-299°_D$ in chl. **m.p.** 133–4. **Soly.** i.w.; s.al.; v.s.et.; v.s.chl., bz.

29 **Cane sugar.** See *Sucrose.*

30 **Cantharene** (*dihydro-o-xylene*). $C_6H_6(CH_3)_2$, 108.09. Col. oily liq., *n.* 1.4895. **D.** 0.8521^{20}_{4}, **b.p.** 135. **Soly.** i.w.; ∞al.; s.et.

31 **Cantharidin** (2, 3-*dimethyl-7-oxabicyclo* [2, 2, 1] *heptane*-2, 3-*dicarboxylic anhydride*). $C_{10}H_{12}O_4$, 196.09. Col. rhomb.pl. **m.p.** 218 (212), **b.p.** subl. at 84. **Soly.** 0.0033w.; 0.02^{18}al.; 0.09et.; s.ac.a., conc.H_2SO_4, alk.; sl.s.chl., acet.

32 **Capraldehyde** (*decanal*; capric aldehyde; caprinaldehyde; n-decyl aldehyde*). $CH_3(CH_2)_8CHO$, 156.16. Liq., *n* 1.42977^{15}. **D.** 0.828^{15}_{4}, **b.p.** 208–9. **Soly.** i.w.; s.al.; s.et.

33 —, oxime (*decanal oxime*; caprinaldoxime*). $CH_3(CH_2)_8CH{:}NOH$, 171.17. Leaf.f.dil.me.al. **m.p.** 69. **Soly.** s.al.; s.et.

34 **Capramide** (*decanamide*; n-decylic amide; capric amide*). $CH_3(CH_2)_8CONH_2$, 171.17. Cr., **D.** 0.999^{20}_{4}, **m.p.** 108(98). **Soly.** i.w.; s.al.; s.et.

35 **Capric acid** (*decanoic acid*; n-capric acid; n-decoic acid; n-decylic acid*). $CH_3(CH_2)_8COOH$, 172.16. Col.need., *n* 1.42855^{40}. **D.** 0.8858^{40}_{4}, **m.p.** 31.5, **b.p.** 268–70. **Soly.** sl.s.w.; s.al.; s.et.

36 —, ethyl ester (*ethyl caprate; ethyl decanoate**). $CH_3(CH_2)_8COOC_2H_5$, 200.19. Col.liq. **D.** 0.870^{15}_{4}; 0.862^{20}_{4}, **m.p.** −19.96, **b.p.** 245 ($110–2^{10}$). **Soly.** 0.0015^{20}w.; ∞al.; ∞et.; ∞chl.

37 —, methyl ester (*methyl decanoate*; methyl caprate*). $CH_3(CH_2)_8COOCH_3$, 186.17. Col.liq. **m.p.** −18, **b.p.** 224. **Soly.** i.w.; v.s.al.; v.s.et.

38 —, **α-octyl-** (2-*octyldecanoic acid*; 9-heptadecanecarboxylic acid*; di-n-octylacetic acid*). $[CH_3(CH_2)_7]_2CHCOOH$, 284.28. Need. or leaf.f.al. **m.p.** 38.5, **b.p.** $270–5^{100}$. **Soly.** i.w.; s.al.

39 **Capric aldehyde.** See *Capraldehyde.*

40 **Capric amide.** See *Capramide.*

41 **Capric anhydride** (*decanoic anhydride*; n-decylic anhydride*). $(CH_3(CH_2)_8CO)_2O$, 326.30. Cr. **m.p.** 23.9. **Soly.** i.w.; s.al.; s.et.

42 **Caprinaldehyde.** See *Capraldehyde.*

43 **Caprinaldoxime.** See *Capraldehyde, oxime.*

44 **Caprinitrile** (*decanenitrile*; capric nitrile; n-nonyl cyanide*). $CH_3(CH_2)_8CN$, 153.16. Col.liq. **D.** 0.8295^{15}_{4}, **m.p.** −17.9, **b.p.** 243.7 (236–7). **Soly.** i.w.; v.sl.s.al.; s.et.

* Name approved by the International Union of Chemistry.

45 Caproaldehyde (*hexanal*; n-caproic aldehyde; n-hexoic aldehyde*). $CH_3(CH_2)_4CHO$, 100.09. Col.liq. **D.** 0.8335^{20}_{4}, **b.p.** 131. **Soly.** i.w.; v.s.al.; v.s.et.

46 —, oxime (*hexanal oxime*; capronaldoxime*). $CH_3(CH_2)_4CH{:}NOH$, 115.11. Cr. **m.p.** 51. **Soly.** s.al.; s.et.

47 —, **α-ethyl-** (*2-ethylhexanal*; butylethylacetaldehyde*). $C_4H_9CH(C_2H_5)CHO$, 128.12. Col.liq., *n* 1.416. **D.** 0.823^{20}_{4}, **m.p.** < −100, **b.p.** 163.4. **Soly.** 0.04^{28}w.

48 —, **α, β, γ, δ-tetrahydroxy-*.** See *Fucose.*

49 Caproamide (*hexanamide**). $CH_3(CH_2)_4CONH_2$, 115.11. Cr. **D.** 0.999^{20}_{4}, **m.p.** 101.0, **b.p.** 255. **Soly.** v.sl.s.w.; v.s.al.; s.et.; s.bz.

50 Caproic acid (*n*) (*hexanoic acid*; n-hexoic acid*). $CH_3(CH_2)_4COOH$, 116.09. Col. oily liq., *n* 1.41635. **D.** 0.945^{0}_{0}; 0.929^{20}_{4}, **m.p.** −1.5 to −2.0, (−9.5); **b.p.** 205 (202). **Soly.** 0.4w.; s.al.; s.et.

51 —, amyl ester (*amyl caproate; pentyl hexanoate**). $CH_3(CH_2)_4COOC_5H_{11}$, 186.17. Col.liq. **b.p.** 222.2.

52 —, butyl ester (*butyl caproate; butyl hexanoate**). $CH_3(CH_2)_4COOC_4H_9$, 172.16. Col.liq. **D.** 0.8843^{0}_{4}, **b.p.** 204.3. **Soly.** v.sl.s.w.; ∞al.; ∞et.

53 —, ethyl ester (*ethyl caproate; ethyl hexanoate**). $CH_3(CH_2)_4COOC_2H_5$, 144.12. Col. to yelsh.liq. **D.** 0.8732^{20}_{4}; 0.8666^{25}_{4}, **m.p.** −67.5, **b.p.** 166–7. **Soly.** 0.0015^{20}w.; s.al.; s.et.

54 —, isoamyl ester (*γ-methylbutyl hexanoate**). $CH_3(CH_2)_4COOC_5H_{11}$, 186.17. Col.liq. **b.p.** $94–6^{10}$. **Soly.** i.w.; s.al.

55 —, methyl ester (*methyl hexanoate*; methyl caproate*). $CH_3(CH_2)_4COOCH_3$, 130.11. Col.liq. **D.** 0.9038^{0}_{4}, **b.p.** 149.5. **Soly.** i.w.; v.s.al.; v.s.et.

56 —, *p*-phenylphenacyl ester. $CH_3(CH_2)_4COOCH_2COC_6H_4C_6H_5$, 310.17. **m.p.** 65.

57 —, piperazinium salt. $C_4H_{10}N_2{\cdot}2C_5H_{11}COOH$, 318.28. Wh.cr. **m.p.** 111–1.5. **Soly.** s.w.; s.al.; i.et.; s.h.acet.

58 —, **α-amino-.** See *Norleucine.*

59 —, **α-bromo-** (*2-bromohexanoic acid**). $CH_3(CH_2)_3CHBrCOOH$, 195.00. Liq. **b.p.** 240 ($128–31^{10}$). **Soly.** s.al.; s.et.

60 —, **α, ε-diamino-.** See *Lysine.*

61 —, **α-ethyl-** (*butylethylacetic acid; 3-heptanecarboxylic acid; 2-ethylhexanoic acid**). $CH_3(CH_2)_3CH(C_2H_5)COOH$, 144.12. Col.liq. **D.** 0.903^{20}_{4}, **m.p.** <0, **b.p.** 223–5. **Soly.** 0.2.

62 —, **α-hydroxy-** (*2-hydroxyhexanoic acid**). $CH_3(CH_2)_3CHOHCOOH$, 132.09. Col.need. **m.p.** 62, **b.p.** subl. 100. **Soly.** s.w.; s.al.; s.et.

63 —, **γ-hydroxy-,** lactone (*4-hydroxyhexanoic acid lactone*). $CH_3CH_2CH(CH_2)_2COO$, 114.08. Col.liq. **m.p.** < −18, **b.p.** 220. **Soly.** s.w.; s.al.

64 —, **α-methyl-** (*2-methylhexanoic acid**). $CH_3(CH_2)_3CH(CH_3)COOH$, 130.11. Liq. **b.p.** 209.6. **Soly.** ∞w.; ∞al.; ∞et.

65 —, **δ-methyl-** (*5-methylhexanoic acid*; isoamylacetic acid; isoheptylic acid*). $(CH_3)_2CH(CH_2)_3COOH$, 130.11. Col. liq. **D.** 0.9261^{15}_{4}; 0.9138^{24}_{4}, **m.p.** < −25, **b.p.** 211.5 (216.5). **Soly.** sl.s.w.; s.al.; s.et.

66 Caproic aldehyde. See *Caproaldehyde.*

67 Caproic anhydride (*hexanoic anhydride**). $[CH_3(CH_2)_4CO]_2O$, 214.17. Col.oil. **D.** 0.9279^{17}_{4}, **m.p.** −40.6, **b.p.** 241–3 sl.d. **Soly.** d.w.; s.al.; ∞et.

68 Caproic nitrile. See *Capronitrile.*

69 Caprokol. See *Resorcinol, 4-hexyl-.*

70 Capronaldoxime. See *Caproaldehyde, oxime.*

71 Caprone. See *6-Hendecanone*.*

72 Capronitrile (*hexanenitrile*; caproic nitrile; n-amyl cyanide*). $CH_3(CH_2)_4CN$, 97.09. Col.liq., *n* $1.40851^{14.8}$. **D.** 0.809^{20}_{4}, **m.p.** −79.4, **b.p.** 163. **Soly.** v.sl.s.w.; s.al.; s.et.

73 Caprophenone, 2, 4-dihydroxy- (*4-caproylresorcinol*). $CH_3(CH_2)_4COC_6H_3(OH)_2$, 208.12. **m.p.** 56, **b.p.** $196–8^{7}$. **Soly.** i.w.; s.al.; s.et.; v.s.bz.; s.chl., acet., pet.eth.

74 Caproyl chloride (*hexanoyl chloride**). $CH_3(CH_2)_4COCl$, 134.54. Col.liq., *n* 1.4867. **D.** 0.9704^{25}_{4}, **m.p.** −87.3, **b.p.** 153. **Soly.** d.w.; d.al.; s.et.

75 Caprylaldehyde (*octanal*; caprylic aldehyde; n-octylaldehyde*). $CH_3(CH_2)_6CHO$, 128.12. Col.liq., *n* 1.4217. **D.** 0.821^{20}_{4}, **b.p.** 163.4 (81^{32}). **Soly.** v.sl.s.w.; ∞al.; ∞et.

76 —, oxime (*octanal oxime*; caprylaldoxime*). $CH_3(CH_2)_6CH{:}NOH$, 143.14. Cr. **m.p.** 58–9, **b.p.** $120–5^{10}$.

For explanations and abbreviations see beginning of table.

77 Caprylamide (*octanamide**). CH_3-$(CH_2)_6CONH_2$, 143.14. Col.leaf. **m.p.** 110 (104), **b.p.** >200 d. **Soly.** 0.45^{100}w.; s.al.; s.et.

78 ***sec-n*-Caprylamine.** See *Heptylamine, α-methyl-**.

79 Capryl chloride (*decanoyl chloride**). $CH_3(CH_2)_8COCl$, 190.61. Col.liq. **D.** 0.973_{4}^{8}, **m.p.** −34.5, **b.p.** 232.3 (195–6). **Soly.** d.w.; d.al.; s.et.

80 Caprylene. See *Octylene.*

81 Caprylic acid (*octanoic acid*; n-octoic acid; n-octylic acid*). CH_3-$(CH_2)_6COOH$, 144.12. Col.leaf. or oily liq., *n* 1.4285. **D.** 0.910_{4}^{20}, **m.p.** 16, **b.p.** 237.5. **Soly.** 0.25^{100}w.; ∞al.; ∞et.; s.bz., chl., CS_2, glac.ac.a.

82 —, ethyl ester (*ethyl caprylate; ethyl octanoate**). $CH_3(CH_2)_6COOC_2H_5$, 172.16. Col.liq. **D.** 0.878_{4}^{17}; 0.8623_{4}^{25}, **m.p.** −44.8 (−43.1), **b.p.** $207–8^{753}$. **Soly.** 0.063^{20}w.; s.al.; s.et.

83 —, isoamyl ester (*γ-methylbutyl octanoate**). $CH_3(CH_2)_6COOC_5H_{11}$, 214.20. Col.liq. **b.p.** 136^{10}. **Soly.** i.w.; s.al.

84 —, methyl ester (*methyl octanoate*; methyl caprylate*). $CH_3(CH_2)_6COOCH_3$, 158.14. Col.liq. **D.** 0.887_{4}^{20}, **m.p.** −41, **b.p.** 192.9. **Soly.** i.w.; v.s.al.; v.s.et.

85 —, *p*-phenylphenacyl ester. CH_3-$(CH_2)_6COOCH_2COC_6H_4C_6H_5$, 338.20. **m.p.** 67.

86 —, **α-amino-, *dl-*** (*dl-2-aminooctanoic acid**). $CH_3(CH_2)_5CH(NH_2)COOH$, 159.14. Waxy pl. **m.p.** 263–4, **b.p.** d., subl. **Soly.** 0.6^{100}w.; v.sl.s.al.; v.sl.s.et.

87 —, **α-hydroxy-** (*2-hydroxyoctanoic acid**). $CH_3(CH_2)_5CHOHCOOH$, 160.12. Pl. **m.p.** 69.5. **Soly.** v.sl. s.w.; v.s.al.; v.s.et.

88 Caprylic anhydride (*octanoic anhydride*; n-octoic anhydride*). $[CH_3$-$(CH_2)_6CO]_2O$, 270.23. Liq. **D.** 0.9021_{4}^{20}, **m.p.** −1, **b.p.** 285. **Soly.** d.w.; s.al.; ∞et.

89 Caprylidene. See 1-*Octyne**.

90 Caprylone. See 8-*Pentadecanone**.

91 Caprylonitrile (*octanenitrile*; n-heptyl cyanide*). $CH_3(CH_2)_6CN$, 125.13. Col.liq. **D.** 0.820_{4}^{17}; 0.8058_{4}^{30}, **m.p.** −45.6, **b.p.** 205.2 (194–5). **Soly.** i.w.; v.sl.s.al.; s.et.

92 Caprylyl chloride (*octanoyl chloride**). $CH_3(CH_2)_6COCl$, 162.57. Liq. **D.** 0.9671_{4}^{0}, **m.p.** −6, **b.p.** 195.55. **Soly.** d.w.; d.al.; s.et.

93 Carbamamidine. See *Guanidine.*

94 Carbamic acid, benzyl ester (*benzyl carbamate; benzyl aminomethanoate**). $NH_2COOCH_2C_6H_5$, 151.08. Leaf. **m.p.** 86, **b.p.** 220 d. **Soly.** sl.s.w.; s.al.; s.et.

95 —, ethyl ester (*ethyl carbamate; urethan*). $NH_2COOC_2H_5$, 89.06. Col. need.f.lgr. **D.** 0.9862_{4}^{21}; 1.11_{20}^{20}, **m.p.** 50 (48), **b.p.** 180. **Soly.** $100+^{25}$w.; 166^{25}al.; v.s.et.; v.s.bz.; s.chl., glyc.; sl.s.lgr.

96 —, isoamyl ester (*isoamyl carbamate; isoamyl urethan*). $NH_2COOC_5H_{11}$, 131.11. Need.f.w. **D.** 0.944_{4}^{70-8}, **m.p.** 63.5. **b.p.** 220. **Soly.** s.h.w.; s.al.; s.et.

97 —, isobutyl ester (*β-methylpropyl aminomethanoate**). NH_2COOCH_2CH-$(CH_3)_2$, 117.09. Col.leaf. **D.** 0.943_{4}^{20}, **m.p.** 55, **b.p.** 206–7. **Soly.** i.w.; s.al.; s.et.

98 —, methyl ester (*methyl urethan*). NH_2COOCH_3, 75.05. Col.pl. **D.** 1.136_{4}^{56}, **m.p.** 52, **b.p.** 177. **Soly.** 217^{11}w.; 73^{15}al.; s.et.

00 —, propyl ester (*n-propyl carbamate*). $NH_2COOC_3H_7$, 103.08. Col.pr. **m.p.** 60–1 (53), **b.p.** 200. **Soly.** v.s.w.; v.s.al.; s.et.

01 —, **cyclohexylethylthiolthiono-,** cyclohexylethylammonium salt. $C_6H_{11}(C_2H_5)NCSSNH_2(C_2H_5)C_6H_{11}$, 330.40. Pa.yel.cr. **m.p.** 95–6. **Soly.** v.s.w.; v.s.al.; s.et.

02 —, **cyclopentamethylenedithio-,** salts. See under 1-*Piperidinecarbodithioic acid.*

03 —, **dibenzylthiolthiono-,** dibenzylammonium salt. $(C_6H_5CH_2)_2$-$NCSSNH_2(CH_2C_6H_5)_2$, 470.37. Yel. cr. **m.p.** 82.5. **Soly.** s.w.; v.s.al.; sl.s.et.

04 —, —, zinc salt. $[(C_6H_5CH_2)_2NCSS]_2$-Zn, 609.85. Cream colored powd. **m.p.** 176–7. **Soly.** i.w.; i.al.; i.et.; sl.s.chl.

05 —, **dibutylthiolthiono-,** zinc salt. $[(C_4H_9)_2NCSS]_2Zn$, 473.92. Cream colored powd. **D.** 1.26_{4}^{20}. **m.p.** 108–9. **Soly.** i.w.; i.al.; sl.s.et.; sl.s.chl.

06 —, **diethylthiolthiono-,** benzal diester. $[(C_2H_5)_2NCSS]_2CHC_6H_5$, 386.46. Yel.cr. **m.p.** 178–9. **Soly.** i.w.; s.h.al.

07 —, —, diethylammonium salt. $(C_2H_5)_2NCSSNH_2(C_2H_5)_2$, 222.31. Pa.yel.pl. **m.p.** 81–2. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.

* Name approved by the International Union of Chemistry.

08 Carbamic acid, diethylthiolthiono-, 6-nitrobenzothiazyl ester. See *2-Benzothiazolethiol, 6-nitro-, diethylthiolthionocarbamic ester.*

09 —, —, zinc salt. $[(C_2H_5)_2NCSS]_2Zn$, 361.79. Wh.powd. **D.** 1.24^{20}_{4}, **m.p.** 173–4. **Soly.** i.w.; i.al.; i.et.; sl.s.chl.

10 —, **dimethylthiolthiono-,** dimethylammonium salt. $(CH_3)_2NCSSNH_2(CH_3)_2$, 166.25. Pa.yel.pl. **m.p.** 129–30. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.

11 —, —, 2, 4-dinitrophenyl ester. $(CH_3)_2NCSSC_6H_3(NO_2)_2$, 287.21. Yel.cr. **D.** 1.54^{20}_{4}, **m.p.** 139. **Soly.** i.w.; s.h.al.

12 —, —, selenium tetrasalt. $[(CH_3)_2NCSS]_4Se$, 559.90. Dense or.cr. **m.p.** 179–80. **Soly.** i.w.; i.al.; i.et.; sl.s.chl.

13 —, —, zinc salt. $[(CH_3)_2NCSS]_2Zn$, 305.73. Wh.powd. **D.** 2.00^{20}_{4}, **m.p.** 248–50. **Soly.** i.w.; i.al.; i.et.; sl.s.chl.

14 —, **diphenyl-,** ethyl ester (*diphenylurethan*). $(C_6H_5)_2NCOOC_2H_5$, 241.13. Col.pr.f.lgr. **m.p.** 71–2, **b.p.** 360. **Soly.** s.w.; v.s.al.; v.s.et.

15 —, **dithio-** (*aminodithioformic acid; aminomethanethionothiolic acid**). NH_2CS_2H, 93.15. Col.need. **Soly.** v.s. d.w.; s.al.; s.et.

16 —, **ethyl-,** ethyl ester (*ethylurethan*). $C_2H_5NHCOOC_2H_5$, 117.09. Col.liq. **D.** 0.981^{20}_{4}, **b.p.** 176. **Soly.** $63.2^{15.5}$w.

17 —, **ethylidenedi-,** diethyl ester (*ethylidenediurethan*). $CH_3CH(NHCOOC_2H_5)_2$, 204.14. Need. **m.p.** 125–6, **b.p.** $170\text{–}80^{20}$ d. **Soly.** sl.s.c.w.; s.al.; s.et.

18 —, **isobutyl-,** ethyl ester (*ethyl isobutylcarbamate; isobutylurethan*). $(CH_3)_2CHCH_2NHCOOC_2H_5$, 145.13. Col.liq., *n* 1.4288. **D.** 0.943^{20}_{4}, **m.p.** <-65, **b.p.** 96^{17}. **Soly.** i.w.

19 —, **methyl-,** ethyl ester (*methylurethan*). $CH_3NHCOOC_2H_5$, 103.08. Col.liq., *n* $1.4200^{18.9}$. **D.** 1.009^{19}, **b.p.** 170. **Soly.** $94.7^{15.5}$w.; s.al.

20 —, **nitro-,** ethyl ester (*nitrourethan*). $NO_2NHCOOC_2H_5$, 134.06. Col.leaf.f. lgr. **m.p.** 64. **Soly.** v.s.w.; v.s.al.; v.s.et.; sl.s.lgr.

21 —, **phenyl-,** esters. See under *Carbanilic acid.*

22 —, **propyl-,** ethyl ester (*n-propylurethan*). $C_3H_7NHCOOC_2H_5$, 131.11. Liq. **D.** 0.992^{15}, **b.p.** $191.5\text{–}2.5^{758}$ (186). **Soly.** $9.80^{15.5}$w.

23 —, **thiol-,** ethyl ester (*aminomethanethiolic acid ethyl ester; thiourethan*). $NH_2COSC_2H_5$, 105.12. Pl. or leaf. **m.p.** 108 (102–9), **b.p.** subl.d. **Soly.** v.sl.s.c., s.h.w.; v.s.h.al.; v.s.h.et.

24 —, **thiono-,** ethyl ester (*thiourethan; xanthogenamide*). $NH_2CSOC_2H_5$, 105.12. Monocl.leaf.f.et. **m.p.** 41–2, **b.p.** d. **Soly.** i.(v.sl.s.)w.; s.al.; s.et.

25 Carbamide. See *Urea.*

26 Carbamide oxide. See *Urea, hydroxy-.*

27 Carbamonitrile. See *Cyanamide.*

28 Carbamyl chloride (*chloroformamide; urea chloride; carbamide chloride*). H_2NCOCl, 79.48. Col.liq. **m.p.** 50, **b.p.** 61–2. **Soly.** d.w.; d.al.

29 Carbanil. See *Isocyanic acid, phenyl ester.*

30 Carbanilic acid, ethyl ester (*N-phenylurethan; ethyl phenylcarbamate*). $C_6H_5NHCOOC_2H_5$, 165.09. Lng.need. f.w. **D.** 1.106^{20}_{4}; 1.079^{60}_{4}, **m.p.** 52, **b.p.** 238. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.bz.

31 —, isobutyl ester (*isobutyl phenylcarbamate*). $C_6H_5NHCOOCH_2CH(CH_3)_2$, 193.13. Cr. **m.p.** 80, **b.p.** 216 d. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

32 —, **o-hydroxy-,** lactone. See 2(3)-*Benzoxazolone.*

33 Carbanilide (*N, N′-diphenylurea, sym-diphenylurea*). $C_6H_5NHCONHC_6H_5$, 212.11. Col.rhomb.f.al., $[\alpha]1.583°_D$. **D.** 1.239^{20}_{4}, **m.p.** 238–9 (235), **b.p.** 260 subl. **Soly.** 0.015^{25}w.; s.al.; v.s.et.

34 —, *N, N′***diethyl-** (*N, N′-diethyl-N, N′-diphenylurea**). $CO[N(C_2H_5)(C_6H_5)]_2$, 268.17. Col.cr.f.w. **m.p.** 72–3(54). **Soly.** s.w.; v.s.al.

35 —, **2, 2′-dimethylthio-** (*di-o-tolylthiourea*). $CS(NHC_6H_4CH_3)_2$, 256.20. V.sm.col.need.f.al. **m.p.** 156–8, **b.p.** 218. **Soly.** v.sl.s.w.; sl.s.al.; v.sl.s.et.; s.ac.a., bz.

36 —, **4, 4′-dimethylthio-** (*di-p-tolylthiourea*). $CS(NHC_6H_4CH_3)_2$, 256.20. V.sm.rhomb.need. **m.p.** 178–9 (176–7). **Soly.** v.sl.s.w.; sl.s.al.; v.sl.s.et.

37 —, *N, N′***-diphenyl-.** See *Urea, tetraphenyl-.*

38 —, *N***-methyl-.** $C_6H_5(CH_3)NCONHC_6H_5$, 226.13. Col.need. **m.p.** 104, **b.p.** 203–5. **Soly.** i.w.; sl.s.al.; v.s.et.; v.s.bz.

39 —, **2, 2′, 4, 4′-tetranitro-.** $[(NO_2)_2C_6H_3NH]_2CO$, 392.11. Yel.need. **m.p.** 189. **Soly.** i.w.; v.s.al.; v.sl.s.et.

40 —, **thio-** (*N, N′-diphenylthiourea; sym-diphenylthiourea*). $(C_6H_5NH)_2CS$, 228.17. Col.rhomb.leaf.f.al. **D.** $1.321^{\frac{1}{4}}$, **m.p.** 154, **b.p.** d. **Soly.** i.(v.sl.s.)w.; s.al.; s.et.

For explanations and abbreviations see beginning of table.

41 **Carbanilide, thio- *o*, *o'*-dimethyl-** (*sym-di-o-tolylthiourea*). $(CH_3C_6H_4NH)_2CS$, 256.20. Need.f.al. **m.p.** 158, **b.p.** 216–8. **Soly.** i.w.; s.h.al.; i.et.; s.ac.a.,bz.

42 **Carbanilonitrile.** See *Cyananilide.*

43 **Carbazide.** See *Carbohydrazide.*

44 **Carbazole** (*dibenzopyrrole; diphenylenimine*). $C_6H_4NHC_6H_4$, 167.08. Col. leaf. **m.p.** 246 (243–5), **b.p.** 354.8. **Soly.** i.w.; $0.92^{1.4}$al.; 3.1^{30}et.; 5.3^{50}bz.; 3.1^{80}tol.; 11.1^{30}acet.; sl.s.ac.a., chl., CS_2, CCl_4.

45 —, ***N*-acetyl-.** $CH_3CONC_{12}H_8$, 209.09. Need.f.w. **m.p.** 69, **b.p.** >360 d. **Soly.** i.c., sl.s.h.w.; v.s.al.; v.s.et.; v.s.bz.

46 —, ***N*-ethyl-.** $C_{12}H_8NC_2H_5$, 195.11. Leaf.f.et. **m.p.** 67–8. **Soly.** s.h.al.; s.et.

47 **Carbinol.** See *Methanol**.

48 —, **acetyl-.** See *Acetol.*

49 —, **acetylenyl-.** See *2-Propyn-1-ol**.

50 —, **acetylmethyl-.** See *Acetoin.*

51 —, **allyl-.** See *3-Buten-1-ol**.

52 —, **allyldiethyl-.** See *5-Hexen-3-ol, 3-ethyl-**.

53 —, **allyldimethyl-.** See *4-Penten-2-ol, 2-methyl-**.

54 —, **allylmethyl-.** See *4-Penten-2-ol**.

55 —, ***p*-aminodiphenyl-.** See *Benzohydrol, p-amino-.*

56 —, **amyl-.** See *1-Hexanol**.

57 —, **amyldiethyl-.** See *3-Octanol, 3-ethyl-**.

58 —, **amyldimethyl-.** See *2-Heptanol, 2-methyl-**.

59 —, **amylhexyl-.** See *6-Dodecanol**.

60 —, **amylmethyl-.** See *2-Heptanol**.

61 —, **amylpropyl-.** See *4-Nonanol**.

62 —, **benzoyl-.** See *Acetophenone, α-hydroxy-.*

63 —, **benzoylphenyl-.** See *Benzoin.*

64 —, **benzyl-.** See *Phenethyl alcohol.*

65 —, **benzylphenyl-.** See *Ethanol, 1, 2-diphenyl-.*

66 —, **bis-*p*-aminophenyl-4-amino-*m*-tolyl-.** See *Rosaniline.*

67 —, **butyl-.** See *1-Pentanol**.

68 —, ***sec*-butyl-.** See *1-Butanol, 2-methyl-**.

69 —, ***tert*-butyl-.** See *1-Propanol, 2, 2-dimethyl-**.

70 —, **butyldimethyl-.** See *2-Hexanol, 2-methyl-**.

71 —, ***tert*-butyldimethyl-.** See *2-Butanol, 2, 3, 3-trimethyl-**.

72 —, **butylethylmethyl-.** See *3-Heptanol, 3-methyl-**.

73 —, **butylmethyl-.** See *2-Hexanol**.

74 —, **dibutyl-.** See *5-Nonanol**.

75 —, **diethyl-.** See *3-Pentanol**.

76 —, **diethylisobutyl-.** See *3-Hexanol, 3-ethyl-5-methyl-**.

77 —, **diethylisopropyl-.** See *3-Pentanol, 3-ethyl-2-methyl-**.

78 —, **diethylmethyl-.** See *3-Pentanol, 3-methyl-**.

79 —, **diethylpropyl-.** See *3-Hexanol, 3-ethyl-**.

80 —, ***p*, *p'*-dihydroxytriphenyl-.** See *Benzaurin.*

81 —, **diisoamyl-.** See *5-Nonanol, 2, 8-dimethyl-**.

82 —, **diisobutyl-.** See *4-Heptanol, 2, 6-dimethyl-**.

83 —, **diisopropyl-.** See *3-Pentanol, 2, 4-dimethyl-**.

84 —, **dimethyl-.** See *Isopropyl alcohol.*

85 —, **dimethylethyl-.** See *2-Butanol, 2-methyl-**.

86 —, **dimethylphenyl-.** See *2-Propanol, 2-phenyl-.*

87 —, **dimethylpropenyl-.** See *3-Penten-2-ol**.

88 —, **dimethylpropyl-.** See *2-Pentanol, 2-methyl-**.

89 —, **diphenyl-.** See *Benzohydrol.*

90 —, **diphenylene-.** See *9-Fluorenol**.

91 —, **dipropyl-.** See *4-Heptanol.*

92 —, **ethyl-.** See *Propyl alcohol.*

93 —, **ethyldipropyl-.** See *4-Heptanol, 4-ethyl-**.

94 —, **ethylhexyl-.** See *3-Nonanol**.

95 —, **ethylisobutyl-.** See *3-Hexanol, 5-methyl-**.

96 —, **ethylisopropyl-.** See *3-Pentanol, 2-methyl-**.

97 —, **ethylisopropylmethyl-.** See *3-Pentanol, 2, 3-dimethyl-**.

98 —, **ethylmethyl-.** See *sec-Butyl alcohol.*

99 —, **ethylmethylpropyl-.** See *3-Hexanol, 3-methyl-**.

00 —, **ethylphenyl-.** See *1-Propanol, 1-phenyl-**.

* Name approved by the International Union of Chemistry.

01 Carbinol, ethylpropyl-. See 3-*Hexanol**.

02 —, **ethylvinyl-.** See 1-*Penten-3-ol**.

03 —, **ethynyl-.** See 2-*Propyn-1-ol**.

04 —, **α-furyl-.** See *Furfuryl alcohol.*

05 —, **heptyl-.** See 1-*Octanol**.

06 —, **heptylmethyl-.** See 2-*Nonanol**.

07 —, **hexyldimethyl-.** See 2-*Octanol, 2-methyl-**.

08 —, **hexylpropyl-.** See 4-*Decanol**.

09 —, **isoamyl-.** See 1-*Pentanol*, 4-*methyl-**.

10 —, **isoamylmethyl-.** See 2-*Hexanol*, 5-*methyl-**.

11 —, **isobutyl-.** See *Isoamyl alcohol.*

12 —, **isobutyldimethyl-.** See 2-*Pentanol*, 2, 4-*dimethyl-**.

13 —, **isobutylmethyl-.** See 2-*Pentanol*, 4-*methyl-**.

14 —, **isohexyl-.** See 1-*Hexanol*, 5-*methyl-**.

15 —, **isopropyl-.** See *Isobutyl alcohol.*

16 —, **isopropyldimethyl-.** See 2-*Butanol*, 2, 3,-*dimethyl-**.

17 —, **methyl-.** See *Ethyl alcohol.*

18 —, **methyl-*tert*-butyl-.** See *Pinacolyl alcohol.*

19 —, **methyldipropyl-.** See 4-*Heptanol*, 4-*methyl-**.

20 —, **methylhexyl-.** See 2-*Octanol**.

21 —, **methylisopropyl-.** See 2-*Butanol*, 3-*methyl-**.

22 —, **methylnonyl-.** See 2-*Hendecanol**.

23 —, **methylphenyl-.** See *Benzyl alcohol, α-methyl-.*

24 —, **methylpropyl-.** See 2-*Pentanol**.

25 —, **methylvinyl-.** See 3-*Buten-2-ol**.

26 —, **1-naphthyldiphenyl-** (*diphenyl-α-naphthylcarbinol*). $(C_6H_5)_2(C_{10}H_7)$-COH, 310.14. Cr.f.lgr. **m.p.** 136, **b.p.** d. **Soly.** i.w.; s.h.al.; v.s.et.; s.bz.; sl.s.h.lgr.

27 —, **nonyl-.** See 1-*Decanol**.

28 —, **phenyl-.** See *Benzyl alcohol.*

29 —, **propenyl-.** See 2-*Buten-1-ol**.

30 —, **propyl-.** See *Butyl alcohol(n).*

31 —, **styryl-.** See *Cinnamic alcohol.*

32 —, **α-thienyl-.** See 2-*Thiophenecarbinol.*

33 —, ***o*-tolyl-** (*o-methylbenzyl alcohol; o-tolubenzyl alcohol*). $CH_3C_6H_4CH_2OH$, 122.08. Col.need. **D.** 1.023^{40}_{4}, **m.p.** 34, **b.p.** 219 (223.3). **Soly.** 1^{20}, 1.5^{100}w.; v.s.al.; v.s.et.

34 —, ***m*-tolyl-** (*m-methylbenzyl alcohol; m-tolubenzyl alcohol*). $CH_3C_6H_4CH_2$-OH, 122.08. Col.liq. **D.** 1.036^{0}_{4}, **m.p.** <-20, **b.p.** 217. **Soly.** 5c.w.; s.al.; s.et.

35 —, ***p*-tolyl-** (*p-methylbenzyl alcohol; p-tolubenzyl alcohol*). $CH_3C_6H_4CH_2$-OH, 122.08. Col.need. **m.p.** 59.5, **b.p.** 217. **Soly.** sl.s.c.w.; v.s.al.; v.s.et.

36 —, ***p*, *p'*, *p''*-triaminotriphenyl-.** See *Pararosaniline.*

37 —, **triethyl-.** See 3-*Pentanol*, 3-*ethyl-**.

38 —, **trimethyl-.** See *tert-Butyl alcohol.*

39 —, ***p*₃-trinitrotriphenyl-.** See *Carbinol, tris(p-nitrophenyl)-.*

40 —, **triphenyl-.** $(C_6H_5)_3COH$, 260.12. Hex.pr.f.bz. **D.** 1.188^{20}_{4}, **m.p.** 162.5, **b.p.** >360. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.bz.

41 —, **tripropyl-.** See 4-*Heptanol*, 4-*propyl-**.

42 —, **tris(*p*-aminophenyl)-.** See *Pararosaniline.*

43 —, **tris(*p*-nitrophenyl)-.** (*p_3-trinitrotriphenylcarbinol; 4, 4', 4''-trinitrotritanol*). $(NO_2C_6H_4)_3COH$, 395.13. Monocl. or rhomb.cr.f.bz. **m.p.** 193 (171-2). **Soly.** sl.s.h.al.; sl.s.et.; s.bz., ac.a.

44 Carbinol-o-carboxylic anhydride, triphenyl-. See *Phthalide*, 3, 3-*diphenyl-.*

45 Carbinylamine, diethyl-. See *Propylamine, α-ethyl-.*

46 —, **dimethylethyl-.** See *tert-Amylamine.*

47 —, **methylisopropyl-.** See *Propylamine, α, β-dimethyl-.*

48 —, **methylpropyl-.** See *Butylamine, α-methyl-.*

49 —, **trimethyl-.** See *tert-Butylamine.*

50 Carbitol. See *Diethylene glycol, monoethyl ether.*

51 —, **butyl.** See *Diethylene glycol, monobutyl ether.*

52 —, **diethyl.** See *Ether, bis(β-ethoxyethyl).*

53 —, **methyl.** See *Diethylene glycol, monomethyl ether.*

For explanations and abbreviations see beginning of table.

54 Carbocinchomeronic acid (2, 3, 4-*pyridinetricarboxylic acid**). $C_5H_2N(COOH)_3 \cdot 1\frac{1}{2}H_2O$, 238.07. Rhomb.f. w. **m.p.** ($-H_2O$, 115–20), anh. 250 d. **Soly.** 1.2^{15}w.; sl.s.al.; i.et.; i.bz.

55 β-Carbocinchomeronic acid. See 3, 4, 5-*Pyridinetricarboxylic acid.*

56 Carbodiimide, diphenyl- (*carbodiphenylimide*). $C_6H_5N{:}C{:}NC_6H_5$, 194.09.
α: Syrup. **b.p.** 330–1. **Soly.** d.h.al.; v.s.bz.; d.HCl.
β: Cr. **m.p.** 168–70. **Soly.** v.sl.s.w.; v.sl.s.al.; v.sl.s.et.

57 Carbodiphenylimide. See *Carbodiimide, diphenyl-.*

58 Carbohydrazide (*carbonic acid dihydrazide; carbazide*). $CO(NHNH_2)_2$, 90.08. Need.f.dil.al. **m.p.** 152 exp. **Soly.** v.v.s.w.; v.v.s.al.; v.v.s.et.; i.bz., chl.

59 —, 1, 5-diphenyl- (*sym-diphenylcarbazide*). $(C_6H_5NHNH)_2CO$, 242.14. Leaf. **m.p.** 172–3, **b.p.** d. **Soly.** i.w.; s.al.; sl.s.et.; s.bz.

60 Carbolic acid. See *Phenol.*

61 Carbomethene. See *Ketene.*

62 Carbon bisulfide. See *Carbon disulfide.*

63 Carbon dioxide (*carbonic anhydride; carbonic acid gas*). CO_2, 44.00. Col. odorl.gas. **D.** 1.977^{0}_{760}g/l; liq., 1.101^{-37}; solid 1.56^{-79}, **m.p.** $-56.6^{5.2\text{atm.}}$, **b.p.** -78.5 subl. **Soly.** 179.7^{0}cm³, $.355^{0}$g, 90.1^{20}cm³, $.097^{40}$g, $.058^{60}$g w.; 31^{15}cm³al.

64 Carbon disulfethyl. See *Carbonic acid, dithiol-, diethyl ester.*

65 Carbon disulfide (*carbon bisulfide*). CS_2, 76.12. Col.inflam.liq., *n* $.1629501^{8}$. **D.** 1.2628^{20}_{4}, **m.p.** -108.6; frz. -111, **b.p.** 46.3. **Soly.** 0.22^{22}w.; ∞al.; ∞et.; ∞bz.

66 Carbon hexachloride. See *Ethane, hexachloro-*.*

67 Carbonic acid, dibutyl ester. $CO(OCH_2CH_2CH_2CH_3)_2$, 174.14. Col.liq. **D.** 0.9244^{20}_{4}, **b.p.** 207^{720}. **Soly.** i.w.; s.al.; s.et.

68 —, diethyl ester (*ethyl carbonate*). $(C_2H_5)_2CO_3$, 118.08. Col.inflam.liq., *n* 1.38456. **D.** 0.9751^{20}_{4}, **m.p.** -43.0, **b.p.** 125.8. **Soly.** i.w.; ∞al.; ∞et.

69 —, dihydrazide. See *Carbohydrazide.*

70 —, diisoamyl ester (*isoamyl carbonate*). $CO(OC_5H_{11})_2$, 202.17. Liq. **D.** 0.912^{15}_{4}, **b.p.** 228.7.

71 —, diisobutyl ester (*isobutyl carbonate*). $CO[OCH_2CH(CH_3)_2]_2$, 174.14. Liq. **D.** 0.919^{15}_{4}, **b.p.** 190.3. **Soly.** i.w.; ∞al.; ∞et.

72 —, dimethyl ester (*methyl carbonate*). $CO(OCH_3)_2$, 90.05. Col.liq., *n* 1.3687. **D.** 1.0694^{20}_{4}, **m.p.** 0.5, **b.p.** 90–1. **Soly.** i.w.; s.al.; s.et.

73 —, diphenyl ester (*phenyl carbonate; diphenyl carbonate*). $(C_6H_5)_2CO_3$, 214.08. Need.f.al. **D.** 1.1215^{87}_{4}, **m.p.** 78; 81 **b.p.** 306 (302). **Soly.** i.w.; s.al.; s.et.; s.bz., CCl_4.

74 —, dipropyl ester. $CO(OCH_2CH_2CH_3)_2$, 146.11. Col.liq. **D.** 0.9411^{20}_{4}, **b.p.** 168.2. **Soly.** v.sl.s.w.; ∞al.; ∞et.

75 —, ethyl methyl ester. $CH_3C_2H_5CO_3$, 104.06. Col.liq. **D.** 1.002^{27}_{4}, **m.p.** -14.5 **b.p.** 109.2. **Soly.** i.w.; ∞al.; ∞et.

76 —, chloro-, esters. See under *Formic acid, chloro-.*

77 —, dithiol-, diethyl ester (*ethyl dithiolcarbonate; carbon disulfethyl*). $CO(SC_2H_5)_2$, 150.20. Yel.liq. **D.** 1.085^{19}, **b.p.** 196.7. **Soly.** i.w.; s.al.; s.et.

78 —, thiolthiono-, *O*-ethyl ester. See *Xanthogenic acid.*

79 —, trithio-. $CS(SH)_2$, 110.20. Red brn.oil. **D.** >1, **m.p.** d. 20–30, **b.p.** 57 d. **Soly.** i.d.w.; s.al.; s.et.; s.Na_2CO_3.

80 Carbonic acid gas. See *Carbon dioxide.*

81 Carbonic anhydride. See *Carbon dioxide.*

82 Carbonimide, esters. See under *Isocyanic acid.*

83 Carbon monoxide. CO, 28.00. Col.odorl.pois.gas. **D.** Liq. 0.814^{-195}_{4}; 1.250^{0}_{4}g/l, **m.p.** 207 (-213), **b.p.** -190 (-192). **Soly.** 0.0044^{0}g, 0.0028^{20}g, 0.0010^{80}g, 3.5^{0}cm³w.; 20^{20}cm³ al.; s.bz., ac.a., Cu_2Cl_2.

84 Carbon oxysulfide. See *Carbonyl sulfide.*

85 Carbon suboxide (*malonic anhydride* (so-called); *dioxopropadiene*). OC:C:CO, 68.00. Col.liq. or gas, *n* 1.454. **D.** 1.114^{0}, **m.p.** -111.3 (-107), **b.p.** 7. **Soly.** d.w., s.et.

86 Carbon tetrabromide (*tetrabromomethane**). CBr_4, 331.66. Col. monocl.tab., *n* $1.59998^{99.5}_{(He)}$. **D.** 3.42, **m.p.** α48.4; β90.1, **b.p.** 189.5sl.d. **Soly.** 0.024^{30}w.; s.al.; s.et.; s.chl.

* Name approved by the International Union of Chemistry.

87 **Carbon tetrachloride** (*tetrachloromethane**). CCl_4, 153.83. Col.liq., *n* 1.46305[15]. **D.** 1.595$^{20}_{4}$; 1.63195$^{0}_{4}$, **m.p.** −22.8; frz. to trimorph. **m.p.** −28.6; −23.8; −21.2, **b.p.** 76–7. **Soly.** 0.08[20]w.; ∞al.; ∞et.; ∞chl., bz.

88 **Carbon tetraiodide** (*tetraiodomethane**). CI_4, 519.68. Dk.red cub. **D.** 4.32, **m.p.** 171 d., **b.p.** subl. 90–100[vac.]. **Soly.** i., d.h.w.; s., d.h. al.; s.et.

89 **Carbonyl chloride.** See *Phosgene.*

90 **Carbonyl sulfide** (*carbon oxysulfide*). COS, 60.06. Gas. **D.** Liq. 1.24[−87]; (A) 2.105; 2.721g/l, **m.p.** −138, **b.p.** −50.2 (−47.5). **Soly.** 100cm³w.; 800[22]cm³al.; 4.4[13]cm³pyr.; 12[13]cm³ nitrobz.; 1500[22]cm³tol.

91 **Carbostyril** (*2-quinolinol or 2(1)-quinolone; o-aminocinnamic acid, lactam*). C_9H_7NO, 145.06. Pr.f.al. **m.p.** 200, **b.p.** subl. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.dil.HCl.

92 —, **3-ethyl-.** $C_6H_4NHCOC(C_2H_5)CH$, 173.09. Col.cr. **m.p.** 168.

93 —, **4-methyl-**(*2(1)-lepidone*). $C_{10}H_9NO$. 159.08. Col.need.f.w. **m.p.** 217.4, **b.p.** 270[17]. **Soly.** v.sl.s.c.w.; v.s.h.al.; v.sl.s.et.; sl.s.bz.

94 **Carbothialdine.** $C_5H_{10}N_2S_2$, 162.21. Cr. **Soly.** i.w.; sl.s.al.; i.et.; s.a.

95 **Carbylamine chloride, phenyl-.** See *Aniline, N-(dichloromethylene)-.*

Carbylamine derivatives. See *Amyl isocyanide, Butyl isocyanide,* etc.

96 **Carminic acid.** $C_{22}H_{20}O_{13}$, 492.16. Red.monocl.pr. **m.p.** 136 d. **Soly.** v.s.w.; s.al.; v.sl.s.et.; s.conc.H_2SO_4, alk.; i.bz., chl.

97 **Carnaubyl alcohol.** $C_{24}H_{50}O$, 354.39. Leaf. **m.p.** 69. **Soly.** sl.s.w., s.al.

99 **α-Carotene** (*α-carotin*). $C_{40}H_{56}$, 536.44. [α]+364$^{20}_{Cd}$ in bz. **m.p.** 175.

00 **β-Carotene** (*β-carotin*). $C_{40}H_{56}$, 536.44. Red-br.glist.cr. **m.p.** 181–2. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.CS_2, bz., pet.eth.; sl.s.me.al., chl.

01 **Carotin.** See *Carotene.*

02 ***d*-Carpaine.** $C_{14}H_{25}NO_2$, 239.20. Monocl.pr.f.al. [α]+21°55′D in al. **m.p.** 121. **Soly.** i.w.; 11al.; 3et.; s.chl., bz., amyl.al., CS_2.

03 —, hydrochloride. $C_{14}H_{25}NO_2{\cdot}HCl$, 275.67. Lng.wh.rhomb. or monocl. need. **m.p.** 225 d. **Soly.** 11.6w.; s.al.; s.et.

04 **Carubinose.** See *d-Mannose.*

05 **Carvacrol** (*2-p-cymenol; cymophenol*). $CH_3(C_3H_7)C_6H_3OH$, 150.11. Col. oily liq., *n* 1.52295. **D.** 0.976, **m.p.** 0.5 (1–2), **b.p.** 237.9. **Soly.** v.sl.s.w.; s.al.; s.et.; s.alk.

06 —, **hexahydro-.** See *Carvomenthol.*

07 **Carvacrylamine** (*2-p-cymylamine; 2-amino-p-cymene; 5-isopropyl-2-methylaniline; cymidine*). $(CH_3)_2CH(CH_3)C_6H_3NH_2$, 149.13. Oil, *n* 1.543[19]. **D.** 0.9942,^{20} **m.p.** −16, **b.p.** 241; 118[12]. **Soly.** v.sl.s.w.; s.al.; s.et.

08 **Carvene.** See *d-Limonene.*

09 **Carvenone** (*3-p-menthen-2-one*). $C_{10}H_{16}O$, 152.12. Liq., *n* 1.48377[19]. **D.** 0.9263$^{20}_{4}$, **b.p.** 233. **Soly.** i.w.

10 **Carveol, dihydro-** (*p-menth-8(9)-en-2-ol*). $C_{10}H_{17}OH$, 154.14. Liq., *n* 1.48168. **D.** 0.927, **b.p.** 225.

11 **Carvol.** See *d-Carvone.*

12 **Carvomenthene** (*1-p-menthene*). $C_{10}H_{18}$, 138.14. Col. oily liq. **D.** 0.829[20], **b.p.** 175. **Soly.** s.al.

13 **Carvomenthol** (*2-p-menthanol; hexahydrocarvacrol*). $C_{10}H_{19}OH$, 156.16. Oil, *n* 1.46296. **D.** 0.904[20], **b.p.** 222 (220). **Soly.** s.al.; s.et.

14 **Carvone, dihydro-** (*p-menth-8(9)-en-2-one*). $C_{10}H_{16}O$, 152.12. Oily liq., *n* 1.47174[19], [α]−19° (−16°)D. **D.** 0.9253$^{20}_{4}$, **b.p.** 220–1.

15 ***dl*-Carvone,** oxime (*dl-carvoxime*). $C_{10}H_{14}{:}NOH$, 165.13. Monocl.cr. **m.p.** 93–4 (70–71). **Soly.** s.w.; s.al.

16 ***d*-Carvone** (*d-6, 8(9)-p-menthadien-2-one; carvol*). $C_{10}H_{14}O$, 150.11. Col. liq., *n* 1.49994[18.2], [α]+62.07D. (*l* [α]−39.34°$^{18}_{D}$ in al.) **D.** 0.9608$^{20}_{4}$, **b.p.** 230 (227–8; 225). **Soly.** v.sl.s.w.; ∞al.; ∞et.; s.chl.

17 ***dl*-Carvoxime.** See *dl-Carvone, oxime.*

18 **Caryophyllin.** $(C_{10}H_{16}O)_3$, 456.37. Silky need., [α]+54.5°D in al. **m.p.** 310, **b.p.** subl. 285. **Soly.** i.w.; sl.s.al., v.s.et.; i.alk.

19 ***d*-Catechin.** See *d-Catechol.*

20 **Catechol.** See also *Pyrocatechol.*

21 ***d*-Catechol** (*d-catechin; 3, 5, 7, 3′, 4′-flavanpentol* (one form); 2-(3, 4-*dihydroxyphenyl*)-3, 5, 7-*chromantriol* (one form)). $C_{15}H_{14}O_6$, 290.11. Wh.cr. powd. or need.f.w. **D.** 1.344$^{1}_{4}$, **m.p.** 175 (217), **b.p.** 240–5 d. **Soly.** s.w.; s.al.; 0.59 et.; s.et.ac., alk.

22 **Cedrarine.** See *Quinazoline, 3, 4-dihydro-3-phenyl-.*

For explanations and abbreviations see beginning of table.

23 Cedrene (artificial). $C_{15}H_{24}$, 204.19. Col.liq., *n* 1.5001^{19}, $[\alpha]-52.6°_D$. **D.** 0.929, **b.p.** 262–3.

24 Cedriret. See *Cerulignone.*

25 Cellobiose (*cellose; glucose β-glucoside*). $C_{12}H_{22}O_{11}$, 342.17. Col. need., $[\alpha]+24.4°_D$ in w. **m.p.** 225. **Soly.** s.w.; v.v.sl.s.al.; v.v.sl.s.et.; i.acet.

27 —, octaacetate(α) (*octaacetylcellobiose*). $C_{12}H_{14}O_3(OOCCH_3)_8$, 678.30. Col. silky need., $[\alpha]+41.5°_D$ in chl. **m.p.** 228–9. **Soly.** i.w.; s.h.al.; i.et.

28 Cellose. See *Cellobiose.*

29 Cellosolve. See *Ethanol, 2-ethoxy-*.*

30 —, **benzyl.** See *Ethanol, 2-benzyloxy-.*

31 —, **butyl.** See *Ethanol, 2-butoxy-.*

32 —, **methyl.** See *Ethanol, 2-methoxy-*.*

33 Cellulose. $(C_6H_{10}O_5)_x$, $(162.08)_x$. Wh.amorph. **D.** 1.27–1.61. **Soly.** i.w.; i.al.; i.et.; s.$Cu(NH_3)_4(OH)_2$; i.all ord.org.solv.

34 —, acetate, penta-. $C_6H_5(OOCCH_3)_5$, 372.16. Ylsh.amor. **Soly.** i.w.; s.al.

35 —, —, tetra-. $C_6H_6O(OOCCH_3)_4$, 330.14. Ylsh.amor. **m.p.** soft. abt. 150. **Soly.** i.w.; i.al.; i.et.; s.chl., glac.ac.a., nitro-bz.; i.amyl acetate, me.al., acet.

36 —, —, tri-. $C_6H_7O_2(OOCCH_3)_3$, 288.12. Ylsh.amor. **Soly.** i.w.; i.al.; i.et.; s.chl., glac.ac.a., nitro-bz.; i.acet.

37 —, hexanitrate (*chief constituent of guncotton*). $C_{12}H_{14}(ONO_2)_6O_4$, 594.16. Wh.amor. **D.** 1.66, **m.p.** ign. 160–70. **Soly.** i.w.; i.al.; i.et.; v.v.sl.s.et.+al.; s.nitro-bz.; i.bz.
All nitro celluloses are soluble in acet., et.ac., amyl acetate.

38 —, pentanitrate. $C_{12}H_{15}(ONO_2)_5O_5$, 549.16. Wh.amor. **D.** *ca.* 1.66. **Soly.** i.w.; i.al.; i.et.; s.et.+al.; i.bz.

39 —, tetranitrate (*constituent of collodion*). $C_{12}H_{16}(ONO_2)_4O_6$, 504.16. Wh.amor. **D.** 1.66. **Soly.** i.w.; i.al.; i.et.; s.et.+al., me.al.; i.bz.

40 —, trinitrate (*constituent of collodion*). $C_{12}H_{17}(ONO_2)_3O_7$, 459.16. Wh.amor. **D.** 1.66. **Soly.** i.w.; s.al.; s.me.al., h.glac.ac.a.; i.bz.

41 Cerane (*isohexacosane*). $C_{26}H_{54}$, 366.42. Cr.f.et. **m.p.** 61, **b.p.** $207^{0.7}$. **Soly.** i.w.; s.al.; s.et.

42 Cerotic acid (*hexacosanoic acid**). $CH_3(CH_2)_{24}COOH$, 396.41. Col.need. f.al. **D.** 0.836^{79}, **m.p.** 87.7 (80–2), **b.p.** d.. **Soly.** i.w.; v.sl.s.al.; 20^{25}et.; s.acet., bz.

43 Cerotin. See *Ceryl alcohol.*

44 Cerulignone (3, 3′, 5, 5′-*tetramethoxydiphenoquinone; coerulignone; cedriret*). $C_{16}H_{16}O_6$, 304.12. Bluish gr.need. **m.p.** d. **Soly.** i.w.; i.al.; s. H_2SO_4, phenol; i.ord.org.solv.

45 Ceryl alcohol (1-*hexacosanol*; cerotin; n-hexacosyl alcohol*). $CH_3(CH_2)_{24}CH_2OH$, 382.42. Col.rhomb.pl. **m.p.** 79–81, **b.p.** 305^{20} d. **Soly.** i.w.; s.al.; s.et.

46 Cetane. See *Hexadecane*.*

47 Cetyl alcohol (1-*hexadecanol; n-hexadecyl alcohol; ethal*). $CH_3(CH_2)_{15}OH$, 242.27. Leaf.f.al., *n* $1.4283^{78.9}$. **D.** 0.8176^{50}_{4}, **m.p.** 49.3, **b.p.** 190^{15}; 344. **Soly.** i.w.; 102al.; s.et.; 97^{24}me.al.; s.bz.

48 —, acetate. See *Acetic acid, cetyl ester.*

49 Cetyl cyanide. See *Margaronitrile.*

50 Cetylene. See 2-*Hexadecyne.*

51 Cetyl ether (1-*hexadecyloxyhexadecane*; hexadecyl ether; dicetyl ether*). $(C_{16}H_{33})_2O$, 466.51. Leaf. **m.p.** 55, **b.p.** 270 d. **Soly.** sl.s.w.; s.al.; s.et.

52 Cetyl iodide (1-*iodohexadecane*; n-hexadecyl iodide*). $CH_3(CH_2)_{14}CH_2I$, 352.18. Leaf.f.al., *n* 1.4806. **D.** 1.123, **m.p.** 22, **b.p.** 211^{15}. **Soly.** i.w.; s.al.; s.et.

53 Cetyl sulfate (*hexadecyl sulfate; di-n-hexadecyl sulfate*). $[CH_3(CH_2)_{15}]_2SO_4$, 546.57. **m.p.** 66.2–6.3.

54 Cevadine. See *Veratrine* (crystalline).

55 Chalcone (*benzalacetophenone; benzylideneacetophenone; phenyl styryl ketone. 1, 3-diphenyl-2-propen-1-one*). $C_6H_5CH:CHCOC_6H_5$, 208.09. Pa.yel-rhomb.pl. **D.** 1.071^{62}_{4}, **m.p.** 62 (55–7), **b.p.** 348. **Soly.** i.w.; sl.s.al.; s.et.; s.chl., bz., CS_2, conc.H_2SO_4; v.sl.s.lgr.

56 *d*-**Chaulmoogric acid** (*d*-13-(2-*cyclopentenyl)tridecanoic acid*).
$CH{=}CHCH_2CH_2CH(CH_2)_{12}COOH$,
280.25. Col.leaf.f.al.$[\alpha]+62°_D$ in chl. **m.p.** 68.5, **b.p.** $247–8^{20}$. **Soly.** i.w.; v.sl.s.al.; s.et.; s.chl.

57 Chavibetol (5-*allylguaiacol; betel phenol*). $CH_2:CHCH_2C_6H_3(OH)(OCH_3)$, 164.09. Liq., *n* 1.5413. **D.** 1.0690^{15}_{15}, **m.p.** 8.5, **b.p.** 254–5. **Soly.** i.w.; s.al.; s.et.

58 Chavicol (*p-allylphenol*). $CH_2:CHCH_2C_6H_4OH$, 134.08. Liq., *n* 1.5441^{18}. **D.** 1.033^{18}_{4}, **m.p.** > −25, **b.p.** 237. **Soly.** s.w.; ∞al., ∞et.; ∞chl.

* Name approved by the International Union of Chemistry.

59 Chavicol, methyl ether. See *Estragole.*

60 Chelerythrine, alcoholate. $C_{21}H_{19}NO_5 \cdot C_2H_6O$, 411.20. Rhbdr.leaf.; sol. bl.fluores. **m.p.** 207. **Soly.** sl.s.w.; sl.s.al.; v.s.et.; s.chl., amyl al., bz.

61 Chelidonine, hydrochloride. $C_{20}H_{19}NO_5 \cdot HCl$, 389.62. Wh.fine cr. **Soly.** 0.31^{18}w.; sl.s.al.

62 *d*-Chelidonine. $C_{20}H_{19}NO_5 \cdot H_2O$, 371.17. Monocl.tab. **m.p.** 135–6. **Soly.** i.w.; v.s.al.; v.s.et.; s.chl., amyl al.

64 Chinalgen. See *Analgen.*

65 Chloral (*trichloroethanal*; trichloroacetaldehyde*). CCl_3CHO, 147.38. Col. liq., *n* 1.45572. **D.** 1.512^{20}_{4}, **m.p.** −57.5, **b.p.** 98. **Soly.** s.w.; ∞al.; ∞et.; s.chl.

66 —, alcoholate (2, 2, 2-*trichloro-1-ethoxyethanol*; chloral hydrate monoethyl acetal*). $CCl_3CH(OH)OC_2H_5$, 193.43. Col.need. **D.** 1.143^{40}_{4}, **m.p.** 44–7 (55), **b.p.** 115. **Soly.** v.s.w.; s.al.; s.et.

67 —, diethyl acetal. See *Ethane,* 1, 1, 1-*trichloro*-2, 2-*diethoxy-*.*

68 —, hydrate (2, 2, 2-*trichloro*-1, 1-*ethanediol*; trichloroethylidene glycol*). $CCl_3CH(OH)_2$, 165.39. Col.monocl. tab. *n* 1.538, 1.600, 1.602. **D.** 1.9081^{20}_{4}, **m.p.** 51.7 (61–3), **b.p.** 96.3^{764} (98d.). **Soly.** 21.3^{17}w.; 77^{25}al.; 66.7^{25}et.; s.chl.

69 Chloral-antipyrine. See *Hypnal.*

70 Chloranil (*tetrachloroquinone; tetrachloro-p-benzoquinone*). $C_6Cl_4O_2$, 245.83. Yel.monocl.pr.f.bz. **m.p.** 290 (in sealed tube), **b.p.** subl. **Soly.** i.w.; s.h.al.; s.et.; s.bz., sl.s.chl., CS_2.

71 Chloranilic acid (2, 5-*dichloro*-3, 6-*dihydroxyquinone*). $C_6Cl_2(OH)_2O_2$, 208.93. Red leaf. **m.p.** 283–4. **Soly.** v.sl.s.w.

72 Chlorbutanol. See *Chloretone.*

73 Chlorbutol. See *Chloretone.*

74 Chloretone (1, 1, 1-*trichloro-2-methyl-2-propanol*; trichloro-tert-butyl alcohol; acetone-chloroform; chlorbutol; chlorbutanol*). $(CH_3)_2C(OH)CCl_3$, 177.43. Wh.cr. $(+1H_2O)$f.w. **m.p.** $+1H_2O$ 80–1 (anh. 97), **b.p.** 167. **Soly.** i.c.w.; v.s.al.; v.s.et.; 125glyc.; s.chl, acet., bz., glac.ac.a.

75 Chlorhydrin. See 1, 2-*Propanediol,* 3-*chloro-.*

76 Chlorine cyanide. See *Cyanogen chloride.*

Chloro-. See the parent compounds (e.g., for chloroacetic acid see *Acetic acid, chloro-*).

77 Chloroacetal (2-*chloro*-1, 1-*diethoxyethane*; chloroacetaldehyde diethyl acetal*). $CH_2ClCH(OC_2H_5)_2$, 152.56. Liq., **D.** 1.026^{15}_{4}, **b.p.** 156.8 (62–64). **Soly.** sl.s.w.; ∞al. ∞et.

78 Chloroacetol. See *Propane,* 2, 2-*dichloro-*.*

79 Chloroform (*trichloromethane**). $CHCl_3$, 119.38. Col.liq., *n* 1.44643^{18}. **D.** 1.49845^{15}_{4}, **m.p.** −63.5, **b.p.** 61.26 (58–61.5). **Soly.** 1.0^{15}w.; ∞al.; const. boil.mixt.7 %et.al.; ∞et.; s.bz., acet., CS_2.

80 —, **methyl-.** See *Ethane,* 1, 1, 1-*trichloro-*.*

81 —, **nitro-.** See *Chloropicrin.*

82 —, **phenyl-.** See *Toluene, α-trichloro-.*

83 Chlorogenine. See *Alstonine.*

84 α-Chlorohydrin. See 1, 2-*Propanediol, 3-chloro-*.*

85 Chlorophyll a. $C_{55}H_{72}MgN_4O_5 \cdot \frac{1}{2}H_2O$, 901.92. Hex. lancet shaped pl. **m.p.** 150–3, **b.p.** d. **Soly.** i.w.; v.s.al.; v.s.et.; s.pet.eth.

86 Chlorophyll b. $C_{55}H_{70}MgN_4O_6$, 906.90. Pl. **m.p.** 183–5. **Soly.** i.w.; v.s.al.; v.s.et.; s.me.al.

87 Chloropicrin (*trichloronitromethane*; nitrochloroform*). CCl_3NO_2, 164.38. Col. liq., *n* 1.46075^{23}. **D.** 1.651^{20}_{4}; 1.69225^{0}_{4}, **m.p.** −64, frz. −69, **b.p.** 112. **Soly.** i.w.; ∞al.; ∞et.

88 Chloroprene (2-*chloro*-1, 2-*butadiene**). $CH_2:CHCCl:CH_2$, 88.50. Col. liq., *n* 1.4583. **D.** 0.9583^{20}_{20}, **b.p.** 59.4. **Soly.** v.sl.s.w.; ∞al.; ∞et.; s.most org. solv.

89 Cholalic acid. See *Cholic acid.*

90 Cholanic acid, trihydroxy-. See *Cholic acid.*

91 Cholesterol (*cholesterin*). $C_{27}H_{45}OH$, 386.36. Monocl.pearly leaf.; cr.+$1H_2O$f.dil.al. **D.** 1.067^{20}_{4}, **m.p.** anh. 148.5, **b.p.** 360 d. **Soly.** 0.26^{20}w.; 1.08^{17}, 11^{78}al.; 18et.; s.bz., chl., CS_2, pyr., h.ac.a.

92 —, benzoate. $C_6H_5COOC_{27}H_{45}$, 490.39. Pl. **m.p.** 150–1. **Soly.** i.al.; s.et.

93 Cholestrophan (*dimethylparabanic acid*). $\underline{N(CH_3)CON(CH_3)}COCO$, 142.06. Pearl.leaf. **m.p.** 145, **b.p** 275–7. **Soly.** sl.s.w.; sl.s.al.

For explanations and abbreviations see beginning of table.

94 Cholic acid (*cholalic acid; trihydroxycholanic acid; colalin*). $C_{24}H_{40}O_5 \cdot H_2O$, 426.33. Rhomb.cr.$+1H_2O$ f.w. **m.p.** 195 (anh.), **b.p.** d. 160. **Soly.** 0.025w.; 4.27 70%al.; 1.40c.et.; s.ac.a., acet., alk.

95 Choline (*(β-hydroxyethyl)trimethylammonium hydroxide; bilineurine; sincaline; amanitine*). $HOCH_2CH_2N(CH_3)_3OH$, 121.13. Col.visc.liq. **Soly.** s.w.; s.al.; i.et.

96 —, ***O*-acetyl-,** bromide (*(β-acetoxyethyl) trimethylammonium bromide*). $CH_3COOCH_2CH_2N(CH_3)_3Br$, 226.05. Col.need. **m.p.** 143, **b.p.** d. **Soly.** v.s.w.; v.s.al.; s.et.

97 —, ***O*-acetyl-β-methyl-,** chloride (*β-acetoxypropyltrimethylammonium chloride*). $CH_3CH(OOCCH_3)CH_2N(CH_3)_3Cl$, 195.61. Micro.need.f.al., et. **m.p.** 172–3, **b.p.** d. **Soly.** v.s.w.; v.s.al.; i.et.

98 —, **β-methyl-,** chloride (*β-hydroxypropyltrimethylammonium chloride*). $CH_3CHOHCH_2N(CH_3)_3Cl$, 153.59. Wh.pr.cr.f.N.butanol. **m.p.** 165–7, **b.p.** d. **Soly.** v.s.w.; v.s.al.; i.et.

99 3, 5, 7-Chromantriol. See *d-Catechol.*

00 Chromone (1, 4-*benzopyrone; γ-benzopyrone*). $C_6H_4OCH{:}CHCO$, 146.05. Wh.need.f.pet.eth. **m.p.** 59, **b.p.** subl. **Soly.** i.w.; s.al.; s.et.; s.chl., bz.

01 Chromone, 2-phenyl-. See *Flavone.*

02 Chromotropic acid (4, 5-*dihydroxy-2, 7-naphthalenedisulfonic acid*). $(HO)_2C_{10}H_4(SO_3H)_2$, 320.18. Need. or leaf. $(+2H_2O)$. **Soly.** v.s.w.; i.al.; i.et.

03 Chrysammic acid (2, 4, 5, 7-*tetranitrochrysazin; chrysamminic acid;* 1, 8-*dihydroxy*-2, 4, 5, 7-*tetranitroanthraquinone*). $C_{14}H_2(NO_2)_4(OH)_2O_2$, 420.06. Yel.monocl.pr. **m.p.** exp. **Soly.** i.w.; s.al.; s.et.; s.min.a.

04 Chrysaniline (*2-amino-5-p-aminophenylacridine*). $C_{19}H_{15}N_3 \cdot 2H_2O$, 321.17. Yel.need. **m.p.** 270. **Soly.** v.sl.s.w.; sl.s.al.

05 Chrysarobin. $C_{30}H_{26}O_7$, 508.28. Yel.leaf. **m.p.** 205–10 (170–8). **Soly.** i.w.; s.al.; s.et.; s.chl.; sl.s.c.bz., CS_2.

06 Chrysazin (1, 8-*dihydroxyanthraquinone*). $HOC_6H_3(CO)_2C_6H_3OH$, 240.06. Red or yel.need. or leaf.f.al. **m.p.** 193 (191). **Soly.** sl.s.w.; s.al.; s.et.; s.caust.alk., chl., ac.a., nitro-bz.

07 —, **2-hydroxy-.** See *Anthraquinone,* 1, 2, 8-*trihydroxy-.*

08 —, **3-methyl-.** See *Chrysophanic acid.*

09 —, **2, 4, 5, 7-tetranitro-.** See *Chrysammic acid.*

10 Chrysazol (1, 8-*anthracenediol*;* 1, 8-*anthradiol*). $HOC_6H_3(CH)_2C_6H_3OH$, 210.08 Yel.need.f.dil.al. **m.p.** 225 d. **Soly.** i.w.; s.al.; s.et.; s.alk., et.ac., bz.

11 Chrysene (*benzo[a]phenanthrene*). $C_{18}H_{12}$, 228.09. Col.rhomb.pl.f.bz. or ac.a. with red-vlt. fluores. **m.p.** 254 (250), **b.p.** 448. **Soly.** v.sl.s.w.; 0.08c.al.; v.sl.s.et.; s.h.tol.; sl.s.CS_2; v.sl.s.bz.

12 Chrysenequinone. See *Chrysoquinone.*

13 Chrysin (5, 7-*dihydroxyflavone*). $C_{15}H_{10}O_4$, 254.08. Pa.yel.pl. **m.p.** 275, **b.p.** subl. **Soly.** i.w.; 0.43 c.al.; sl.s.et.; sl.s.lgr., CS_2, bz., chl., alk.

14 Chrysoidine (base) (2, 4-*diaminoazobenzene;* 4-*phenylazo-m-phenylenediamine*). $C_6H_5N{:}NC_6H_3(NH_2)_2$, 212.13. Pa.yel.cr.f.w. **m.p.** 117.5. **Soly.** sl.s.w.; s.al.; s.et.; v.s.chl.

15 —, hydrochloride. $C_6H_5N{:}NC_6H_3(NH_2)_2HCl$, 248.59. Redsh.-br.cr. or powd. **Soly.** v.s.w.; s.al.

16 Chrysophanic acid (1, 8-*dihydroxy-3-methylanthraquinone;* 3-*methylchrysazin*). $C_{14}H_5(OH)_2(CH_3)O_2$, 254.08. Hex. or monocl.yel.cr.f.al. **D.** 0.92, **m.p.** 196, **b.p.** subl. **Soly.** sl.s.w.; 0.05^{015}, 0.44h.al.; s.et.; s.chl., bz.; sl.s.CS_2.

17 Chrysoquinone (*chrysenequinone;* 1, 2-*chrysenedione*). $C_{18}H_{10}O_2$, 258.08. Redsh.or.need.f.ac.a. **m.p.** 239.5 (235), **b.p.** subl. **Soly.** i.w.; s.h.al.; sl.s.et.; s.H_2SO_4, h.bz.; sl.s.c.ac.a., tol.

18 Cinchamidine. See *Hydrocinchonidine.*

19 Cinchomeronic acid (3, 4-*pyridinedicarboxylic acid*). $C_5H_3N(CO_2H)_2$, 167.05. Pr.f.w. or HCl. **m.p.** 260 d-(266), **b.p.** d. **Soly.** v.sl.s.w.; sl.s.al.; v.sl.s.et.; i.chl.

20 Cinchonamine. $C_{19}H_{24}N_2O$, 296.20. Rhomb.need.f.al. **m.p.** 194 (185). **Soly.** i.w.; s.al.; s.et.; s.bz., chl.

21 Cinchonicine (*cinchotoxine*). $C_{19}H_{22}N_2O$, 294.19. Need., $[\alpha]47.2°^{21.5}_{D}$ in al. or chl. **m.p.** 58–60. **Soly.** sl.s.w.; s.al.; s.et.; s.chl., bz.

* Name approved by the International Union of Chemistry.

22 **Cinchonidine.** $C_{19}H_{22}N_2O$, 294.19. Trim.pr.f.al., *n* 1.610, 1.625, 1.675, [α] $-107.9^{17.8}_{D}$. **m.p.** 210.5 (202). **Soly.** $0.019^{11.5}$w.; 4.81c.al.; 0.41c.et.; s.chl.

23 —, bisulfate. $C_{19}H_{22}N_2O \cdot H_2SO_4 \cdot 5H_2O$, 482.34. Lng.monocl.pr. **Soly.** v. s.w.; v.s.al.

24 —, hydrochloride. $C_{19}H_{22}N_2O \cdot HCl \cdot H_2O$, 348.67. Wh.cr.powd. **m.p.** anh. 242. **Soly.** 5^{20}w.; $25.6^{18.5}$al.; 0.33^{25}et.; v.s.chl.

25 —, sulfate. $(C_{19}H_{22}N_2O)_2 \cdot H_2SO_4 \cdot 3H_2O$, 740.50. Monocl.glist.need., efflor. **m.p.** anh. 205. **Soly.** 1.54w.; 1.37al.; 0.024et.; 0.16^{25}chl.

26 **Cinchonine.** $C_{19}H_{22}N_2O$, 294.19. Col.need., col.monocl.f.al., *n* 1.570, 1.685, 1.690, [α] $229.6°^{17}_{D}$ in al. **m.p.** 255 (264), **b.p.** subl. 220. **Soly.** 0.027^{20}w.; 0.795^{20}al.; 0.27^{10}et.; s.chl.

27 —, bisulfate. $C_{19}H_{22}N_2O \cdot H_2SO_4 \cdot 4H_2O$, 464.33. Wh.rhomb.octah. **Soly.** 217^{14}w.; 111^{14}al.; s.et.

28 —, hydrochloride. $C_{19}H_{22}N_2O \cdot HCl \cdot 2H_2O$, 366.68. Col.monocl.,[α]+165.5. **m.p.** anh. 217–8. **Soly.** 4.5c.w.; 100al.; 0.18et.; s.chl.

29 —, nitrate. $C_{19}H_{22}N_2O \cdot HNO_3 \cdot \frac{1}{2}H_2O$, 366.21. Col.monocl. **Soly.** 3.79^{12}w.; s.al.

30 —, sulfate. $(C_{19}H_{22}N_2O)_2 \cdot H_2SO_4 \cdot 2H_2O$, 722.48. Col.rhomb., [α]+ $170.3°_{D}$. **m.p.** anh. 198.5. **Soly.** 1.55^{13}w.; 17^{11}al.; 0.043et.; 2.1chl.

31 —, **hydroxy-.** See *Cupreine.*

32 **Cinchotine** (*hydrocinchonine; pseudocinchonine*). $C_{19}H_{24}N_2O$, 296.20. Pr., [α] $+204.5°^{14}_{D}$ in et.al. **m.p.** 286. **Soly.** i.c.; s.h.w.; sl.s.al.; v.sl.s.et.

33 **Cinchotoxine.** See *Cinchonicine.*

34 **Cineole** (1, 8-*epoxy-p-menthane; eucalyptole; cajeputole*). $C_{10}H_{18}O$, 154.14. Col.liq., *n* 1.4584^{15}. **D.** 0.9239^{20}_{4}, **m.p.** +1.5, **b.p.** 176–7. **Soly.** 0.2c.w.; ∞al.; ∞et.; s.chl.; glac.ac.a., oils.

35 **1, 4-Cineole** (*p-cineole;* 1, 4-*epoxy-p-menthane*). $C_{10}H_{18}O$, 154.14. *n* 1.4479^{18}. **D.** 0.8997^{20}, **m.p.** +1, **b.p.** 173.4. **Soly.** 0.2c.w.; ∞al.; ∞et.

36 ***l*-Cineolic acid** (*l-tetrahydro*-2, 6, 6-*trimethyl*-1, 4-*pyran*-2, 5-*dicarboxylic acid**). $C_{10}H_{16}O_5$, 216.12. Cr., α 1.480; γ1.522. **m.p.** 196–7 d. **Soly.** 1.4d.w.; 0.79h.al.; 0.71et.; sl.s.chl.

37 **Cinnamaldehyde** (3-*phenylpropenal*; β-phenylacrolein; cinnamic aldehyde*). $C_6H_5CH{:}CHCHO$, 132.06, col. liq., *n* 1.61949. **D.** 1.1119^{15}_{4}, **m.p.** −7.5, **b.p.** 251. **Soly.** v.sl.s.w.; ∞al.; ∞et.

38 **Cinnamein.** See *Cinnamic acid, benzyl ester.*

39 **Cinnamene.** See *Styrene.*

40 **Cinnamic acid** (ordinary or *trans*) (*trans-β-phenyl-acrylic acid; trans-benzenepropenoic acid*). $C_6H_5CH{:}CHCOOH$, 148.06. Col.monocl. **D.** 1.2475^{4}_{4}, **m.p.** 133, **b.p.** 300. **Soly.** 0.1^{20}w.; 23^{20}al.; v.s.et.; s.bz., glac.ac.a., CS_2, 5.9^{15}chl.

41 —, allyl ester (*allyl cinnamate*). $C_6H_5CH{:}CHCOOC_3H_5$, 188.09. Wh.-yel. cr. **D.** 1.052^{20}_{20}, **b.p.** 286 d. **Soly.** i.w.; v.s.al.; ∞et.

42 —, benzyl ester (*cinnamein*). $C_6H_5CH{:}CHCOOCH_2C_6H_5$, 238.11. Col. pr. **m.p.** 39, **b.p.** 244^{25}; $195–200^{5}$. **Soly.** s.h.al.; s.et.

43 —, dibromide. See *Hydrocinnamic acid, α, β-dibromo-.*

44 —, ethyl ester (*ethyl trans-3-phenylpropenoate*). $C_6H_5CH{:}CHCOOC_2H_5$, 176.09. Col.liq., *n* 1.55982. **D.** 1.049, **m.p.** 6.5 (12), **b.p.** 271; 141^{15}. **Soly.** i.w.; s.al.; v.s.et.

45 —, methyl ester (*methyl cinnamate*). $C_6H_5CH{:}CHCOOCH_3$, 162.08. Col. cr., *n* $1.57661^{21.4}$. **D.** 1.0911^{20}_{4}; 1.042^{36}_{0}, **m.p.** 36, **b.p.** 261.9 (259.6). **Soly.** i.w.; v.s.al.; s.et.

46 —, γ-phenylallyl ester. See *Styracin.*

47 —, *p*-phenylphenacyl ester ($C_6H_5CH{:}CHCOOCH_2COC_6H_4C_6H_5$, 342.14. **m.p.** 182.5.

48 —, **α-acetyl-,** ethyl ester (*ethyl α-benzalacetoacetate*). $C_6H_5CH{:}C(COCH_3)COOC_2H_5$, 218.11. **m.p.** 59, **b.p.** 181^{17}. **Soly.** s.al.; s.et.

49 —, **o-amino-** (*β-(o-aminophenyl)acrylic acid*). $NH_2C_6H_4CH{:}CHCOOH$, 163.08. Yel.need. **m.p.** 159 d. **Soly.** sl.s.c., s.h.w.; s.al.; s.et.

50 —, —, lactam. See *Carbostyril.*

51 —, ***m*-amino-.** $NH_2C_6H_4CH{:}CHCOOH$, 163.08. Pa.yel.need., **m.p.** 181. **Soly.** sl.s.w.; s.al.; s.et.

52 —, ***p*-amino-.** $NH_2C_6H_4CH{:}CHCOOH$, 163.08. Pa.yel.need. **m.p.** 175–6 d. **Soly.** sl.s.w.; s.al.; s.et.

For explanations and abbreviations see beginning of table.

53 **Cinnamic acid, α-bromo-** (*2-bromo-3-phenylpropenoic acid; α-bromo-β-phenylacrylic acid*). $C_6H_5CH:CBrCOOH$, 226.97. *cis:* rhomb.f.w. **m.p.** 120–1, **b.p.** $111^{0.6}$. **Soly.** s.h.w.; s.al.; s.CS_2, bz. *trans:* need.f.w. **m.p.** 131–2, **b.p.** $121^{0.6}$. **Soly.** v.sl.s.h.w.; ∞al.; ∞et.

54 —, **β-bromo-** (*3-bromo-3-phenylpropenoic acid: β-bromo-β-phenylacrylic acid*). $C_6H_5CBr:CHCOOH$, 226.97. *cis:* monocl.f.al. **m.p.** 160, **b.p.** $111^{0.6}$. **Soly.** sl.s.h.w.; sl.s.c.al.; s.et.; s.chl., h.bz. *trans:* need.f.w. **m.p.** 134–5, **b.p.** $122^{0.6}$. **Soly.** sl.s.h.w.; s.al.; s.h.bz.; sl.s.CS_2.

55 —, **o-carboxy-** (*o, β-styrenedicarboxylic acid*). $(COOH)C_6H_4CH:CHCOOH$, 192.06. Need.f.w. **m.p.** 175. **Soly.** sl.s.w.; v.s.al.; sl.s.et.; i.bz.

56 —, **p-carboxy-** (*p, β-styrenedicarboxylic acid*). $(COOH)C_6H_4CH:CHCOOH$, 192.06. Infus.powd. **m.p.** 358 d., **b.p.** subl. >350. **Soly.** i.w.; s.h.ac.a.

57 —, **2, 4-dihydroxy-.** See *Umbellic acid.*

58 —, **2, 5-dihydroxy-** (*3-(2, 5-dihydroxyphenyl)propenoic acid*). $(HO)_2C_6H_3CH:CHCOOH$, 180.06. Cr.f.w. **m.p.** 207 d. **Soly.** s.al.

59 —, **3, 4-dihydroxy-.** See *Caffeic acid.*

60 —, **α-ethyl-.** $C_6H_5CH:C(C_2H_5)COOH$, 176.09. Need.f.w. **m.p.** 104–5 (81). **Soly.** 0.01^{25}w.; s.al.; s.et.; sl.s.pet.eth.

61 —, **o-hydroxy-.** See *o-Coumaric acid.*

62 —, **m-hydroxy-.** See *m-Coumaric acid.*

63 —, **p-hydroxy-.** See *p-Coumaric acid,*

64 —, **3-hydroxy-4-methoxy-.** See *Isoferulic acid.*

65 —, **4-hydroxy-3-methoxy-.** See *Ferulic acid.*

66 —, **β-ketohydro-.** See *Acetic acid, benzoyl-.*

67 —, **α-methyl-** (*α-benzalpropionic acid*). $C_6H_5CH:C(CH_3)COOH$, 162.08. Need. or pr.f.bz., **m.p.** 74, **b.p.** 288. **Soly.** 0.12h.w.; s.al.; s.et.; s.CS_2, bz.

68 —, **o-nitro-.** $NO_2C_6H_4CH:CHCOOH$ 193.06. Sc. or need.f.al. **m.p.** 240, **b.p.** subl. **Soly.** i.c.w.; 0.21^{25}al.

69 —, —, ethyl ester. $NO_2C_6H_4CH:CHCOOC_2H_5$, 221.09. Yel.rhomb.-need. **m.p.** 44. **Soly.** v.s.al.; v.s.et.; v.s.bz.

70 —, **m-nitro-.** $NO_2C_6H_4CH:CHCOOH$, 193.06. Col.(yel.)need.f.al. **m.p.** 193 (199–200). **Soly.** v.sl.s.w.; sl.s.al.

71 —, —, ethyl ester. $NO_2C_5H_4CH:CHCOOC_2H_5$, 221.09. **m.p.** 74–6. **Soly.** i.w.; sl.s.al.; sl.s.et.

72 —, —, methyl ester. $NO_2C_6H_4CH:CHCOOCH_3$, 207.08. Pa.yel.pr.f.al. **m.p.** 123–4, **b.p.** d. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; v.s.chl., bz.

73 —, **p-nitro-.** $NO_2C_6H_4CH:CHCOOH$, 193.06. Lt.yel.pr.f.al. **m.p.** 286. **Soly.** 0.0265^{25}w.; sl.s.h.al.; v.sl.s.et.; i.CS_2, lgr.

74 —, —, ethyl ester. $NO_2C_6H_4CH:CHCOOC_2H_5$, 221.09. Yel.tricl.need. **m.p.** 141 (136–7). **Soly.** i.w.; sl.s.al.; sl.s.et.

75 —, **α-phenyl-** (*trans-α, β-diphenylacrylic acid*). $C_6H_5CH:C(C_6H_5)COOH$, 224.09. (*trans*) wh.need.f. dil.al.; (*cis*) need. **m.p.** (*trans*) 172; (*cis*) 137–8, **b.p.** subl. **Soly.** sl.s.h.w.; s.al.; s.et.

76 *allo*-**Cinnamic acid** (*cis-cinnamic acid* (68°)). $C_6H_5CH:CHCOOH$, 148.06. Monocl.pr. **D.** $1.284\frac{4}{4}$, **m.p.** 68, **b.p.** 125^{19}; 265 d. **Soly.** 0.937^{25}w.; v.s.al.; v.s.et.

77 —, **α-β-dibromo-** (*cis-2, 3-dibromo-3-phenylpropenoic acid*; β-dibromocinnamic acid*). $C_6H_5CBr:CBrCOOH$, 305.88. Yel.pl.f.chl. **m.p.** 100, **b.p.** $124^{0.5}$. **Soly.** i.w.; s.al.; s.et.; s.chl., ac.a., lgr.; sl.s.pet.eth.

78 **Cinnamic alcohol** (*3-phenyl-2-propen-1-ol*; styrylcarbinol; γ-phenylallyl alcohol; cinnamyl alcohol; styrone*). $C_6H_5CH:CHCH_2OH$, 134.08. Need., *n* 1.58190. **D.** 1.0440^{20}_{4}, **m.p.** 33, **b.p.** 257.5. **Soly.** sl.s.w.; v.s.al.; v.s.et.

79 —, **4-hydroxy-3-methoxy-.** See *Coniferyl alcohol.*

80 **Cinnamic anhydride** (*trans-β-phenylacrylic anhydride*). $(C_6H_5CH:CHCO)_2O$, 278.11. Need.f.al. **m.p.** 135–6. **Soly.** i.w.; sl.s.al.; s.bz.

81 **Cinnamone.** See *Styryl ketone.*

82 **Cinnamoyl chloride.** See *Cinnamyl chloride.*

83 **Cinnamyl alcohol.** See *Cinnamic alcohol.*

* Name approved by the International Union of Chemistry.

84 **Cinnamyl chloride** (*cinnamoyl chloride; trans-β-phenylacrylyl chloride; trans-benzenepropenoyl chloride*). $C_6H_5CH{:}CHCOCl$, 166.51. Cr., *n* $1.61364^{42.5}$. **m.p.** 36, **b.p.** 257.5. **Soly.** i.w.; s.al.; s.et.; s.pet.eth., chl.

85 **Cinnamyl chloride.** See also *Propene, 3-chloro-1-phenyl-**.

86 **Citraconic acid** (*cis-methylbutenedioic acid*; methylmaleic acid*). $CH_3C(COOH){:}CHCOOH$, 130.05. Monocl. **D.** 1.617, **m.p.** 91. **Soly.** 238c.w.; sl.s.et.; sl.s.bz., chl.; i.CS_2.

87 **Citraconic anhydride** (*methylmaleic anhydride*). $OCOC(CH_3){:}CHCO$, 112.03. **D.** 1.25^{15}_{4}, **m.p.** 7–8, **b.p.** 213–4. **Soly.** d.w.; v.s.al.; v.s.et.

88 **Citral a** (*geranial*). $C_{10}H_{16}O$, 152.12. Col.liq., *n* 1.48752, **D.** 0.8868^{20}_{4}, **b.p.** 229 (224–9) d. **Soly.** i.w.; ∞al.; ∞et.

89 **Citral b** (*neral*). $C_{10}H_{16}O$, 152.12. *n* 1.4900. **D.** 0.888^{19}_{4}, **b.p.** 103^{12}.

90 ***dl*-Citramalic acid** (*dl-2-hydroxy-2-methylbutanedioic acid*; dl-α-hydroxypyrotartaric acid; dl-α-methylmalic acid*). $CH_3C(OH)(COOH)CH_2COOH$, 148.06. Monocl.pr. (*d* [α] $+34.7°^{14}_{D}$ in w.) **m.p.** 119 (*d* 95; 109), **b.p.** subl. **Soly.** v.s.w.; s.al.; s.et.; s.acet.; et.ac.; i.bz.

91 **Citrene.** See *d-Limonene.*

92 **Citric acid** (*2-hydroxy-1, 2, 3-propanetricarboxylic acid*; β-hydroxytricarballylic acid*). $(COOH)CH_2C(OH)(COOH)CH_2COOH$, 192.06. Col.rhomb., (cr. $+1H_2O$ f.w.), *n* 1.493, 1.498, 1.509(hyd.). **D.** 1.542^{18}_{4}, **m.p.** $-H_2O$ 70–5; 153, **b.p.** d. **Soly.** 133c.w.; 116^{25}al.; 2.26c.et.

93 —, *p*-phenylphenacyl ester. $C_{48}H_{38}O_{10}$, 774.30. **m.p.** 146.

94 —, trimethyl ester (*methyl citrate*). $C_3H_4(OH)(COOCH_3)_3$, 234.11. Col. tricl. **m.p.** 79, **b.p.** 287 d. **Soly.** sl.s.w.; v.s.al.; v.s.et.

95 —, **hydroxy-.** See *Tricarballylic acid, α, β-dihydroxy-.*

96 ***d*-Citronellal** (*d-rhodinal*). $CH_2{:}C(CH_3)(CH_2)_3CH(CH_3)CH_2CHO$, 154.14. Col.liq., *n* $1.4483^{17.5}$, [α] $+13.09°^{15}_{D}$. **D.** 0.855^{17}_{4}, **b.p.** 205–8. **Soly.** v.sl.s.w.; ∞al.; ∞et.

97 ***l*-Citronellal.** $C_{10}H_{18}O$, 154.14, *n* 1.4570. **D.** 0.8567^{15}_{4}, **b.p.** 205–6. **Soly.** v.sl.s.w.; ∞al.; ∞et.

98 ***dl*-Citronellol** (*dihydrogeraniol*). $C_{10}H_{20}O$, 156.16. **D.** 0.8488^{19}_{4}, **b.p.** 99^{10}.

99 ***d*-Citronellol.** $C_{10}H_{19}OH$, 156.16. Col.liq., *n* 1.45659, [α] $+4°^{17}_{D}$. **D.** 0.8565^{17}_{4}, **b.p.** 222. **Soly.** v.sl.s.w.; ∞al.; ∞et.

00 **Civetone** (*9-cycloheptadecen-1-one**). $CO(CH_2)_7CH{:}CH(CH_2)_7$, 250.23. **m.p.** 32.5 (31), **b.p.** 342^{742}; $158–60^{2}$.

01 **Clupanodonic acid.** $C_{21}H_{33}COOH$, 330.27. Pa.yel.oil, *n* 1.5057^{15}. **D.** 0.9410^{15}_{4}, **m.p.** < −78, **b.p.** 236^{5}. **Soly.** i.w.; s.et.

02 ***l*-Cocaine** (*benzoylmethylecgonine*). $C_8H_{13}N(OOCC_6H_5)(COOCH_3)$, 303.17. Col.monocl.pr.f.al., *n*: liq. 1.50218; solid α1.49., [α] $-15.83°^{20}_{D}$ in chl. **m.p.** 98. **Soly.** 0.16^{25}, 0.38^{80}w.; 20^{25}al.; 26.3et.; s.bz., chl.

03 —, chromate. $C_{17}H_{21}NO_4 \cdot H_2CrO_4 \cdot H_2O$, 422.66. Or.yel.leaf. **m.p.** 127. **Soly.** sl.s.w.

04 —, hydrochloride. $C_{17}H_{21}NO_4 \cdot HCl$, 339.64. Col.monocl.pr.f.al., [α] $-71.95°_D$ in w. **m.p.** 197. **Soly.** 250^{25}w.; 38.4^{25}al.; i.et ; 8chl.; s.glyc.

05 —, **cinnamyl-.** $C_{19}H_{23}NO_4$, 329.19. Need.f.bz. **m.p.** 121. **Soly.** i.w.; s.al.; s.et.; s.chl., bz.

06 **Codamine.** $C_{20}H_{25}NO_4$, 343.20. Pr. **m.p.** 121. **Soly.** sl.s.w.; v.s.al.; s.et.

07 **Codeine** (*morphine methyl ether*). $C_{18}H_{21}NO_3 \cdot H_2O$, 317.19. Col.rhomb. octahdr.($+1H_2O$)f.w., *n* (anh.) 1.620, 1.630, 1.650; (hyd.) 1.543, 1.636, 1.684, [α] $-137.75°_D$ in al. **D.** 1.315^{14}, **m.p.** anh. 155. **Soly.** 0.83^{25}, 1.7^{80}w.; 62.5^{25} al.; 8^{25}et.; s.chl., bz., tol.

08 —, hydrochloride. $C_{18}H_{21}NO_3 \cdot HCl \cdot 2H_2O$, 371.67. Col.need., [α] $-108.2°^{22}_{D}$ in w. **m.p.** anh. 264. **Soly.** 3.84^{15}w.; s.al.

09 —, phosphate. $C_{18}H_{21}NO_3 \cdot H_3PO_4 \cdot 2H_2O$, 433.25. Col.need. or efflor. powd., [α] $-134°_D$. **m.p.** 235 d. **Soly.** 44.5^{25}w.; 0.38^{25}al.; 0.07et.; s.chl.

10 —, sulfate. $(C_{18}H_{21}NO_3)_2 \cdot H_2SO_4 \cdot 5H_2O$, 786.50. Col.rhomb. [α] $-101.2°^{15}_{D}$ in w. **m.p.** 278 d. **Soly.** 3.3^{25}w.; 0.1^{25}al.; i.et.; i.chl.

11 **Coerulignone.** See *Cerulignone.*

12 **Colalin.** See *Cholic acid.*

13 ***l*-Colchicine.** $C_{22}H_{25}NO_6$, 399.20. Yel.varnish; yel.need.f.et.ac. **m.p.** anh. 143–7. **Soly.** 4.54w.; v.s.al.; 0.638et.; v.s.chl.; 1bz.

14 —, compd. with chloroform. $C_{22}H_{25}NO_6 \cdot CHCl_3$, 518.58. Need.f.chl. **Soly.** d.h.w.

15 **α-Collidine** (*4-ethyl-2-methylpyridine**). $CH_3C_5H_3NC_2H_5$, 121.09. Col.liq. **D.** 0.9268^{15}_{4}, **b.p.** 179. **Soly.** s.c., less s.h.w.; v.s.al.; v.s.et.; s.bz.

16 **β-Collidine** (*3-ethyl-4-methylpyridine**). $CH_3{\cdot}C_5H_3N{\cdot}C_2H_5$, 121.09. Col.liq. **D.** 0.966^{0}_{4}; $0.9286^{16.8}_{4}$. **b.p.** 195–6. **Soly.** i.w.; s.al.; s.et.; s.chl.

17 **γ-Collidine** (2, 4, 6-*trimethylpyridine*). $(CH_3)_3C_5H_2N$, 121.09. Col. liq. **D.** 0.917^{20}_{4}, **b.p.** 172. **Soly.** 20.8^{6}, 3.5^{20}w.; s.al.; ∞et.

19 **Conhydrine** (*α-hydroxyconiine; 2-(α-hydroxypropyl)piperidine*). $C_8H_{17}NO$, 143.14. Col.cr.f.et., $[\alpha]+10°_D$. **m.p.** 121, **b.p.** 226. **Soly.** v.s.w.; s.al.; s.et.; s.chl.

20 **ψ-Conhydrine.** See *Pseudoconhydrine.*

21 **α-Coniceine.** $C_8H_{15}N$, 125.13. Col. liq. (mixt.?). **D.** 0.893^{15}_{4}, **m.p.** −16, **b.p.** 158. **Soly.** sl.s.w.

22 **β-Coniceine** (*2-allylpiperidine*). $C_8H_{15}N$, 125.13. Col.need. (*l*) $[\alpha]-50.47°^{15}_{D}$. **D.** 0.8519^{50}_{4}, **m.p.** 39–41, **b.p.** 168–9. **Soly.** sl.s.w.; s.al.; s.et.

23 **γ-Coniceine** (1, 2, 3, 4-*tetrahydro-6-propylpyridine*). $C_8H_{15}N$, 125.13 Col.liq., n $1.46068^{18.4}$. **D.** 0.872^{20}_{4}, 0.8825^{24}_{4}, **m.p.** >−50, **b.p.** 172. **Soly.** sl.s.w.; s.al.

24 **δ-Coniceine.** See *Piperolidine.*

25 **ε-Coniceine** (*methylconidine*). $C_8H_{15}N$, 125.13. Liq. (*d*) $[\alpha]+67.4°^{15}_{D}$. **D.** 0.8856^{15}_{4}, **b.p.** 151–4; (*l*) $[\alpha]-87.34°^{15}_{D}$. **D.** 0.8624^{15}_{4}, **b.p.** 143–5; (*dl*) **D.** 0.8836^{15}_{4}, **b.p.** 150–1. **Soly.** s.al.; s.et.

26 **Conidine, methyl-.** See *ε-Coniceine.*

27 **Coniferin.** $C_{16}H_{22}O_8{\cdot}2H_2O$, 378.20. Glit.need.(+2H₂O), $[\alpha]-66.9°^{20}_{D}$ in w. **m.p.** anh. 185. **Soly.** 0.51w.; sl.s.al.; i.et.

28 **Coniferyl alcohol** (*3-(4-hydroxy-3-methoxyphenyl)-2-propen-1-ol; 4-hydroxy-3-methoxycinnamic alcohol; γ-hydroxyisoeugenol*). $(CH_3O)(OH)C_6H_3CH{:}CHCH_2OH$, 180.09. Pr. **m.p.** 73–4. **Soly.** sl.s.h.w.; s.al.; s.et.; s.alk.

29 **Coniine, α-hydroxy-.** See *Conhydrine.*

30 ***d*-Coniine** (*d-2-propylpiperidine*). $C_5H_{10}N{\cdot}C_3H_7$, 127.14. Col. oily liq., n $1.45119^{21.9}$, $[\alpha]+13.79°$ (+15.7°)D. **D.** 0.845, **m.p.** −2.5, **b.p.** 166.5. **Soly.** 1.lc.w.; ∞al.; v.s.et.; s.bz., chl., amyl al., acet.

31 —, hydrochloride $C_8H_{17}N{\cdot}HCl$, 163.61. Col.rhomb.f.w. **m.p.** 220 (217). **Soly.** 50w.; s.al.; i.et.; s.chl.

32 —, picrate. $C_8H_{17}N{\cdot}C_6H_3N_3O_7$, 356.19. Yel.need.f.h.w. **m.p.** 75. **Soly.** s.al.; s.et.

33 **Conquinamine.** $C_{19}H_{24}N_2O_2$, 312.20. Yel.tetr. **m.p.** 123. **Soly.** s.al.; v.s.et.

34 **Conquinine.** See *Quinidine.*

35 **Conylene** (*octadiene*(one form)). C_8H_{14}, 110.11. Liq. **D.** 0.770^{0}_{4}, **b.p.** 126^{738}. **Soly.** s.al.

36 **Conyrine** (*2-propylpyridine*). $C_3H_7C_5H_4N$, 121.09. Liq. **D.** <1. **m.p.** 2, **b.p.** 165. **Soly.** sl.s.w.; ∞al.; ∞et.

37 **Coriandrol.** See *d-Linaloöl.*

39 **Corybulbine.** $C_{18}H_{15}N(OH)(OCH_3)_3$, 355.20. Need. **m.p.** 238. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.c.HCl.

40 **Corycavine.** $C_{23}H_{23}NO_6$, 409.19. Rhomb.tab.f.al. **m.p.** 218–9. **Soly.** i.w.; i.c.al.; i.alk.

41 ***dl*-Corydaline.** $C_{18}H_{15}N(OCH_3)_4$, 369.22. Col.pr.f.al. (*d*) $[\alpha]+295°^{25}_{D}$ in al. **m.p.** *dl* 135; *dl*-meso, 158–9. **Soly.** i.w.; s.h.al.; s.et.; s.chl.

42 **Corynine.** See *Yohimbine.*

43 **Cotarnine.** $C_{12}H_{15}NO_4$, 237.13. Col.need.f.bz. **m.p.** 132–3 d. **Soly.** sl.s.w.; s.al.; s.et.; s.NH_4OH.

44 —, hydrochloride (*stypticin*). $C_{12}H_{15}NO_4{\cdot}HCl$, 273.59. Yel.cr.powd. **m.p.** 142–4. **Soly.** v.s.w.; v.s.al.

45 —, phthalate (*styptol*). $2C_{12}H_{15}NO_4{\cdot}C_6H_4(COOH)_2$, 742.34. Yel.cr. or powd. **m.p.** 103. **Soly.** v.s.w.

46 **Cotoin** (2, 6-*dihydroxy-4-methoxybenzophenone*). $C_6H_2(OH)_2(OCH_3)COC_6H_5$, 244.09. Yelsh.cr.f.h.w. **m.p.** 130–1. **Soly.** sl.s.w.; s.al.; s.et.; s.bz., chl., CS_2, acet.

47 **Coumalic acid** (2-*oxo*-1, 2-*pyran*-5-*carboxylic acid**).

OCOCH:CHC(COOH):CH (ring closed)

140.03. Pr. **m.p.** 205–10 part.d., **b.p.** 218^{120}; subl.part.d. **Soly.** sl.s.c. w.; s.al.; sl.s.et.; s.ac.a., acet.; i.chl., bz., lgr.

48 ***o*-Coumaric acid** (*o-hydroxycinnamic acid; o-cumaric acid*). $HOC_6H_4CH{:}CHCOOH$, 164.06. Need.f.w. **m.p.** 207–8 d., **b.p.** d. **Soly.** sl.s.w.; v.s.al.; v.sl.s.et.; i.CS_2, chl.

49 —, lactone. See *Coumarin.*

* Name approved by the International Union of Chemistry.

50 **m-Coumaric acid** (*m-hydroxycinnamic acid; m-cumaric acid*). $HOC_6H_4CH{:}CHCOOH$, 164.06. Col.pr.f.w. **m.p.** 191. **Soly.** v.s.h.w.; s.al.; v.s. et.; s.bz.

51 **p-Coumaric acid** (*p-hydroxycinnamic acid; p-cumaric acid*). $HOC_6H_4CH{:}CHCOOH$, 164.06. Col.need. $(+1H_2O)$f.c.w., anh.f.h.w. **m.p.** 210–3 (206). **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; sl.s.bz.; i.lgr.

52 —, **α, β-dihydro-.** See *Phloretic acid.*

54 **Coumarilic acid** (*2-benzofurancarboxylic acid; coumarone-2-carboxylic acid*). $C_8H_5O{\cdot}COOH$, 162.05. Need. f.w. **m.p.** 192–3, **b.p.** 310-15sl.d. **Soly.** s.h.w.; s.al.; sl.s.CS_2, chl.

55 **Coumarin** (*1, 2-benzopyrone; o-coumaric acid lactone; coumarinic lactone*). $C_6H_4OCOCH{:}CH$, 146.05. Col.rhomb.f.et. **D.** 0.935^{20}_{4}, **m.p.** 67–8 (70), **b.p.** 301.72 (290–1). **Soly.** 0.01^{25}w.; 13.7^{16} 90%al.; v.s.et.; s.chl., oils.

56 —, **6, 7-dihydroxy-.** See *Esculetin.*

57 —, **7, 8-dihydroxy-.** See *Daphnetin.*

58 —, **7-hydroxy-.** See *Umbelliferone.*

59 —, **3-methyl-** (*α-methylcoumarin*). $C_6H_4OCOC(CH_3){:}CH$, 160.06. Need. **m.p.** 90. **Soly.** s.al.

60 —, **4-methyl-** (*β-methylcoumarin*). $C_6H_4OCOCH{:}C(CH_3)$, 160.06. Need. f.bz. **m.p.** 82. **Soly.** s.al.; s.bz.

61 **Coumarone.** See *Benzofuran.*

62 **Creatine.** (*(α-methylguanido)acetic acid; methylglycocyamine*). $NH_2C({:}NH)N(CH_3)CH_2COOH$, 131.09. Col.monocl.pr.$(+1H_2O)$f.w. **m.p.** $-H_2O$, 100; anh. 295. **Soly.** 1.35^{18}w.; 0.0063c.al.; i.et.

63 **Creatinine** (*1-methylglycocyamidine*). $CH_3NC({:}NH)NHCOCH_2$, 113.08. Col.rhomb.pr.f.w. **m.p.** 260 d., **b.p.** d. **Soly.** 8.7^{16}w.; 0.98^{16}al.

64 **Creosol** (*2-methoxy-4-methylphenol; 4-methylguaiacol*(OH = 1); *2-methoxy-p-cresol* (OH = 1). $CH_3OC_6H_3(CH_3)OH$, 138.08. Col. oil, *n* 1.5353^{25}. **D.** 1.0919^{25}_{4}, **m.p.** 5.5, **b.p.** 221.8. **Soly.** sl.s.w.; ∞al.; ∞et., ∞bz.

Cresol. (In numbering derivatives, OH = 1).

65 **Cresol, hexahydro-.** See *Cyclohexanol, methyl-.*

66 **o-Cresol** (*o-methylphenol; o-hydroxytoluene; o-cresyl alcohol* (incorrect)). $CH_3C_6H_4OH$, 108.06. Col.cr. or liq., *n* 1.5453. **D.** 1.0465^{20}_{4}, **m.p.** 30, **b.p.** 191.5 **Soly.** 3.1^{40}, 5.6^{100}w.; $\infty^{>30}$al.; $\infty^{>30}$et.; s.chl.; s.ord.org.solv.

67 —, **acetate** (*o-tolyl acetate; o-cresyl acetate*). $CH_3COOC_6H_4CH_3$, 150.08. **b.p.** 208 ($83–5^{10}$). **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

68 —, **3-amino-** (*3-amino-2-methylphenol; 2-amino-6-hydroxytoluene*). $CH_3(NH_2)C_6H_3OH$, 123.08. Need. **m.p.** 129. **Soly.** sl.s.w.; sl.s.et.

69 —, **4-amino-** (*4-amino-2-methylphenol; 5-amino-2-hydroxytoluene*) $CH_3(NH_2)C_6H_3OH$, 123.08. Need.f.bz. **m.p.** 172–3, **b.p.** subl. **Soly.** sl.s.w.; v.s.al.; v.s.et.; sl.s.bz.

70 —, **5-amino-** (*5-amino-2-methylphenol; 4-amino-2-hydroxytoluene*). $CH_3(NH_2)C_6H_3OH$, 123.08. Col.pl. or need. **m.p.** 159–61, **b.p.** subl. **Soly.** sl.s.c., s.h.w.; v.s.al.; v.s.et.

71 —, **4, 6-dinitro-** (*2-methyl-4, 6-dinitrophenol*). $(NO_2)_2C_6H_2(CH_3)OH$, 198.06. Yel.pr.f.al. **m.p.** 85.8. **Soly.** v.sl.s.w.; 10.82^{15}al.; v.s.et.; s.acet.; sl.s.lgr.

72 —, **3-nitro-.** $NO_2(CH_3)C_6H_3OH$, 153.06. Lt.yel.cr.f.w. **m.p.** 142–3. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

73 —, **4-nitro-** (*2-methyl-4-nitrophenol*). $NO_2(CH_3)C_6H_3OH$, 153.06. Need.f.w. **m.p.** 82–5; 79–80. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

74 —, **5-nitro-** (*2-methyl-5-nitrophenol*). $NO_2(CH_3)C_6H_3OH$, 153.06. Yel. need.f.lgr. **m.p.** 118. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

75 —, **6-nitro-** (*2-methyl-6-nitrophenol*). $NO_2(CH_3)C_6H_3OH$, 153.06. Yel.pr. **m.p.** 69.5. **Soly.** i.w.; v.sl.s.al.; v.sl. s.et.

76 —, **3, 4, 5, 6-tetrabromo-.** $CH_3C_6Br_4OH$, 423.70. Yel.need.f.chl. **m.p.** 206–7, **b.p.** d. **Soly.** i.w.; s.al.; v.s.et.

77 —, **thio-** (*2-toluenethiol*; o-tolyl mercaptan*). $CH_3C_6H_4SH$, 124.12. Leaf. **m.p.** 15, **b.p.** 194.3. **Soly.** i.w.; s.al.; v.s.et.

78 **m-Cresol** (*m-methylphenol; m-hydroxytoluene*). $CH_3C_6H_4OH$, 108.06. Col.liq., *n* 1.5398. **D.** 1.034^{20}_{4}, **m.p.** 11–2, **b.p.** 202.8. **Soly.** 2.35^{20}; 5.8^{100}w.; ∞al.; ∞et.; s.chl.; s.ord.org. solv.

For explanations and abbreviations see beginning of table.

79 *m*-**Cresol, 5-amino-** (*5-amino-3-methylphenol; 3-amino-5-hydroxytoluene*). $CH_3(NH_2)C_6H_3OH$, 123.08. **m.p.** 79, **b.p.** 345.

80 —, **6-amino-** (*2-amino-5-methylphenol; 4-amino-3-hydroxytoluene*). $CH_3(NH_2)C_6H_3OH$, 123.08. Col.need. f.bz., **m.p.** 157–9.

81 —, **4-nitro-** (*3-methyl-4-nitrophenol*). $NO_2(CH_3)C_6H_3OH$, 153.06. Need.f. w. **m.p.** 129. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

82 —, **5-nitro-** (*3-methyl-5-nitrophenol*). $NO_2(CH_3)C_6H_3OH$, 153.06. Lt.yel. cr. **m.p.** 90–1. **Soly.** v.sl.s.w.; v.s. al.; v.s.et.

83 —, **6-nitro-** (*3-methyl-6-nitrophenol*). $NO_2(CH_3)C_6H_3OH$, 153.06. Yel. monocl.need.f.et. **m.p.** 56, **b.p.** volat. **Soly.** sl.s.w.; s.al.; v.s.et.

84 —, **thio-** (*3-toluenethiol*; m-tolyl mercaptan*). $CH_3C_6H_4SH$, 124.12. Liq. **D.** 1.0625^{0}_{4}; 1.052^{12}_{4}, **m.p.** <-20, **b.p.** 195–200. **Soly.** i.w.; s.al.; ∞ et.

85 —, **2, 4, 6-trinitro-** $(NO_2)_3C_6H(CH_3)OH$, 243.06. Yel.need.f.w. **m.p.** 106, **b.p.** exp. 150. **Soly.** 0.22^{20}, 0.81^{100}w.; v.s.al.; v.s.et.; s.bz.

86 *p*-**Cresol** (*p-methylphenol; p-hydroxytoluene*). $CH_3C_6H_4OH$, 108.06. Col. pr., n 1.5395. **D.** 1.0347^{20}_{4}, **m.p.** 36 (32–4), **b.p.** 202.5 **Soly.** 2.4^{40}, 5.3^{100}w.; $\infty^{>36}$al.; $\infty^{>36}$et.; s.ord.org. solv.

87 —, **2-amino-** (*2-amino-4-methylphenol; 3-amino-4-hydroxytoluene*). $CH_3(NH_2)C_6H_3OH$, 123.08. Sc.f.et. rhomb.f.bz. **m.p.** 135, **b.p.** subl. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.chl.; sl.s.bz.

88 —, **3-amino-** (*3-amino-4-methylphenol; 2-amino-4-hydroxytoluene*). $CH_3(NH_2)C_6H_3OH$, 123.08. Col.cr. f.w. **m.p.** 144.5, **b.p.** subl. **Soly.** sl.s.w.

89 —, **2, 6-dinitro-*** (*4-methyl-2, 6-dinitrophenol*). $(NO_2)_2C_6H_2(CH_3)OH$, 198.06. Lng.yel.pr. **m.p.** 81. **Soly.** sl.s.w.; s.al.; v.s.et.

90 —, **2-methoxy-.** See *Creosol.*

91 —, **2-nitro-** (*4-methyl-2-nitrophenol*). $NO_2(CH_3)C_6H_3OH$, 153.06. Yel.need. f.dil.al. **D.** 1.2399^{38}_{4}, **m.p.** 36.5 (32), **b.p.** 125^{25}. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

92 —, **3-nitro-** (*4-methyl-3-nitrophenol*). $NO_2(CH_3)C_6H_3OH$, 153.06. Yel.pr.f. et. **m.p.** 77. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

93 —, **thio-** (*4-toluenethiol*; p-tolyl mercaptan*). $CH_3C_6H_4SH$, 124.12. Leaf.f.et. **m.p.** 42–3, **b.p.** 195. **Soly.** i.w.; s.al.; v.s.et.

94 **Cresorcinol** (*4-methylresorcinol; cresorcin; 2, 4-dihydroxytoluene*). $CH_3C_6H_3(OH)_2$, 124.06. Col.cr.f.bz.+pet.et. **m.p.** 104–5, **b.p.** 267–70. **Soly.** s.w.; s.al.; s.et.; sl.s.bz., lgr.

95 **2, 3-Cresotic acid** (*2-hydroxy-3-methylbenzoic acid; 2-hydroxy-m-toluic acid; o-homosalicylic acid; o-cresotic acid; β-cresotic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Lng.need.f.w. **m.p.** 163–4. **Soly.** 0.14^{25}, 1.16^{100}w.; s.al.; s.et.; s.chl.

96 **2, 4-Cresotic acid** (*2-hydroxy-4-methylbenzoic acid; 2-hydroxy-p-toluic acid; α-m-homosalicylic acid; m-cresotic acid; γ-cresotic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Sm.need.f.w. **m.p.** 178, **b.p.** subl. **Soly.** 4.36^{100}w.; v.s.al.; v.s.et.; i.chl.

97 **2, 5-Cresotic acid** (*2-hydroxy-5-methylbenzoic acid; 6-hydroxy-m-toluic acid; p-homosalicylic acid; p-cresotic acid; α-cresotic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Lng.need.f.w. **m.p.** 152.5. **Soly.** v.sl.s.w.; v.s.al.; s.et.; i.CS_2.

98 **2, 6-Cresotic acid** (*2-hydroxy-6-methylbenzoic acid; 6-hydroxy-o-toluic acid; β-m-homosalicylic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Need.f.w. **m.p.** 168. **Soly.** 0.14^{25}w.; v.s.al.; v.s.et.

99 **3, 2-Cresotic acid** (*3-hydroxy-2-methylbenzoic acid; 3-hydroxy-o-toluic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Glit. need.f.w. **m.p.** 145–6. **Soly.** s.w.; v.s.al.; v.s.et.

00 **3, 4-Cresotic acid** (*3-hydroxy-4-methylbenzoic acid; 3-hydroxy-p-toluic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Lng. need. **m.p.** 207, **b.p.** subl. **Soly.** v.sl. s.w.; v.s.al.; s.et.

01 **3, 5-Cresotic acid** (*3-hydroxy-5-methylbenzoic acid; 5-hydroxy-m-toluic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Tab.f. w., **m.p.** 208, **b.p.** subl. **Soly.** 5.25^{100}w.; v.s.al.; v.s.et.

02 **3, 6-Cresotic acid** (*3-hydroxy-6-methylbenzoic acid; 5-hydroxy-o-toluic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Need. f.w. **m.p.** $-H_2O$. 100; 177–8 (183–4). **Soly.** sl.s.w.; v.s.al.; v.s.et.; i.chl.

03 **4, 2-Cresotic acid** (*4-hydroxy-2-methylbenzoic acid; 4-hydroxy-o-toluic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Monocl. f.al. or w. **m.p.** 177.8, **b.p.** 236–7, subl. **Soly.** 94^{100}w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

04 **4, 3-Cresotic acid** (*4-hydroxy-3-methylbenzoic acid; 4-hydroxy-m-toluic acid*). $CH_3C_6H_3(OH)COOH$, 152.06. Monocl. need.f.w. **m.p.** 172, **b.p.** subl.sl.d. **Soly.** s.h.w.; v.s.al.; v.s.et.; s.chl.

05 **Cresyl alcohol.** See *Cresol.*

Cresyl esters of organic acids. See "tolyl ester" under the names of the acids.

06 **Cresyl phosphate.** See *Tolyl phosphate.*

07 **Croceic acid** (*2-naphthol-8-sulfonic acid; β-naphthol-α-monosulfonic acid; Baeyer's acid*). $HOC_{10}H_6SO_3H$, 224.12.

08 **Croconic acid** (*crocic acid*). $C_5O_3(OH)_2·3H_2O$, 196.06. Yel.leaf. **m.p.** $-3H_2O$, 100; anh. 180, **b.p.** subl. **Soly.** 156c.w.; 14.99c.al.

09 **Crotonaldehyde** (*2-butenal*; crotonic aldehyde; β-methylacrolein; propylene aldehyde*). $CH_3CH:CHCHO$, 70.05. Col.inflam.liq., n $1.43838^{17.5}$. **D.** $0.8575^{15}_{?}$, **m.p.** −69; frz. −74, **b.p.** 104–5 (102.4). **Soly.** 18w.; ∞al.; ∞et.; ∞bz., tol.

10 **Crotonic acid** (α or solid). (*trans(?)-2-butenoic acid*; trans(?)-β-methylacrylic acid*). $CH_3CH:CHCOOH$, 86.05. Col.monocl.need.f.w. or lgr., n $1.4228^{79.7}$. **D.** 1.018^{20}_{4}; liq. 0.964^{80}, **m.p.** 72, **b.p.** 189. **Soly.** 8.28^{15}w.; sl.s.lgr.

11 —, methyl ester (*methyl α-crotonate*). $C_3H_5COOCH_3$, 100.06. Col.liq. **D.** 0.981^{4}_{4}, **b.p.** 120.7. **Soly.** i.w.; v.s.al.; v.s.et.

12 —, β-**bromo-** (*3-bromo-trans-2-butenoic acid**). $CH_3CBr:CHCOOH$, 164.96. Leaf. **m.p.** 97 (94–5). **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.CS_2, bz.

13 —, α-**chloro-** (*2-chloro-2-butenoic acid** (one form)). $CH_3CH:CClCOOH$, 120.50. Long need. **m.p.** 99, **b.p.** 212 subl. **Soly.** 2.12c.w.; s.al.; s.et.

14 —, α-**ethyl-** (*2-ethyl-trans(?)-2-butenoic acid*, 2-pentene-3-carboxylic acid**). $CH_3CH:C(C_2H_5)COOH$, 114.08. Col.monocl.pr. **m.p.** 45, **b.p.** 209. **Soly.** sl.s.w.; s.al.; v.s.et.

15 —, β-**hydroxy-** (*3-hydroxy-2-butenoic acid**; desmotropic with acetoacetic acid). $CH_3COH:CHCOOH$, 102.05. Liq. **b.p.** d. **Soly.** ∞w.

16 β-**Crotonic acid** (liquid). See *Isocrotonic acid.*

17 **Crotonic anhydride** (*2-butenoic anhydride**). $(CH_3CH:CHCO)_2O$, 154.08. Col.liq., n 1.47446. **D.** 1.0397^{20}_{4}, **b.p.** 246–8. **Soly.** d.w.; d.al.; ∞et.

18 **Crotonylene.** See *2-Butyne**.

19 **Crotyl alcohol** (and acetate). See *2-Buten-1-ol**.

20 **Cryptopine.** $C_{21}H_{23}NO_5$, 369.19. Pr. f.al., opt.in. **D.** 1.315^{20}_{4}, **m.p.** 220–1 (218). **Soly.** i.w.; sl.s.al.; sl.s.et.; sl.s.chl.; v.sl.s.bz.

21 **Crystal violet** (base) (*hexamethylpararosaniline*). $[(CH_3)_2NC_6H_4]_3COH$, 389.27. Vlt.cr.f.bz. **m.p.** 195. **Soly.** i.w.; s.al.; s.et.

22 **Cubebin.** $C_{20}H_{20}O_6$, 356.16. Wh. need.f.al. or bz., **m.p.** 131–2 (125), **b.p.** not volat. **Soly.** v.sl.s.w.; 1.03^{12} al.; 2.68et.; s.chl.

23 **Cumaldehyde** (*p-isopropylbenzaldehyde; p-cuminic aldehyde*). $C_3H_7C_6H_4CHO$, 148.09. Col.liq., n 1.5301. **D.** 0.978^{20}_{4}, **b.p.** 235. **Soly.** i.w.; s.al.; s.et.

24 **Cumaric acid.** See *Coumaric acid.*

25 **Cumene** (*isopropylbenzene; 2-phenylpropane; cumol*). $C_6H_5CH(CH_3)_2$, 120.09. Col.liq., n 1.4947^{15}. **D.** 0.864^{20}_{4}, **m.p.** −96.9, **b.p.** 152–3. **Soly.** i.w.; s.al.; s.et.; s.bz.

26 —, **hexahydro-.** See *Cyclohexane, isopropyl-.*

27 —, α-**nitro-** (*2-nitro-2-phenylpropane; (α-nitroisopropyl)benzene*). $C_6H_5C(NO_2)(CH_3)_2$, 165.09. Liq. **D.** 1.1025^{20}_{0}. **m.p.** −35, **b.p.** d. 224. **Soly.** i.c.w.

28 *o*-**Cumenol.** See *Phenol, o-isopropyl-.*

29 **Cumic acid** (*p-isopropylbenzoic acid; p-cuminic acid*). $(CH_3)_2CHC_6H_4COOH$, 164.09. Col.tricl.f.al. **D.** 1.163^{4}_{4}, **m.p.** 116.5, **b.p.** subl. **Soly.** 0.015^{25}w.; v.s.al.; v.s.et.

30 **Cumic alcohol** (*p-isopropylbenzyl alcohol; p-cuminic alcohol*). $C_3H_7C_6H_4CH_2OH$, 150.11. Yel.liq. **D.** 0.978^{20}_{0}, **b.p.** 248.4. **Soly.** sl.s.w.; ∞al.; ∞et.

31 α-**Cumidic acid** (*4, 6-dimethylisophthalic acid; 4, 6-dimethyl-1, 3-benzenedicarboxylic acid**). $(CH_3)_2C_6H_2(COOH)_2$, 194.08. Lng.pr.f.bz.+al. or need.f.w. **m.p.** 266 (>320), subl. without melting. **Soly.** sl.s.w.; s.h. al.

32 **Cumidine** (*p-isopropylaniline*). $(CH_3)_2CHC_6H_4NH_2$, 135.11. Col. liq. **D.** 0.957^{20}_{4}, **m.p.** −63, **b.p.** 225. **Soly.** i.w.; s.al.; s.et.; s.bz., a.

33 *p*-**Cuminic acid.** See *Cumic acid.*

34 *p*-**Cuminic alcohol.** See *Cumic alcohol.*

35 *p*-**Cuminic aldehyde.** See *Cumaldehyde.*

For explanations and abbreviations see beginning of table.

36 **Cumol.** See *Cumene.*

37 **Cumylic acid.** See *Durylic acid.*

38 **Cupreine** (*hydroxycinchonine*). $C_{19}H_{20}N_2(OH)_2$, 310.19. Concentric pr. f.et., [α] $-175.5°^{16}_{D}$ in al., **m.p.** anh. 198 (202). **Soly.** i.w.; s.al.; sl.s.et.; v.sl.s. bz., chl.

39 **Curarine.** $C_{19}H_{25}N_2O \cdot OH$, 314.22. Red-br.leaf. **m.p.** 161. **Soly.** i.w.; s.al.

40 **Curcumin** (*1, 7-bis(4-hydroxy-3-methoxyphenyl)-1, 6-heptadiene-3, 5-dione**). $[(CH_3O)(OH)C_6H_3CH{:}CHCO]_2CH_2$, 368.16. Or.-yel.need. or powd. **m.p.** 183 (177). **Soly.** i.w.; s.al.; sl.s.et.; 0.05bz.; s.alk.; sl.s. CS_2; i.lgr.

41 **Curine.** $C_{18}H_{19}NO_3$, 297.16. Col. cr. **m.p.** 212.

42 **Cuscohygrine**(anh.) (*cuskhygrine*) $C_{13}H_{24}N_2O$, 224.20. Oil, **b.p.** 215^{20}. **Soly.** ∞w.

43 **Cuscohygrine**(hydrate). $C_{13}H_{24}N_2O \cdot 3\frac{1}{2}H_2O$, 287.26. Need. **m.p.** 40–1; d. 120–30. **Soly.** s.et., bz. with sep. of H_2O.

44 **Cuskhygrine.** See *Cuscohygrine.*

45 **Cusparine** (*2-homopiperonyl-4-methoxyquinoline*). $C_{19}H_{17}NO_3$, 307.14. Lng.col.need. **m.p.** 91–2. **Soly.** s.al.; s.et.

46 **Cyamelide** (*s-trioxanetriimine; insoluble cyanic acid*). $(HNCO)_3$, 129.05. Wh.amor. **D.** 1.127^{15}_{4}, **b.p.** d. **Soly.** 0.01^{15}w.; i.al.; i.et.; s.conc. H_2SO_4; sl.s.NH_4OH; i. in ord.org.solv.

47 **Cyanamide** (*carbamonitrile*). $CN \cdot NH_2$, 42.03. Col.need., *n* 1.4418^{48}. **D.** 1.083, **m.p.** 44, b.p. 140^{19} d. **Soly.** v.s.w.; v.s.al.; s.et.; s.chl., bz.

48 —, **benzyl-.** $C_6H_5CH_2NHCN$, 132.08. Pl.f.al. **m.p.** 43 (33). **Soly.** i.w.; s.al.; s.et.

49 —, **diethyl-** (*N-cyanodiethylamine*). $CNN(C_2H_5)_2$, 98.09. Liq., *n* 1.4126^{48}. **D.** 0.854, **b.p.** 187 d. (186–90). **Soly.** i.w.; s.al.; s.et.

50 —, **phenyl-.** See *Cyananilide.*

51 **Cyananilide** (*carbanilonitrile; phenylcyanamide; N-cyanoaniline*). C_6H_5-$NHCN$, 118.06. Need.f.et. **m.p.** 47. **Soly.** sl.s.w.; s.al.; s.et.

52 **Cyanic acid.** HOCN, 43.02. Col. gas. **D.** liq. 1.140^{0}_{4}. **b.p.** d. **Soly.** sl.s.w.; s.et.; s.ac.a.

53 —, ethyl ester. C_2H_5OCN, 71.05. Liq. **D.** 1.127^{15}_{4}; 0.89^{20}_{4}. **b.p.** 162 d. **Soly.** i.w.; ∞al.; ∞et.

54 —, insoluble. See *Cyamelide.*

55 —, **thio-.** See *Thiocyanic acid.*

56 **Cyanidine.** See *s-Triazine.*

57 —, **trihydroxy-.** See *Cyanuric acid.*

Cyano-. See the parent compounds (e.g., for cyanoacetic acid see *Acetic acid, cyano-*).

58 **Cyanogen** (gas) (*ethanedinitrile*; oxalonitrile; prussite*). N⋮CC⋮N, 52.02. Col. **pois.** gas. **D.** liq. 0.866^{17}_{4}; 2.335 g/l. **m.p.** −34.4, **b.p.** −20.5. **Soly.** $450^{20}cm^3$w.; $2300^{20}cm^3$al.; $500^{20}cm^3$et.

59 **Cyanogen bromide** (*bromine cyanide*). CNBr, 105.92. Col.need. **D.** 2.015^{20}_{4}, **m.p.** 52, **b.p.** 61.6. **Soly.** s. w.; s.al.; s.et.

60 **Cyanogen chloride** (*chlorine cyanide*). CNCl, 61.47. Col.liq. or pois. gas. **D.** 1.218^{4}_{4}; liq.1.186^{20}_{4}, **m.p.** −6, **b.p.** 13.8. **Soly.** $2500cm^3$w.; $10,000cm^3$al.; $5,000cm^3$et.

61 —, trimer. See *Cyanuric chloride.*

62 **Cyanogen iodide** (*iodine cyanide*). CNI, 152.93. Col.need.f.et. or al. **m.p.** 146.5, seal.tube., **b.p.** subl. **Soly.** s.w.; s.al.; s.et.; s.volat. oils.

63 **Cyanogen sulfide.** See *Thiocyanic acid, cyanogen ester.*

64 **Cyanuramide.** See *Ammelide.*

65 **Cyanuric acid** (*n*) (*s-triazinetriol; trihydroxycyanidine; tricyanic acid*). N:C(OH)N:C(OH)N:C(OH), 129.05. Col.monocl.($+2H_2O$)f.w., efflor. **D.** 1.768^{0}_{4}, **m.p.** >360, **b.p.** d. **Soly.** 0.25^{17}w.; 0.35^{22}al.; v.sl.s.et.; s.conc. H_2SO_4.

66 —, tribenzyl ester (*benzyl cyanurate*). $(C_6H_5CH_2OC{:}N)_3$, 399.19. Need.f.al. **m.p.** 157, **b.p.** >320. **Soly.** i.c.w.; s.al.; sl.s.et.

67 —, **trithio-.** See *Thiocyanuric acid.*

68 **Cyanuric chloride** (*trichloro-s-triazine; trichlorocyanidine; tricyanogen chloride*). $C_3Cl_3N_3$, 184.40. Monocl. f.et. **D.** 1.32^{20}_{4}, **m.p.** 146, **b.p.** 190. **Soly.** sl.s.w.; v.s.al.; s.h.et.; v.s.chl.; s.ac.a.

69 **Cyanurodiamide.** See *Ammeline.*

70 **Cyanurotriamide.** See *Melamine.*

71 **Cyclobutane*** (*tetramethylene*). $CH_2CH_2CH_2CH_2$, 56.06. Liq. or gas, *n* 1.3752^{0}. **D.** 0.703^{0}_{4}, **m.p.** −50, **b.p.** 13. **Soly.** i.w.; ∞al.; ∞et.; v.s.acet.

72 —, **benzoyl-.** See *Ketone, cyclobutyl phenyl.*

* Name approved by the International Union of Chemistry.

73 **Cyclobutane, methyl-.** CH_3-$CHCH_2CH_2CH_2$, 70.08. Col.liq. **D.** 0.694^{20}_{4}, **b.p.** 42. **Soly.** i.w.; ∞al.; ∞et.

74 **1, 2-Cyclobutanedicarboxylic acid*** (*ethylenesuccinic acid*). C_4H_6-$(COOH)_2$, 144.06.
cis: Pl.f.w. **m.p.** 138. **Soly.** s.w.; s.al.; s.et.; sl.s.bz.
trans: (*dl*) Need.f.bz. **m.p.** 131. **Soly.** s.w. (*d*) $[\alpha]$ $+123.3°^{30}_{D}$ in w. **m.p.** 105 (*l*) $[\alpha]$ $-124.3°^{0}_{D}$ in w. **m.p.** 105.

75 **1, 3-Cyclobutanedicarboxylic acid*.** $C_4H_6(COOH)_2$, 144.06.
cis: Pr.f.w. **m.p.** 138–9 (135–6), **b.p.** 252. **Soly.** 34.5w.; vs.al.; v.sl.s.et.
trans: Pr. **m.p.** 171, **b.p.** subl. **Soly.** 3.8w.; v.s.al.; v.sl.s.et.

76 **Cyclobutene*** (*cyclobutylene*). $CH{:}CHCH_2CH_2$, 54.05. Gas. **D.** 0.733^{0}_{4}, **b.p.** 2(−3 to+1). **Soly.** s. acet.

77 **9-Cycloheptadecen-1-one*.** See *Civetone.*

78 **Cycloheptane*** (*heptamethylene; suberane*). $CH_2(CH_2)_5CH_2$, 98.11. Oil, *n* 1.4440. **D.** 0.8099^{20}_{4}, **m.p.** −12, **b.p.** 118.1. **Soly.** i.w.; v.s.al.; v.s.et.

79 **Cycloheptanol*** (*suberyl alcohol; suberol; hydroxyheptamethylene*). CH_2-$(CH_2)_5CHOH$, 114.11. **D.** 0.9717^{0}_{0}; 0.9565^{20}_{4}, **b.p.** 185.2 (184.5). **Soly.** 1.1w.; v.s.al.; v.s.et.

80 **Cycloheptanone*** (*suberone; keto-heptamethylene*). $CO(CH_2)_5CH_2$, 112.09. Oil, *n* $1.46027^{21.9}$. **D.** 0.9508^{20}_{4}, **b.p.** 179.5. **Soly.** sl.s.w.; v.s.al.; s.et.

81 **Cycloheptene*** (*suberene; suberylene*). $CH{:}CH(CH_2)_4CH_2$, 96.09. Oil, *n* 1.4552. **D.** 0.8228^{20}_{4}, **b.p.** 115. **Soly.** i.w.; s.al.; s.et.

82 **1, 3-Cyclohexadiene*** (1, 2-*dihydrobenzene; $\Delta^{1,3}$-cyclohexadiene*). $CH{:}CHCH{:}CHCH_2CH_2$, 80.06. Col.liq., *n* 1.4758(1.4744). **D.** 0.8404^{20}_{4}, **m.p.** −98, **b.p.** 80.5 (83–4). **Soly.** i.w.; s.al.; v.s.et.

83 **—, 5-isopropyl-2-methyl-.** See *α-Phellandrene.*

84 **1, 4-Cyclohexadiene*** (1, 4-*dihydrobenzene; $\Delta^{1,4}$-cyclohexadiene*). $CH{:}CHCH_2CH{:}CHCH_2$, 80.06. Col.liq., *n* 1.4729. **D.** 0.8471^{20}_{4}, **b.p.** 86–7 (81–2). **Soly.** i.w.; ∞al.; ∞et.

85 **Cyclohexadiene-1,2-dicarboxylic acid*.** See *Phthalic acid, dihydro-.*

86 **1, 3-Cyclohexadiene-1, 4-dicarboxylic acid*** (2, 3-*dihydroterephthalic acid*). $C_6H_6(COOH)_2$, 168.06. Flocks. **Soly.** i.c., s.h.w.

87 **1, 4-Cyclohexadienedione*.** See *Quinone.*

88 **Cyclohexane*** (*hexahydrobenzene; hexamethylene*). C_6H_{12}, 84.09. Col. liq., *n* 1.42900^{15}. **D.** 0.7791^{20}_{4}, **m.p.** 6.5, **b.p.** 81.4. **Soly.** i.w.; ∞al.; ∞et.

89 **—, amino-.** See *Cyclohexylamine*.*

90 **—, bromo-** (*cyclohexyl bromide*). $C_6H_{11}Br$, 163.00. Col.liq., *n* 1.49564^{15}. **D.** 1.3290^{15}_{0}, **b.p.** 163–5. **Soly.** i.w.; ∞al.; ∞et.

91 **—, chloro-*** (*cyclohexyl chloride*). $C_6H_{11}Cl$, 118.54. Col.liq., *n* 1.46264. **D.** 1.0161^{0}_{0}; 1.000^{20}_{4}, **m.p.** −43.9, **b.p.** 142.5. **Soly.** i.w.; ∞al.; ∞et.; ∞bz.

92 **—, 1, 3-dimethyl-** (*hexahydro-m-xylene*). $C_6H_{10}(CH_3)_2$, 112.12. Col. liq., (*cis*) *n* 1.4269, (*trans*) *n* 1.4254. **D** (*cis*) 0.7735^{20}_{4}; (*trans*) 0.772^{20}_{4}, **m.p.** −85, **b.p.** (*cis*) 121; (*trans*) 119^{756}. **Soly.** i.w.; ∞al.; ∞et.

93 **—, 1, 4-dimethyl-** (*hexahydro-p-xylene*). $C_6H_{10}(CH_3)_2$, 112.12. Col. liq., *n* 1.421. **D.** (*cis*) 0.7671^{20}_{4}; (*trans*) 0.7638^{20}_{4}, **m.p.** −86, **b.p.** 120.5.

94 **—, 1, 2, 3, 4, 5, 6-hexabromo-*** (*α* or *trans*) (*benzene trans-hexabromide*). $C_6H_6Br_6$, 557.54. Col.monocl.pr. **m.p.** 212. **Soly.** i.w.; sl.s.al.; sl.s.et.

95 **—, —** (*β* or *cis*) (*benzene β-hexabromide*). $C_6H_6Br_6$, 557.54. Cub.cr. f.bz. **m.p.** 253 d. **Soly.** i.al.; i.et.; sl.s.bz.

96 **—, 1, 2, 3, 4, 5, 6-hexachloro-** (*α* or *trans*) (*benzene trans-hexachloride*). $C_6H_6Cl_6$, 290.79. Col.monocl.pr. **D.** 1.87^{20}_{4}, **m.p.** 157, **b.p.** 288 d. **Soly.** i.w.; s.h.al.; 4.35^{15}chl.; 6.5^{18}bz.; v.s. aniline.

97 **—, —** (*β* or *cis*) (*benzene cis-hexachloride*). $C_6H_6Cl_6$, 290.79. Col.cr. **D.** 1.89^{19}_{4}, **m.p.** 310, **b.p.** subl. **Soly.** i.w.; sl.s.al.; 0.13chl.; 1^{22}bz.; 0.289^{16}ac. a.

98 **—, —** (*γ*) (*benzene γ-hexachloride*). $C_6H_6Cl_6$, 290.79 Need.f.al. **m.p.** 112–3. **Soly.** i.w.

99 **—, —** (*δ*) (*benzene δ-hexachloride*). $C_6H_6Cl_6$, 290.79. Pl. **m.p.** 129–32.

For explanations and abbreviations see beginning of table.

00 Cyclohexane, isopropyl- (*hexahydrocumene; normenthane*). $C_6H_{11}C_3H_7$, 126.14. Col.liq. **D.** 0.787^{20}_{4}, **b.p.** 150. **Soly.** i.w.; v.s.al.; v.s.et.

01 —, 4-isopropyl-1-methyl-. See *p-Menthane.*

02 —, methyl- (*hexahydrotoluene; cyclohexylmethane*). $CH_3C_6H_{11}$, 98.11. Col. liq., *n* 1.4235. **D.** 0.7864^{0}_{4}; 0.769^{20}_{4}, **m.p.** −126.4, **b.p.** 100.3. **Soly.** i.w.; s.al.; s.et.

03 —, phenyl- (*cyclohexylbenzene; 1, 2, 3, 4, 5, 6-hexahydrobiphenyl*). $C_6H_5C_6H_{11}$, 160.12. Oil, **D.** 0.9440^{20}_{4}, **m.p.** 7, **b.p.** 237.5. **Soly.** i.w.; v.s.al.; v.s.et.

04 —, 1, 3, 5-trimethyl- (*hexahydromesitylene*). $C_6H_9(CH_3)_3$, 126.14. Col. liq. **D.** 0.7884^{20}_{4}, **b.p.** 135–8.

05 Cyclohexanecarboxylic acid* (*hexahydrobenzoic acid*). $C_6H_{11}COOH$, 128.09. Col.monocl.pr., *n* $1.4561^{33.8}$. **D.** 1.048^{15}_{4}, **m.p.** 31, **b.p.** 233. **Soly.** 0.201^{15}w.; v.s.al.; v.s.et.

06 —, 2-hydroxy- (*hexahydrosalicylic acid*). $HOC_6H_{10}COOH$, 144.09. Cr. f.w. **m.p.** 111. **Soly.** v.s.w.; v.s. al.; v.s.et.; sl.s.bz.

07 —, 1, 2, 4, 5-tetrahydroxy-*. See *Quinic acid.*

08 1, 2-Cyclohexanedicarboxylic acid* (*hexahydrophthalic acid*). $C_6H_{10}(COOH)_2$, 172.09. *cis:* tricl.pr.f.w.; *trans:* monocl.leaf.f.w. **m.p.** *cis* 192; d. $-H_2O$ >192; *trans* 221. **Soly.** 0.2w.; s.al.; s.acet.

09 1, 4-Cyclohexanedicarboxylic acid* (*hexahydroterephthalic acid*). $C_6H_{10}(OOOH)_2$, 172.09.
cis: Leaf.f.w. **m.p** 161–2. **Soly.** v.s.h.w.; s.al.; s.et.
trans: Pr.f.w. **m.p.** 300 subl. **Soly.** 1.34 h.w.; v.s.al.

10 1, 3-Cyclohexanedione* (*3-hydroxy-2-cyclohexen-1-one** (tautomeric form); *dihydroresorcinol; hydroresorcinol*). $COCH_2COCH_2CH_2CH_2$ or $COCH{:}COHCH_2CH_2CH_2$, 112.06. Pr.f.bz. or ethyl acetate. **m.p.** 105–6. **Soly.** s.w.; s.al.; v.sl.s.et.; s.chl.; v.sl.s.CS_2, lgr.

11 1, 4-Cyclohexanedione* (*tetrahydroquinone; p-quinone tetrahydride*). $CO(CH_2)_2COCH_2CH_2$, 112.06. Monocl. f.w. **m.p.** 78, **b.p.** subl. 100. **Soly.** s.w.; s.al.; s.et.

12 1, 2, 3, 4, 5, 6-Cyclohexanehexacarboxylic acid* (*hexahydromellitic acid.* $C_6H_6(COOH)_6$, 348.09. Cr. **m.p.** d. **Soly.** v.s.w.; v.s.al.; v.s.et.

13 1, 2, 3, 4, 5, 6-Cyclohexanehexol*. See *i-Inositol.*

14 Cyclohexanehexone*, hydrate (*triquinoyl hydrate*). $C_6O_6{\cdot}8H_2O$, 312.12. Micr.need.f.dil.HNO_3. **m.p.** 95. **Soly.** s.h.w.; i.al.; i.et.; s.alk.

15 Cyclohexanepentol*. See *d-Quercitol.*

16 1, 3, 5,-Cyclohexanetrione*, trioxime (*1, 3, 5-trihydroxaminobenzene; phloroglucinol trioxime*). $C_6H_6(NOH)_3$ or $C_6H_3(NHOH)_3$, 171.09. Cr.powd. **m.p.** exp. 155. **Soly.** v.sl.s.w.; v.sl.s.al.; s.chl., ac.a.

17 Cyclohexanol* (*hexahydrophenol; hexalin*). $C_6H_{11}OH$, 100.09. Col.need., hyg., *n* $1.46560^{22.6}$. **D.** 0.9624^{20}_{4}, **m.p.** 24(22–5), **b.p.** 161.5. **Soly.** 5.67^{15}w.; s.al.; s.et.; ∞bz., CS_2, turpentine.

18 —, acetate (*cyclohexyl acetate*). $CH_3COOC_6H_{11}$, 142.11. **b.p.** 177 (171–6). **Soly.** i.w.; ∞al.; ∞et.

19 —, benzoate (*cyclohexyl benzoate; cyclohexyl benzenecarboxylate**). $C_6H_5COOC_6H_{11}$, 204.12. **b.p.** 160^{18}. **Soly.** i.w.; s.al.; s.et.

20 —, 2-methyl- (*hexahydro-o-cresol*). $CH_3C_6H_{10}OH$, 114.11. Col.liq., *n* $1.46585^{13.4}$. **D.** 0.9332, **b.p.** 165–6. **Soly.** v.sl.s.w.; ∞al.; ∞et.

21 —, 3-methyl-(*l*) (*l-hexahydro-m-cresol*). $CH_3C_6H_{10}OH$, 114.11. Syrup, *n* $1.45734^{24.4}$. **D.** 0.9157^{20}_{4}, **m.p.** −47, **b.p.** 175–6 (170–2). **Soly.** 1.03w.; ∞al.; ∞et.

22 —, 4-methyl- (*hexahydro-p-cresol*). $CH_3C_6H_{10}OH$, 114.11. Arom.liq., *n* $1.45833^{20.7}$. **D.** 0.924^{14}_{4}; 0.917^{20}_{4}, **b.p.** 173–4. **Soly.** v.sl.s.w.; ∞al.; ∞et.

23 Cyclohexanone* (*ketohexamethylene; pimelic ketone*). $CO(CH_2)_4CH_2$, 98.08. Col.liq., *n* 1.4507. **D.** 0.9478^{20}_{4}, **m.p.** frz. −45, **b.p.** 156.7 (155). **Soly.** v.s.w.; s.al.; s.et.

24 —, 2, 5-dimethyl-(*d*). $COCH(CH_3)CH_2CH_2CH(CH_3)CH_2$, 126.11. Oil. **D.** 0.8985, **b.p.** $172–4^{750}$. **Soly.** i.w.; s.al.; s.et.

25 —, 2-methyl-. $COCH(CH_3)CH_2CH_2CH_2$, 112.09. Liq., *n* $1.45049^{14.6}$. **D.** 0.9248^{18}, **b.p.** 163. **Soly.** i.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

26 **Cyclohexanone, 3-methyl-** $COCH_2CH(CH_3)CH_2CH_2CH_2$, 112.09. Liq., *n* $1.44313^{25.15}$. **D.** 0.921^{20}_{4}, **b.p.** 168 (164–5). **Soly.** i.w.; s.al.; s.et.

27 —, **4-methyl-.** $COCH_2CH_2CH(CH_3)CH_2CH_2$, 112.09. Liq., *n* $1.44322^{24.4}$. **D.** 0.912^{24}_{4}, **b.p.** 169. **Soly.** i.w.; s.al.; s.et.

28 **Cyclohexanone pinacol.** See 1, *2-Ethanediol*, 1, *2-dicyclohexyl-*.

29 **Cyclohexene*** (*1, 2, 3, 4-tetrahydrobenzene*). $CH_2CH_2CH_2CH_2CH:CH$, 82.08. Col.liq., *n* 1.44507^{22}. **D.** 0.8102^{20}_{4}, **m.p.** −103.7, **b.p.** 83. **Soly.** i.w.; s.al.; v.s.et.

30 —, **4-isopropyl-1-methyl-3-.** See *Menthene.*

31 —, **3-isopropyl-6-methylene-.** See *β-Phellandrene.*

32 —, **4-methyl-** (*1, 2, 3, 6-tetrahydrotoluene*). $CH:CHCH_2CH(CH_3)CH_2CH_2$, 96.09. Liq. **D.** 0.841^{16}_{4}; 0.801^{20}_{4}, **b.p.** 102–3. **Soly.** i.w.; s.al.; s.et.

33 **1-Cyclohexene-1-carboxylic acid*** (2, 3, 4, *5-tetrahydrobenzoic acid*). $CH_2(CH_2)_3CH:CCOOH$, 126.08. Cr., *n* 1.4903. **D.** 1.109^{20}_{4}; 1.072^{47}_{4}, **m.p.** 29, **b.p.** 243. **Soly.** 0.7^{20}w.

34 **1-Cyclohexene-1, 2-dicarboxylic acid*** (*Δ¹-tetrahydrophthalic acid*). $C_6H_8(COOH)_2$, 170.08. Monocl.leaf.f.w. **m.p.** 120. **Soly.** v.s.w.

35 **2-Cyclohexen-1-one, 3-hydroxy-*.** See 1, *3-Cyclohexanedione**.

36 **Cyclohexyl acetate.** See *Cyclohexanol, acetate.*

37 **Cyclohexylamine*** (*hexahydroaniline; aminocyclohexane*). $C_6H_{11}NH_2$, 99.11. Col.liq., *n* 1.43716. **D.** 0.8191^{20}_{4} (0.8678). **b.p.** 134. **Soly.** sl.s.w.; s.al.; s.et.

38 —, *N*-**butyl-.** $C_6H_{11}NH(CH_2)_3CH_3$, 155.17. Col.liq. **b.p.** 200–4. **Soly.** sl.s.w.; v.s.al.; v.s.et.

39 —, *N*-**ethyl-.** $C_6H_{11}NHC_2H_5$, 127.14. Col.liq. **b.p.** $163–5^{745}$. **Soly.** sl.s.w.; ∞al.; ∞et.

40 —, —, cyclohexylethylthiolthionocarbamate. See under *Carbamic acid, cyclohexylethylthiolthiono-.*

41 —, *N*-**methyl-.** $C_6H_{11}NHCH_3$, 113.13. Col.liq. **b.p.** 145–7. **Soly.** sl.s.w.; v.s.al.; ∞et.

42 **Cyclohexyl benzoate.** See *Cyclohexanol, benzoate.*

43 **Cyclohexyl bromide.** See *Cyclohexane, bromo-*.*

44 **Cyclohexyl chloride.** See *Cyclohexane, chloro-*.*

45 **1, 3-Cyclopentadiene*.** $CH:CHCH:CHCH_2$, 66.05. Col.liq., *n* 1.4446^{19}. **D.** 0.80475^{19}_{4}, **b.p.** 42.5. **Soly.** i.w.; ∞al.; ∞et.; ∞bz.

46 **Cyclopentane*** (*pentamethylene*). $CH_2CH_2CH_2CH_2CH_2$, 70.08. Col.liq., *n* 1.4039. **D.** 0.7510^{20}_{4}, **m.p.** −93.3, **b.p.** 49.5. **Soly.** i.w.; ∞al.; ∞et.

47 —, **bromo-*** (*cyclopentyl bromide*). C_5H_9Br, 148.99. *n* 1.4875^{19}. **D.** 1.3692^{15}_{15}, **b.p.** 137–9.

48 **Cyclopentanecarboxylic acid, 3-carbamyl-1, 2, 2-trimethyl-.** See *α-Camphoramic acid.*

49 —, **3-carbamyl-2, 2, 3-trimethyl-.** See *β-Camphoramic acid.*

50 —, **1, 2, 2, 3-tetramethyl-*.** See *Campholic acid.*

51 **1, 2-Cyclopentanedicarboxylic acid*.** $C_5H_8(COOH)_2$, 158.08.
cis: Need.f.w. **m.p.** 139, **b.p.** anh. 150–60. **Soly.** v.s.w.; s.al.
trans: Warts f.w. **m.p.** 161. **Soly.** v.s.h.w.; v.s.al.; v.sl.s.et.; s.et.ac.; sl.s.bz., chl.

52 **1, 3-Cyclopentanedicarboxylic acid*.** $C_5H_8(COOH)_2$, 158.08.
cis: Pr.f.w. **m.p.** 121, **b.p.** 300 d. **Soly.** v.s.h.w.; v.s.al.; v.s.et.; s.chl., acet., h.bz.
trans: Pr.f.CCl_4 **m.p.** 88. **Soly.** v.s.c.w.

53 —, **1, 2, 2-trimethyl-**(*cis*). See *Camphoric acid.*

54 —, **1, 2, 2-trimethyl-**(*trans*). See *Isocamphoric acid.*

55 **1, 3-Cyclopentanedicarboxylic anhydride*.** See *Camphoric anhydride.*

56 **Cyclopentanol*.** $CH_2CH_2CH_2CH_2CHOH$, 86.08. Oil, *n* 1.41530. **D.** 0.9488^{20}_{4}, **b.p.** 139–40. **Soly.** sl.s.w.; s.al.

For explanations and abbreviations see beginning of table.

57 **Cyclopentanone*** (*ketopentamethylene; adipic ketone*). $COCH_2CH_2CH_2CH_2$, 84.06. Oil, *n* 1.4366. **D.** 0.9480^{20}_{4}, **m.p.** −58.2, **b.p.** 130.6. **Soly.** sl.s.w.; ∞al.; ∞et.

58 **Cyclopentene***. $CH:CHCH_2CH_2CH_2$, 68.06. Liq., *n* 1.4218^{18}. **D.** 0.7743^{18}_{4}, **m.p.** −93.3, **b.p.** 45–6 (44). **Soly.** i.w.; s.al.; s.et.

59 **—, 2-acetyl-1, 3, 3, 4, 4-pentamethyl-.** See *Desoxymesityl oxide.*

60 **1-Cyclopentene-1-ethylamine, 2, 3, 3-trimethyl-.** See *β-Camphylamine.*

61 **Cyclopentyl bromide.** See *Cyclopentane, bromo-**.

62 **Cyclopropane*** (*trimethylene*). $CH_2CH_2CH_2$, 42.05. Col.gas. **D.** 0.720^{-79}, **m.p.** −126.6, **b.p.** −34.4. **Soly.** i.w.; v.s.al.; v.s.et.

63 **—, 1, 1-dimethyl-** (*1, 1-dimethyltrimethylene*). $(CH_3)_2CCH_2CH_2$, 70.08. *n* 1.366. **D.** 0.6604, **b.p.** 21. **Soly.** i.w.; s.al.; s.et.; s.H_2SO_4.

64 **—, methyl-.** $CH_3CHCH_2CH_2$, 56.06. Col.gas. **D.** 0.691^{-20}, **b.p.** .5. **Soly.** sl.s.w.; v.s.al.; v.s.et.

65 **Cyclopropanecarboxylic acid*** (*ethyleneacetic acid*). $CH_2CH_2CHCOOH$, 86.05. *n* $1.43754^{17.1}$, **m.p.** 18, **b.p.** 183. **Soly.** sl.s.w.; s.al.; s.et.

66 **1, 1-Cyclopropanedicarboxylic acid*.** See *Vinaconic acid.*

67 **1, 2, 3-Cyclopropanetricarboxylic acid*.** $C_3H_3(COOH)_3$, 174.05. Col. cr. **m.p.** 220. **Soly.** s.w.; s.al.

68 ***o*-Cymene** (*o-isopropyltoluene; 2-isopropyl-1-methylbenzene*). $CH_3C_6H_4CH(CH_3)_2$, 134.11. Col.liq., *n* $1.50206^{16.15}$. **D.** 0.876^{20}_{4}, **m.p.** −73.5, **b.p.** 175 (175–8). **Soly.** i.w.; s.al.; s.et.; s.chl.

69 ***m*-Cymene** (*m-isopropyltoluene; 3-isopropyl-1-methylbenzene; isocymene*). $CH_3C_6H_4CH(CH_3)_2$, 134.11. Col.liq., *n* $1.49385^{17.05}$. **D.** 0.8696^{20}_{4}, **m.p.** <−25, **b.p.** 175.7. **Soly.** i.w.; s.al.; s.et.; s.chl.

70 ***p*-Cymene** (*cymene; p-isopropyltoluene; 4-isopropyl-1-methylbenzene*). $CH_3C_6H_4CH(CH_3)_2$, 134.11. Col.liq., *n* $1.49474^{15.0}$. **D.** 0.8570^{20}_{4}, **m.p.** −73.5 (−68.9), **b.p.** 176. **Soly.** i.w.; v.s.al.; s.et.; s.chl.

71 **—, 2-acetyl-.** See *Acetophenone, 5-isopropyl-2-methyl-.*

72 **—, 2-amino-.** See *Carvacrylamine.*

73 **—, 2-bromo-** (*2-bromo-4-isopropyl-1-methylbenzene*). $CH_3C_6H_3BrC_3H_7$, 213.02. Liq. **D.** 1.269^{17}_{4}, **b.p.** 233–5. **Soly.** i.w.; v.s.al.; s.et.

74 **—, hexahydro-.** See *p-Menthane.*

75 **—, 2-nitro-** (*4-isopropyl-1-methyl-2-nitrobenzene*). $C_{10}H_{13}NO_2$, 179.11. Arom. oil. **D.** 1.067^{20}_{4}, **b.p.** 152^{15}. **Soly.** i.w.; v.s.al.; v.s.et.

76 **2-*p*-Cymenecarboxylic acid, 3-hydroxy-.** See *o-Thymotic acid.*

77 **2, 5-*p*-Cymenediol.** See *Thymohydroquinone.*

78 **2-*p*-Cymenol.** See *Carvacrol.*

79 **3-*p*-Cymenol.** See *Thymol.*

80 **Cymidine.** See *Carvacrylamine.*

81 **Cymophenol.** See *Carvacrol.*

82 **2-*p*-Cymylamine.** See *Carvacrylamine.*

83 **3-*p*-Cymylamine.** See *Thymylamine.*

84 ***l*-Cysteine** (*l-2-amino-3-mercaptopropanoic acid*; l-β-mercaptoalanine*). $HSCH_2CH(NH_2)COOH$, 121.12. Cr. powd. **Soly.** v.s.w.; s.ac.a., NH_4OH.

85 ***dl*-Cystine.** $[SCH_2CH(NH_2)COOH]_2$, 240.23. Need. **m.p.** 260 (225–7). **Soly.** 0.006^{25}w.

86 ***d*-Cystine.** $[SCH_2CH(NH_2)COOH]_2$, 240.23. Wh.hex.pl. **m.p.** 247–9. **Soly.** 0.011^{25}w.; i.al.; s.min.a., alk.

87 ***l*-Cystine** (*l-3, 3′-dithiobis(2-aminopropanoic acid*); l-β, β′-dithiodialanine; dicysteine*). $[SCH_2CH(NH_2)COOH]_2$, 240.23. Hex.pl.f.dil.HCl, *n* 1.700, 1.640, [α] − $206°^{20}_{D}$ in dil.HCl. **m.p.** 258–61 d. **Soly.** 0.011^{25}, 0.052^{75}w.; i.al.; i.et.; s.min.a., caustic alk, NH_4OH; i.chl., bz.

88 ***meso*-Cystine.** $[SCH_2CH(NH_2)COOH]_2$, 240.23. **Soly.** 0.006^{25}w.

89 **Cytisine** (*ulexine; sophorine; baptitoxine*). $C_{11}H_{14}N_2O$, 190.13. Col.lg. rhomb.cr. [α] − $119.1°^{17}_{D}$ in w. **m.p.** 152–3. **Soly.** 78^{16}w.; 30.1^{8}al.; i.et.; s.chl., bz.; i.CS_2, CCl_4.

90 ***β*-Cytisolidine.** See *Quinoline, 6, 8-dimethyl-**.

91 **Dambose.** See *i-Inositol.*

92 **Daphnetin** (*7, 8-dihydroxycoumarin*). $OCOCH:CHC_6H_2(OH)_2$, 178.05. Pa. yel.need. **m.p.** 256. **Soly.** v.s.h.w.; s.h.dil.al.; v.sl.s.et.; i.chl., bz.

* Name approved by the International Union of Chemistry.

93 Daturine. See *Hyoscyamine.*

94 *dl*-Daturine. See *Atropine.*

95 Decalin. See *Naphthalene, decahydro-*.*

96 Decamethylene glycol. See 1, 10-*Decanediol*.*

97 Decanal*. See *Capraldehyde.*

98 Decanamide*. See *Capramide.*

99 Decane* (*n-decane*). $CH_3(CH_2)_8CH_3$, 142.17. Col.liq., *n* 1.41203. **D.** 0.73014^{20}_{4}, **m.p.** −30 to −32, **b.p.** 174. **Soly.** i.w.; ∞al.; ∞et.

00 —, 1-amino-. See *Decylamine*.*

01 —, 1-iodo-* (*prim-n-decyl iodide*). $CH_3(CH_2)_9I$, 268.08. Liq., *n* 1.48269. **D.** 1.2567^{20}_{4}, **b.p.** 132^{15}.

02 Decanedioic acid*. See *Sebacic acid.*

03 1, 10-Decanediol* (*decamethylene glycol*). $CH_2OH(CH_2)_8CH_2OH$, 174.17. **m.p.** 71.5, **b.p.** 179^{11}. **Soly.** v.sl.s.w.; s.al.; i.et.

04 Decanenitrile*. See *Caprinitrile.*

05 Decanoic acid*. See *Capric acid.*

06 Decanoic anhydride*. See *Capric anhydride.*

07 1-Decanol* (*n-decyl alcohol; nonylcarbinol*). $CH_3(CH_2)_8CH_2OH$, 158.17. Col.visc.liq., *n* 1.43719. **D.** 0.8297^{20}_{4}, **m.p.** 7, **b.p.** 231. **Soly.** i.w.; s.al.; ∞et.

08 —, acetate (*n-decyl acetate*). $CH_3COO(CH_2)_9CH_3$, 200.19. Col.liq. **m.p.** −15.05, **b.p.** 191.5; 125^{15}. **Soly.** i.w.; s.al.; s.et.; s.bz.

09 —, nitrate (*n-decyl nitrate*). $CH_3(CH_2)_9ONO_2$, 203.17. Liq. **D.** 0.951^{0}_{4}, **b.p.** $127–8^{11}$.

10 —, nitrite (*n-decyl nitrite*). $CH_3(CH_2)_9ONO$, 187.17. Liq. **b.p.** $105–8^{12}$.

11 —, sulfate (*n-decyl sulfate; di-n-decyl sulfate*). $[CH_3(CH_2)_9]_2SO_4$, 378.39. **m.p.** 37.6–7.8.

12 4-Decanol* (*hexylpropylcarbinol; sec-decyl alcohol*). $CH_3(CH_2)_2CHOH(CH_2)_5CH_3$, 158.17. Thk.col.oil. **D.** 0.826^{20}_{4}, **b.p.** 210–1. **Soly.** i.w.; s.al.

13 2-Decanone* (*methyl octyl ketone*). $CH_3COC_8H_{17}$, 156.16. Liq. **D.** 0.825, **m.p.** 3.5, **b.p.** 211. **Soly.** i.w.; s.al.; s.et.

14 3-Decanone* (*ethyl heptyl ketone*). $C_2H_5CO(CH_2)_6CH_3$, 156.16. Liq. **b.p.** 211. **Soly.** s.al.; s.et.

15 4-Decanone* (*hexyl propyl ketone*). $CH_3(CH_2)_2CO(CH_2)_5CH_3$, 156.16. Col. liq. **D.** 0.824^{20}_{4}, **m.p.** −9, **b.p.** 207. **Soly.** v.sl.s.w.; ∞al.; ∞et.

16 Decanoyl chloride*. See *Capryl chloride.*

17 1-Decene* (*n-decylene*). $CH_2{:}CH(CH_2)_7CH_3$, 140.16. Col.liq., *n* 1.4385^{17}. **D.** 0.763^{0}_{4}, **m.p.** −87, **b.p.** 172. **Soly.** i.w.; ∞al.; ∞et.

18 1-Decine. See 1-*Decyne*.*

19 *n*-Decoic acid. See *Capric acid.*

20 *n*-Decyl alcohol. See 1-*Decanol*.*

21 *sec*-Decyl alcohol. See 4-*Decanol*.*

22 *tert*-Decyl alcohol. See 4-*Heptanol, 4-propyl-*; 3-Octanol, 3-ethyl-*.*

23 *n*-Decyl aldehyde. See *Capraldehyde.*

24 *n*-Decylamide. See *Capramide.*

25 Decylamine*(*n*) (*1-aminodecane*). $CH_3(CH_2)_9NH_2$, 157.19. Leaf. **D.** 0.951^{0}_{4}, **m.p.** 17, **b.p.** 218. **Soly.** i.w.

26 *n*-Decylene. See 1-*Decene*.*

***n*-Decyl esters.** See under 1-*Decanol.*

27 *n*-Decylic acid. See *Capric acid.*

28 *n*-Decylic amide. See *Capramide.*

29 *n*-Decylic anhydride. See *Capric anhydride.*

30 *prim-n*-Decyl iodide. See *Decane, 1-iodo-*.*

31 1-Decyne* (*1-decine; n-octylacetylene*). $CH{:}C(CH_2)_7CH_3$, 138.14. Col.liq. **D.** 0.791, **m.p.** −40, **b.p.** $80–2^{32}$. **Soly.** i.w.; s.al.; s.et.

32 Dehydroacetic acid (*3-acetyl-6-methyl-2, 4-pyrandione*). $OCOCH(COCH_3)$-$COCH{:}C(CH_3)$, 168.06. Rhomb.need. or pl. **m.p.** 109, **b.p.** 270. **Soly.** 1^{6}w.; s.h.al.; s.et.

33 Dehydromucic acid (*2, 5-furandicarboxylic acid*). $C_4H_2O(COOH)_2$, 156.03. Pl.f.h.al.; need.f.w. **m.p.** >320. **Soly.** i.c.w.

34 —, dimethyl ester. $C_4H_2O(COOCH_3)_2$, 184.06. Need.f.w. **m.p.** 109–10, **b.p.** $154–6^{15}$. **Soly.** i.c.w.; s.al.; s.et.

35 —, tetrahydro-3, 4-dihydroxy-. See *Isosaccharic acid.*

36 Dehydromucyl chloride (*2, 5-furandicarbonyl chloride*). $C_4H_2O(COCl)_2$, 192.93. Yel.pl. **m.p.** 80, **b.p.** *ca.* 245. **Soly.** v.s.w.; v.s.et.

37 Delphinine. $C_{34}H_{47}NO_9$, 577.37. Rhomb.pl. **m.p.** 191 d. **Soly.** 0.002^{20} w.; 4.8^{20}al.; 9^{20}et.; v.s.chl.

38 Derritol. $C_{21}H_{22}O_6$, 370.17. Yel. need.f.me.al. **m.p.** 161.

For explanations and abbreviations see beginning of table.

39 **Desoxalic acid** (*1, 2-dihydroxy-1, 1, 2-ethanetricarboxylic acid**). (COOH)CH(OH)C(OH)(COOH)$_2$, 194.05. Hyg.cr. **b.p.** d. 50. **Soly.** v.s.w.; v.s.al.; sl.s.et.

40 **Desoxybenzoin** (*α-phenylacetophenone; benzyl phenyl ketone*). $C_6H_5CH_2COC_6H_5$, 196.09. Wh.pl.f.al. **m.p.** 60 (55–6), **b.p.** 322. **Soly.** sl.s.h.w.; s.al.; s.et.

41 —, *α, α′*-**benzalbis-.** See *Benzamarone: Isobenzamarone.*

42 **Desoxymesityl oxide** (*2-acetyl-1, 3, 3, 4, 4-pentamethylcyclopentene*). $C_{12}H_{20}O$, 180.16. Liq. **b.p.** 218–20. **Soly.** i.w.

43 **Dextrin** (*starch gum; British gum; amylin; gommelin*). $(C_6H_{10}O_5)_x$, $(162.08)_x$. Col. amor., [α] gen. > +200°D. **D.** 1.0384^{20}_{4}, **m.p.** d. **Soly.** s.w.; i.al.; i.et.

44 **Dextronic acid.** See *d-Gluconic acid.*

45 **Dextrose.** See *D-Glucose.*

Di-. For dibromo, diethyl, etc. derivatives see the parent compounds (e.g., *Acetic acid, dibromo-; Benzene, diethyl-*).

46 **Diacetamide.** $(CH_3CO)_2NH$, 101.06. Col.need.f.et. **m.p.** 78, **b.p.** 223.5. **Soly.** s.w.; s.al.; s.et.; s.lgr.

47 —, *N*-**phenyl-.** See *Diacetanilide.*

48 **Diacetanilide** (*N-phenyldiacetamide; N, N-diacetylaniline*). $(CH_3CO)_2NC_6H_5$, 177.09. Col.pl.f.lgr. **m.p.** 37–8, **b.p.** 142^{11}. **Soly.** s.w.; s.al.; s.bz., lgr., tol.

49 —, *p*-**ethoxy-** (*N, N-diacetyl-p-phenetidine*). $(CH_3CO)_2NC_6H_4OC_2H_5$, 221.13. Need. **m.p.** 148–50 (53–4), **b.p.** 182^{12}. **Soly.** 0.25w.; v.s.al.; v.sl.s.et.

50 **Diacetin.** See *Glycerol, diacetate.*

51 **Diacetoacetic acid,** ethyl ester (*ethyl 2-acetyl-3-oxobutanoate*; ethyl α-acetylacetoacetate*). $(CH_3CO)_2CHCOOC_2H_5$, 172.09. Col.liq., n $1.46950^{18.3}$. **D.** 1.104^{15}_{4}; 1.089^{32}_{28}, **b.p.** 211 sl.d. **Soly.** sl.s.w.; v.s.al.; v.s.et.

52 **Diacetone alcohol.** See *2-Pentanone, 4-hydroxy-4-methyl-**.

53 **Diacetonealkamine, benzoylvinyl-.** See *β-Eucaine.*

54 **Diacetosuccinic acid,** diethyl ester (*diethyl 2, 3-diacetylbutanedioate*; ethyl α, β-diacetylsuccinate*). $(CH_3COCHCOOC_2H_5)_2$, 258.14.
$α_1$ Oil. **Soly.** v.sl.s.w.; s.al.; s.et.; 10 lgr.
$α_2$ Cr. **m.p.** 20–2. **Soly.** v.s.al.; v.s.et.
$α_3$ Pr. **m.p.** 31–2. **Soly.** i.w.; v.s.al.; v.s.et.
$α_4$ Rhomb. **D.** 1.209^{20}_{4}, **m.p.** 89–90. **Soly.** 15al.; 20et.

55 **Diacetyl.** See *2, 3-Butanedione**.

56 **Diacetyl dioxime.** See *Glyoxime, dimethyl-.*

57 **Diacetyl peroxide.** See *Acetyl peroxide.*

58 **Dial.** See *Barbituric acid, 5, 5-diallyl-.*

59 **Diallyl.** See *1, 5-Hexadiene**.

60 **Diallylamine** (*di-2-propenylamine**). $(CH_2{:}CHCH_2)_2NH$, 97.09. Liq. **b.p.** 111–2.

61 **Diallyl sulfide.** See *Allyl sulfide.*

62 **Dialuramide.** See *Uramil.*

63 **Dialuric acid** (*5-hydroxybarbituric acid; tartronylurea*). NHCONHCOCHOHCO, 144.05. Col.tetr. **m.p.** 214–5 d. **Soly.** sl.s.w.

Diamino-. See the parent compounds (e.g., for diaminophenol see *Phenol, diamino-;* for diaminonaphthalene see *Naphthalenediamine*).

64 **Diamylamine** (*di-n-amylamine*). $[CH_3(CH_2)_4]_2NH$, 157.19. Col.liq. **b.p.** $202–3^{745}$. **Soly.** v.sl.s.w.; v.s.al.; ∞et.

65 **Diamyl ketone.** See *6-Hendecanone**.

66 **Di-*n*-amyl sulfate.** See *Amyl sulfate.*

67 **Diarsenic tetramethyl.** See *Cacodyl.*

68 **1, 2-Diazine.** See *Pyridazine.*

69 **1, 3-Diazine.** See *Pyrimidine.*

70 **1, 4-Diazine.** See *Pyrazine.*

71 **Diazoacetic acid,** ethyl ester. See under *Acetic acid, diazo-.*

72 **Diazoaminobenzene*** (*1, 3-diphenyltriazene*; benzenediazoanilide*). $C_6H_5N{:}NNHC_6H_5$, 197.11. (1) Golden-yel.leaf. or pr.f.al. **m.p.** 98–9; **b.p.** d.w.sl.exp. **Soly.** i.w.; s.h.al.; s.et.; s.bz. (2) yel.pr. **m.p.** 80–1.

73 —, (isomeric form). $C_6H_5N{:}NNHC_6H_5$, 197.11. Yel.pr. **m.p.** 80–1, **b.p.** exp. **Soly.** i.w.; s.h.al.; s.et.; s.bz., lgr.

* Name approved by the International Union of Chemistry.

74 **Diazoaminobenzene, 4,4′-dinitro-*** (1,3-*bis(p-nitrophenyl)-triazene**). $NO_2C_6H_4NNNHC_6H_4NO_2$, 287.11. Yel.cr. **m.p.** 233 d. (224–6). **Soly.** i.w.; v.sl.s.h.al.; s.et.

75 —, **4-methyl-.** See *Triazene, 1-phenyl-3-p-tolyl-*.

76 **1,1′-Diazoaminonaphthalene*** (*1,3-di-1-naphthyltriazene**). $C_{10}H_7N$:-$NNHC_{10}H_7$, 297.14. Yel.leaf.f.al. **m.p.** exp.

77 **2,2′-Diazoaminonaphthalene*** (*1,3-di-2-naphthyltriazene**). $C_{10}H_7N$:-$NNHC_{10}H_7$, 297.14. Red need.f.xylene. **m.p.** 156.

78 **Diazobenzene chloride,** etc. See *Benzenediazonium chloride**, etc.

79 **Diazobenzene imide.** See *Benzene, triazo-*.

80 **Diazobenzene perbromide.** See *Benzenediazonium tribromide**.

81 **Diazobenzolic acid.** See *Aniline, N-nitro-*.

82 **1, 2-Diazole.** See *Pyrazole*.

83 **Diazomethane.** See *Methane, diazo-*.

84 **Dibenzanthracene**(*aj, αα′* or **1,2,7,8**) (*1, 2, 7, 8-dinaphthanthracene*). $C_{22}H_{14}$, 278.11. Brnsh.need.f.ac.a. **m.p.** 195–6. **Soly.** i.w.; i.al.; i.et.

85 **Dibenzo-*p*-dithiin.** See *Thianthrene*.

86 **Dibenzofuran** (*diphenylene oxide; biphenylene oxide*). $C_6H_4OC_6H_4$, 168.06. Col.leaf.f.al., bl.fluor. **m.p.** 87, **b.p.** 288. **Soly.** i.w.; sl.s.al.; v.s.et.; s.bz.

87 —, **3-amino-.** $C_{12}H_7O{\cdot}NH_2$, 183.08. Need. **m.p.** 99–99.5. **Soly.** i.w.; v.s.h.al.; v.s.et.

88 —, **2-bromo-.** $C_{12}H_7BrO$, 246.97. Leaf. **m.p.** 110, **b.p.** 220^{40}. **Soly.** i.w.; s.h.al.; s.et.

89 —, **3-nitro-.** $O_2NC_{12}H_7O$, 213.06. Yel.need. **m.p.** 181–3. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.h.glac.ac.a.

90 **2-Dibenzofurancarboxylic acid.** $C_{12}H_7O{\cdot}COOH$, 212.06. Amor. **m.p.** 246–7. **Soly.** v.sl.s.w.; s.h.al.; s.et.

91 **Dibenzo**(*ai*)**phenanthrene.** See *Picene*.

92 **Dibenzo-1, 4-pyran.** See *Xanthene*.

93 **Dibenzopyrrole.** See *Carbazole*.

94 **Dibenzothiophene-2, 7-diamine,** 9-dioxide. See *Benzidine sulfone*.

95 **Dibenzoyl.** See *Benzil*.

96 **Dibenzyl.** See *Bibenzyl*.

97 **Dibenzylamine*.** $(C_6H_5CH_2)_2NH$, 197.13. Col.liq., *n* 1.57432^{22}. **D.** 1.026^{22}, **m.p.** −26, **b.p.** 300 (268–71^{250}). **Soly.** i.w.; v.s.al.; v.s.et.

98 —, dibenzylthiolthionocarbamate. See under *Carbamic acid, dibenzylthiolthiono-*.

99 —, ***N*-phenyl-**(*N, N-dibenzylaniline*). $(C_6H_5CH_2)_2NC_6H_5$, 273.16. Need. or pr.f.al., *n* 1.60647^{80}. **D.** 1.04436^{80}_{4}, **m.p.** 71–2 (69.5), **b.p.** >300 d. **Soly.** i.w.; sl.s.al.; s.et.; s.bz.

00 **Dibenzyl disulfide.** See *Benzyl disulfide*.

Dibromo-. See the parent compounds (e.g., for dibromobenzene see *Benzene, dibromo-*).

01 ***β*-Dibromohydrin.** See *1-Propanol, 2, 3-dibromo-**.

02 **Dibutylamine*** (*di-n-butylamine*). $(C_4H_9)_2NH$, 129.16. Col.liq. **D.** 0.767^{20}_{4}, **b.p.** 159–61. **Soly.** s.w.; v.s.al.; v.s.et.

03 —, ***N*-phenyl-.** See *Aniline, N, N-dibutyl-*.

04 **Di-*n*-butyl sulfate.** See *Butyl sulfate*.

05 **Dichloramine(T).** (*N, N-dichloro-p-toluenesulfonamide*). $CH_3C_6H_4SO_2$-NCl_2, 240.04. Pa.yelsh.cr. or powd. **m.p.** 83. **Soly.** sl.s.w.; s.al.; s.et., s.bz., chl., CCl_4, ac.a.

Dichloro-. See the parent compounds (e.g., for dichlorobenzene see *Benzene, dichloro-*).

06 ***α*-Dichlorohydrin.** See *2-Propanol, 1, 3-dichloro-**.

07 ***β*-Dichlorohydrin.** See *1-Propanol, 2, 3-dichloro-**.

08 **Dichloronitrohydrin.** See *2-Propanol, 1, 3-dichloro, nitrate**.

09 **Dicyan(o)diamide.** See *Guanidine, 1-cyano-*.

10 **Dicyan(o)diamidine.** See *Urea, guanyl-*.

11 **Dicyclohexylamine*.** $(C_6H_{11})_2NH$, 181.19. Col.liq. **b.p.** 254–6^{745}. **Soly.** sl.s.w.; v.s.al.; ∞ et.

12 **Dicysteine.** See *l-Cystine*.

13 **Di-*n*-decyl sulfate.** See *1-Decanol, sulfate*.

14 **Di-*n*-dodecyl sulfate.** See *Dodecyl sulfate*.

15 **Diethanolamine** (*2, 2′-iminodiethanol; β, β′-dihydroxydiethylamine; iminoethyl alcohol* (incorrect)). $HN(CH_2$-$CH_2OH)_2$, 105.09. Col.liq. or pr., *n* 1.4776. **D.** 1.0966^{30}_{4}, **m.p.** 28, **b.p.** 268; 270^{748}. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.; sl.s.bz.

For explanations and abbreviations see beginning of table.

Diethyl. For diethyl derivatives see the parent compounds (e.g., for diethylbenzene see *Benzene, diethyl-*). For diethyl esters of organic acids see the acids.

16 Diethylamine*. $(C_2H_5)_2NH$, 73.09. Col.inflam.liq., *n* 1.38730^{18}. **D.** 0.7108^{20}_{4}, **m.p.** −50 (−39), **b.p.** 55.5. **Soly.** $81.5^{14.4}$w.; s.al.; s.et.

17 —, diethylthiolthionocarbamate. See under *Carbamic acid, diethylthiolthiono-*.

18 —, hydrochloride (*diethylammonium chloride**). $(C_2H_5)_2NH \cdot HCl$, 109.56. Leaf.f.et.al. **D.** 1.048^{21}_{4}, **m.p.** 219–20, **b.p.** 330. **Soly.** 232^{25}w.; sl.s.c.al.; i.et.

19 —, ***N*-cyano-.** See *Cyanamide, diethyl-*.

20 —, **β, β′-dihydroxy-.** See *Diethanolamine.*

21 —, **β, β′-dihydroxy-*N*-methyl-.** See *Ethanol, 2, 2′-methyliminodi-*.

22 —, ***N*-formyl-.** See *Formamide, N, N-diethyl-*.

23 —, **β-hydroxy-.** See *Ethanol, 2-ethylamino-**.

24 —, ***N*-methyl-.** $(C_2H_5)_2NCH_3$, 87.11. Col.liq. **b.p.** 63–5. **Soly.** v.s.w.; s.al.; s.et.

25 —, ***N*-nitro-** (*diethylnitramine; nitric diethylamide*). $(C_2H_5)_2NNO_2$, 118.09. Liq. **b.p.** 206^{757}. **Soly.** sl.s.w.; ∞al.; ∞et.

26 —, ***N*-nitroso-** (*diethylnitrosamine; nitrous diethylamide*). $(C_2H_5)_2NNO$, 102.09. Yel.liq., *n* $1.43864^{19.9}$. **D.** 0.9422^{20}_{4}, **b.p.** 177 (175.4). **Soly.** s.w.; ∞al.; ∞et.

27 —, ***N*-phenyl-.** See *Aniline, N, N-diethyl-*.

28 Diethylenediamine. See *Piperazine.*

29 Diethylene dioxide. See *p-Dioxane.*

30 Diethylene disulfide. See *p-Dithiane.*

31 Diethylene glycol (*2, 2′-oxydiethanol; 2, 2′-dihydroxyethyl ether*). $O(CH_2CH_2OH)_2$, 106.08. Col.liq. **D.** 1.132^{0}_{4}; 1.1177^{20}_{4}, **m.p.** −10.45 (−6.5), **b.p.** 244.5 (245–50). **Soly.** s.w.; s.al.; s.et.

32 —, diethyl ether. See *Ether, bis(β-ethoxyethyl)*.

33 —, dioleate. $(C_{17}H_{33}COOC_2H_4)_2O$, 634.58. Pa.yel.liq. **D.** 0.9310^{20}_{4}. **Soly.** Dispersible w.; ∞al.; ∞et.

34 —, distearate (*glycosterin*). $(C_{17}H_{35}COOC_2H_4)_2O$, 638.61. Wh. wax-like solid. **D.** 0.9333^{20}_{4}, **m.p.** 54–5. **Soly.** Dispersible w.; i.al.; i.et.

35 —, monobutyl ether (*2-(β-butoxyethoxy)ethanol*; butyl carbitol*). $C_4H_9OCH_2CH_2OCH_2CH_2OH$, 162.14. Col. liq. **D.** 0.9553^{20}_{4}, **b.p.** 231.2. **Soly.** ∞w.; v.s.al.; v.s.et.

36 —, monobutyl ether acetate. $C_4H_9O(CH_2)_2O(CH_2)_2OOCCH_3$, 204.16. Col. liq. **D.** 0.985^{20}_{4}, **b.p.** 245.

37 —, monoethyl ether (*2-(β-ethoxyethoxy)ethanol*; carbitol*). $C_2H_5OCH_2CH_2OCH_2CH_2OH$, 134.11. Col.liq. **D.** 0.9902^{20}_{4}, **b.p.** 201.9. **Soly.** ∞w.; v.s.al.; s.et.

38 —, monoethyl ether acetate. $C_2H_5O(CH_2)_2O(CH_2)_2OOCCH_3$, 176.12. Col liq. **D.** 1.009^{20}_{4}, **b.p.** 218. **Soly.** ∞w

39 —, monomethyl ether (*2-(β-methoxyethoxy)ethanol*; methyl carbitol*). $CH_3OCH_2CH_2OCH_2CH_2OH$, 120.09. Col liq. **D.** 1.0354^{20}_{4}, **b.p.** 193.2. **Soly** ∞w.

40 Diethylene oxide 2-iminoethyl alcohol. See *4-Morpholineëthanol.*

41 Diethylenimide oxide. See *Morpholine.*

42 Diethyl ether. See *Ethyl ether.*

43 Diethylphosphoric acid (*diethyl hydrogen phosphate*). $PO(OC_2H_5)_2OH$ 154.11. Liq. **D.** 0.6872^{17}_{4}, **b.p.** 59 **Soly.** i.w.

44 Diethyl sulfate. See *Ethyl sulfate.*

45 Diethyl sulfite. See *Ethyl sulfite.*

46 Difurfurylamine (*α, α′-di-2-furyldimethylamine*). $(C_4H_3OCH_2)_2NH$ 177.09. Col.liq. **b.p.** 102–3[1]. **Soly** i.w.; s.et.

47 *m*-Digallic acid (*gallic acid 3-monogallate*). $C_{14}H_{10}O_9$, 322.08. Need $(+1H_2O)$f.al. + w. **m.p.** 268–70 d.

49 Diglycolamidic acid. See *Acet acid, iminodi-*.

50 Diglycolic acid (*oxydiethanoic acid; oxydiacetic acid*). $O(CH_2COOH)$ 134.05. Rhomb. or monocl.pr $(+1H_2O)$f.w. **m.p.** 148, **b.p.** **Soly.** s.w.; s.al.; s.et.

51 Diglycolide. See *Glycolide.*

52 Diglycolyl diamide. See *Glycin anhydride.*

53 Diguanide. See *Biguanide.*

54 Di-*n*-heptyl sulfate. See *Hept sulfate.*

55 Di-*n*-hexadecyl sulfate. See *Cet sulfate.*

56 Dihexyl. See *Dodecane*.*

* Name approved by the International Union of Chemistry.

57 **Di-*n*-hexyl sulfate.** See *Hexyl sulfate.*

Dihydro-. See the parent compounds (e.g., for dihydronaphthalene see *Naphthalene, dihydro-.*)

Dihydroxy-. See the parent compounds (e.g., for dihydroxyanthraquinone, see *Anthraquinone, dihydroxy-;* for dihydroxynaphthalene see *Naphthalenediol.*)

58 **Diimide, dinaphthyl-.** See *Azonaphthalene.*

59 **—, diphenyl-.** See *Azobenzene.*

60 **—, dixenyl-.** See *Azobiphenyl.*

61 **—, ethylphenyl-.** See *Benzeneazoethane.*

62 **—, methylphenyl-.** See *Benzeneazomethane.*

63 **—, α-naphthyl-β-naphthyl-.** See *1, 2′-Azonaphthalene.*

64 **Diisoamylamine** (*bis(γ-methylbutyl)-amine**). $[(CH_3)_2CHCH_2CH_2]_2NH$, 157.19. Col.liq., *n* 1.42289^{21}. **D.** 0.7672^{21}_{4}, **m.p.** −44, **b.p.** 190 (185–8). **Soly.** sl.s.(i.)w.; s.al.; ∞et.

65 **Diiosamyl sulfate.** See *Isoamyl sulfate.*

66 **Diisoamyl sulfide.** See *Isoamyl sulfide.*

67 **Diisobutylamine** (*bis(β-methylpropyl)amine**). $[(CH_3)_2CHCH_2]_2NH$, 129.16. Col.liq., *n* 1.40934. **D.** 0.7450^{20}_{0}, **m.p.** −70; frz. −77, **b.p.** 139–40. **Soly.** v.sl.s.w.; s.al.; s.et.

68 **Diisobutylene.** $(CH_3)_2C{:}CHC(CH_3)_3$ or $CH_2{:}C(CH_3)CH_2C(CH_3)_3$, 112.12. Col.liq. **D.** 0.715^{15}_{4}, **b.p.** 102.6.

69 **Diisobutyl sulfate.** See *Isobutyl sulfate.*

70 **Diisocrotyl.** See *2, 4-Hexadiene, 2, 5-dimethyl-*.*

71 **Diisopropylamine*.** $[(CH_3)_2CH]_2$-NH, 101.13. Col.liq. **D.** 0.722^{22}_{0}, **b.p.** 83–4. **Soly.** sl.s.w.

72 **—, *N*-nitroso-** (*diisopropylnitrosamine; nitrous diisopropylamide*). $[(CH_3)_2CH]_2NNO$, 130.13. Cr.f.et. **m.p.** 46, **b.p.** 194.5. **Soly.** v.sl.s.w.; v.s.al.; s.et.; s.bz.

73 **Diketone, dimethyl.** See *2, 3-Butanedione*.*

74 **—, diphenyl.** See *Benzil.*

75 **α, γ-Dilaurin.** See *Glycerol, 1, 3-dilaurate.*

Dimethyl. For dimethyl derivatives see the parent compounds (e.g., for dimethylbenzoic acid see *Benzoic acid, dimethyl-*). For dimethyl esters of organic acids see the acids.

76 **Dimethylamine*.** $(CH_3)_2NH$, 45.06. Col.liq. or gas, *n* liq. 1.350^{17}. **D.** 0.6804^{0}_{4}, **m.p.** −96.0, **b.p.** 7.4. **Soly.** v.s.w.; s.al.; s.et.

77 —, dimethylthiolthionocarbamate. See under *Carbamic acid, dimethylthiolthiono-.*

78 —, hydrochloride (*dimethylammonium chloride**). $(CH_3)_2NH{\cdot}HCl$, 81.53. Need.f.al. **m.p.** 171. **Soly.** 369^{25}w.; v.s.al.; i.et.; 25.16^{25}chl.

79 **—, α, α'-dicyano-.** See *Acetonitrile, iminodi-.*

80 **—, α, α'-di-2-furyl-.** See *Difurfurylamine.*

81 **—, *N*-nitro-** (*dimethylnitramine; nitric dimethylamide*). $(CH_3)_2NNO_2$, 90.06. **m.p.** 57–8, **b.p.** 187. **Soly.** s.w.; s.al.; s.et.

82 **—, *N*-nitroso-** (*dimethylnitrosamine; nitrous dimethylamide*). $(CH_3)_2NNO$, 74.06. Yel. oily liq., *n* 1.43743^{18}. **D.** 1.0049^{18}_{4}, **b.p.** 152–3. **Soly.** s.w.; s.al.; s.et.

83 **Dimethylarsenic monochloride.** See *Cacodyl chloride.*

84 **Dimethylenimine.** See *Ethylenimine.*

α, α-Dimethylpropyl. See *tert-Butyl.*

85 **Dimethyl sulfate.** See *Methyl sulfate.*

86 **Dimethyl sulfite.** See *Methyl sulfite.*

87 **1, 2, 7, 8-Dinaphthanthracene.** See *Dibenzanthracene.*

88 **α-Dinaphthol.** See *4, 4′-Bi-1-naphthol.*

89 **Dinaphthyl.** See *Binaphthyl.*

90 **Di-2-naphthylamine*.** $C_{10}H_7$-$NHC_{10}H_7$, 269.13. Leaf.f.bz. **m.p.** 171, **b.p.** 471. **Soly.** i.w.; sl.s.al.; s.et.; s.h.ac.a., bz.; blue fluores.

91 **Dinicotinic acid** (*3, 5-pyridinedicarboxylic acid**). $C_5H_3N(COOH)_2$, 167.05. Cr. **m.p.** 323, **b.p.** d. **Soly.** v.sl.s.w.

Dinitro-. See the parent compounds (e.g., for dinitrobenzene see *Benzene, dintro-*).

92 **Di-*n*-nonyl sulfate.** See *Nonyl sulfate.*

93 **Di-*n*-octadecyl sulfate.** See *Octadecyl sulfate.*

94 **Di-*n*-octyl sulfate.** See *Octyl sulfate.*

95 **Dionin.** See *Morphine, ethyl-, hydrochloride.*

96 ***m*-Dioxane** (1, 3-*dioxane; trimethylene glycol methylene ether; trimethylene methylene dioxide*). $OCH_2OCH_2CH_2CH_2$, 88.06. Col.liq., *n* 1.41652. **D.** 1.03422^{20}_{4}, **b.p.** 105^{755}. **Soly.** ∞w.; ∞al.; ∞et.

97 ***p*-Dioxane** (1, 4-*dioxane; diethylene dioxide; glycol ethylene ether*). $OCH_2CH_2OCH_2CH_2$, 88.06. Col.liq., *n* 1.4232. **D.** 1.0353^{20}_{4} (1.03034^{25}_{4}), **m.p.** 11.7 (9–13), **b.p.** 101.5. **Soly.** ∞w.; ∞al.; ∞et.; ∞most org.liq.

98 **2, 5-*p*-Dioxanedione.** See *Glycolide.*

99 **2, 5-*p*-Dioxanedione, 3, 6-dimethyl-.** See *Lactide.*

00 **Dioxindole.** See *Oxindole, 3-hydroxy-.*

01 **1, 3-Dioxolane, 2-methyl-** (*ethylene ethylidene ether; glycol ethylidene diether*). $OCH(CH_3)OCH_2CH_2$, 88.06. **D.** 1.002^{0}_{4}, **b.p.** 82.5. **Soly.** 66.7w.

02 *α, γ*-**Dipalmitin.** See *Glycerol,* 1, 3-*dipalmitate.*

03 **Dipentene.** See *dl-Limonene.*

04 **Diphenic acid** (2, 2′-*biphenyldicarboxylic acid; o, o′-bibenzoic acid;* 1, 10-*diphenic acid*). $(COOH)C_6H_4$-C_6H_4COOH, 242.08. Monocl.leaf.f.w. **m.p.** 228–9, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; s.most.org.solv.

05 —, dimethyl ester (*methyl diphenate*). $(C_6H_4COOCH_3)_2$, 270.11. Pr.f.me.al. **m.p.** 74.

06 —, diphenyl ester (*ethyl diphenate*). $(C_6H_4COOC_2H_5)_2$, 298.14. **m.p.** 42.

07 —, **4, 4′, 5, 5′, 6, 6′-hexahydroxy-,** dilactone. See *Ellagic acid.*

08 —, **3-nitro-**(COOH = 1) (*o-nitrodiphenic acid*). $COOHC_6H_3NO_2C_6$-H_4COOH, 287.08, **m.p.** 248–50 d.

09 —, **4-nitro-** (*m-nitrodiphenic acid*). $COOHC_6H_3NO_2C_6H_4COOH$, 287.08, **m.p.** 268.

10 —, **5-nitro-** (*p-nitrodiphenic acid*). $COOHC_6H_3NO_2C_6H_4COOH$, 287.08. **m.p.** 214–6.

11 **Diphenic anhydride.** $(C_6H_4CO)_2$-O, 224.06. **m.p.** 219, **b.p.** subl. **Soly.** i.w.; sl.s.et.

12 **Diphenimide.** $(C_6H_4CO)_2NH$, 223.08. Need. **m.p.** 217.5 (219). **Soly.** i.w.; sl.s.al.; i.et.; s.chl.

13 **Diphenine.** See *Hydrazobenzene,* 4, 4′-*diamino-.*

14 **Diphenoquinone, 3, 3′, 5, 5′-tetramethoxy-.** See *Cerulignone.*

15 **Diphenoyl chloride** (2, 2′-*biphenyldicarbonyl chloride*). $(C_6H_4COCl)_2$, 278.98. **m.p.** 94 (97). **Soly.** sl.s.et.; s.bz.

16 **Diphenyl.** See *Biphenyl.*

Diphenyl-. For diphenyl derivatives see the parent compounds (e.g., for diphenylmethane see *Methane, diphenyl-*).

17 **Diphenylamine*** (*N-phenylaniline; anilinobenzene*). $(C_6H_5)_2NH$, 169.09. Col.monocl.leaf. **D.** 1.159^{22}_{4}, **m.p.** 53, **b.p.** 302. **Soly.** 0.03^{25}w.; 44c.al.; v.s.et.; 57.5me.al.; s.bz., lgr.

18 —, ***N*-acetyl-.** See *Acetamide, N, N-diphenyl-.*

19 —, ***o*-amino-.** See *o-Phenylenediamine, N-phenyl-.*

20 —, ***p*-amino-.** See *p-Phenylenediamine, N-phenyl-.*

21 —, ***N*-benzyl-** (*N, N-diphenylbenzylamine*). $C_6H_5CH_2N(C_6H_5)_2$, 259.14. Need. **m.p.** 95 (88.5). **Soly.** v.sl.s.w.; sl.s.c., s.h.al.; v.s.et.

22 —, ***p, p′*-bisdimethylamino-** (*leuco base of Bindschedler green; tetramethyl-*4, 4′-*diaminodiphenylamine*). NH-$[C_6H_4N(CH_3)_2]_2$, 255.19. Tetr.pl.f. CS_2, **m.p.** 119. **Soly.** v.sl.s.w.; s.al.; s.et.

23 —, **4, 4′-diamino-** (*p, p′-iminodianiline*). $NH_2C_6H_4NHC_6H_4NH_2$, 199.13. Leaf.f.w. **m.p.** 158, **b.p.** d. **Soly.** sl.s.w.; s.al.; s.et.

24 —, **2, 4′-dinitro-*.** $NO_2C_6H_4NHC_6$-H_4NO_2, 259.09. Yelsh.-red need.f.bz. **m.p.** 222 (156–7). **Soly.** i.w.; sl.s.al.; s.acet., chl., pyr.

25 —, **4, 4′-dinitro-*.** $NO_2C_6H_4NHC_6$-H_4NO_2, 259.09. Yel.need.f.al. **m.p.** 216 (214.5). **Soly.** i.w.; sl.s.al.; 5.66^{23} acet.; s.glac.ac.a.; sl.s.bz.

26 —, ***N*-ethyl-.** $(C_6H_5)_2NC_2H_5$, 197.13. Liq. **b.p.** 297. **Soly.** i.w.; s.al.; s.et.

27 —, ***N*-formyl-.** See *Formamide, N, N-diphenyl-.*

28 —, **hydroxy-.** See *Phenol, anilino-.*

29 —, ***N*-methyl-.** $(C_6H_5)_2NCH_3$, 183.11. Col.liq. **D.** 1.048^{20}_{4}, **m.p.** −7.6, **b.p.** 293.4. **Soly.** i.w.; s.al.; s.et.

30 —, ***p*-nitro-.** $NO_2C_6H_4NHC_6H_5$, 214.09. Yel.need. **m.p.** 132, **b.p.** 211.0^{30}. **Soly.** i.w.; v.s.al.; v.s.ac.a.

31 —, ***N*-nitroso-** (*diphenylnitrosamine; nitrous diphenylamide*). $(C_6H_5)_2NNO$, 198.09. Yel.monocl.pl.f.lgr. **m.p.** 66.5. **Soly.** sl.s.c., v.s.h.al.; s.h.bz.

* Name approved by the International Union of Chemistry.

32 **Diphenylamine, *p*-nitroso-.** NO-$C_6H_4NHC_6H_5$, 198.09. Grn.pl.f.al. or bz., **m.p.** 143. **Soly.** sl.s.w.; s.c., v.s.h.al.; s.et.; v.s.chl.; s.bz.

33 **—, thio-.** See *Phenothiazine.*

34 **Diphenyl carbonate.** See *Carbonic acid, diphenyl ester.*

35 **Diphenylene ketone oxide.** See *Xanthone.*

36 **Diphenylene oxide.** See *Dibenzofuran.*

37 **Diphenylenimine.** See *Carbazole.*

38 **Diphenyline.** See *2, 4′-Biphenyldiamine.*

39 **Diphosgene** (*trichloromethyl chloroformate; superpalite; perchloromethyl formate*). $ClCOOCCl_3$, 197.83. Col. liq. **D.** 1.653^{14}_{4}, **m.p.** −57, **b.p.** 127.5. **Soly.** i.w.; v.s.al.; v.s.et.

40 **Dipicolinic acid** (2, 6-*pyridinedicarboxylic acid*; α, α′-dipicolinic acid*). $C_5H_3N(COOH)_2 \cdot 1\frac{1}{2}H_2O$, 194.07. Col.need.($+1\frac{1}{2}H_2O$)f.w. **m.p.** anh. 226 d. **Soly.** v.sl.s.w.; v.sl.s.al.

41 **Diplumbane, hexaethyl-.** See *Lead, hexaethyldi-.*

42 **Diplumbic hexaethyl.** See *Lead, hexaethyldi-.*

43 **Dipropargyl.** See 1, 5-*Hexadiyne*.*

44 **Di-2-propenylamine*.** See *Diallylamine.*

45 **Dipropylamine*** (*di-n-propylamine*). $(CH_3CH_2CH_2)_2NH$, 101.13. Col.liq., n $1.40455^{13.5}$. **D.** 0.7384^{20}_{4}, **m.p.** −39.6, **b.p.** 110.7. **Soly.** s.w.; s.al.; ∞ et.

46 **—, *N*-nitroso-** (*dipropylnitrosamine; nitrous dipropylamide*). $(CH_3CH_2CH_2)_2NNO$, 130.13. Yel.liq. **D.** $0.910^{2.5}_{4}$, **b.p.** 205. **Soly.** v.sl.s.w.; ∞ al.; ∞ et.

47 **Dipropylene.** See 2, 4-*Hexadiene*.*

48 **Di-*n*-propyl sulfate.** See *Propyl sulfate.*

49 **Dipyridine.** See *Nicotyrine.*

50 **Dipyridyl.** See *Bipyridyl.*

51 **5, 10-Dipyrrolo[1, 2-*a*, 1, 2-*d*]pyrazinedione.** See *Pyrocoll.*

53 **Diquinolyl.** See *Biquinoline.*

54 *α, γ*-**Distearin.** See *Glycerol, 1, 3-distearate.*

55 **Disulfide, bis(dibutylthiocarbamyl)** (*tetrabutylthiuram disulfide*). $[(C_4H_9)_2NCS]_2S_2$, 408.54. Yel.or.liq. **Soly.** i.w.; sl.s.al.; s.et.

56 **—, bis(diethylthiocarbamyl)** (*tetraethylthiuram disulfide*). $[(C_2H_5)_2NCS]_2S_2$, 296.41. Yel.cr. **m.p.** 70. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.chl.

57 **—, bis(dimethylthiocarbamyl)** (*tetramethylthiuram disulfide*). $[(CH_3)_2NCS]_2S_2$, 240.35. Yel.cr. **D.** 1.29^{20}_{4}, **m.p.** 155–6 (141–5). **Soly.** i.w.; sl.s.al.; sl.s.et.; s.chl.

58 **—, bis(ethylmethylthiocarbamyl)** (*diethyldimethylthiuram disulfide*). $[(CH_3)C_2H_5NCS]_2S_2$, 268.38. Yel.cr. **m.p.** 72. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.chl.

59 **—, bis(1-piperidylthiocarbonyl)** (*dicyclopentamethylenethiuram disulfide*). $(C_5H_{10}NCS)_2S_2$, 320.41. Yel. cr. **m.p.** 129–30. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.chl.

60 **—, bis(tetrabenzylthiocarbamyl)** (*tetrabenzylthiuram disulfide*). $[(C_6H_5CH_2)_2NCS]_2S_2$, 544.47. Yel.cr. **m.p.** 132–3. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.chl.

61 **—, diacetyl.** See *Acetyl disulfide.*

62 **—, 2, 2′-dibenzothiazyl.** See *Benzothiazole, 2, 2′-dithiobis-(S = 1).*

63 **—, dibenzoyl.** See *Benzoyl disulfide.*

64 **—, diethyl.** See *Ethyl disulfide.*

65 **—, diisoamyl.** See *Isoamyl disulfide.*

66 **—, dimethyl.** See *Methyl disulfide.*

67 **—, diphenyl.** See *Phenyl disulfide.*

68 **—, diphenylene.** See *Thianthrene.*

69 **Ditaine.** See *Echitamine.*

70 **Ditan.** See *Methane, diphenyl-.*

71 **—, *α*-methyl-.** See *Ethane, 1, 1-diphenyl-.*

72 **Di-*n*-tetradecyl sulfate.** See *Tetradecyl sulfate.*

73 ***p*-Dithiane** (1, 4-*dithiane; diethylene disulfide; tetrahydro-p-dithiin*). $SCH_2CH_2SCH_2CH_2$ (ring), 120.18. Col.monocl.f. et. **m.p.** 112, **b.p.** 200. **Soly.** v.sl.s. w.; v.s.al.; v.s.et.; s.CS_2.

74 **1, 3, 5-Dithiazine, 5, 6-dihydro-2, 4, 6-trimethyl-.** See *Thialdine.*

75 *α, α*-**Dithienyl.** See 2, 2′-*Bithiophene.*

76 ***p*-Dithiin, tetrahydro-.** See *Di-p-thiane.*

77 **Ditolan azotide.** See *Amaron.*

78 **Di-*o*-tolylamine.** $(CH_3C_6H_4)_2NH$, 197.13. Bl.cr. **m.p.** 52–3, **b.p.** 313.4. **Soly.** v.sl.s.w.

For explanations and abbreviations see beginning of table.

79 **Di-*m*-tolylamine.** $(CH_3C_6H_4)_2NH$, 197.13. Liq. **m.p.** <-12, **b.p.** 320. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

80 **Di-*p*-tolylamine.** $(CH_3C_6H_4)_2NH$, 197.13. Col.need.f.pet.eth. **m.p.** 79, **b.p.** 330.5. **Soly.** v.sl.s.w.

81 **Diurea.** See *p-Urazine.*

82 **Divinyl.** See 1, 3-*Butadiene*.*

83 **Docosane*(*n*).** $CH_3(CH_2)_{20}CH_3$, 310.36. Cr.f.al. **D.** 0.778^{44}_{4}, **m.p.** 44.4, **b.p.** 317.4(224^{15}). **Soly.** i.w.; 4^{78}al.; v.s.et.

84 **Docosanoic acid*.** See *Behenic acid.*

85 ***cis*-13-Docosenoic acid*.** See *Erucic acid.*

86 ***trans*-13-Docosenoic acid*.** See *Brassidic acid.*

87 ***n*-Docosoic acid.** See *Behenic acid.*

88 **13-Docosynoic acid*.** See *Behenolic acid.*

89 **Dodecanal*.** See *Lauraldehyde.*

90 **Dodecane*** (*n-dodecane; bihexyl; dihexyl*). $CH_3(CH_2)_{10}CH_3$, 170.20. Col. liq. **D.** 0.766^{0}_{4}; 0.7511^{20}_{4}, **m.p.** −12, **b.p.** 214.5; 145^{100}. **Soly.** i.w.; v.s.al.; v.s.et.

91 **—, 1-amino-.** See *Dodecylamine*.*

92 **—, 1-bromo-*** (*dodecyl bromide; lauryl bromide*). $CH_3(CH_2)_{10}CH_2Br$, 249.11. Liq. **b.p.** 175–80^{45}. **Soly.** i.w.; s.al.; s.et.

93 **Dodecanenitrile*.** See *Lauronitrile.*

94 **Dodecanoic acid*.** See *Lauric acid.*

95 **1-Dodecanol*** (*n-dodecyl alcohol; lauryl alcohol*). $CH_3(CH_2)_{11}OH$, 186.20. Leaf.f.dil.al. **D.** 0.8309^{24}_{4}, **m.p.** 22.6 (24), **b.p.** 255. **Soly.** i.w.; s.al.; s.et.

96 **6-Dodecanol*** (*amylhexylcarbinol*). $CH_3(CH_2)_4CHOH(CH_2)_5CH_3$, 186.20. Cr. **m.p.** 30, **b.p.** 119^{9}. **Soly.** s.al.; s.et.

97 **Dodecanoyl chloride*.** See *Lauryl chloride.*

98 **1-Dodecene*** (*α-dodecylene*). $C_{12}H_{24}$, 168.19. Col.liq. **D.** 0.7732^{0}_{4}; 0.762^{20}_{4}, **m.p.** −31.5, **b.p.** 213–5. **Soly.** i.w.; v.s.al.; v.s.et.

99 ***n*-Dodecyl alcohol.** See 1-*Dodecanol*.*

00 **Dodecylamine*** (*pri-n-dodecylamine; 1-aminododecane*). $CH_3(CH_2)_{11}NH_2$, 185.22. **m.p.** 27–8, **b.p.** 247–9; 134–5^{15}.

01 ***α*-Dodecylene.** See 1-*Dodecene*.*

02 **Dodecyl sulfate** (*di-n-dodecyl sulfate*). $[CH_3(CH_2)_{11}]_2SO_4$, 434.45. **m.p.** 48.4 8.5.

03 **Dotriacontane*** (*n-dotriacontane*). $CH_3(CH_2)_{30}CH_3$, 450.51. Cr.pl.f.et. **D.** $0.775^{79.4}$, **m.p.** 74–5(70), **b.p.** 310^{15}. **Soly.** v.sl.s.c.al.; s.h.et.; s.h.ac.a.

04 **Duboisine.** See *Hyoscyamine.*

05 **Dulcin.** See *Urea, p-phenetyl-.*

06 **Dulcitol** (1, 2, 3, 4, 5, 6-*hexanehexol** (one form); *dulcite; melampyrin*). $C_6H_8(OH)_6$, 182.11. Col.monocl.pr. **D.** 1.466^{15}_{4}, **m.p.** 188, **b.p.** $295^{3.5}$. **Soly.** 3.2^{15}w.; 0.0734^{15}al.; v.sl.s.et.

07 **Durene** (1, 2, 4, 5-*tetramethylbenzene*). $(CH_3)_4C_6H_2$, 134.11. Col.monocl.leaf., *n β* 1.615. **D.** liq. 0.838^{81}_{4}, **m.p.** 80 (78–9), **b.p.** 193–5, subl. **Soly.** i.w.; s.al.; s.et.; s.bz.; v.s.ac.a.

08 **Durylic acid** (2, 4, 5-*trimethylbenzoic acid; cumylic acid*). $(CH_3)_3C_6H_2COOH$, 164.09. Col.need.f.bz. **m.p.** 149.5. **Soly.** v.sl.s.h.w.; v.s.al.; v.s.et.; s.bz.

09 **Ecgonidine.** See *dl-Anhydroecgonine.*

10 **Ecgonine, benzoyl-.** $C_{16}H_{19}NO_4 \cdot 4H_2O$, 361.22. Lust.need.f.w. **m.p.** 90–2; anh. 193–5. **Soly.** sl.s.c., s.h.w.; s.al.; i.et.; s.dil.a., alk.

11 **—, benzoylmethyl-.** See *Cocaine.*

12 *l*-**Ecgonine** (*tropinecarboxylic acid*). $C_9H_{15}NO_3 \cdot H_2O$, 203.14. Col.monocl. pr.f.al. **D.** 1.370^{12}; 0.777^{37}_{4}, **m.p.** 198; anh. 205. **Soly.** 21.7^{17}w.; 1.5al.; v.sl.s.et.

13 —, hydrochloride. $C_9H_{15}NO_3 \cdot HCl$, 221.59. Rhomb. or tricl.tab., $[\alpha] - 57°_D$. **m.p.** 246. **Soly.** s.w.; sl.s.al.

14 **Echitamine** (*ditaine*). $C_{22}H_{28}N_2O_4 \cdot 4H_2O$, 456.30. Col.cr., $[\alpha] - 28.8°^{15}_{D}$. **m.p.** 206 d. **Soly.** s.w.; v.s.al.; sl.s.et.; s.chl.; sl.s.bz.

15 **Echitin.** $C_{32}H_{52}O_2$, 468.41. Leaf. **m.p.** 170. **Soly.** 0.06^{15} 80% al.; sl.s.et.; v.s.chl.

16 **Eglantine.** See *α-Toluic acid, isobutyl ester.*

17 **Eicosane*** (*n-eicosane*). $CH_3(CH_2)_{18}CH_3$, 282.33. Cr., *n* $1.434^{42.9}$. **D.** 0.778^{37}_{4}, **m.p.** 38, **b.p.** 205^{15}. **Soly.** i.w.; ∞et.

18 **Eicosanoic acid*.** See *Arachidic acid.*

19 **1-Eicosanol*** (*pri-n-eicosyl alcohol; arachic alcohol*). $CH_3(CH_2)_{18}CH_2OH$, 298.33. Wh.waxy mass. **m.p.** 71, **b.p.** 220^{3}. **Soly.** i.w.; v.sl.s.al.; s.h.bz.

20 ***n*-Eicosoic acid.** See *Arachidic acid.*

21 ***pri-n*-Eicosyl alcohol.** See 1-*Eicosanol*.*

22 **Elkonogen.** See 2-*Naphthol*-6-*sulfonic acid, 1-amino-, sodium salt.*

* Name approved by the International Union of Chemistry.

23 Elaidic acid (*trans-9-octadecenoic acid**). $C_8H_{17}CH:CH(CH_2)_7COOH$, 282.27. Col.leaf.f.al. **D.** 0.851^{79}_{4}, **m.p.** 51.5(44–5), **b.p.** 288^{100}. **Soly.** i.w.; s.al.; s.et.; s.bz., chl.

24 —, dibromide (*θ, ι-dibromostearic acid* (one form)). $C_{17}H_{33}Br_2COOH$, 442.10. **m.p.** 27. **Soly.** i.w.; i.al.; s.et.

25 —, ethyl ester. $C_{17}H_{33}COOC_2H_5$, 310.30. Oil. **D.** 0.868^{18}_{4}, **b.p.** $217–8.5^{15}$. **Soly.** i.w.; s.al.; s.et.

26 —, methyl ester. $C_{17}H_{33}COOCH_3$, 296.28. Liq. **D.** 0.872^{15}_{4}, **b.p.** 213.5^{15}. **Soly.** i.w.; s.al.; s.et.

27 β-Elaterin. $C_{20}H_{28}O_5$, 348.22. Hex. pl. **m.p.** 195(216). **Soly.** i.w.; s.al.; sl.s.et.; s.chl.; sl.s.bz.

28 Eleomargaric acid (*9, 13-octadecadienoic acid**(?)). $C_{17}H_{31}COOH$, 280.25. Rhomb.pl. **m.p.** 48. **Soly.** s.al.; s.et.

29 α-Eleostearic acid (*9, 12-octadecadienoic acid** (one form)). $C_{17}H_{31}COOH$, 280.25. Leaf. or need.f.al. **m.p.** α48–9; β72, **b.p.** 235^{12} sl.d. **Soly.** i.w.; s.al.; v.s.et.; v.s.CS_2; s.h.ac.a.

30 β-Eleostearic acid* (*9, 12-octadecadienoic acid** (one form)). $C_{17}H_{31}COOH$, 280.25. Pl. or need.f.al. **m.p.** 72. **Soly.** i.w.; sl.s.al.; s.warm glac.ac.a.

31 Ellagic acid (*4, 4′, 5, 5′, 6, 6′-hexahydroxydiphenic acid dilactone*). $C_{14}H_6O_8 \cdot 2H_2O$, 338.08. Yel.cr. **D.** 1.667^{18}_{4}. **m.p.** d. **Soly.** v.sl.s.h.w.; sl.s.al.; i.et.

32 Emetine. $C_{30}H_{40}N_2O_5$, 508.33. Pl. f.al. or et. **m.p.** 74(68). **Soly.** 0.1w.; v.s.al.; v.s.et.; s.chl.; sl.s.bz.

33 —, hydrochloride (*d*). $C_{29}H_{40}N_2O_4 \cdot 2HCl \cdot 7H_2O$, 679.37. Need.f.h.w. **m.p.** 235–55. **Soly.** s.w.; s.al.; s.et.

34 Emodin (*1, 3, 8-trihydroxy-6-methylanthraquinone; rheum emodin; frangula emodin*). $CH_3C_{14}H_4O_2(OH)_3$, 270.08. Or.-red monocl.need.f.ac.a. **m.p.** 253 (250), **b.p.** subl. **Soly.** i.w.; s.al.; s.glac.ac.a., amyl al., alk.sols.

35 Enanthaldehyde (*heptanal*; enanthal; heptyl aldehyde; enanthole; n-heptaldehyde*). $CH_3(CH_2)_5CHO$, 114.11. Col.liq., *n* 1.4131. **D.** 0.850^{20}_{4}, **m.p.** −45, **b.p.** 155. **Soly.** sl.s.w.; s.al.; ∞et.

36 —, oxime (*heptanal oxime*; enanthaldoxime; n-heptaldoxime*). $CH_3(CH_2)_5CH:NOH$, 129.13. Large pl.f.al., *n* $1.421^{83.9}$. **D.** 0.8583^{20}_{4}; 0.834^{83}_{4}, **m.p.** 55.5, **b.p.** 195. **Soly.** v.sl.s.w.; s.al.; s.et.

37 Enanthic acid (*heptanoic acid*; enanthylic acid; oenanthic acid; n-heptoic acid; n-heptylic acid*). $CH_3(CH_2)_5COOH$, 130.11. Col.oily liq., *n* $1.42162^{19.8}$. **D.** 0.9127^{25}_{4}, **m.p.** −10, **b.p.** 223.5 ($108–10^9$). **Soly.** 0.241^{15} w.; s.al.; s.et.

38 —, ethyl ester (*ethyl heptanoate**). $CH_3(CH_2)_5COOC_2H_5$, 158.14. Col. liq., *n* 1.4122. **D.** 0.872^{15}_{4}, **b.p.** 187.1; $67–70^8$. **Soly.** i.w.; s.al.; ∞et.

39 —, heptyl ester (*n-heptyl n-heptylate*). $CH_3(CH_2)_5COOC_7H_{15}$, 228.22. Col.liq. **D.** 0.865^{19}_{4}, **b.p.** $273–4^{754}$ ($137–40^{10}$). **Soly.** i.w.; s.al.; s.et.

40 —, methyl ester (*methyl heptanoate**). $CH_3(CH_2)_5COOCH_3$, 144.12. Liq.; *n* 1.4114. **D.** 0.881^{15}_{8}, **b.p.** 172.1 (174–6).

41 —, p-phenylphenacyl ester. $CH_3(CH_2)_5COOCH_2COC_6H_4C_6H_5$, 324.19. **m.p.** 62.

42 —, piperazinium salt. $C_4H_{10}N_2 \cdot 2C_6H_{13}COOH$, 346.31. Wh.cr. **m.p.** 95–6. **Soly.** s.w.; s.al.; i.et.; s.h.acet.

43 Enanthic anhydride (*heptanoic anhydride**). $[CH_3(CH_2)_5CO]_2O$, 242.20. Liq., *n* 1.4312. **D.** 0.932^{20}_{4}, **m.p.** 17. **b.p.** 258 ($170–3^{15}$). **Soly.** i.w.; s.al.; s.et.

44 Enanthole. See *Enanthaldehyde.*

45 Enanthone. See *7-Tridecanone*.*

46 Enanthylic acid. See *Enanthic acid.*

47 Enanthylidene. See *1-Heptyne*.*

48 Enneamethylene glycol. See *1, 9-Nonanediol*.*

49 Eosin (*2, 4, 5, 7-tetrabromofluorescein*). $C_{20}H_8Br_4O_5$, 647.73. Red monocl. need. **Soly.** i.w.; s.al.; s.ac.a., alk.

50 Eosin (dye) (*alkali salt of eosin*). $C_{20}H_6Br_4Na_2O_5$, 691.70. Red-br.powd. **Soly.** s.w.; s.al.

51 Ephedrine (*2-methylamino-1-phenyl-1-propanol* (one form)). $C_6H_5CHOHCH(NHCH_3)CH_3 \cdot H_2O$, 183.14. Col.cr.f.et. **m.p.** 43 (40), **b.p.** 255 d. **Soly.** s.w.; s.al.; s.et.; s.chl.

52 —, hydrochloride(*l*). $C_{10}H_{15}NO \cdot HCl$, 201.59. Wh.need. **m.p.** 216 d. **Soly.** s.w.; s.al.; i.et.

53 —, sulfate. $(C_{10}H_{15}NO)_2 \cdot H_2SO_4$, 428.33. Wh.cr. **Soly.** s.w.; s.h.al.

54 Epichlorohydrin (*α-epichlorohydrin; 1-chloro-2, 3-epoxypropane; γ-chloropropylene oxide; (chloromethyl)oxirane*). OCH_2CHCH_2Cl, 92.50. Col.liq., *n* $1.44195^{11.55}$. **D.** 1.203^{0}_{4}; 1.1801^{20}_{4}, **m.p.** −25.6, **b.p.** 117. **Soly.** i.w.; ∞al.; ∞et.

For explanations and abbreviations see beginning of table.

55 Epicyanohydrin (*β, γ-epoxybutyronitrile; γ-cyanopropylene oxide; oxiraneacetonitrile*). OCH_2CHCH_2CN, 83.05. Pr. **m.p.** 162. **Soly.** s.h.w.; s.al.

56 *α*-**Epidibromohydrin.** See *Propene*, 2, 3-*dibromo*-*.

57 *α*-**Epidichlorohydrin.** See *Propene*, 2, 3-*dichloro*-*.

58 Epihydric alcohol. See *Glycidol*.

59 Epiiodohydrin (*α-epiiodohydrin;* 1, 2-*epoxy-3-iodopropane; γ-iodopropylene oxide; (iodomethyl)oxirane*). OCH_2CHCH_2I, 183.96. Liq. **D.** 2.03^{13}_{4}, **b.p.** 160–80. **Soly.** i.w.; s.al.; s.et.

60 Epinephrine. See *Adrenaline*.

61 Ergosterol (*ergosterin*). $C_{27}H_{42}O$, 382.33. Cr. **m.p.** 160–3. **Soly.** i.w.; s.al.; s.et.

62 Ergotinine (amorphous). See *Ergotoxine*.

63 *d*-**Ergotinine.** $C_{35}H_{39}N_5O_5$, 609.34. Lng.need.f.al., sol.fluores.vlt., [α]335°D in al. **m.p.** 229. **Soly.** i.w.; 0.5^{20}al.; s.et.; s.chl., bz., acet.

64 Ergotoxine (*ergotinine(amorphous)*). $C_{35}H_{41}N_5O_6$, 627.36. Wh.amor.powd. **m.p.** 162–4. **Soly.** v.sl.s.w.; s.h.al.; sl.s.et.; s.NaOH.

65 Erucic acid(*cis*) (*cis*-13-*docosenoic acid**). $CH_3(CH_2)_7CH{:}CH(CH_2)_{11}$-COOH, 338.33. Col.need.f.al. **D.** 0.860^{55}_{4}, **m.p.** 33.5 (31–2), **b.p.** 281^{30}. **Soly.** i.w.; 173al.; v.s.et.; 163^{21}me.al.

66 *trans*-**Erucic acid.** See *Brassidic acid*.

67 Erythrene. See 1, 3-*Butadiene**.

68 *i*-**Erythritol** (*anti*-1, 2, 3, 4-*butanetetrol*; ordinary erythrite; erythrol; erythroglucin; phycitol*). $(CH_2OHCHOH)_2$, 122.08. Wh.tetr.pr., *n* 1.544, 1.521. **D.** 1.451^{20}_{4}, **m.p.** 119–20 (126), **b.p.** 331. **Soly.** 61.5w.; sl.s.al.; i.et.

69 —, anhydride (1, 2, 3, 4-*diepoxybutane** (one form); *bioxirane*). $OCH_2CHCHCH_2O$, 86.05. Col.liq. **D.** 1.113^{18}_{4}, **b.p.** 138. **Soly.** ∞d.w.

70 —, tetranitrate (*erythrol tetranitrate; nitroerythrite*). $(CHNO_3CH_2NO_3)_2$, 302.08. Leaf.f.al. **m.p.** 61, **b.p.** exp. by percussion. **Soly.** i.w.; s.al.; s.et.

71 Erythroglucin. See *i-Erythritol*.

72 Erythrohydroxyanthraquinone. See *Anthraquinone*, 1-*hydroxy*-.

73 Erythrol. See *i-Erythritol*.

74 Erythrosin (2, 4, 5, 7-*tetraiodofluorescein*). $C_{20}H_8I_4O_5$, 835.74. Or.cr.f.et. **Soly.** i.w.; s.al.; v.sl.s.et.; i.bz.

75 Erythrosin(dye) (*alkali salt of erythrosin; iodeosin B*). $C_{20}H_6I_4Na_2O_5$, 879.72. Red-br.powd. **Soly.** s.w.; s.al.

76 Esculetin (6, 7-*dihydroxycoumarin; aesculetin*). $(HO)_2C_6H_2OCOCH{:}CH$, 178.05. Need. **m.p.** 270 d. **Soly.** sl.s.c.w.; s.al.; v.sl.s.et.; s.dil.alk.

77 Esculin (*aesculin*). $C_{15}H_{16}O_9\cdot\frac{1}{2}H_2O$, 349.13. Wh.need., $[\alpha]-14.6°^{18}_{D}$ in me. al. **m.p.** 160 d.; anh. 205, **b.p.** d. 230. **Soly.** 0.16c., 8h.w.; 4.58^{78}al.; v.sl.s.et.; s.h.chl., ac.a., alk.

78 Eserine. See *Physostigmine*.

79 Estragole (*estragol; p-allylanisole; chavicol methyl ether*). $CH_2{:}CHCH_2$-$C_6H_4OCH_3$, 148.09. Oil, *n* $1.5230^{17.5}_{D}$, **D.** 0.9645^{21}_{4}, **b.p.** 215. **Soly.** i.w.; s.al.; s.et.

80 Ethal. See *Cetyl alcohol*.

81 Ethanal*. See *Acetaldehyde*.

82 —, **hydroxy-*.** See *Glycolaldehyde*.

83 —, **trichloro-*.** See *Chloral*.

84 Ethanamide*. See *Acetamide*.

85 —, **2-cyano-2-nitro-*.** See *Fulminuric acid*.

86 —, **2-hydroxy-*.** See *Glycolamide*.

87 Ethanamidine*. See *Acetamidine*.

88 Ethane* (*bimethyl; methylmethane; dimethyl*). CH_3CH_3, 30.05. Col.gas. **D.** 1.357^{0} g/1; 0.561^{-100}, **m.p.** −172, **b.p.** −88.3. **Soly.** 4.7^{20}cm³w.; 46^{4}cm³ al.

89 —, **amino-.** See *Ethylamine**.

90 —, **1-amino-1-phenyl-.** See *Benzylamine, α-methyl-*.

91 —, **1-amino-2-phenyl-.** See *Phenethylamine*.

92 —, **arsino-.** See *Arsine, ethyl-*.

93 —, **1, 2-bisphenylsulfonyl-*** (*ethylenebisphenylsulfone*). $(CH_2SO_2C_6H_5)_2$, 310.23. Need. or leaf.f.al. **m.p.** 180. **Soly.** sl.s.h.w.; sl.s.h.al.; s.glac.ac.a., bz.

94 —, **bromo-*.** See *Ethyl bromide*.

95 —, **1-bromo-2-chloro-*** (*ethylene chlorobromide*). CH_2ClCH_2Br, 143.40. Col.liq. **D.** 1.689^{18}_{4}, **m.p.** −16.6, **b.p.** 107–8. **Soly.** 0.688^{30}w.; ∞al.; ∞et.

96 —, **1-bromo-2-ethoxy-*.** See *Ether, β-bromoethyl ethyl*.

* Name approved by the International Union of Chemistry.

97 **Ethane, 1-bromo-1-phenyl.** See *Benzene, (α-bromoethyl)-.*

98 **—, chloro-*.** See *Ethyl chloride.*

99 **—, 1-chloro-2-(β-chloroethoxy)-*.** See *Ether, bis-β-chloroethyl.*

00 **—, 1-chloro-2-(β-chloroethylthio)-*.** See *Sulfide, β, β′-dichloroethyl.*

01 **—, 1-chloro-1-ethoxy-*.** See *Ether, α-chloroethyl ethyl.*

02 **—, 1-chloro-2-ethoxy-*.** See *Ether, β-chloroethyl ethyl.*

03 **—, *sym*-diacetyl-.** See 2, 5-*Hexanedione*.*

04 **—, 4, 4′-diamino-*sym*-diphenyl-.** See *α, α-Bi-p-toluidine.*

05 **—, 1, 1-dibromo-*** (*ethylidene bromide; ethylidene dibromide*). CH_3-$CHBr_2$, 187.86. Liq., *n* 1.51277. **D.** $2.089^{20.5}_{4}$, **b.p.** 110 (108–10). **Soly.** i.w.; v.s.al.; v.s.et.

06 **—, 1, 2-dibromo-*.** See *Ethylene bromide.*

07 **—, 1, 1-dichloro-*** (*ethylidene chloride; ethylidene dichloride*). CH_3-$CHCl_2$, 98.95. Col.liq., *n* 1.41655. **D.** 1.174^{20}_{4}, **m.p.** −96.7, **b.p.** 57.3. **Soly.** 0.55^{20}w.; v.s.al.; v.s.et.

08 **—, 1, 1-dichloro-2, 2-diethoxy-*.** See *Acetal, dichloro-.*

09 **—, 1, 2-dichloro-*.** See *Ethylene chloride.*

10 **—, 1, 2-dichloro-1-ethoxy-*.** See *Ether, α, β-dichloroethyl.*

11 **—, dichlorotetrafluoro-.** $C_2F_4Cl_2$, 170.91. Col.gas. **b.p.** 4. **Soly.** i.w.; s.al.; s.et.

12 **—, 1, 1-diethoxy-*.** See *Acetal.*

13 **—, 1, 1-diiodo-*** (*uns-diiodoethane; ethylidene iodide; ethylidene diiodide*). CH_3CHI_2, 281.87. Liq. **D.** 2.84^{0}_{4}, **b.p.** 179. **Soly.** i.w.; v.s.al.; v.s.et.

14 **—, 1, 2-diiodo-*.** See *Ethylene iodide.*

15 **—, 1, 1-dimethoxy-*** (*acetaldehyde dimethyl acetal; dimethyl acetal; ethylidene dimethyl ether*). $CH_3CH(OCH_3)_2$, 90.08. Col.inflam.liq. **D.** 0.8476^{25}_{4}, **b.p.** 64.5. **Soly.** s.w.; s.al.; s.et.; s.chl.

16 **—, 1, 1-dinitro-*** (*uns-dinitroethane*). $CH_3CH(NO_2)_2$, 120.05. Liq. **D.** $1.3503^{23.5}_{23.5}$, **b.p.** 185–6. **Soly.** sl.s.w.; s.al.; s.et.

17 **—, 1, 2-diphenoxy-*** (*glycol diphenyl ether; ethylene diphenyl ether*). $(CH_2OC_6H_5)_2$, 214.11. Col.leaf.f.al. **m.p.** 98.5. **Soly.** v.sl.s.(i.)w.; s.h.al.; v.s.et.; s.chl.

18 **—, 1, 1-diphenyl-** (*uns-diphenylethane; α-methylditan*). $(C_6H_5)_2$-$CHCH_3$, 182.11. Col.oil, *n* 1.5761. **D.** 1.006^{21}_{4}; 0.9877^{25}_{4}, **b.p.** 272 (268–86). **Soly.** i.w.; s.al.; s.et.

19 **—, 1, 2(or sym)diphenyl-.** See *Bibenzyl.*

20 **—, 1, 2-epoxy-*.** See *Ethylene oxide.*

21 **—, ethenyloxy-*.** See *Ether, ethyl vinyl.*

22 **—, ethoxy-*.** See *Ethyl ether.*

23 **—, 1-ethoxy-2-(β-ethoxyethoxy)-*.** See *Ether, bis(β-ethoxyethyl).*

24 **—, ethyldithio-*.** See *Ethyl disulfide.*

25 **—, ethylsulfinyl-*.** See *Ethyl sulfoxide.*

26 **—, ethylsulfonyl-*.** See *Ethyl sulfone.*

27 **—, ethylthio-*.** See *Ethyl sulfide.*

28 **—, fluoro-*.** See *Ethyl fluoride.*

29 **—, hexabromo-*** (*perbromoethane*). CBr_3CBr_3, 503.50. Rhomb.pr., *n* 1.740, 1.847, 1.863. **D.** 3.823^{20}_{4}, **m.p.** 148–9 d., **b.p.** d. 210. **Soly.** i.w.; sl.s.al.; sl.s.et.; v.s.CS_2.

30 **—, hexachloro-*** (*perchloroethane; carbon hexachloride*). CCl_3CCl_3, 236.74. Col.rhomb.tab.f.al. or et. **D.** 2.091^{20}_{4}, **m.p.** subl. 187. **Soly.** i.w.; v.s.al.; v.s.et.

31 **—, hexamethyl-.** See *Butane*, 2, 2, 3, 3-*tetramethyl-*.*

32 **—, hexaphenyl-.** $(C_6H_5)_3CC$-$(C_6H_5)_3$, 486.23. Col.cr. **m.p.** 145–7 d. **Soly.** i.w.; v.sl.s.al.; s.chl.

33 **—, iodo-*.** See *Ethyl iodide.*

34 **—, methoxy-*.** See *Ether, ethyl methyl.*

35 **—, methylthio-*.** See *Sulfide, ethyl methyl.*

36 **—, naphthyl-.** See *Naphthalene, ethyl-.*

37 **—, nitro-.** $C_2H_5NO_2$, 75.05. Liq., *n* $1.39007^{24.3}$. **D.** 1.056^{15}_{15}, **m.p.** < -50. **b.p.** 114.8. **Soly.** sl.s.w.; ∞al.; ∞et.; s.chl., dil.alk.

38 **—, pentabromo-*.** $CHBr_2CBr_3$, 424.59. Monocl.pr. **D.** 3.312^{20}_{4}, **m.p.** 57, **b.p.** 210^{300} d. **Soly.** i.w.; s.al.; v.s.et.

39 **—, pentachloro-*.** $CHCl_2CCl_3$, 202.29. Liq., *n* $1.50250^{24.0}$. **D.** 1.709^{0}_{4}; 1.6728^{25}_{4}, **m.p.** −29, **b.p.** 162. **Soly.** i.w.; ∞al.; ∞et.

40 **—, pentachloro(pentachloroethoxy)-*.** See *Ether, bis(pentachloroethyl).*

For explanations and abbreviations see beginning of table.

41 **Ethane, pentaiodo-*.** CHI_2Cl_3, 659.61. Col.monocl.pr.f.ac.a. **D.** 3.312^{20}_{4}, **m.p.** 56–7, **b.p.** 210 d. **Soly.** i.w.; s.al.; v.s.et.; s.ac.a., bz.

42 **—, perbromo-.** See *Ethane, hexabromo-**.

43 **—, perchloro-.** See *Ethane, hexachloro-**.

44 **—, phenyl-.** See *Benzene, ethyl-*.

45 **—, phosphino-.** See *Phosphine, ethyl-*.

46 **—, 1, 1, 1, 2-tetrabromo-*** (*unstetrabromoethane*). CH_2BrCBr_3, 345.68. Col.liq., *n* 1.62772. **D.** 2.875^{20}_{4}, **m.p.** 0, **b.p.** $103.5^{13.5}$. **Soly.** s.al.

47 **—, 1, 1, 2, 2-tetrabromo-*** (*symtetrabromoethane; acetylene tetrabromide*). $CHBr_2CHBr_2$, 645.68. Col.-yel.liq., *n* 1.63795. **D.** 2.9638^{20}_{4}, **m.p.** 0.1, **b.p.** 151^{54}; d. 239–42. **Soly.** 0.0651^{30}w.; ∞al.; ∞et.; ∞chl., aniline, ac.a.

48 **—, 1, 1, 1, 2-tetrachloro-*** (*unstetrachloroethane*). CH_2ClCCl_3, 167.84. Liq., *n* $1.48162^{23.2}$. **D.** 1.588^{20}_{4}, **b.p.** 130.5. **Soly.** i.w.; ∞al.; ∞et.

49 **—, 1, 1, 2, 2-tetrachloro-*** (*symtetrachloroethane; acetylene tetrachloride*). $CHCl_2CHCl_2$, 167.84. Col.liq., *n* 1.4942. **D.** 1.600^{20}_{4}, **m.p.** −43.8 (−36), **b.p.** 146.3. **Soly.** i.w.; ∞al.; ∞et.

50 **—, 1, 1, 1, 2-tetraphenyl-** (*unstetraphenylethane; triphenylbenzylmethane; α-benzyltritan*). $(C_6H_5)_3CCH_2C_6H_5$, 334.17. Col.monocl.f.et. **m.p.** 144, **b.p.** $277–80^{21}$. **Soly.** i.w.; sl.s.al.; sl.s.et.

51 **—, 1, 1, 2, 2-tetraphenyl-** (*symtetraphenylethane*). $(C_6H_5)_2CHCH(C_6H_5)_2$, 334.17. Col.rhomb.need.f.chl. **D.** 1.182^{20}_{4}, **m.p.** 211 (209), **b.p.** 383. **Soly.** 0.76^{78}al.; 14bz.; s.ac.a.

52 **—, 1, 1, 2-tribromo-*** (*vinyl tribromide*). $CH_2BrCHBr_2$, 266.77. Liq., *n* 1.58902. **D.** 2.579^{20}_{4}, **m.p.** −26, **b.p.** 188.4. **Soly.** s.al.

53 **—, 1, 1, 1-trichloro-*** (*methylchloroform*). CH_3CCl_3, 133.39. Col. liq., *n* $1.43765^{21.0}$. **D.** 1.3249^{21}_{4}, **b.p.** 74.1. **Soly.** i.w.; ∞al.; ∞et.

54 **—, 1, 1, 1-trichloro-2, 2-diethoxy-*** (*chloral diethyl acetal; trichloroacetal*). $CCl_3CH(OC_2H_5)_2$, 221.46. Liq. **D.** 1.266^{14}_{4}, **b.p.** 197. **Soly.** 0.5w.; ∞al.; ∞et.; ∞glyc.

55 **—, 1, 1, 2-trichloro-*** (*vinyl trichloride*). $CH_2ClCHCl_2$, 133.39. Col. liq., *n* 1.4711. **D.** 1.443^{20}_{4}, **m.p.** −36.7, **b.p.** 113.5. **Soly.** i.w.; ∞al.; ∞et.

56 **—, 1, 1, 2-trichloro-1, 2, 2-trifluoro-.** $C_2Cl_3F_3$, 187.37. **D.** 1.621^{0}_{4} **m.p.** −37, **b.p.** 47.7. **Soly.** i.w.; s.al.; s.et.; ∞bz.

57 **—, 1, 1, 1-triethoxy-*.** See *Orthoacetic acid, triethyl ester*.

58 **—, 1, 1, 1-triiodo-*** (*methyliodoform*). CH_3CI_3, 407.78. Yel.octahdr. **m.p.** 95 d. **Soly.** sl.s.al.; v.s.et.; v.s.CS_2, bz.; sl.s.lgr.

59 **—, 1, 1, 1-triphenyl-** (*α-methyltritan*). $(C_6H_5)_3CCH_3$, 258.14. Need. f.al. or et. **m.p.** 95. **Soly.** i.w.; sl.s.c., s.h.al.; v.s.et.

60 **—, 1, 1, 2-triphenyl-.** $(C_6H_5)_2CHCH_2C_6H_5$, 258.14. Monocl.leaf.f. dil.al. **m.p.** 54–4.5, **b.p.** $348–9^{751}$. **Soly.** i.w.; v.s.al.; v.s.et.

61 **Ethaneazobenzene.** See *Benzeneazoethane*.

62 **Ethanedial*.** See *Glyoxal*.

63 **Ethanediamide*.** See *Oxamide*.

64 **1, 2-Ethanediamine*.** See *Ethylenediamine*.

65 **1, 1-Ethanedicarboxylic acid, 1-hydroxy-2-phenyl-.** See *Tartronic acid, benzyl-*.

66 **Ethanedinitrile*.** See *Cyanogen*.

67 **Ethanedioic acid*.** See *Oxalic acid*.

68 **1, 1-Ethanediol, 2, 2, 2-tribromo-*.** See *Bromal, hydrate*.

69 **—, 2, 2, 2-trichloro-*.** See *Chloral, hydrate*.

70 **1, 2-Ethanediol*.** See *Glycol*.

71 **—, 1, 2-dicyclohexyl-** (*dodecahydrohydrobenzoin; cyclohexanone pinacol*). $C_{14}H_{26}O_2$, 198.17. Need. **m.p.** 129–30. **Soly.** v.s.bz.; s.pet.eth.

72 **—, 1, 2-diphenyl-.** See *Hydrobenzoin; Isohydrobenzoin*.

73 **—, 1, 1, 2, 2-tetraphenyl-*.** See *Benzopinacol*.

74 **Ethanedioyl chloride*.** See *Oxalyl chloride*.

75 **1, 2-Ethanedisulfonic acid*** (*ethylenedisulfonic acid*). $C_2H_4(SO_3H)_2$, 190.17. Cr.f.ac.a. **m.p.** 104. **Soly.** v.s.w.; v.s.al.

76 **1, 2-Ethanedithiol*** (*dithioglycol; ethylene mercaptan; ethylene dimercaptan*). $HSCH_2CH_2SH$, 94.17. Liq. **D.** 1.123, **b.p.** 146. **Soly.** s.al.; v.s.alk.; s.NH_4OH.

* Name approved by the International Union of Chemistry.

77 Ethanenitrile*. See *Acetonitrile.*

78 —, **2-oxo-2-phenyl-.** See *Benzoyl cyanide.*

79 Ethanesulfinic acid* (*ethylsulfinic acid*). $C_2H_5SO_2H$, 94.11. Syrup. **Soly.** s.alk.

80 Ethanesulfonic acid* (*ethylsulfonic acid*). $C_2H_5SO_2OH$, 110.11. Hyg.cr. **Soly.** s., deliq.w.; s.al.; s.alk.

81 —, **2-amino-.** See *Taurine.*

82 —, **2-hydroxy-.** See *Isethionic acid.*

83 Ethanesulfonyl chloride* (*ethylsulfonyl chloride*). $C_2H_5SO_2Cl$, 128.56. Liq. **D.** 1.357^{20}_{4}, **b.p.** 177.5. **Soly.** d.w.; d.al.; v.s.et.

84 1, 1, 2, 2-Ethanetetracarboxylic acid*, tetraethyl ester (*ethyl sym-ethanetetracarboxylate*). $(COOC_2H_5)_2CHCH(COOC_2H_5)_2$, 318.17. Pr. **m.p.** 76 (72–4), **b.p.** 305 d. **Soly.** s.al.

85 Ethanethial*, trimer. See *sym-Trithiane, 2, 4, 6-trimethyl-.*

86 Ethanethiol* (*ethyl mercaptan; ethyl hydrosulfide; ethyl thioalcohol*). C_2H_5SH, 62.11. Liq., *n* 1.43055. **D.** 0.840. **m.p.** −121 (−147.3), **b.p.** 34.7 (34.5–5.5). **Soly.** 1.5w.; s.al.; s.et.; s.alk.

87 —, sodium derivative (*sodium mercaptide; sodium thioethylate*). C_2H_5SNa, 84.10. Wh.cr. **Soly.** s.w.; s.al.

88 Ethanethiolic acid*. See *Acetic acid, thiol-.*

89 Ethanethionamide*. See *Acetamide, thio-.*

90 1, 1, 1-Ethanetricarboxylic acid* (*ethenyltricarboxylic acid*). $CH_3C(COOH)_3$, 162.05. Pr. **m.p.** 159 d. **Soly.** s.w.; s.al.; s.et.

91 1, 1, 2-Ethanetricarboxylic acid, 1, 2-dihydroxy-*. See *Desoxalic acid.*

92 Ethanoic acid*. See *Acetic acid.*

93 —, **oxo-***. See *Glyoxylic acid.*

94 Ethanoic anhydride*. See *Acetic anhydride.*

95 Ethanol*. See *Ethyl alcohol.*

96 —, **2-allyl-.** See 4-*Penten*-1-*ol**.

97 —, **1-amino-***. See *Acetaldehyde-ammonia.*

98 —, **2-amino-*** (*β-aminoethyl alcohol; ethanolamine; ethylolamine; β-hydroxyethylamine*). $NH_2CH_2CH_2OH$, 61.06. Col.liq., *n* 1.4539. **D.** 1.0180^{20}_{4}, **m.p.** 10.5, **b.p.** 172.2. **Soly.** ∞w.; ∞al.; 0.72et.; s.chl.; sl.s.bz., lgr.

99 —, **2-anilino-** (*β-hydroxyethylaniline; ethoxylaniline*). $C_6H_5NHCH_2CH_2OH$, 137.09. Col.liq. **D.** 1.110^{0}_{4}, **b.p.** 286. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl.

00 —, **2-benzyloxy-** (*glycolmonobenzyl ether; benzyl cellosolve*). $C_6H_5CH_2OCH_2CH_2OH$, 152.09. Col.liq. **D.** 1.068, **m.p.** < −75, **b.p.** 256. **Soly.** 0.4w.

01 —, **2-bromo-*** (*β-bromoethyl alcohol; ethylene bromohydrin*). CH_2BrCH_2OH, 124.96. Col.liq., *n* 1.4915. **D.** 1.7720^{20}_{4}, **b.p.** 150.3. **Soly.** s.w.; ∞al.; ∞et.

02 —, —, acetate (*β-bromoethyl acetate*). $CH_3COOCH_2CH_2Br$, 166.97. Col. liq. **D.** 1.514^{20}_{4}, **m.p.** −13.8, **b.p.** 161.5–4.5. **Soly.** v.s.w.; ∞al.; ∞et.

03 —, **2-butoxy-*** (*glycol monobutyl ether; butyl cellosolve*). $C_4H_9OCH_2CH_2OH$, 118.11. Col.liq. **D.** 0.9027^{20}_{4}, **b.p.** 170.6. **Soly.** ∞w.; ∞al.; ∞et.

04 —, **2-(β-butoxyethoxy)-***. See *Diethylene glycol, monobutyl ether.*

05 —, **2-chloro-*** (*β-chloroethyl alcohol; ethylene chlorohydrin*). CH_2ClCH_2OH, 80.50. Col.liq. **D.** 1.213^{20}_{4}, **m.p.** −69, **b.p.** 128.8. **Soly.** ∞w.; s.al.; 2.3^{15}et.

06 —, —, acetate (*β-chloroethyl acetate; 2-chloroethyl ethanoate**). $CH_3COOCH_2CH_2Cl$, 122.51. Col.liq., *n* 1.4247. **D.** 1.1783^{0}_{4}, **b.p.** 145. **Soly.** i.w.; ∞al.; ∞et.

07 —, **2, 2-dichloro-*** (*β, β-dichloroethyl alcohol*). $CHCl_2CH_2OH$, 114.95. Liq. **D.** 1.145^{15}_{4}, **b.p.** 146. **Soly.** sl.s.w.; s.al.; s.et.

08 —, **2-diethylamino-*** (*β-diethylaminoethylalcohol; 2-hydroxytriethylamine*). $(C_2H_5)_2NCH_2CH_2OH$, 117.13. Col.liq., *n* 1.4400^{25}. **D.** 0.8601^{15}_{15}; 0.884^{20}_{4}, **b.p.** 160 (161–3). **Soly.** ∞w.; s.et.; s.bz.

09 —, **2-diethylamino-,** p-aminobenzoate hydrochloride. See *Procaine, hydrochloride.*

10 —, **2-dimethylamino-*** (*β-dimethylaminoethyl alcohol*). $(CH_3)_2NCH_2CH_2OH$, 89.09. Col.liq., *n* 1.43. **D.** 0.8866^{20}_{4}, **b.p.** 135 (131–4). **Soly.** ∞w.; ∞al.; ∞et.

11 —, **1, 2-diphenyl-** (*benzylphenylcarbinol*). $C_6H_5CH_2CHOHC_6H_5$, 198.11. Need. **m.p.** 66–8, **b.p.** $167–70^{10}$. **Soly.** v.sl.s.w.; s.al.; v.s.et.

12 —, **2-ethoxy-*** (*glycol monoethyl ether; cellosolve*). $C_2H_5OCH_2CH_2OH$, 90.08. Col.liq. **D.** 0.9311^{20}_{4}, **b.p.** 135.1. **Soly.** ∞w.; ∞al.; ∞et.

For explanations and abbreviations see beginning of table.

13 Ethanol, 2-ethoxy*, acetate (*β-ethoxyethyl acetate; cellosolve acetate*). $CH_3COOCH_2CH_2OC_2H_5$, 132.09. Col. liq. **D.** 0.9749^{20}_{4}, **b.p.** 156.2 (150–60). **Soly.** 22w.; ∞al.; ∞et.

14 —, **2-(β-ethoxyethoxy)-.** See *Diethylene glycol, monoethyl ether.*

15 —, **2-ethylamino-*** (*β-hydroxydiethylamine*). $C_2H_5HNCH_2CH_2OH$, 89.09. Liq., *n* 1.444. **D.** 0.914^{20}_{4}, **b.p.** $167–9^{751}$. **Soly.** v.s.w.; v.s.al.; v.s.et.

16 —, **2, 2′-ethylenedioxydi-.** See *Triethylene glycol.*

17 —, **2, 2′-ethyliminodi-** (*β, β′-dihydroxytriethylamine*). $C_2H_5N(CH_2CH_2OH)_2$, 133.13. Yel.liq., *n* 1.4663. **D.** 1.0135^{20}_{4}, **b.p.** $251–2^{750}$. **Soly.** s.w.; s.al.; sl.s.et.

18 —, **2-heptyl-2-methyl-.** See *1-Nonanol, 2-methyl-*.*

19 —, **2, 2′-iminodi-.** See *Diethanolamine.*

20 —, **2-methoxy-*** (*glycol monomethyl ether; methyl cellosolve*). $CH_3OCH_2CH_2OH$, 76.06. Col.liq. **D.** 0.9660^{20}_{4}, **b.p.** 124.3. **Soly.** ∞w.; v.s.al.; s.et.

21 —, —, acetate (*glycol monomethyl ether acetate; methyl cellosolve acetate*). $CH_3COOCH_2CH_2OCH_3$, 118.08. Liq. **D.** 1.0054^{20}_{20}, **b.p.** 143. **Soly.** ∞w.

22 —, 2-(β-**methoxyethoxy**)-. See *Diethylene glycol, monomethyl ether.*

23 —, **2-methylamino-*.** (*β-hydroxy-N-methylethylamine*). $CH_3HNCH_2CH_2OH$, 75.08. Col.liq., *n* 1.4385. **D.** 0.937^{20}_{4}, **b.p.** 159^{747}. **Soly.** ∞w.; ∞al.; ∞et.

24 —, **2, 2′-methyliminodi-** (*β, β′-dihydroxy-N-methyldiethylamine*). $CH_3N(CH_2CH_2OH)_2$, 119.11. Liq., *n* 1.4678. **D.** 1.0377^{20}_{4}, **b.p.** $246–8^{747}$. **Soly.** ∞w.; ∞al.; sl.s.et.

25 —, **2-methyl-2-propyl-.** See *1-Pentanol, 2-methyl-*.*

26 —, **2, 2′, 2″-nitrilotri-** (*triethylolamine; triethanolamine; β, β′, β″-trihydroxytriethylamine*). $N(CH_2CH_2OH)_3$, 149.13. Visc.col.liq., *n* 1.4852. **D.** 1.1242^{20}_{4}, **m.p.** 21.2, **b.p.** $277–9^{150}$. **Soly.** ∞w.; ∞al.; sl.s.et.

27 —, **2-nitro-.** $NO_2CH_2CH_2OH$, 91.05. Col.liq. **D.** 1.270^{13}_{4}, **m.p.** < −80, **b.p.** 193.8. **Soly.** v.s.w.; v.s.al.; v.s.et.

28 —, **2, 2′-oxydi-.** See *Diethylene glycol.*

29 —, **pentamethyl-.** See *2-Butanol, 2, 3, 3-trimethyl-*.*

30 —, **1-phenyl-.** See *Benzyl alcohol, α-methyl-.*

31 —, **2-phenyl-.** See *Phenethyl alcohol.*

32 —, **2, 2′-thiodi-** (*thiodiglycol; bis-β-hydroxyethyl sulfide*). $S(CH_2CH_2OH)_2$, 122.14. Col.liq., *n* 1.519. **D.** 1.1824^{20}_{4}, **m.p.** −16, **b.p.** 168^{14}. **Soly.** ∞w.; ∞al.; sl.s.et.

33 —, **2, 2, 2-trichloro-*.** CCl_3CH_2OH, 149.39. Rhomb.tab. **D.** 1.550^{20}_{4}, **m.p.** 17.8, **b.p.** 152.2. **Soly.** sl.s.w.; ∞al.; ∞et.

34 —, **2, 2, 2-trichloro-1-ethoxy-*.** See *Chloral, alcoholate.*

35 Ethanolamine. See *Ethanol, 2-amino-*.*

36 1-Ethanone, 2-ethoxy-1, 2-diphenyl-. See *Benzoin, ethyl ether.*

37 Ethanoyl bromide*. See *Acetyl bromide.*

38 Ethanoyl chloride*. See *Acetyl chloride.*

39 Ethanoyl fluoride*. See *Acetyl fluoride.*

40 Ethanoyl iodide*. See *Acetyl iodide.*

41 Ethanoyl peroxide*. See *Acetyl peroxide.*

42 Ethene*. See *Ethylene.*

43 —, **ethenyloxy-*.** See *Vinyl ether.*

44 —, **ethenylthio-*.** See *Vinyl sulfide.*

45 Ethenol. See *Vinyl alcohol.*

46 Ethenone. See *Ketene.*

47 Ethenylamine*. See *Vinylamine.*

48 Ethenyltricarboxylic acid. See *1, 1, 1-Ethanetricarboxylic acid*.*

49 Ether. See *Ethyl ether.*

50 —, **allyl cresyl.** See *Ether, allyl tolyl.*

51 —, **allyl ethyl** (*3-ethoxypropene**). $C_2H_5OCH_2CH:CH_2$, 86.08. Col.liq., *n* 1.38810. **D.** 0.765^{20}_{4}, **b.p.** 67.6. **Soly.** i.w.; ∞al.; ∞et.

52 —, **allyl isoamyl** (*3-methyl-1-(2-propenoxy)butane**). $CH_2:CHCH_2OCH_2CH_2CH(CH_3)_2$, 128.12. Liq. **b.p.** 120. **Soly.** v.sl.s.w.; ∞al.; ∞et.

53 —, **allyl methyl** (*3-methoxypropene**). $CH_2:CHCH_2OCH_3$, 72.06. Col.liq. **D.** 0.77^{11}_{4}, **b.p.** 46. **Soly.** v.sl.s.w.; ∞al.; ∞et.

54 —, **allyl 2-naphthyl** (*2-(2-propenoxy)naphthalene**). $C_{10}H_7OCH_2CH:CH_2$, 184.09. Oil. **b.p.** d. 210. **Soly.** i.w.

55 —, **allyl phenyl** (*2-propenoxybenzene**). $CH_2:CHCH_2OC_6H_5$, 134.08. Col.oil. **D.** 0.9856^{15}_{15}, **b.p.** 192. **Soly.** i.w.; s.al.; ∞et.

* Name approved by the International Union of Chemistry.

56 Ether, allyl *o*-tolyl (*2-(2-propenoxy) toluene*; allyl o-cresyl ether*). CH_2:$CHCH_2OC_6H_4CH_3$, 148.09. Oil. **D.** 0.969^{15}_{4}, **b.p.** 205–8; 85^{12}.

57 —, allyl *m*-tolyl (*3-(2-propenoxy)-toluene**). CH_2:$CHCH_2OC_6H_4CH_3$, 148.09. **D.** 0.965^{15}_{4}, **b.p.** 211–4; $92–4^{12}$.

58 —, allyl *p*-tolyl (*4-(2-propenoxy)-toluene**). CH_2:$CHCH_2OC_6H_4CH_3$, 148.09. **D.** 0.9728^{16}_{16}, **b.p.** 214.5; 91^{12}.

59 —, β-aminoethyl ethyl. See (*Ethylamine, β-ethoxy-**.

60 —, amyl ethyl (*1-ethoxypentane**). $C_2H_5O(CH_2)_4CH_3$, 116.12. Liq. **D.** 0.759^{18}_{4}, **b.p.** 119–20. **Soly.** sl.s.w.; ∞al.; ∞et.

61 —, amyl methyl. See *Pentane, 1-methoxy-**.

62 —, amyl phenyl (*amoxybenzene*). $CH_3(CH_2)_4OC_6H_5$, 164.12. Liq. **b.p.** 111^{17}.

63 —, benzyl butyl (*1-benzyloxybutane*). $C_6H_5CH_2O(CH_2)_3CH_3$, 164.12. **D.** 0.9310^{19}_{4}, **b.p.** $220–1^{744}$. **Soly.** i.w.; ∞al.; ∞et.

64 —, benzyl ethyl (*α-ethoxytoluene*). $C_2H_5OCH_2C_6H_5$, 136.09. Col.liq. **D.** 0.949^{20}_{4}, **b.p.** 185. **Soly.** i.w.; ∞al.; ∞et.

65 —, benzyl methyl (*α-methoxytoluene*). $C_6H_5CH_2OCH_3$, 122.08. Liq. **D.** 0.987^{20}_{4}, **b.p.** 174. **Soly.** i.w.; s.al.; s.et.

66 —, benzyl 2-naphthyl (*2-benzyloxynaphthalene**). $C_6H_5CH_2OC_{10}H_7$ 234.11. Leaf.f.al. **m.p.** 99. **Soly.** i.w.; v.s.al.; v.s.et.; s.chl., bz.

67 —, bis-*p*-bromophenyl (*4, 4′-dibromodiphenyl ether; 1-bromo-4-(4-bromophenoxy)benzene**). $BrC_6H_4OC_6H_4$-Br, 327.89. Leaf.f.al. **m.p.** 53–4 (54–6), **b.p.** 338–40. **Soly.** i.w.; v.s.al.; ∞et.; v.s.bz.

68 —, bis-β-chloroethyl (*1-chloro-2-(β-chloroethoxy)ethane*; sym-dichloroethyl ether; β, β′-dichlorodiethyl ether*). $(ClC_2H_4)_2O$, 142.98. Liq., *n* 1.457. **D.** 1.222^{20}_{4}, **m.p.** −50, **b.p.** 178. **Soly.** 1.02w.; s.al.; s.et.

69 —, bis-β-chloroisopropyl (*1-chloro-2-(β-chloroisopropoxy)propane*; β, β′-dichloroisopropyl ether*) $ClCH_2CH$-$(CH_3)OCH(CH_3)CH_2Cl$, 171.01. Col. liq. **D.** 1.1127, **b.p.** 187.1 ($93–5^{18}$). **Soly.** 0.19w.

70 —, bischloromethyl (*chloro(chloromethoxy)methane*; sym-dichlorodimethyl ether*). CH_2ClOCH_2Cl, 114.95. Liq., *n* 1.4346. **D.** 1.315^{20}_{4}, **b.p.** 106. **Soly.** d.w.; ∞al.; ∞et.

71 —, bis(*p*-chlorophenyl) (*4, 4′-dichlorodiphenyl ether*). $(ClC_6H_4)_2O$, 238.98. *n* 1.611. **D.** 1.3164^{11}_{4}, **b.p.** 312–4. **Soly.** i.w.

72 —, bis-β-ethoxyethyl (*1-ethoxy-2-(β-ethoxyethoxy)ethane*; diethylene glycol diethyl ether; diethyl carbitol*). $(C_2H_5OCH_2CH_2)_2O$, 162.14. Col.liq. **D.** 0.907^{20}_{4}, **b.p.** 188. **Soly.** ∞w.

73 —, bis-*p*-nitrophenyl (*1-nitro-4-(4-nitrophenoxy)benzene*; 4, 4′-dinitrodiphenyl ether*). $NO_2C_6H_4OC_6H_4NO_2$, 260.08. Yel.need.f.al. **m.p.** 142–3. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.ac.a., bz.

74 —, bispentachloroethyl (*pentachloro(pentachloroethoxy)ethane*; perchloroether; decachlorodiethyl ether*). $C_2Cl_5OC_2Cl_5$, 418.57. Tetr.scales. **D.** 1.900^{14}_{4}, **m.p.** 69, **b.p.** d.

75 —, β-bromoethyl ethyl (*1-bromo-2-ethoxyethane*; β-bromoethyl ether*). Br-$CH_2CH_2OC_2H_5$, 152.99. **D.** 1.370^{0}_{4}, **b.p.** 126–9. **Soly.** sl.s.w.; ∞al.; ∞et.

76 —, bromophenyl methyl. See *Anisole, bromo-*.

77 —, butyl cresyl. See *Ether, butyl tolyl*.

78 —, butyl ethyl (*1-ethoxybutane**). $(C_2H_5)O(CH_2)_3CH_3$, 102.11. Col.liq. **D.** 0.752^{20}_{4}, **m.p.** −124, **b.p.** 91.4 (90–3). **Soly.** i.w.; ∞al.; ∞et.

79 —, *tert*-butyl ethyl (*2-ethoxy-2-methylpropane**). $C_2H_5OC(CH_3)_3$, 102.11. Liq. **D.** 0.7519^{20}_{4}, **b.p.** 68–9. **Soly.** i.w.; s.al.; s.et.

80 —, butyl 2-furylmethyl (*butyl furfuryl ether*). $C_4H_3OCH_2OC_4H_9$, 154.11. Col.liq. **D.** 0.955^{20}_{4}, **b.p.** $189–90^{765}$. **Soly.** i.w.; s.al.; v.s.et.

81 —, butyl methyl (*1-methoxybutane**). $CH_3O(CH_2)_3CH_3$, 88.09. Col.liq. **D.** 0.764^{0}_{4}· 0.744^{20}_{4}, **m.p.** −115.5, **b.p.** 70.3. **Soly.** v.sl.s.w.; ∞al.; ∞et.

82 —, butyl phenyl (*butoxybenzene**). $CH_3(CH_2)_3OC_6H_5$, 150.11. Col.liq. **D.** 0.950^{0}_{0}; 0.9300^{20}_{4}, **b.p.** 210.3 ($98–9^{10}$).

83 —, *n*-butyl tetrahydrofurfuryl. *See Furan, 2-butoxymethyltetrahydro-*.

84 —, butyl *o*-tolyl (*2-butoxytoluene*; butyl o-cresyl ether*). $CH_3C_6H_4O$-$(CH_2)_3CH_3$, 164.12. **D.** 0.9437^{0}_{0}, **b.p.** 223.0.

85 —, butyl *m*-tolyl (*3-butoxytoluene**). $CH_3C_6H_4OC_4H_9$, 164.12. **D.** 0.9407^{0}_{0}, **b.p.** 229.2.

86 —, butyl *p*-tolyl (*4-butoxytoluene**). $CH_3C_6H_4OC_4H_9$, 164.12. **D.** 0.9419^{0}_{0}, **b.p.** 229.5.

For explanations and abbreviations see beginning of table.

87 Ether, cetyl phenyl (1-*phenoxyhexadecane**). $C_6H_5OCH_2(CH_2)_{14}CH_3$, 318.30. Leaf., *n* $1.4556^{82.4}_{\alpha}$. **D.** $0.8434^{82.4}_{4}$, **m.p.** 41.8, **b.p.** 200^{1}.

88 —, chlorodiethyl. See *Ether, chloroethyl ethyl.*

89 —, α-chloroethyl ethyl (1-*chloro-1-ethoxyethane**; *α-chlorodiethyl ether*). $CH_3CHClOC_2H_5$, 108.53. **b.p.** 98 part.d.

90 —, β-chloroethyl ethyl (1-*chloro-2-ethoxyethane**; *β-chlorodiethyl ether*). $CH_2ClCH_2OC_2H_5$, 108.53. Liq. **D.** 1.0572^{0}_{4}; 0.989^{20}_{4}, **b.p.** 107–8.

91 —, chloromethyl methyl (*chloromethoxymethane**). $ClCH_2OCH_3$, 80.50. Liq., *n* 1.3974. **D.** 1.0625^{10}_{4}, **m.p.** −103.5, **b.p.** 59.5. **Soly.** d.w.; s.al.; s.et.

92 —, chlorophenyl ethyl. See *Phenetole, chloro-.*

93 —, cresyl ethyl. See *Ether, ethyl tolyl.*

94 —, cresyl methyl. See *Ether, methyl tolyl.*

95 —, cresyl propyl. See *Ether, propyl tolyl.*

96 —, decachlorodiethyl. See *Ether, bis(pentachloroethyl).*

97 —, diallyl. See *Allyl ether.*

98 —, di-*n*-amyl. See *Amyl ether.*

99 —, dibenzyl. See *Benzyl ether.*

00 —, 4, 4′-dibromodiphenyl. See *Ether, bis-p-bromophenyl.*

01 —, dibutyl. See *Butyl ether.*

02 —, dicetyl. See *Cetyl ether.*

03 —, dichloro-. See *Ether, α, β-dichloroethyl ethyl.*

04 —, β, β′-dichlorodiethyl. See *Ether, bis-β-chloroethyl.*

04₁ —, *sym*-dichlorodimethyl. See *Ether, bischloromethyl.*

05 —, 4, 4′-dichlorodiphenyl. See *Ether, bis-p-chlorophenyl.*

06 —, *sym*-dichloroethyl. See *Ether, bis-β-chloroethyl.*

07 —, α, β-dichloroethyl ethyl (1, 2-*dichloro-1-ethoxyethane**; *dichloroether; α, β-dichloroethyl ether*). $CH_2ClCHClOC_2H_5$, 142.98. Col.inflam. liq. **D.** 1.174^{20}_{4}, **b.p.** 140–5. **Soly.** v.s.al.; v.s.et.

08 —, β, β′-dichloroisopropyl. See *Ether, bis-β-chloroisopropyl.*

09 —, diethyl. See *Ethyl ether.*

10 —, di-*n*-heptyl. See *Heptyl ether.*

11 —, 2, 2′-dihydroxydiethyl. See *Diethylene glycol.*

12 —, 2, 2′-dihydroxyethyl. See *Diethylene glycol.*

13 —, diisoamyl. See *Isoamyl ether.*

14 —, diisobutyl. See *Isobutyl ether.*

15 —, diisopropyl. See *Isopropyl ether.*

16 —, dimethyl. See *Methyl ether.*

17 —, dinaphthyl. See *Naphthyl ether.*

18 —, di-*n*-octyl. See *Octyl ether.*

19 —, diphenyl. See *Phenyl ether.*

20 —, di-*n*-propyl. See *Propyl ether.*

21 —, divinyl. See *Vinyl ether.*

22 —, ethylene diphenyl. See *Ethane, 1, 2-diphenoxy-**.

23 —, ethyl 2-furylmethyl (*ethyl furfuryl ether*). $C_4H_3OCH_2OC_2H_5$, 126.08. Col.liq. **D.** 0.9844^{20}_{4}, **b.p.** 149.5–50.5[770]. **Soly.** i.w.; s.al.; s.et.

24 —, ethyl heptyl (1-*ethoxyheptane**). $C_2H_5O(CH_2)_6CH_3$, 144.16. **D.** 0.790^{16}_{4}, **b.p.** 166.6. **Soly.** i.w.; s.al.; s.et.

25 —, ethyl hexyl (1-*ethoxyhexane**). $C_2H_5O(CH_2)_5CH_3$, 130.14. Liq. **D.** 0.8327^{0}_{4}, **b.p.** 137. **Soly.** i.w.; v.s.al.; s.et.

25₁ —, ethylidene diethyl. See *Acetal.*

25₂ —, ethylidene dimethyl. See *Ethane, 1, 1-dimethoxy-**.

26 —, ethyl isoamyl (1-*ethoxy-3-methylbutane**). $C_2H_5OCH_2CH_2CH(CH_3)_2$, 116.12. Col.liq. **D.** 0.764^{18}_{4}, **b.p.** 112. **Soly.** i.w.; ∞al.; ∞et.

27 —, ethyl isobutyl (1-*ethoxy-2-methylpropane**). $C_2H_5OCH_2CH(CH_3)_2$, 102.11. Col.liq. **D.** 0.751^{20}_{4}, **b.p.** 80(78–80). **Soly.** i.w.; ∞al.; ∞et.

28 —, ethyl isopropyl (2-*ethoxypropane**). $C_2H_5OCH(CH_3)_2$, 88.09. Col. liq. **D.** 0.745^{0}_{4}, **b.p.** 54. **Soly.** s.w.; ∞al.; ∞et.

29 —, ethyl methyl (*methoxyethane**). $CH_3OC_2H_5$, 60.06. Col.liq. or gas. **D.** 0.7260^{0}_{4}, **b.p.** 7.9(11–2). **Soly.** s.w.; ∞al.; ∞et.

30 —, ethyl β-methylaminoethyl. See *Ethylamine, β-ethoxy-N-methyl-.*

31 —, ethyl β-4-morpholylethyl. See *Morpholine, 4-(β-ethoxyethyl)-.*

32 —, ethyl 1-naphthyl (1-*ethoxynaphthalene**). $C_{10}H_7OC_2H_5$, 172.09. Liq., *n* 1.602. **D.** 1.061^{20}_{4}; 1.0548^{25}_{4}, **m.p.** 5.5, **b.p.** 276.4; 160^{19}. **Soly.** i.w.; v.s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

33 **Ether, ethyl 2-naphthyl** (*2-ethoxynaphthalene*; bromelia; nerolin (new)*). $C_{10}H_7OC_2H_5$, 172.09. Pl., *n* $1.5932^{47.3}$. **D.** 1.0606^{25}_{4}, **m.p.** 37.5, **b.p.** 282. **Soly.** i.w.; sl.s.al.; s.et.

34 —, **ethyl octyl** (*1-ethoxyoctane**). $C_2H_5O(CH_2)_7CH_3$, 158.17. Liq. **D.** 0.794^{17}_{4}, **b.p.** 182–4. **Soly.** i.w.; s.al.; s.et.

35 —, **ethyl phenyl.** See *Phenetole.*

36 —, **ethyl propargyl.** See *Propyne, 3-ethoxy-*.*

37 —, **ethyl propyl** (*1-ethoxypropane**). $C_2H_5OC_3H_7$, 88.09. Col. liq., *n* 1.36948. **D.** 0.747 (0.732^{20}_{4}), **m.p.** < -79, **b.p.** 64(61.4). **Soly.** s.w.; ∞al.; ∞et.

38 —, **ethyl tetrahydrofurfuryl.** See *Furan, 2-ethoxymethyltetrahydro-.*

39 —, **ethyl o-tolyl** (*2-ethoxytoluene*; o-cresyl ethyl ether*). $CH_3C_6H_4OC_2H_5$, 136.09. Liq., *n* $1.508^{13.3}$. **D.** $0.9592^{13.3}_{4}$, **b.p.** 180.1; $69.6–70.2^{12}$.

40 —, **ethyl *m*-tolyl** (*3-ethoxytoluene**). $CH_3C_6H_4OC_2H_5$, 136.09. *n* 1.513. **D.** 0.9560^{0}_{0}, **b.p.** 192; $73–5^{10}$.

41 —, **ethyl *p*-tolyl** (*4-ethoxytoluene*). $CH_3C_6H_4OC_2H_5$, 136.09. Liq., *n* 1.5107^{15}. **D.** 0.9662^{0}_{0}, **b.p.** 189.9; $70–1^{16}$.

42 —, **ethyl vinyl** (*ethenoxyethane**). $CH:CH_2OC_2H_5$, 72.06. Liq. **D.** 0.763^{14}_{0}, **b.p.** 35.5. **Soly.** sl.s.w.; s.al., ∞et.

45 —, **2-furylmethyl methyl** (*furfuryl methyl ether*). $C_4H_3OCH_2OCH_3$, 112.06. Col.liq. **D.** 1.0163^{20}_{4}, **b.p.** $134–5^{762}$. **Soly.** i.w.; s.al.; v.s.et.

46 —, **heptyl methyl** (*1-methoxyheptane**). $CH_3OC_7H_{15}$, 130.14. Col.liq. **D.** 0.795^{0}_{0}, **b.p.** 149.8. **Soly.** i.w.; ∞al.; ∞et.

47 —, **heptyl phenyl** (*1-phenoxyheptane**). $C_6H_5O(CH_2)_6CH_3$, 192.16. **D.** 0.9319^{0}_{0}, **b.p.** 266.8.

48 —, **hexyl phenyl** (*hexyloxybenzene; 1-phenoxyhexane**). $CH_3(CH_2)_5OC_6H_5$, 178.14. **D.** 0.9426^{0}_{4}, **b.p.** 246.

49 —, **isoamyl 1-naphthyl** (*1-(γ-methylbutoxy)naphthalene**). $C_{10}H_7$-$OCH_2CH_2CH(CH_3)_2$, 214.14. Liq., *n* $1.5705^{14.2}$. **D.** $1.0069^{14.2}$, **b.p.** $317–9^{742}$ d.

50 —, **isoamyl 2-naphthyl** (*2-(γ-methylbutoxy)naphthalene**). $C_{10}H_7$-$OCH_2CH_2CH(CH_3)_2$, 214.14. Leaf., *n* 1.5768^{12}. **D.** 1.0155^{12}_{4}, **m.p.** 26.5, **b.p.** 323–6 d. **Soly.** i.w.; s.al.; s.et.

51 —, **isoamyl phenyl** (*isoamoxybenzene; 3-methyl-1-phenoxybutane*). C_6H_5O-$(CH_2)_2CH(CH_3)_2$, 164.12. Col.liq., *n* 1.4872. **D.** 0.9198^{22}, **b.p.** 225.

52 —, **isobutyl methyl** (*1-methoxy-2-methylpropane**). CH_3OCH_2CH-$(CH_3)_2$, 88.09. Liq. **D.** 0.7507^{0}_{4}, **b.p.** 59^{741}. **Soly.** i.w.; s.al.; s.et.

53 —, **isobutyl phenyl** (*isobutoxybenzene; 2-methyl-1-phenoxypropane*). $(CH_3)_2CHCH_2OC_6H_5$, 150.11. Col. liq. **D.** 0.939^{16}_{4}, **b.p.** 198.

54 —, **isopropyl methyl** (*2-methoxypropane**). $CH_3OCH(CH_3)_2$, 74.08. Col. liq. **D.** 0.7347^{15}_{15}, **b.p.** 32.5^{777}. **Soly.** sl.s.w.; s.al.; s.et.

55 —, **isopropyl phenyl** (*isopropoxybenzene; 2-phenoxypropane*). $(CH_3)_2$-$CHOC_6H_5$,136.09.Col.liq. **D.** 0.9464^{15}_{15}, **b.p.** 177.2.

56 —, **methylene diethyl.** See *Methane, diethoxy-*.*

57 —, **methylene dimethyl.** See *Methane, dimethoxy-*.*

58 —, ***o, o′*-methylenediphenyl.** See *Xanthene.*

59 —, **methylenedipropyl.** See *Methane, dipropoxy-*.*

60 —, **methyl 1-naphthyl** (*1-methoxynaphthalene*; methyl α-naphthyl ether*). $C_{10}H_7OCH_3$, 158.08. Col.liq., *n* $1.6232^{13.9}$. **D.** 1.0964^{14}_{4}, **m.p.** < -10, **b.p.** 265–9 (258). **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

61 —, **methyl 2-naphthyl** (*2-methoxynaphthalene*; methyl β-naphthyl ether; nerolin(old); yara-yara*). $C_{10}H_7OCH_3$, 158.08. Col.leaf.f.et. **m.p.** 72, **b.p.** 274. **Soly.** sl.s.w.; sl.s.al.; v.s.et.; s.CS_2, bz.

62 —, **methyl phenyl.** See *Anisole.*

63 —, **methyl propargyl.** See *Propyne, 3-methoxy-*.*

64 —, **methyl propyl** (*1-methoxypropane**). $CH_3OCH_2CH_2CH_3$, 74.08. Col. liq., *n* 1.3579. **D.** 0.738^{20}_{4}, **b.p.** 38.9. **Soly.** 3.05^{25}w.; ∞al.; ∞et.

65 —, **methyl 6-quinolyl.** See *Quinoline, 6-methoxy-.*

66 —, **methyl *o*-tolyl** (*2-methoxytoluene*; o-cresyl methyl ether*). $CH_3C_6H_4OCH_3$, 122.08. Liq., *n* $1.5199^{15.3}$. **D.** 0.9851^{15}_{15}, **b.p.** 171.3. **Soly.** i.w.; v.s.al.; v.s.et

67 —, **methyl *m*-tolyl** (*3-methoxytoluene**). $CH_3C_6H_4OCH_3$, 122.08. Liq., *n* 1.506. **D.** 0.9766^{15}_{15}, **b.p.** 177.2 (172–3).

For explanations and abbreviations see beginning of table.

68 **Ether, methyl *p*-tolyl** (*4-methoxytoluene**). $CH_3C_6H_4OCH_3$, 122.08. Liq., *n* 1.512. **D.** 0.9757^{15}_{15}, **b.p.** 176.5 (173–4).

69 —, **1-naphthyl propyl** (*1-propoxynaphthalene**). $C_{10}H_7OCH_2CH_2CH_3$, 186.11. Liq., *n* $1.5928^{18.4}$. **D.** $1.0447^{18.4}$, **b.p.** 298–9.

70 —, **2-naphthyl propyl** (*2-propoxynaphthalene**). $C_{10}H_7OCH_2CH_2CH_3$, 186.11. Need. **m.p.** 39.5–40.

71 —, **octyl phenyl** (*1-phenoxyoctane**). $C_6H_5O(CH_2)_7CH_3$, 206.17. Col.liq. **D.** 0.9139^{15}_{15}, **m.p.** 8, **b.p.** 285.2.

72 —, **perchloro-.** See *Ether, bis(pentachloroethyl).*

73 —, **phenyl propyl** (*propoxybenzene**). $C_3H_7OC_6H_5$, 136.09. Col.liq. **D.** 0.9530^{15}_{15}, **b.p.** 190.5. **Soly.** s.al.; s.et.

74 —, **phenyl vinyl** (*ethenoxybenzene**). $C_6H_5OCH{:}CH_2$, 120.06. **b.p.** 155–6.

75 —, **propyl *o*-tolyl** (*2-propoxytoluene*; o-cresyl propyl ether*). $CH_3C_6H_4O(CH_2)_2CH_3$, 150.11. **D.** 0.9517^{0}_{0}, **b.p.** 204.1.

76 —, **propyl *m*-tolyl** (*3-propoxytoluene**). $CH_3C_6H_4OC_3H_7$, 150.11. **D.** 0.9484^{0}_{0}, **b.p.** 210.6.

77 —, **propyl *p*-tolyl** (*4-propoxytoluene**). $CH_3C_6H_4OC_3H_7$, 150.11. **D.** 0.9497^{0}_{0}, **b.p.** 210.4.

78 **Ethine.** See *Acetylene.*

79 **Ethinyl tribromide.** See *Ethylene, tribromo-.*

80 **Ethinyl trichloride.** See *Ethylene, trichloro-.*

81 **Ethionic anhydride** (*carbyl sulfate; 1, 3, 2, 4-dioxadithiane 2, 4-bisdioxide*). $SO_2OCH_2CH_2SO_2O$, 188.15. Deliq.cr. **m.p.** 80. **Soly.** d.w.

82 **Ethocain.** See *Procaine, hydrochloride.*

83 **Ethoxyamine*** (*α-ethylhydroxylamine*). $C_2H_5ONH_2$, 61.06. Col.liq. **D.** $0.883^{7.5}$, **b.p.** 68. **Soly.** ∞w.; ∞al.; ∞et.

Ethyl. For ethyl derivatives see the parent compounds (e.g., for ethylbenzene see *Benzene, ethyl-*). For ethyl esters of organic acids see the acids.

84 **Ethyl acetate.** See *Acetic acid, ethyl ester.*

85 **Ethyl alcohol** (*ethanol*; methylcarbinol; alcohol; spirit of wine*). CH_3CH_2OH, 46.05. Col.liq., *n* $1.36242^{18.35}$. **D.** 0.7893^{20}_{4}; 0.78505^{25}_{4}, **m.p.** −117.3; −114.6, **b.p.** 78.5 (78.37). **Soly.** ∞w.; ∞et.; ∞chl.; s.me.al.

—. For other derivatives see Ethanol.

86 —, esters with organic acids. See "ethyl ester," under the names of the acids.

87 **Ethylamine*** (*aminoethane*). $C_2H_5NH_2$, 45.06. Col.liq. **D.** 0.7059^{0}_{4}; 0.689^{15}_{15}, **m.p.** −80.6, **b.p.** 16.6. **Soly.** ∞w.; ∞al.; ∞et.

88 —, hydrobromide (*ethylammonium bromide**). $C_2H_5NH_2{\cdot}HBr$, 125.99. **D.** 1.741^{20}_{4}, **m.p.** 159.5.

89 —, hydrochloride (*ethylammonium chloride**). $C_2H_5NH_2{\cdot}HCl$, 81.53. Monocl., deliq.leaf. **D.** 1.2045^{21}_{4}. **m.p.** 109 (76–80), **b.p.** d. 315. **Soly.** 238^{17}w.; s.al.; i.et.

90 —, ***N*-benzal-** (*N-ethylbenzalimine; N-benzylideneethylamine*). $C_6H_5CH{:}NC_2H_5$, 133.09. *n* 1.541^{20}_{He}. **D.** 0.937^{20}_{4}, **b.p.** 195. **Soly.** i.w.; ∞al.; ∞et.

91 —, ***β, β*-diethoxy-*** (*aminoacetal; acetalylamine*). $(C_2H_5O)_2CHCH_2NH_2$, 133.13. Liq., *n* 1.4120. **D.** 0.9161^{25}_{4}, **b.p.** 163; $52–3^{2}$. **Soly.** s.w.; s.al.; s.et.; s.chl.

92 —, ***β, β*-diethoxy-*N, N*-dimethyl-** (*dimethylaminoacetal*). $(CH_3)_2NCH_2CH(OC_2H_5)_2$, 161.16. Yel.liq. **D.** 0.885^{7}_{4}, **b.p.** 170–1. **Soly.** s.w.; s.al.; s.et.

93 —, ***α, α*-dimethyl-.** See *tert-Butylamine.*

94 —, ***β*-ethoxy-*** (*β-aminoethyl ethyl ether*). $C_2H_5OCH_2CH_2NH_2$, 89.09. Liq., *n* 1.4101. **D.** 0.8512^{20}_{4}, **b.p.** 108. **Soly.** ∞w.; ∞al.; ∞et.

95 —, ***β*-ethoxy-*N*-methyl-** (*ethyl β-methylaminoethyl ether*). $CH_3NHCH_2CH_2OC_2H_5$, 103.11. Liq., *n* 1.4147. **D.** 0.8363^{20}_{4}, **b.p.** $114–5^{744}$.

96 —, ***β*-hydroxy-.** See *Ethanol, 2-amino-*.*

97 —, ***β*-hydroxy-*N, N*-dimethyl-.** See *Ethanol, 2-dimethylamino-*.*

98 —, ***β*-hydroxy-*N*-methyl-.** See *Ethanol, 2-methylamino-*.*

99 —, ***α*-phenyl-.** See *Benzylamine, α-methyl-.*

00 —, ***β*-phenyl-.** See *Phenethylamine.*

01 **Ethyl arsenate** (*triethyl arsenate; ethyl orthoarsenate*). $(C_2H_5)_3AsO_4$, 226.05. **D.** 1.3264^{0}_{4}, **b.p.** 238. **Soly.** d.c.w.

02 **Ethyl arsenite** (*triethyl arsenite, ethyl orthoarsenite*). $(C_2H_5)_3AsO_3$, 210.05. **D.** 1.224^{0}_{4}, **b.p.** 166. **Soly.** d.c.w.

03 **Ethyl borate** (*triethyl borate; triethoxyboron*). $B(OC_2H_5)_3$, 145.94. Col liq., *n* 1.381. **D.** $0.864^{26.5}$, **b.p.** 120 **Soly.** d.w.; ∞al.; ∞et.

* Name approved by the International Union of Chemistry.

04 Ethyl bromide (*bromoethane**). CH_3-CH_2Br, 108.96. Col.liq., *n* 1.42386. **D.** 1.430^{20}_{4}; 1.4505^{-5}_{4}, **m.p.** −119, **b.p.** 38.0. **Soly.** 1.08^{0}, $0.96^{17.5}$, 0.91^{20} w.; ∞al.; ∞et.; ∞chl.

05 —, vinyl-. See 1-*Butene, 4-bromo-**.

06 Ethyl chloride (*chloroethane**). CH_3-CH_2Cl, 64.50. Col.liq. or gas. **D.** 0.9214^{0}_{4}, **m.p.** −138.7, **b.p.** 12.2. **Soly.** 0.574^{20}w.; 48.3^{21}al.; ∞et.

07 Ethyl cyanide. See *Propionitrile*.

08 Ethyl disulfide (*ethyldithioethane*; diethyl disulfide*). $(C_2H_5)_2S_2$, 122.20. Oil, *n* 1.50633^{20}. **D.** 0.99267^{20}_{4}, **b.p.** 153–4. **Soly.** v.sl.s.w.; ∞al.; ∞et.

09 Ethylene (*ethene*; elayl*). CH_2:CH_2, 28.03. Col.gas, *n* 1.363^{-100}. **D.** 1.245^{0} g/l; 0.566^{-102}_{4}, **m.p.** 169.4; frz. −181, **b.p.** −103.9. **Soly.** 25.6^{0} cm^3w.; $360cm^3$al.; s.et.

10 —, esters. See "diacetate," "dibenzoate," etc. under *Glycol*.

11 —, bromo-. See *Vinyl bromide*.

12 —, 1-bromo-2-phenyl-. See *Styrene, β-bromo-*.

13 —, butyl-. See 1-*Hexene**.

14 —, *sec*-butyl-. See 1-*Pentene, 3-methyl-**.

15 —, *tert*-butyl-. See 1-*Butene*, 3, 3-*dimethyl-**.

16 —, 1-butyl-1-methyl-. See 1-*Hexene, 2-methyl-**.

17 —, 1-butyl-2-methyl-. See 2-*Heptene**.

18 —, 1-*sec*-butyl-1-methyl-. See 1-*Pentene*, 2, 3-*dimethyl-**.

19 —, 1-*sec*-butyl-2-methyl-. See 2-*Hexene, 4-methyl-**.

20 —, chloro-. See *Vinyl chloride*.

21 —, 1, 2-dibromo- (*acetylene dibromide; sym-dibromoethylene*). CHBr:-CHBr, 185.85. Col.liq., *n* 1.5428. **D.** $2.271^{17.5}_{4}$, **m.p.** *cis* −53; *trans* −6.5, **b.p.** *cis* 110^{754}; *trans* 108. **Soly.** i.w.; v.s.al.; v.s.et.

22 —, 1, 1-dichloro- (*uns-dichloroethylene*). CH_2:CCl_2, 96.93. Liq. **D.** 1.250^{15}_{4}, **b.p.** 37. **Soly.** i.w.

23 —, 1, 2(or *sym*)**-dichloro-** (*acetylene dichloride*). CHCl:CHCl, 96.93. [*cis:* Liq., *n* 1.4490^{15}. **D.** 1.265^{15}_{4}, **m.p.** −50, **b.p.** 48.4. *trans:* Liq., *n* 1.4519^{15}. **D.** 1.291^{15}_{4}, **m.p.** −80.5, **b.p.** 60.3.] **Soly.** i.w.; ∞al.; ∞et.

24 —, 1, 1(or *uns*)**-diethyl-.** See 1-*Butene, 2-ethyl-**.

25 —, 1, 2(or *sym*)**-diethyl-.** See 3-*Hexene**.

26 —, 1, 1-diethyl-2-methyl-. See 2-*Pentene, 3-ethyl-**.

27 —, 1, 2(or *sym*)**-diisopropyl-.** See 3-*Hexene*, 2, 5-*dimethyl-**.

28 —, 1, 1(or *uns*)**-dimethyl-.** See *Propene, 2-methyl-**.

29 —, 1, 2(or *sym*)**-dimethyl-.** See 2-*Butene**.

30 —, 1, 1-dimethyl-2-propyl-. See 2-*Hexene, 2-methyl-**.

31 —, 1, 2-dimethyl-1-propyl-. See 2-*Hexene, 3-methyl-**.

32 —, 1, 1-diphenyl- (*uns-diphenylethylene*). $(C_6H_5)_2C$:CH_2, 180.09. Col. liq., *n* 1.610^{14}. **D.** 1.038^{14}_{4}; 1.0206^{32}_{4}, **m.p.** 9, **b.p.** 277.

33 —, *trans*-1, 2-diphenyl-. See *Stilbene*.

34 —, ethyl-. See 1-*Butene**.

35 —, 1-ethyl-1, 2-dimethyl-. See 2-*Pentene, 3-methyl-**.

36 —, 2-ethyl-1, 1-dimethyl-. See 2-*Pentene, 2-methyl-**.

37 —, 1-ethyl-1-isobutyl-. See 1-*Butene, 2-ethyl-3-methyl-**.

38 —, 1-ethyl-2-isopropyl-. See 3-*Hexene, 2-methyl-**.

39 —, 1-ethyl-1-methyl-. See 1-*Butene, 2-methyl-**.

40 —, 1-ethyl-2-methyl-. See 2-*Pentene**.

41 —, 1-ethyl-1-propyl-. See 1-*Pentene, 2-ethyl-**.

42 —, 1-ethyl-2-propyl-. See 3-*Heptene**.

43 —, ethyltrimethyl-. See 2-*Pentene*, 2, 3-*dimethyl-**.

44 —, iodo-. See *Vinyl iodide*.

45 —, isoamyl-. See 1-*Hexene, 5-methyl-**.

46 —, isobutyl-. See 1-*Pentene, 4-methyl-**.

47 —, 1-isobutyl-1-methyl-. See 1-*Pentene*, 2, 4-*dimethyl-**.

48 —, 1-isobutyl-2-methyl-. See 2-*Hexene, 5-methyl-**.

49 —, isopropyl-. See 1-*Butene, 3-methyl-**.

50 —, 1-isopropyl-1, 2-dimethyl-. See 2-*Pentene*, 3, 4-*dimethyl-**.

51 —, 2-isopropyl-1, 1-dimethyl-. See 2-*Pentene*, 2, 4-*dimethyl-**.

52 —, 1-isopropyl-1-methyl-. See 1-*Butene*, 2, 3-*dimethyl-**.

53 —, 1-isopropyl-2-methyl-. See 2-*Pentene, 4-methyl-**.

For explanations and abbreviations see beginning of table.

54 **Ethylene, methyl-.** See *Propene**.

55 **—, 1-methyl-1-phenyl-.** See *Benzene, isopropenyl-.*

56 **—, 1-methyl-1-propyl-.** See *1-Pentene, 2-methyl-**.

57 **—, 1-methyl-2-propyl.** See *2-Hexene**.

58 **—, perchloro-.** See *Ethylene, tetrachloro-.*

59 **—, phenyl-.** See *Styrene.*

60 **—, propyl-.** See *1-Pentene**.

61 **—, pseudobutyl-.** See *1-Butene, 3, 3-dimethyl-**.

62 **—, tetrachloro-** (*perchloroethylene*). $CCl_2{:}CCl_2$, 165.83. Col.liq., *n* 1.50547. **D.** 1.6311^{15}_{4}, **m.p.** −22.35, **b.p.** 121.20. **Soly.** i.w.; ∞al.; ∞et.

63 **—, tetraiodo-.** $CI_2{:}CI_2$, 531.68. Yel. monocl.pr. **D.** 2.983^{20}_{4}, **m.p.** 187, **b.p.** subl. **Soly.** i.w.; sl.s.al.; sl.s.et.; v.s.CS_2; s.bz., chl., tol., ac.a.

64 **—, tetramethyl-.** See *2-Butene, 2, 3-dimethyl-**.

65 **—, tetraphenyl-.** $(C_6H_5)_2C{:}C(C_6H_5)_2$, 332.16. Col.monocl. or rhomb. f.bz. **m.p.** 227(221), **b.p.** 425. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; v.s.bz.

66 **—, tribromo-** (*ethinyl tribromide*). $CHBr{:}CBr_2$, 264.76. Liq. **D.** $2.708^{20.5}$, **b.p.** 163–4; $53–5^{9}$.

67 **—, trichloro-** (*ethinyl trichloride*). $CHCl{:}CCl_2$, 131.38. Col.liq., *n* 1.4777. **D.** 1.45560^{25}_{4}, **m.p.** −73(−86), **b.p.** 87. **Soly.** 0.1w.; ∞al.; ∞et.

68 **—, trimethyl-.** See *2-Butene, 3-methyl-**.

69 **—, triphenyl-** (*α-phenylstilbene*). $(C_6H_5)_2C{:}CHC_6H_5$, 256.12. Narrow leaf. f.al. or ac.a. **m.p.** 72–3, **b.p.** 220–1^{14}. **Soly.** i.w.; v.s.al.; v.s.et.

70 **—, vinyl-.** See *1, 3-Butadiene**.

71 **Ethylene bromide** (*1, 2-dibromoethane*; ethylene dibromide; glycol dibromide*). CH_2BrCH_2Br, 187.86. Col. liq., *n* 1.53789. **D.** 2.1701^{20}_{4}, **m.p.** 9.97(10), **b.p.** 131.6. **Soly.** 0.431^{30}w.; s.al.; ∞et.

72 **Ethylene bromohydrin.** See *Ethanol, 2-bromo-**.

73 **Ethylenecarboxylic acid.** See *Acrylic acid.*

74 **Ethylene chloride** (*1, 2-dichloroethane*; ethylene dichloride; glycol dichloride*). CH_2ClCH_2Cl, 98.95. Col. liq., *n* 1.44432. **D.** 1.257^{20}_{4}, **m.p.** −35.3, **b.p.** 83.5–3.7. **Soly.** 0.92^{0}, 0.869^{20}w.; s.al.; ∞et.; s.ord.org.solv.

75 **Ethylene chlorobromide.** See *Ethane, 1-bromo-2-chloro-**.

76 **Ethylene chlorohydrin.** See *Ethanol, 2-chloro-**.

77 **Ethylene cyanide.** See *Succinonitrile.*

78 **Ethylene cyanohydrin.** See *Hydracrylonitrile.*

79 **Ethylenediamine**(anh.) (*1, 2-ethanediamine**). $NH_2CH_2CH_2NH_2$, 60.08. Col.liq., *n* $1.45400^{26.1}$. **D.** 0.8994^{20}_{4}, **m.p.** 8.5, **b.p.** 116.1(117). **Soly.** s.w.; 0.236 et.; i.bz.

80 **Ethylenediamine**(hydrate). $NH_2CH_2CH_2NH_2{\cdot}H_2O$, 78.09. Col.liq., *n* 1.4500. **D.** 0.963^{24}_{4}, **m.p.** 10, **b.p.** 118.

81 —, hydrochloride (*ethylenediammonium chloride*). $HCl{\cdot}NH_2CH_2CH_2NH_2{\cdot}HCl$, 133.01. *n* 1.633.

82 **—, *N, N'*-diphenyl-** (*sym-diphenylethylenediamine; ethylenediphenyldiamine*). $C_6H_5NHCH_2CH_2NHC_6H_5$, 212.14. Col.leaf.f.dil.al. **m.p.** 65. **Soly.** i.w.; v.s.al.; v.s.et.

83 **1, 1-Ethylenedicarboxylic acid, 2-phenyl-.** See *Malonic acid, benzal-.*

84 ***cis*-1, 2-Ethylenedicarboxylic acid.** See *Maleic acid.*

85 ***trans*-1, 2-Ethylenedicarboxylic acid.** See *Fumaric acid.*

86 **Ethylene diiodide.** See *Ethylene iodide.*

87 **Ethylene dimercaptan.** See *1, 2-Ethanedithiol**.

88 **Ethylenediphenyldiamine.** See *Ethylenediamine, N, N'-diphenyl-.*

89 **Ethylene diphenyl ether.** See *Ethane, 1, 2-diphenoxy-**.

90 **Ethylenedisulfonic acid.** See *1, 2-Ethanedisulfonic acid**.

91 **Ethylene ethylidene ether.** See *1, 3-Dioxolane, 2-methyl-.*

92 **Ethylene glycol.** See *Glycol.*

93 **Ethylene imine.** See *Ethylenimine.*

94 **Ethylene iodide** (*1, 2-diiodoethane*; ethylene diiodide; glycol diiodide*). CH_2ICH_2I, 281.87. Yel.monocl.pr.f.et. **D.** 2.132^{10}_{4}, **m.p.** 81–2, **b.p.** d. **Soly.** sl.s.w.; s.al.; s.et.

95 **Ethylene lactic acid.** See *Hydracrylic acid.*

96 **Ethylene mercaptan.** See *1, 2-Ethanedithiol**.

97 **Ethylene nitrate.** See *Glycol, dinitrate.*

98 **Ethylene nitrite.** See *Glycol, dinitrite.*

* Name approved by the International Union of Chemistry.

99 Ethylene oxide (*1, 2-epoxyethane*; oxirane*). $(CH_2)_2O$, 44.03. Col.liq. or gas, *n* $1.35988^{8.4}$. **D.** 1.965^0 g/l; 0.887^7_4, **m.p.** −111.3, **b.p.** 10.7. **Soly.** ∞ w.; ∞ al.; ∞ et.

00 —, α, α-dimethyl- (*1, 2-epoxy-2-methylpropane; isobutylene oxide*). $CH_2C(CH_3)_2O$, 72.06. Liq. **D.** 0.831, **b.p.** 51–2. **Soly.** s.al.; s.et.

01 Ethylenimine (*dimethylenimine; dihydroazirine*). $NHCH_2CH_2$, 43.05. Oil, **D.** 0.832^{24}_{4}, **b.p.** 55–6. **Soly.** ∞ w.; s.al.

02 Ethyl ether (*ethoxyethane*; diethyl ether; ether; ethyl oxide; sulfuric ether*). $C_2H_5OC_2H_5$, 74.08. Col.liq. or rhomb., *n* $1.35424^{17.1}$. **D.** 0.7135^{20}_{4}, **m.p.** stab. −116.2; unst. −123.3, **b.p.** 34.5. **Soly.** 7.42^{20}, 5.64^{30}w.; ∞ al.; ∞ et.; ∞ chl., bz.; s.conc.H_2SO_4.

03 Ethyl fluoride (*fluoroethane**). CH_3-CH_2F, 48.04. Gas. **D.** 2.198^0 g/l. **b.p.** −32. **Soly.** 198^{14}cm³w.; v.s.al.; v.s.et.

04 Ethyl hydrogen sulfate. See *Ethylsulfuric acid.*

05 Ethyl hydrosulfide. See *Ethanethiol*.*

06 Ethylidene bromide. See *Ethane, 1, 1-dibromo-*.*

07 Ethylidene chloride. See *Ethane, 1, 1-dichloro-*.*

08 Ethylidene cyanohydrin. See *Lactonitrile.*

09 Ethylidene glycol, tribromo-. See *Bromal, hydrate.*

10 —, trichloro-. See *Chloral, hydrate.*

11 Ethylidene iodide. See *Ethane, 1, 1-diiodo-*.*

12 Ethyl iodide (*iodoethane**). CH_3CH_2-I, 155.96. Col.liq., *n* $1.5222^{7.0}$. **D.** 1.933^{20}_{4}; 1.9245^{24}_{4}, **m.p.** −108.5 (105–11), **b.p.** 72.2. **Soly.** 0.4^{20}w.; s.al.; s.et.; s.bz., chl.

13 Ethyl isocyanide (*ethylcarbylamine**). C_2H_5NC, 55.05. Col.liq., *n* 1.3659^{24}. **D.** 0.7402^{20}_{4}, **m.p.** < −66, **b.p.** 79. **Soly.** v.s.w.; ∞ al.; ∞ et.

14 Ethyl ketone. See *3-Pentanone*.*

15 Ethyl mercaptan. See *Ethanethiol*.*

16 Ethyl mustard oil. See *Isothiocyanic acid, ethyl ester.*

17 Ethyl nitrate (*nitric ether*). C_2H_5-ONO_2, 91.05. Col.inflam.liq., *n* $1.38484^{21.6}$. **D.** 1.105^{20}_{4}, **m.p.** −102 (−112), **b.p.** 88.7. **Soly.** 1.3^{55}(i.)w.; ∞ al.; ∞ et.

18 Ethyl nitrite (*nitrous ether*). C_2H_5-ONO, 75.05. Col. or yelsh.liq. **D.** $0.900^{15.5}$, **b.p.** 17. **Soly.** v.sl.s.w.; ∞ al.; s.et.

19 Ethyloglycolic acid. See *Acetic acid, ethoxy-.*

20 Ethylolamine. See *Ethanol, 2-amino-*.*

21 Ethyl orthoarsenate. See *Ethyl arsenate.*

22 Ethyl orthoarsenite. See *Ethyl arsenite.*

23 Ethyl orthosilicate. $(C_2H_5)_4SiO_4$, 208.22. Col.liq. **D.** 0.933^{20}_{4}, **b.p.** 165.5. **Soly.** d.w.; v.s.al.; ∞ et.

24 Ethyl oxide. See *Ethyl ether.*

25 Ethyl phosphate (*triethyl phosphate*) $(C_2H_5)_3PO_4$, 182.14. Liq., *n* 1.40616^{10}. **D.** 1.0686^{20}_{4}, **b.p.** 216. **Soly.** 100^{25}d. w.; s.al.; s.et.

26 Ethyl phosphite (*triethyl phosphite*) $(C_2H_5)_3PO_3$, 166.14. Col.liq., *n* 1.4079. **D.** 0.9687^{20}_{4}, **b.p.** 156.5. **Soly.** i.w.; v.s.al.; v.s.et.

27 Ethyl selenide (*diethylselenide*). $(C_2H_5)_2Se$, 137.28. Liq., *n* 1.4768. **D.** 1.2300^{20}_{4}, **b.p.** 108. **Soly.** i.w.

28 Ethyl silicate. See *Ethyl orthosilicate.*

29 Ethyl sulfate (*diethyl sulfate*). $(C_2H_5)_2SO_4$, 154.14. Col. oily liq., *n* 1.3902. **D.** 1.180^{15}_{15}; 1.172^{20}_{4}, **m.p.** −26, **b.p.** 208 sl.d. (96^{15}). **Soly.** i., sl.d.w.; ∞, d.h.al.; ∞ et.

30 Ethyl sulfide (*ethylthioethane*; diethyl sulfide*). $(C_2H_5)_2S$, 90.14. Col. liq., *n* 1.44233. **D.** 0.837^{20}_{4}, **m.p.** −102.1, **b.p.** 92. **Soly.** 0.313^{20}w.; s.al.; s.et.

31 Ethylsulfinic acid. See *Ethanesulfinic acid*.*

32 Ethyl sulfite (*diethyl sulfite*). $(C_2H_5)_2$-SO_3, 138.14. Col.liq., *n* 1.4198^{11}. **D.** 1.1062^0_4; 1.077^{20}_{4}, **b.p.** 158 (161.3). **Soly.** s.d.w.; s.al.; s.et.

33 Ethyl sulfone (*ethylsulfonylethane*; diethyl sulfone*). $(C_2H_5)_2SO_2$, 122.14. Rhomb.pl. **D.** 1.357^{20}_{4}, **m.p.** 73–4 (70), **b.p.** 248. **Soly.** 15.6^{16}w.; s.h.et.; v.s.bz., i.pet.eth.

34 Ethylsulfonic acid. See *Ethanesulfonic acid*.*

35 Ethyl sulfoxide (*ethylsulfinylethane*; diethyl sulfoxide*). $(C_2H_5)_2SO$, 106.14. Syrupy liq. **m.p.** 5, **b.p.** 89^{15}d. **Soly.** s.w.; s.al.; s.et.

36 Ethylsulfuric acid (*ethyl hydrogen sulfate; acid ethyl sulfate*). C_2H_5-OSO_3H, 126.11. Col. oily liq. **D.** 1.316^{17}_{4}, **b.p.** 280, d. **Soly.** v.s.w.; s.al.; s.et.

For explanations and abbreviations see beginning of table.

37 **Ethyl telluride** (*tellurium ethyl; diethyl telluride*). $(C_2H_5)_2Te$, 185.58. Red-yel.liq. **D.** 1.599^{15}_{4}, **b.p.** 138. **Soly.** i.w.; s.al.

38 **Ethyl thioalcohol.** See *Ethanethiol**.

39 **Ethyne*.** See *Acetylene.*

40 **Ethynyl bromide.** See *Acetylene, bromo-.*

41 α-**Eucaine.** $C_{19}H_{27}NO_4$, 333.22. Shining pr.cr. **m.p.** 103–5. **Soly.** v.s.et.

42 —, hydrochloride. $C_{19}H_{27}NO_4{\cdot}HCl{\cdot}H_2O$, 387.70. Rosettes f.sm.cr. **m.p.** *ca.* 200 d. **Soly.** 10w.; 117al.; sl.s.et.

43 β-**Eucaine** (*benzamine; betacaine*). $C_{15}H_{21}NO_2$, 247.17. Wh.cr. **m.p.** 78 (91). **Soly.** v.s.et.

44 —, hydrochloride. $C_{15}H_{21}NO_2{\cdot}HCl$, 283.64. Wh.pl. or pr. **m.p.** 268 d. **Soly.** 3.33w.; 3.53al.; s.et.; s.chl.

45 —, lactate (*4-benzoxy-2, 2, 6-trimethylpiperidine lactate; benzamine lactate; benzoylvinyldiacetonealkamine lactate*). $C_{15}H_{21}NO_2{\cdot}C_3H_6O_3$, 337.22. Col.cr. **Soly.** s.w.; s.al.

46 **Eucalyptole.** See *Cineole.*

47 **Eugenic acid.** See *Eugenol.*

48 **Eugenol** (*4-allylguaiacol; eugenic acid*). $CH_2{:}CHCH_2C_6H_3(OCH_3)OH$, 164.09. Col.liq., *n* $1.5416^{19.4}$. **D.** 1.0664^{20}_{4}; 1.0620^{25}_{4}, **m.p.** 10.3, **b.p.** 252–3. **Soly.** v.sl.s.w.; ∞al.; ∞et.; s.chl., oils.

49 —, methyl ether. See *Veratrole, 4-allyl-.*

50 —, **methyl-.** See *Veratrole, 4-allyl-.*

51 **Eugetic acid** (*5-allyl-3-methoxysalicylic acid; eugetinic acid*). $C_3H_5C_6H_2(OCH_3)(OH)COOH$, 208.09. Pr.f.w. **m.p.** anh. 127, **b.p.** d. **Soly.** sl.s.c.w.; s.al.; s.et.; s.$(NH_4)_2CO_3$.

52 **Eupittone** (*hexamethoxyaurin; eupittonic acid*). $C_{19}H_8(OCH_3)_6O_3$, 470.20. Or.need.f.al. **m.p.** 200 d. **Soly.** sl.s.h.al.; s.glac.ac.a.; s.alk., bl. color.

53 **Euxanthic acid.** $C_{19}H_{16}O_{10}{\cdot}3H_2O$, 458.17. Pa.yel.need. **m.p.** 155–8 d. (162), **b.p.** d. **Soly.** sl.s.w.; s.h.al.; v.sl.s.et.; s.alk.

54 **Euxanthone** (*1,7-dihydroxyxanthone*). $HOC_6H_3(CO)(O)C_6H_3OH$, 228.06. Yel. need. **m.p.** 240, **b.p.** subl.d. **Soly.** i.w.; s.h.al.; sl.s.et.; s.alk.

55 —, **3-methoxy-.** See *Gentisin.*

56 **Evernic acid** (*orsellinic acid 4-everninate; lecanoric acid monomethyl ether*). $C_{17}H_{16}O_7$, 332.12. Need. or pr.f.al. **m.p.** 168–9 d. (164). **Soly.** i.c., v.sl.s.h.w.; s.al.; s.et.

57 **Everninic acid** (*2-hydroxy-6-methylanisic acid; orsellinic acid 4-methyl ether*). $CH_3OC_6H_2(OH)(CH_3)COOH$, 182.08. Cr.f.w. **m.p.** 170–1 d. (157) **Soly.** s.h.w.; s.al.; s.et.; s.h.bz.

58 *d*-**Evodiamine.** $C_{19}H_{17}N_3O$, 303.16. Yel.leaf. **m.p.** 278. **Soly.** i.dil.a.

59 *i*-**Evodiamine** (hydrate). $C_{19}H_{17}N_3O{\cdot}H_2O$, 321.17. Rhomb.leaf. **m.p.** 146–7.

60 **Exalgin.** See *Acetanilide, N-methyl-.*

62 **6-Fenchanol.** See *Isofenchyl alcohol.*

63 **2-Fenchanone.** See *Fenchone.*

64 *l*-α-**Fenchene** (*l-7, 7-dimethyl-2-methylenenorcamphane*). $C_{10}H_{16}$, 136.12. Liq., *n* 1.4724^{19}. **D.** 0.864^{20}_{4}, **b.p.** 158 (155–6). **Soly.** i.w.; ∞al.; ∞et.

65 *d*-**Fenchone** (*d-2-fenchanone; d-1, 3, 3-trimethyl-2-norcamphanone; fenchone*). $C_{10}H_{16}O$, 152.12. Oil, *n* $1.4647^{14.5}$. **D.** 0.9460^{20}_{4}, **m.p.** 6, **b.p.** 193–5. **Soly.** i.w.; v.s.al.; v.s.et.

66 **Ferulic acid** (*4-hydroxy-3-methoxycinnamic acid*). $HO(OCH_3)C_6H_3CH{:}CHCOOH$, 194.08. Rhomb.need.f.w. **m.p.** 168 (169–70), **b.p.** d. **Soly.** s.h.w.; v.s.al.; sl.s.et.; sl.s.bz.

67 **Filixic acid.** $C_{35}H_{40}O_{12}$, 652.31. Cr. **m.p.** 184 (160). **Soly.** i.w.; i.al.; sl.s.et.; s.CS_2.

68 **Fisetin** (*3,7,3′,4′-tetrahydroxyflavone*). $HOC_6H_3OC[C_6H_3(OH)_2]C(OH)CO$, 286.08. Yel.need. **m.p.** 360. **Soly.** i.w.; s.al.; sl.s.et.; sl.s.bz.

69 **Flavaniline** (*2-(p-aminophenyl)lepidine*). $NH_2C_6H_4C_9H_5N{\cdot}CH_3$, 234.13. Col.pr.f.bz. **m.p.** 97. **Soly.** v.sl.s.w.; s.al.; s.bz.

70 **3, 5, 7, 3′, 4′-Flavenpentol.** See *d-Catechol.*

71 **Flavianic acid,** histidine salt. See *Histidine, diflavianate.*

72 **Flavol** (*2, 6-anthracenediol*; 2, 6-anthradiol*). $HOC_6H_3(CH)_2C_6H_3OH$. 210.08. Yel.cr.powd.f.al. **m.p.** 295–300 d. (270 d.). **Soly.** i.w.; v.s.al.; v.s.et.; s.ac.a.

73 **Flavone** (*2-phenylchromone; 2-phenyl-1, 4-benzopyrone*). $C_6H_4OC(C_6H_5){:}CHCO$, 222.08. Col.f.lgr. **m.p.** 97. **Soly.** i.w.; s.al.; s.et.

74 —, **5, 7-dihydroxy-.** See *Chrysin.*

75 —, **3, 5, 7, 2′, 4′-pentahydroxy-.** See *Morin.*

76 —, **3, 5, 7, 3′, 4′-pentahydroxy-.** See *Quercetin.*

* Name approved by the International Union of Chemistry.

77 **Flavone, 3, 7, 3′, 4′-tetrahydroxy-.** See *Fisetin.*

78 **Flavopurpurin** (1, 2, 6-*trihydroxyanthraquinone*). $HOC_6H_3(CO)_2C_6H_2(OH)_2$, 256.06. Yel.need.f.al. **m.p.** >360, **b.p.** 459. **Soly.** v.sl.s.h.w.; s.h.al.; sl.s.et.

79 **Fluoran** (9-*hydroxy-9-xanthene-o-benzoic acid lactone*). $C_{20}H_{12}O_3$, 300.09. Flat need. **m.p.** 173–5. **Soly.** s.al.; s.H_2SO_4, HNO_3.

80 —, **2, 7-dihydroxy-.** See *Hydroquinonephthalein.*

81 **Fluoranthene** (*idryl*). $C_{16}H_{10}$, 202.08. Col.monocl.need.f.al. **m.p.** 110, **b.p.** 251^{60}. **Soly.** i.w.; sl.s.c.al.; v.s.et.; s.CS_2, ac.a.

82 **Fluorene** (*diphenylenemethane*). $C_6H_4CH_2C_6H_4$, 166.08. Col.leaf.f.al. **m.p.** 116 (100–7), **b.p.** 295 (298). **Soly.** i.w.; sl.s.al.; v.s.et.; s.bz., CS_2.

83 —, **keto-.** See 9-*Fluorenone**.

84 —, **9-oxo-.** See 9-*Fluorenone**.

85 **Fluorene alcohol.** See 9-*Fluorenol**.

86 **9-Fluorenol*** (*fluorene alcohol; diphenylenecarbinol*). $C_6H_4CHOHC_6H_4$, 182.08. Hex.need.f.w. **m.p.** 153 (156). **Soly.** s.al.; s.et.; s.bz.

87 **9-Fluorenone*** (9-*oxofluorene; ketofluorene; diphenylene ketone*). $C_6H_4COC_6H_4$, 180.06. Yel.rhomb.pr. **m.p.** 84, **b.p.** 341.5. **Soly.** i.w.; v.s.al.; v.s.et.

88 **Fluorescein** (*resorcinolphthalein*). $C_{20}H_{12}O_5$, 332.09. Or.-red cr.powd. **m.p.** 312–8 d.(d. 290). **Soly.** i.w.; s.al.; sl.s.et.; s.alk.sol., dil.a., h.glac.ac.a.; i.bz., chl.

89 —, **dibromohydroxymercuri-,** disodium salt. See *Mercurochrome* 220 *soluble.*

90 —, **4, 5-dihydroxy-.** See *Galleïn.*

91 —, **2, 4, 5, 7-tetrabromo-.** See *Eosin.*

92 —, **2, 4, 5, 7-tetraiodo-.** See *Erythrosin.*

Fluoro-. See the parent compounds (e.g., for fluorobenzene see *Benzene, fluoro-*.)

93 **Fluoroform** (*trifluoromethane**). CHF_3, 70.01. Gas. **b.p.** $20^{40atm.}$ **Soly.** 75cm³w.; 394.5cm³al.; sl.s.chl.

94 **Formal.** See *Methane, dimethoxy-**.

95 **Formaldehyde** (*methanal*; oxomethane*). HCHO, 30.02. Col.gas. **D.** 0.815^{-20}_{4}, **m.p.** −92, **b.p.** −21. **Soly.** s.w.; s.al.; s.et.

96 —, diethyl acetal. See *Methane, diethoxy-**.

97 —, dimethyl acetal. See *Methane, dimethoxy-**.

98 —, dipropyl acetal. See *Methane, dipropoxy-**.

99 —, oxime (*formoxime; formaldoxime*). HCH:NOH, 45.03. Col.liq. **b.p.** 84. **Soly.** *ca.* 10, d.h.w.

00 —, **2-thienyl-.** See 2-*Thiophenecarbonal.*

01 —, **thio-** (trimer) (*s-trithiane; trimethylene trisulfide; trithioformaldehyde; methanethial** (trimer). $SCH_2SCH_2SCH_2$, 138.23. Tetr.pr. **m.p.** 215–6, **b.p.** subl. **Soly.** i.c., sl.s.h.w.; sl.s.al.; sl.s.et.

02 **Formaldoxime.** See *Formaldehyde, oxime.*

03 **Formamide** (*methanamide**). $HCONH_2$, 45.03. Col.liq., $n\,1.44530^{22.7}$, **D.** 1.134^{20}_{4}; 1.1292^{25}_{4}, **m.p.** 2.55, **b.p.** 210.7 d. ($92–5^{10}$). **Soly.** ∞w.; ∞al.; sl.s.et.; sl.s.bz.

04 —, oxime (*methenyl amidoxime; isuretin*). $HC(:NOH)NH_2$, 60.05. Rhomb.f.acet. or al. **m.p.** 114, **b.p.** d. **Soly.** s.w.; sl.s.al.; sl.s.et.; i.bz.

05 —, **chloro-.** See *Carbamyl chloride.*

06 —, *N*, ***N*-diethyl-** (*N-formyldiethylamine*). $HCON(C_2H_5)_2$, 101.09. Col. liq. **D.** 0.908^{19}_{4}, **b.p.** 174–6. **Soly.** s.w.; s.al.; s.et.

07 —, *N*, ***N*-diphenyl-** (*N-formyldiphenylamine; N-phenylformanilide*). $HCON(C_6H_5)_2$, 197.09. Rhomb.f.al. **D.** 1.230^{22}_{4}, **m.p.** 74(70–1), **b.p.** 220. **Soly.** s.h.w.; s.al.; s.et.; s.bz.

08 —, ***N*-ethyl-** (*N-ethylmethanamide*). $HCONHC_2H_5$, 73.06. Liq. **D.** 0.952^{21}_{4}, **b.p.** 197–9. **Soly.** ∞w.; ∞al.; ∞et.

09 —, ***N*-phenyl-.** See *Formanilide.*

10 —, **ureido-.** See *Biuret.*

11 **Formamidine, amino-.** See *Guanidine.*

12 —, ***N*, *N′*-diphenyl-.** $C_6H_5N{:}CHNHC_6H_5$, 196.11. Need.f.al. **m.p.** 136, **b.p.** >250. **Soly.** sl.s.w.; s.al.; v.s.et.; s.bz., acet., chl., CS_2; sl.s.pet. eth.

13 **Formamine.** See *Hexamethylenetetramine.*

14 Formanilide (*N-phenylformamide*). $HCONHC_6H_5$, 121.06. Col.monocl. pr. **D.** 1.1437^{17}_{4}; 1.112^{60}_{4}, **m.p.** 47.5, **b.p.** 271. **Soly.** s.w.; v.s.al.; s.et.

15 —, ***N*-phenyl-.** See *Formamide, N, N-diphenyl-.*

16 Formic acid (*methanoic acid**). $HCOOH$, 46.02. Col.liq., *n* 1.37137. **D.** 1.22647^{15}_{4}; 1.220^{20}_{4}, **m.p.** 8.40, **b.p.** 100.7. **Soly.** ∞w.; ∞al.; ∞et.; ∞glyc.

17 —, allyl ester (*allyl formate; 2-propenyl methanoate**). $HCOOCH_2CH:CH_2$, 86.05. Liq. **D.** 0.948^{18}_{4}, **b.p.** 83. **Soly.** sl.s.w.; s.al.; ∞et.

18 —, amyl ester (*amyl formate; pentyl methanoate**). $HCOO(CH_2)_4CH_3$, 116.09. Col.liq., *n* $1.3951^{11.5}$. **D.** 0.8926^{15}_{4}, **m.p.** −73.5, **b.p.** 130.4. **Soly.** sl.s.w.; ∞al.; ∞et.

19 —, benzyl ester (*benzyl formate; benzyl methanoate*). $HCOOCH_2C_6H_5$, 136.06. Arom.liq. **D.** 1.081^{20}_{4}, **b.p.** 203.4. **Soly.** i.w.; s.al.; ∞et.

20 —, butyl ester (*butyl formate; butyl methanoate**). $HCOOC_4H_9$, 102.08. Col.liq., *n* 1.3891. **D.** 0.9108^{0}_{4}; 0.8848^{25}_{4}, **m.p.** −90.0, **b.p.** 106.8. **Soly.** sl.s.w.; ∞al.; ∞et.

21 —, *sec*-butyl ester. $HCOOCH(CH_3)C_2H_5$, 102.08. **D.** 0.882^{20}_{4}, **b.p.** 97. **Soly.** sl.s.w.; ∞al.; ∞et.

22 —, ethyl ester (*ethyl formate; ethyl methanoate**). $HCOOC_2H_5$, 74.05. Col. liq., *n* 1.35975. **D.** 0.9236^{20}_{4}, **m.p.** −80.5, **b.p.** 54.3. **Soly.** 11.8^{25}w.; s.al.; s.et.

23 —, ethylene ester. See *Glycol, diformate.*

24 —, geranyl ester. See *Geraniol, formate.*

25 —, heptyl ester (*n-heptyl formate*). $HCOOC_7H_{15}$, 144.12. Col.liq. **D.** 0.894^{0}_{4}, **b.p.** 176.7. **Soly.** i.w.; s.al.; s.et.

26 —, hexyl ester (*n-hexyl formate*). $HCOO(CH_2)_5CH_3$, 130.11. Col.liq. **D.** 0.898^{0}_{4}, **b.p.** 153.6. **Soly.** v.s.w.; ∞al.; ∞et.

27 —, isoamyl ester (*γ-methylbutyl methanoate**). $HCOO(CH_2)_2CH(CH_3)_2$, 116.09. Col.liq., *n* 1.391. **D.** 0.871^{20}_{4}, **b.p.** 123.5. **Soly.** 0.307^{22}w.; s.al.; ∞et.

28 —, isobutyl ester (*isobutyl formate; β-methylpropyl methanoate**). $HCOOCH_2CH(CH_3)_2$, 102.08. Col.liq., *n* $1.38584^{19.9}$. **D.** 0.875^{20}_{4}, **m.p.** −95.3, **b.p.** 98.2. **Soly.** 1.01^{22}w.; ∞al.; ∞et.

29 —, isopropyl ester (*isopropyl methanoate**). $HCOOCH(CH_3)_2$, 88.06. Liq. **D.** 0.883^{0}_{4}; 0.873^{20}_{4}, **b.p.** 71.3 (66.5–8.5). **Soly.** 2.1^{22}w.; ∞al.; ∞et.

30 —, *l*-linalyl ester. See *l-Linaloöl, formate.*

31 —, methyl ester (*methyl methanoate*; methyl formate*). $HCOOCH_3$, 60.03. Col.liq., *n* 1.344. **D.** 0.98149^{15}_{4}; 0.975^{20}_{4}, **m.p.** −99.0, **b.p.** 31.50. **Soly.** 30.4^{20}w.; ∞al.; s.et.; s.me.al.

32 —, octyl ester (*n-octyl formate*). $HCOO(CH_2)_7CH_3$, 158.14. Col.liq., *n* 1.414. **D.** $0.872^{12.5}_{4}$, **b.p.** 198. **Soly.** i.w.

33 —, *p*-phenylphenacyl ester. $HCOOCH_2COC_6H_4C_6H_5$, 240.09. **m.p.** 74.

34 —, propyl ester (*n-propyl formate*). $HCOOC_3H_7$, 88.06. Col.liq., *n* 1.3771. **D.** 0.9006^{20}_{4}, **m.p.** −92.9, **b.p.** 81.3. **Soly.** 2.79^{20}w.; ∞al.; ∞et.

35 —, **acetyl-.** See *Pyruvic acid.*

36 —, ***o*-aminobenzoyl-.** See *Isatic acid.*

37 —, **benzoyl-.** See *Glyoxylic acid, phenyl-.*

38 —, **chloro-,** butyl ester (*n-butyl chlorocarbonate*). $ClCOO(CH_2)_3CH_3$, 136.53. **D.** 1.074^{25}_{4}, **b.p.** 140–5. **Soly.** d.w.; d.al.; ∞et.

39 —, —, ethyl ester (*ethyl chloromethanoate*; ethyl chlorocarbonate*). $ClCOOC_2H_5$, 108.50. Col.liq. **D.** 1.138^{20}_{4}, **m.p.** −80.6, **b.p.** 94. **Soly.** d.w.; d.al.; s.et.; s.bz., chl.

40 —, —, isoamyl ester (*γ-methylbutyl chloromethanoate*; isoamyl chlorocarbonate*). $ClCOOC_5H_{11}$, 150.54. Col. liq. **D.** 1.024^{25}_{25}, **b.p.** 156. **Soly.** d.w.; ∞al.; ∞et.

41 —, —, isobutyl ester (*β-methylpropyl chloromethanoate*; isobutyl chlorocarbonate*). $ClCOOCH_2CH(CH_3)_2$, 136.53. Col.liq. **D.** 1.037^{25}_{4}, **b.p.** 130. **Soly.** d.w.; s., d.al.; ∞et.; s.bz., chl.

42 —, —, methyl ester (*methyl chloromethanoate*; methyl chlorocarbonate*) $ClCOOCH_3$, 94.48. Col.liq. **D.** 1.236^{15}_{4}, **b.p.** 71.4. **Soly.** d.w.; ∞al. ∞et.; s.bz., chl.

43 —, —, propyl ester (*n-propyl chlorocarbonate*). $ClCOOCH_2CH_2CH_3$ 122.51. Col.liq. **D.** 1.090^{20}_{4}, **b.p.** 116. **Soly.** d.w.; ∞al.; ∞et.

44 —, —, trichloromethyl ester. See *Diphosgene.*

45 —, **cyano-,** ethyl ester (*ethyl cyanomethanoate*; cyanoethyl carbonate*) $CNCOOC_2H_5$, 99.05. Liq. **D.** 1.013^{20}_{4} **b.p.** 116. **Soly.** i.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

46 **Formic acid, phenyl-.** See *Benzoic acid.*

47 **—, 2-thenoyl-.** See *2-Thiopheneacetic acid, α-keto-.*

48 **Formohydrazide*** (*formylhydrazine*). $HCONHNH_2$, 60.05. Yel.pl. or need., **m.p.** 54. **Soly.** i.w.; s.h.al.; s.h.et.; v.s.chl., bz.

49 **Formonitrolic acid** (*methylnitrolic acid*). $HC(:NOH)NO_2$, 90.03. Need. f.et. **m.p.** 64. **Soly.** v.s.w.; s.al.; v.s.et.

50 **Formosa camphor.** See *d-Camphor.*

51 **Formoxime.** See *Formaldehyde, oxime.*

52 **Formyl chloride, chloro-.** See *Phosgene.*

53 **Frangula emodin.** See *Emodin.*

54 **Frangulin.** $C_{20}H_{20}O_9$, 404.16. Yel. need. **m.p.** 226. **Soly.** v.sl.s.w.; s.h.al.; s.h.et.; s.h.bz.

55 **Fraxin.** $C_{16}H_{18}O_{10}$, 370.14. Need.f. al. **m.p.** 190. **Soly.** s.h.w.; s.al.; i.et.

56 D-**Fructosamine** (*isoglucosamine; isodextrosamine*). $CH_2OH(CHOH)_3COCH_2NH_2$, 179.11. Syrup. **Soly.** i.al.; i.et.; s.dil.a.

57 D-**Fructose** (*levulose; fruit sugar*). $C_6H_{12}O_6$, 180.09. Need.f.w. **D.** 1.598^{20}_{4}; 1.669^{17}_{4}; **m.p.** 105(95). **Soly.** v.s.w.; 6.71^{18}al.; s.et.

58 **Fructosin.** See *Levulin (synthetic).*

59 **Fruit sugar.** See D-*Fructose.*

61 **Fucose** (2, 3, 4, 5-*tetrahydroxyhexanal** (one form)). $C_6H_{12}O_5$, 164.09. Need. f.al. **m.p.** 145, **b.p.** d. **Soly.** v.s.w.; 1.66^{22}al.; i.et.

62 **Fulminic acid,** silver salt (*silver fulminate; fulminating silver*). $AgCNO$, 149.89. Sm.wh.need.f.w. **m.p.** exp. **Soly.** 0.075^{13}w.; s.al.; s.NH_4OH; i.HNO_3.

63 **Fulminuric acid** (*2-cyano-2-nitroethanamide*; cyanonitroacetamide; isocyanuric acid*). $CNCH(NO_2)CONH_2$, 129.05. Col.pr.f.al. **m.p.** 145exp. **Soly.** s.w.; s.al.; v.sl.s.et.; i.chl., bz., lgr.

64 **Fumaric acid** (*trans-butenedioic acid*; trans-1, 2-ethylenedicarboxylic acid*). $HOOCCH:CHCOOH$, 116.03. Col. monocl.pr. **D.** 1.635^{20}_{4}, **m.p.** 287 (293–5), **b.p.** 290; subl. 200. **Soly.** 0.70^{25}, 9.8^{100}w.; $5.75^{29.7}$, 4.76^{76}al.; 0.72^{25} et.; v.sl.s.CCl_4, chl.

65 **—,** diethyl ester (*ethyl fumarate; diethyl fumarate*). $(:CHCOOC_2H_5)_2$, 172.09. Col.liq. **D.** 1.054^{20}_{20}, **m.p.** 0.6, **b.p.** 218. **Soly.** sl.s.w.; s.al.; s.et.

66 —, dimethyl ester (*methyl fumarate*). $(:CHCOOCH_3)_2$, 144.06. Col.tricl.pr. **m.p.** 102, **b.p.** 192. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.c.chl.

67 —, monoethyl ester (*monoethyl fumarate*). $HOOCCH:CHCOOC_2H_5$, 144.06. Pl. **m.p.** 66, **b.p.** 147^{16}. **Soly.** sl.s.w.; v.s.al.; v.s.et.

68 —, **bromo-.** $BrC(COOH):CHCOOH$, 194.94. Pl. **m.p.** 185–6, **b.p.** d. 200. **Soly.** s.w.; s.al.

69 —, **chloro-.** $ClC(COOH):CHCOOH$, 150.48. Pl.f.ac.a. **m.p.** 191–2, **b.p.** subl. **Soly.** v.s.w.; v.s.al.; v.s.et.; sl.s.bz.

70 —, **methyl-.** See *Mesaconic acid.*

71 **Furacrolein.** See *Acrolein, β-2-furyl-.*

72 **Furacrylic acid.** See *2-Furanacrylic acid.*

73 **Fural.** See *Furfural.*

74 **2-Furaldehyde.** See *Furfural.*

75 **Furan** (*furfuran*). $OCH:CHCH:CH$ (ring), 68.03. Col.liq., *n* 1.42157. **D.** 0.9366^{20}_{4}. **b.p.** 31^{745}. **Soly.** i.w.; v.s.al.; v.s.et.

76 —, **2-acetyl-.** See *Ketone, 2-furyl methyl.*

77 —, **2-benzoyl-.** See *Ketone, 2-furyl phenyl.*

78 —, **3-bromo-** (*β-furyl bromide*). C_4H_3BrO, 146.94. Liq., *n* 1.4981. **D.** 1.650^{20}_{4}, **b.p.** $101.9–2.2^{744}$. **Soly.** i.w.; s.al.

79 —, **2-butoxymethyltetrahydro-** (*tetrahydrofurfuryl n-butyl ether*). $C_4H_7O \cdot CH_2OC_4H_9$, 158.14. Col.liq. **D.** 0.9150^{20}_{4}, **b.p.** $194.5–6.0^{721}$. **Soly.** i.w.; s.al.; s.et.

80 —, **2-chloro** (*β-chlorofurfuran*). C_4H_3ClO, 102.48. Col.liq., *n* 1.4571. **D.** 1.1923^{20}_{4}, **b.p.** $77.2–7.5^{744}$. **Soly.** i.w.; s.al.

81 —, **2-chloromercuri-.** $C_4H_3O \cdot HgCl$, 303.09. Col.cr.powd.f.al. **m.p.** 148. **Soly.** i.w.; s.h.al.; sl.s.et.

82 —, **2-(chloromethyl)-** (*furfuryl chloride*). $C_4H_3OCH_2Cl$, 116.50. Col.liq., *n* 1.4941. **D.** 1.1783^{20}_{4}, **b.p.** $49.1–9.4^{26}$. **Soly.** i.w.; s.al.; s.et.

83 —, **2-(chloromethyl)tetrahydro-** (*tetrahydrofurfuryl chloride*). $C_4H_7O \cdot CH_2Cl$, 120.53. Col.liq. **D.** 1.1102^{20}_{4}. **b.p.** $149.0–9.5^{721}$.

84 —, **2-(diethoxymethyl)-** (*furfural diethyl acetal*). $C_4H_3O \cdot CH(OC_2H_5)_2$, 170.11. Col.liq. **b.p.** $184–5^{740}$. **Soly.** i.w.; v.s.al.

85 —, **2, 5-dimethyl-.** $CH_3C_4H_2O \cdot CH_3$, 96.06. Col.liq., *n* 1.4363. **D.** $0.9026^{17.7}_{4}$, **b.p.** 94. **Soly.** i.w.; s.al.; s.et.; s.chl., ac.a., bz.

For explanations and abbreviations see beginning of table.

86 **Furan, 2, 5-dinitro-.** $C_4H_2O(NO_2)_2$, 158.03. Need.f.w., pr.f.al. **m.p.** 101. **Soly.** i.c.al.; s.et.

87 —, **2, 5-diphenyl-.** $C_4H_2O(C_6H_5)_2$, 220.09. Need. or leaf.f.dil.al. **m.p.** 91, **b.p.** 343–5. **Soly.** i.w.; v.s.al.; v.s.et.; s.most org.solv.

88 —, **2-ethoxymethyltetrahydro-** (*tetrahydrofurfuryl ethyl ether*). C_4H_7O·$CH_2OC_2H_5$, 130.11. Col.liq. **D.** 0.9386. **b.p.** $152–4^{726}$.

89 —, **2-iodo-.** C_4H_3IO, 193.94. Col. liq. **b.p.** $43–5^{15}$. **Soly.** v.s.et.

90 —, **3-iodo-.** C_4H_3IO, 193.94. Col. liq. **D.** 2.045^{20}_{4}, **b.p.** 132.2^{732}. **Soly.** i.w.; s.et.

91 —, **2, 2′-mercuridi-.** See *Mercury, di-2-furyl-.*

92 —, **2-methyl-.** See *Silvan.*

93 —, **3-methyl-.** $C_4H_3O·CH_3$, 82.05. Col.liq. **D.** 0.923^{18}_{4}, **b.p.** 65.5. **Soly.** s.al.; s.et.

94 —, **2-nitro-.** $C_4H_3O·NO_2$, 113.03. Lt.yel.monocl.f.pet.eth. **m.p.** 28.8–9.2. **Soly.** i.w.; s.et.; s.alk.

95 —, **tetrahydro-** (*tetramethylene oxide*). $OCH_2CH_2CH_2CH_2$, 72.06. Liq. **b.p.** 67. **Soly.** v.s.w.; s.al.

96 —, **thio.** See *Thiophene.*

97 —, **2, 3, 4-trichloro-.** C_4HCl_3O. 171.38. **D.** 1.5471^{20}_{4}, **b.p.** $151.7–2.7^{734}$.

98 **2-Furanacetonitrile** (*2-furylacetonitrile; furfuryl cyanide*). $C_4H_3O·CH_2$-CN, 107.05. Col.liq. **D.** 1.0854^{25}_{4}, **m.p.** $78–80^{20}$. **Soly.** sl.s.w.; v.s.al.; v.s.et.

99 **2-Furanacrylic acid** (*β-2-furylacrylic acid; 2-furalacetic acid; furacrylic acid*). $C_4H_3OCH{:}CHCOOH$, 138.05. Wh.cr. **m.p.** 141–2, **b.p.** 226. **Soly.** i.w.; ∞ al.; s.et.

00 —, amyl ester (*n-amyl furfuracrylate*). $C_4H_3O·CH{:}CHCOOC_5H_{11}$, 208.12. Col. liq. **D.** 1.0322^{20}_{4}, **b.p.** 119.4. **Soly.** i.w.

01 —, butyl ester (*n-butyl furacrylate*). $C_4H_3OCH{:}CHCOOC_4H_9$, 194.11. Col. liq. **D.** 1.0482^{20}_{4}, **b.p.** 121.0^{5}. **Soly.** i.w.; s.al.

02 —, ethyl ester (*ethyl furfuracrylate; ethyl furacrylate; ethyl β-1-furylacrylate*). $C_4H_3O·CH{:}CHCOOC_2H_5$, 166.08. Col.liq. **D.** 1.0891^{25}_{4}, **m.p.** 24.5, **b.p.** $118–9^{10}$; $132–3^{18}$. **Soly.** i.w.; s.al.

03 —, methyl ester (*methyl furacrylate*). $C_4H_3OCH{:}CHCOOCH_3$, 152.06. Col. liq. **m.p.** 27.5, **b.p.** $114–5^{16}$; $227–8^{744}$. **Soly.** i.w.; s.al.

04 —, propyl ester (*n-propyl. furacrylate*)- $C_4H_3OCH{:}CHCOOC_3H_7$, 180.09. Col liq. **D.** 1.0744, **b.p.** 119^{7}. **Soly.** i.w.; s.al.

05 **2-Furancarbinol.** See *Furfury alcohol.*

06 **2-Furancarbonal*.** See *Furfural.*

07 **2-Furancarbonyl chloride.** See *Pyromucyl chloride.*

08 **2-Furancarboxylic acid.** See *Pyromucic acid.*

09 **3-Furancarboxylic acid** (*3-furoi acid*). $C_4H_3O·COOH$, 112.03. Col need.f.w. **m.p.** 120.5–1.5, **b.p.** $105–10^{12}$. **Soly.** i.c.w.; v.s.et.

10 —, **4, 5-dihydro-5-keto-.** See *Aconi acid.*

11 —, **2, 5-dimethyl-.** See *Pyrotritari acid.*

12 —, **2-methyl-.** $CH_3C_4H_2O·COOH$ 126.05. Col.cr.f.w. **m.p.** 102–3. **Soly** s.al.; s.et.

13 —, —, ethyl ester. $CH_3C_4H_2O·COO$-C_2H_5, 154.08. Col.liq. **b.p.** $85–7^{20}$ **Soly.** i.w.; s.et.

14 —, **tetrahydro-5-oxo-.** See *Paraconic acid.*

15 **2, 5-Furandicarbonyl chloride.** Se *Dehydromucyl chloride.*

16 **2, 3-Furandicarboxylic acid.** C_4-$H_2O(COOH)_2$, 156.03. Col.cr.powd **m.p.** 225. **Soly.** s.w.; s.al.; s.et.

17 —, dimethyl ester. $C_4H_2O(COOH_3)_2$ 184.06. Col.gran.cr. **m.p.** 37 **Soly.** i.w.; s.al.; v.s.et.

18 **2, 5-Furandicarboxylic acid.** Se *Dehydromucic acid.*

19 **2, 5-Furandione.** See *Maleic anhydride.*

20 **2-Furanmethylamine.** See *Furfurylamine.*

21 **Furfural** (*2-furancarbonal*; 2-furaldehyde; fural; furfuraldehyde; furol furfurole*). C_4H_3OCHO, 96.03. Col liq., *n* 1.52608. **D.** 1.1598^{20}_{4}, **m.p** −38.7, **b.p.** 161.7. **Soly.** 8.3^{20}w ∞ al.; ∞ et.

22 —, diacetate (*furfurylidene diacetate*) $C_4H_3OCH(OOCCH_3)_2$, 198.08. Co cr.f.pet.eth. **m.p.** 52–3, **b.p.** 22 $(143–4^{20})$. **Soly.** i.w.; s.al.; s.et.

23 —, diethyl acetal. See *Furan, 2 (diethoxymethyl)-.*

24 —, hydramide (*trifuraldiamine; fu furamide; hydrofuramide*). (C_5H_4O) N_2, 268.11. Need.f.al. **m.p.** 121(117 **b.p.** 250 d. **Soly.** i.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

25 **Furfural,** phenylhydrazone. $C_4H_3OCH{:}NNHC_6H_5$, 186.09. **m.p.** 97. **Soly.** i.w.; s.al.; s.et.

26 —, **5-methyl-** (*δ-methylfurfurole*). $CH_3C_4H_2O{\cdot}CHO$, 110.05. Col.liq. **D.** 1.1072^{18}_{4}; 1.109^{18}_{18}, **b.p.** 187; $106\text{–}7^{60}$. **Soly.** 3.3w.; v.s.al.; ∞ et.

27 —, **5-nitro-.** $NO_2C_4H_2O{\cdot}CHO$, 141.03. Straw yel. **m.p.** 36. **Soly.** s.et.

28 —, **tetrahydro-** (*furfural tetrahydride*). $C_4H_7O{\cdot}CHO$, 100.06. Col. liq. **D.** 1.10947^{23}_{4}, **b.p.** $144\text{–}5^{740}$. **Soly.** i.w.; s.al.

29 **Furfuralcohol.** See *Furfuryl alcohol.*

30 **Furfuramide.** See *Furfural, hydramide.*

31 **Furfuran.** See *Furan.*

32 **Furfurine.** $C_{15}H_{12}N_2O_3$, 268.11. Lt. br.need. **m.p.** 117. **Soly.** i.w.; s.al.; s.et.

33 **Furfurole.** See *Furfural.*

34 **Furfuryl alcohol** (*2-furancarbinol; furfuralcohol; α-furylcarbinol*). $C_4H_3OCH_2OH$, 98.05. Col.liq., *n* 1.4852. **D.** 1.1351^{20}_{4}, **b.p.** 170.2. **Soly.** ∞ w.; ∞ al.; ∞ et.

35 —, acetate. $C_4H_3OCH_2OOCCH_3$, 140.06. Col.liq., *n* 1.4603^{25}. **D.** 1.1175^{20}_{4}, **b.p.** $175\text{–}7^{764}$. **Soly.** i.w.; s.al.; s.et.

36 —, butyrate. $C_4H_3OCH_2OOCC_3H_7$, 168.09. Col.liq. **D.** 1.0530^{20}_{4}, **b.p.** $212\text{–}3^{764}$ $(69\text{–}70^{1})$. **Soly.** v.sl.s.w.; s.al.; ∞ et.

37 —, propionate. $C_4H_3OCH_2OOCC_2H_5$ 154.08. Col.liq. **D.** 1.1085^{20}_{4}, **b.p.** $195\text{–}6^{762}$. **Soly.** v.sl.s.(i) w.; s.al.; ∞ et.

38 —, pyromucate (*furfuryl furoate*). $C_4H_3OCO_2CH_2C_4H_3O$, 192.06. Dimorphous. **D.** 1.395(1.330), **m.p.** 27.5(19.5), **b.p.** 122^{2}. **Soly.** i.w.; s.al.; s.et.

39 —, **methyl-** (*methyl-2-furancarbinol*). $CH_3C_4H_2O{\cdot}CH_2OH$, 112.06. Col.liq. **D.** 1.0769^{20}_{4}, **b.p.** $194\text{–}6^{744}$. **Soly.** s.w.; v.s.al.; v.s.et.

40 —, **tetrahydro-** (*tetrahydro-2-furancarbinol*). $C_4H_7O{\cdot}CH_2OH$, 102.08. Col. liq., *n* 1.4508. **D.** 1.0495^{20}_{4}, **b.p.** $177\text{–}8^{743}$. **Soly.** ∞ w.; ∞ al.; ∞ et.

41 **Furfurylamine** (*2-furanmethylamine*). $C_4H_3OCH_2NH_2$, 97.06. Col. liq. **D.** < 1, **b.p.** 144–6. **Soly.** ∞ w.; s.al.; s.et.

42 —, **tetrahydro-** (*tetrahydro-2-furanmethylamine*). $OCH(CH_2NH_2)CH_2CH_2CH_2$, 101.09. Col.liq. **b.p.** $151\text{–}2^{735}$. **Soly.** ∞ w.; ∞ al.; ∞ et.

43 **Furfuryl chloride.** See *Furan, 2-(chloromethyl)-.*

Furfuryl esters. See under *Furfuryl alcohol.*

44 **Furfurylidene diacetate.** See *Furfural, diacetate.*

45 **Furfuryl mercaptan** (*2-furylmethanethiol*). $C_4H_3OCH_2SH$, 114.11. Col. oily liq., *n* 1.5329. **D.** 1.1319^{20}_{4}, **b.p.** 155; 84^{65}. **Soly.** i.w.

46 **Furil** (*bipyromucyl; di-2-furylglyoxal*). $C_4H_3OCOCOC_4H_3O$, 190.05. Yel.need. **m.p.** 165–6. **Soly.** i.w.; s.al.; s.et.

47 **Furoic acid, 2-Furoic acid.** See *Pyromucic acid.*

48 **3-Furoic acid.** See *3-Furancarboxylic acid.*

49 **Furoin.** $C_4H_3OCHOHCOC_4H_3O$, 192.06. Lt.br.need. **m.p.** 134–5. **Soly.** i.w.; sl.s.al.; s.et.

50 **Furole.** See *Furfural.*

51 **Furoyl chloride.** See *Pyromucyl chloride.*

52 **β-Furyl bromide.** See *Furan, 3-bromo-.*

53 **G acid.** See 2-*Naphthol*-6, 8-*disulfonic acid.*

54 D-**Galactonic acid** (*d-lactonic acid*). $CH_2OH(CHOH)_4COOH$, 196.09. Need.f.w. **m.p.** 95–100, **b.p.** d. 140–1. **Soly.** s.w.

55 D-**Galactose.** $C_6H_{12}O_6$, 180.09. Hex. tab.f.al. **m.p.** $+1H_2O$ 118–20; anh. 165–8. **Soly.** 10.3^{0}, 68.3^{25}w.; 0.59^{38} 85 % al.; v.sl.s.me.al.

56 D-**Galacturonic acid.** $C_5H_9O_5COOH$, 194.08. Micro need., $[\alpha]$ $+53.59°$D. **m.p.** 159–60 d. **Soly.** s.w.; s.h.al.; i.et.

57 **Gallacetophenone** (*2, 3,4-trihydroxyacetophenone; 4-acetylpyrogallol*). $CH_3COC_6H_2(OH)_3$, 168.06. Leaf. **m.p.** 173. **Soly.** sl.s.w.; s.al.; s.et.; v.sl. s.bz.

58 **Gallanilide** (*gallanol; 3, 4, 5-trihydroxybenzanilide*). $C_6H_5NHCOC_6H_2(OH)_3$, 245.09. Col.cr. or powd. **m.p.** 205. **Soly.** s.h.w.; s.al.; s.et.

59 **Gallein** (*pyrogallolphthalein; 4, 5-dihydroxyfluorescein*). $C_{20}H_{12}O_7$, 364.09. Red cr.powd. **m.p.** d. **Soly.** v.sl. s.h.w.; s.al.; sl.s.et.; s.alk.

60 **Gallic acid** (*3, 4, 5-trihydroxybenzoic acid*). $(HO)_3C_6H_2COOH$, 170.05. Col. monocl.need.f.w. **D.** 1.694^{4}_{4}, **m.p.** 220 d. **b.p.** d. **Soly.** 1.16^{25}, 33^{100}w.; 27.2^{25}al.; 2.5^{15}et.; s.glyc.

For explanations and abbreviations see beginning of table.

61 Gallic acid, 3-monogallate. See *m-Digallic acid.*

62 —, trimethyl ether. See *Benzoic acid, 3, 4, 5-trimethoxy-.*

63 Gallin (3, 4, 5, 6-*tetrahydroxy-9-xanthene-o-benzoic acid*). $C_{20}H_{14}O_7$, 366.11. Need. **Soly.** s.w.; s.al.; s.et.

64 Gelsemine, compd. with acetone. $C_{20}H_{22}N_2O_2{\cdot}(CH_3)_2CO$, 380.23. Pr.f. acet. **m.p.** anh. at 120.

65 ***d*-Gelsemine.** $C_{20}H_{22}N_2O_2$, 322.19. **m.p.** 178. **Soly.** i.w.; s.al.; s.et.; s.chl., bz.

66 —, hydrochloride. $C_{20}H_{22}N_2O_2{\cdot}HCl$, 358.65. Pr.f.w. **m.p.** 300. **Soly.** s.w.; sl.s.al.

67 Gentianin. See *Gentisin.*

68 Gentisic acid (2, 5-*dihydroxybenzoic acid; hydroquinonecarboxylic acid*). $(HO)_2C_6H_3COOH{\cdot}3H_2O$, 208.09. Col. need.f.w. **m.p.** 200, **b.p.** d. **Soly.** v.s.w.; v.s.al.; v.s.et.; i.CS_2, chl., bz.

69 —, **4-hydroxy-.** See *Benzoic acid, 2, 4, 5-trihydroxy-.*

70 Gentisin (1, 7-*dihydroxy-3-methoxyxanthone; 3-methoxyeuxanthone; gentianin*). $C_{14}H_{10}O_5$, 258.08. Yel.need. **m.p.** 267, **b.p.** 400 subl. **Soly.** v.sl.s.w.; sl.s.h.al.; sl.s.h.et.; s.alk.

71 Geranial. See *Citral a.*

72 Geranic acid (3, 7-*dimethyl*-2, 6(and 2, 7)*octadienoic acid**). $C_{10}H_{16}O_2$, 168.12. Thin oil, n $1.48695^{20.2}$, **D.** 0.952^{20}_{4}, **b.p.** 119^{20}. **Soly.** i.w.; s.al.; s.et.

73 Geraniol. $C_{10}H_{18}O$, 154.14. Col.liq., n 1.4798. **D.** 0.8812^{16}_{4}, **m.p.** < −15, **b.p.** 229; $120\text{–}2^{17}$. **Soly.** i.w.; ∞al., 5.41 50% al.; ∞et.

74 —, acetate (*geranyl acetate*). $C_{12}H_{20}O_2$, 196.16. Col.liq., n 1.4660. **D.** 0.917^{15}_{4}, **b.p.** $242\text{–}5^{764}$ d. **Soly.** v.sl.s.w.; v.s.al.; ∞et.

75 —, butyrate (*geranyl butyrate*). $CH_3(CH_2)_2COOC_{10}H_{17}$, 224.19. **D.** 0.9008^{17}_{4}, **b.p.** $151\text{–}3^{18}$. **Soly.** i.w.; s.al.; s.et.

76 —, formate. $HCOOC_{10}H_{17}$, 182.14. Liq. **D.** 0.927^{20}_{4}, **b.p.** $113\text{–}4^{15}$. **Soly.** i.w.; s.al.; s.et.

77 —, **dihydro-.** See *dl-Citronellol.*

78 —, **tetrahydro-.** See *1-Octanol, 3, 7-dimethyl-*.*

Geranyl esters. See under *Geraniol.*

79 Germanium, tetraphenyl-*. $(C_6H_5)_4Ge$, 380.76. Col.tetr. **m.p.** 235.7, **b.p.** >400. **Soly.** i.w.; sl.s.et.; s.chl., bz., tol.; sl.s.acet., lgr.

80 ***d*-Glaucine.** $C_{21}H_{25}NO_4$, 355.2 Yel.rhomb.pr. **m.p.** 119–20. **Soly** s.h.w.; v.s.al.; s.et.; v.s.chl., sl.s.bz.

81 Glonoin. See *Nitroglycerin.*

82 Glucide. See *Saccharin.*

84 **D-Gluco-α-heptose.** $CH_2OH(CHOH)_5CHO$, 210.11. Rhomb.pl. w. **m.p.** 215 d. (180–90). **Soly.** 9.5 v.s.h.w.; v.sl.s.al.

85 **D-Gluconic acid** (*dextronic acid; d-glyconic acid; maltonic acid; glycogeni acid*). $C_5H_6(OH)_5COOH$, 196.09. Cr **m.p.** 125–6; (130–2). **Soly.** s.w. i.al.; i.et.

86 —, δ-lactone. $C_5H_6(OH)_4COO$, 178.08 Need. **m.p.** 146(130–5).

87 **D-Glucosazone.** See *D-Glucose phenylosazone.*

88 Glucose, β-glucoside. See *Cellobiose*

89 **D-Glucose** (anh.) (*dextrose; grap sugar*). $C_6H_{12}O_6$, 180.09. Rhomb need.f.al. **D.** 1.544^{25}_{4}, **m.p.** (+1H_2O 118–20) anh. 146. **Soly.** $83^{17.5}$w. $1.94^{17.5}$al.; i.et.

90 —, (α). $C_6H_{12}O_6{\cdot}H_2O$, 198.11. **D** 1.544^{25}_{4}, **m.p.** 146. **Soly.** 32.3 82.0^{25}w.; 2(initial), 4.5(final)80% al.

91 —, (β). $C_6H_{12}O_6{\cdot}H_2O$, 198.11. Need f.al. **D.** 1.5620^{18}_{4}, **m.p.** 150. **Soly** 154^{15}w.; 4.9(initial), 9.1(final)80% al. i.et.

92 —, diacetate (*diacetyl-d-glucose*) $C_5H_6(OOCCH_3)_2(OH)_3CHO$, 264.12 Col.cr. or lt.yel.amor. **m.p.** < 100 **Soly.** s.w.; s.al.; s.et.; i.bz.

93 —, α-pentaacetate (*pentaacetyl-α-d glucose*). $C_6H_7O(OOCCH_3)_5$, 390.17 Fine need.f.lgr. or al. **m.p.** 113(111–2), **b.p.** subl. **Soly.** $0.15^{18.5}$w. 1.32^{15}al.; 2.7^{15}et.

94 —, β-pentaacetate (*β-pentaacetyl-d glucose*). $C_6H_7O_6(OCCH_3)_5$, 390.17 Need.f.al. **m.p.** 131. **Soly.** $0.09^{18.5}$w. 0.82^{19}al.; 2.1^{15}et.

95 —, μ-pentaacetate. $C_6H_7O(OOCCH_3)_5$, 390.17. Monocl.tab. **m.p** 116–8. **Soly.** s. warm w.; s.al.; sl.s.et

97 —, α-phenylhydrazone. $C_6H_{12}O_5NNHC_6H_5$, 270.16. Col.cr. **m.p.** 160 **Soly.** v.s.w.; v.s.h.al.; v.sl.s.et.

98 —, β-phenylhydrazone. $C_6H_{12}O_5NNHC_6H_5$, 270.16. Col.need. **m.p** 141. **Soly.** sl.s.w.; s.al.; v.sl.s.c.et.

99 —, phenylosazone (*d-glucosone bis phenylhydrazone; dextrosazone; d-glucosazone*). $C_6H_{10}O_4(:NNHC_6H_5)_2$ 358.20. Yel.need. **m.p.** 208 d. **Soly** v.sl.s.w.; s.h.al.

* Name approved by the International Union of Chemistry.

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00 D-**Glucose, pentaacetyl-.** See D-*Glucose, pentaacetate.*

02 **Glucoside, α-methyl-.** $C_7H_{14}O_6$, 194.11. Rhomb.f.w. **m.p.** 165. **Soly.** 63w.; 1.6al.; i.et.

03 —, **β-methyl-.** $C_7H_{14}O_6$, 194.11. Tetr. f.al. **m.p.** 104. **Soly.** 58w.; 4.2al.; i.et.

04 D-**Glucosone,** bisphenylhydrazone. See D-*Glucose, phenylosazone.*

05 **Glutamic acid, β-hydroxy-(dl)** (*dl-α-amino-β-hydroxyglutaric acid*). $COOHCH_2CH(OH)CH(NH_2)COOH$, 163.08. Rhomb.pr. and need. **m.p.** 198 d. **Soly.** v.s.h.w.

06 —, **β-hydroxy-(d)** (*d-2-amino-3-hydroxypentanedioic acid*). $COOHCH_2$-$CHOHCH(NH_2)COOH$, 163.08. Pr. f.w. **m.p.** soft. 100; hyd. 105; (rac. 198 d.), **b.p.** d. >100. **Soly.** v.s.w.; i.al.; i.et.; v.s.ac.a.

07 ***dl*-Glutamic acid** (*dl-glutaminic acid; dl-α-aminoglutaric acid*). COOH-$(CH_2)_2CH(NH_2)COOH$, 147.08. Tetr. pl. **D.** 1.4601^{20}_{4}, **m.p.** 225–7 d. **Soly.** 2.64^{25}, 8.16^{50}w.; v.sl.s.al.; v.sl.s.et.

08 ***d*-Glutamic acid** (*d-glutaminic acid; d-α-aminoglutaric acid*). $COOH(CH_2)_2$-$CH(NH_2)COOH$, 147.08. Tetr.pl. **D.** 1.538, **m.p.** 247–9 d. **Soly.** 0.89^{25}, 2.23^{50}w.; 0.037^{25}75 %, 0.003^{25}100 %, al.; 0.007^{25}me.al.; 0.0004^{25}acet.

09 ***l*-Glutamic acid** (*l-glutaminic acid; l-α-aminoglutaric acid*). $C_3H_5(NH_2)$-$(COOH)_2$, 147.08. Col.rhomb.pl.f.w., n 1.490, 1.605, 1.620. **D.** 1.538 (1.460), **m.p.** 202(198); *l* 213 d. **Soly.** 1.5^{20}w.; 0.07^{15}al.; i.et.

10 —, hydrochloride. $C_5H_9NO_4{\cdot}HCl$. 183.54. Tricl.pl., $[\alpha]1.546°_D$; $[\beta]1.559°_D$, **m.p.** d. 201. **Soly.** v.s., d.w.; s.al.; v.sl.s.conc.HCl.

11 ***dl*-Glutamine** (*dl-α-aminoglutaramic acid*). $C_3H_5(NH_2)(CONH_2)COOH$, 146.09.

dl: Need.f.w. **m.p.** 256. **Soly.** 3.6^{18}w.; i.et.

d: Need. **m.p.** 185–6. **Soly.** 4.25^{25}w.; $.00046^{25}$al.; i.et.

12 **Glutaramic acid, *dl*-α-amino-.** See *dl-Glutamine.*

13 **Glutaric acid** (*pentanedioic acid**). $COOH(CH_2)_3COOH$, 132.06. Col. monocl., n $1.4188^{106.4}$. **D.** 1.429^{15}_{4}; 1.192^{106}_{4}, **m.p.** 97.5; 95–6, **b.p.** 304 d. **Soly.** 64^{20}w.; v.s.al.; v.s.et.; s.bz., chl.; sl.s.pet.eth.

14 —, diethyl ester (*diethyl pentanedioate*; ethyl glutarate*). C_2H_5-$OOC(CH_2)_3COOC_2H_5$, 188.12. Liq. **D.** 1.025^{20}_{4}, **m.p.** −24.1, **b.p.** 237. **Soly.** 0.88^{20}w.; v.s.al.; s.et.

15 —, piperazinium salt. $C_4H_{10}N_2{\cdot}2C_5$-H_8O_4, 350.22. Wh.cr. **m.p.** 152. **Soly.** s.w.; s.h.al.; i.et.

16 —, **α-amino-.** See *Glutamic acid.*

18 —, **α-hydroxy-** (*2-hydroxypentanedioic acid**). $COOHCHOH(CH_2)_2COOH$, 148.06. Sm.col.cr. **m.p.** 72–3. **Soly.** s.w.; s.al.

19 —, **β-keto-.** See *Acetonedicarboxylic acid.*

20 —, **α, β, γ-trihydroxy-(*dl*).** COOH-$(CHOH)_3COOH$, 180.06. Col.tab.f. acet. **m.p.** 152 d. **Soly.** v.s.w.; v.s.h.al.; s.acet.

21 —, **α, β, γ-trihydroxy-(*d* or *l*).** 2, 3, 4-*trihydroxypentanedioic acid**). $COOH(CHOH)_3COOH$, 180.06. Col. leaf.f.acet. **m.p.** 128. **Soly.** v.s.w.; v.s.al.; s.acet.

22 **Glutaronitrile** (*pentanedinitrile*; trimethylene dicyanide; trimethylene cyanide*). $CN(CH_2)_3CN$, 94.06. Col. liq., n $1.4365^{23.2}$. **D.** 0.995^{15}_{4}, **m.p.** −29, **b.p.** 287.4. **Soly.** s.w.; s.al.; i.et.

23 **Glyceraldehyde** (2, 3-*dihydroxypropanal*; α, β-dihydroxypropionaldehyde*). $CH_2OHCHOHCHO$, 90.05. Need. or pr.f.me.al. **D.** 1.453^{18}_{4}, **m.p.** 138. **Soly.** sl.s.w.; v.sl.s.al.; v.sl.s.et.

24 **Glyceric acid** (2, 3-*dihydroxypropanoic acid*; α, β-dihydroxypropionic acid*). $CH_2OHCHOHCOOH$, 106.05. Syrup. **Soly.** ∞w.; ∞al.; i.et.; v.s.acet.

25 —, ethyl ester (*ethyl* 2, 3-*dihydroxypropanoate**). $CH_2OHCHOHCOOC_2H_5$, 134.08. Liq. **D.** 1.191^{15}_{15}, **b.p.** 230–40; 121^{14}. **Soly.** s.w.; v.s.al.; v.s.et.

26 —, methyl ester (*methyl glycerate*). $CH_2OHCHOHCOOCH_3$, 120.06. Liq. **D.** 1.279^{15}_{4}, **b.p.** 239–44; 120^{14}. **Soly.** ∞w.; ∞al.; v.sl.s.et.

27 **Glycerin.** See *Glycerol.*

28 **Glycerol** (*glycerin;* 1, 2, 3-*propanetriol**). $CH_2OHCHOHCH_2OH$. 92.06. Rhomb. or col.liq., n 1.4729. **D.** 1.260^{20}_{4}, **m.p.** 17.9, solidifies at a much lower temperature, **b.p.** 290. **Soly.** ∞w.; ∞al.; i.et.; i.chl.

29 —, borate (*glyceryl borate*). $(C_3H_5$-$BO_3)_x$, $(99.86)_x$. Glassy yel. **Soly.** d.w.

30 —, α-chlorohydrin. See 1, 2-*Propanediol, 3-chloro-**.

For explanations and abbreviations see beginning of table.

31 Glycerol, diacetate (*diacetin*). C_3H_5-$(OH)(OOCCH_3)_2$, 176.09. Col.liq. **D.** 1.184^{15}_{4}, **m.p.** 40, **b.p.** 176^{40}; 280 (250–3). **Soly.** ∞w.; v.s.al.; s.et.; i.CS_2.

32 —, *sym*-dichlorohydrin. See *2-Propanol, 1, 3-dichloro-**.

33 —, *uns*-dichlorohydrin. See *1-Propanol, 2, 3-dichloro-**.

34 —, 1, 3-dilaurate (*α, γ-dilaurin*). $(C_{11}$-$H_{23}COO)_2C_3H_5OH$, 456.41. Cr. **m.p.** 56.6. **Soly.** s.al.; s.et.

35 —, 1, 3-dinitrate. $C_3H_5(OH)(NO_3)_2$·$\frac{1}{2}H_2O$, 191.07. Liq. **D.** 1.47^{15}_{4}, **m.p.** <-30; anh. 26, **b.p.** 148^{15}. **Soly.** 7.7w.; v.s.al.; s.et.

36 —, 1, 3-dipalmitate (*α, γ-dipalmitin*). $(C_{15}H_{31}COO)_2C_3H_5OH$, 568.53. Cr.f. al. or chl. **m.p.** 70. **Soly.** sl.s.c., v.s.h.al.; sl.s.c., v.s.h.et.; s.chl.

37 —, 1, 3-distearate (*α, γ-distearin*). $(C_{17}H_{35}COO)_2C_3H_5OH$, 624.59. Rhomb.pl.f.chl. or lgr. **m.p.** 79.1. **Soly.** sl.s.c., s.h.al.; sl.s.c., s.h.et.

38 —, ethylidene ether. See *Acetoglyceral*.

39 —, monoacetate (*monoacetin*). CH_2-$OHCHOHCH_2OOCCH_3$, 134.08. Col. oil. **D.** 1.2060^{20}_{4}, **b.p.** 158^{165}. **Soly.** v.s.w.; v.s.al.; sl.s.et.; i.bz.

40 —, 1-monolaurate (*α-monolaurin*). $C_{11}H_{23}COOCH_2CHOHCH_2OH$, 274.23. Wh.need. **m.p.** 63.0. **Soly.** sl.s.c., s.h.al.; sl.s.c., s.h.et.

41 —, *α*-mononitrate. $CH_2OHCHOH$-CH_2ONO_2, 137.06. Col.pr. **D.** 1.40^{15}_{4}, **m.p.** 58, **b.p.** 155–60. **Soly.** 70w.; v.s.al.; v.sl.s.et.

42 —, *β*-mononitrate. $CH_2OHCH(ONO_2)$-CH_2OH, 137.06. Leaf. **D.** 1.40^{20}_{4}, **m.p.** 54, **b.p.** 160. **Soly.** s.w.; v.s.al.; sl.s.et.

43 —, 1-monoöleate(*monoölein*). $C_{17}H_{31}$-$COOCH_2CHOHCH_2OH$, 354.30. **D.** 0.947^{24}_{4}, **m.p.** 35. **Soly.** i.w.; s.al.; v.s.et.

44 —, 1-monopalmitate (*α-monopalmitin*). $C_{15}H_{31}COOCH_2CHOHCH_2OH$, 330.30. Leaf. **m.p.** 77.0. **Soly.** $5.306^{22.5}$al.; sl.s.c., s.h.et.

45 —, monoricinoleate. $C_{17}H_{33}COOC_3$-$H_5(OH)_2$, 356.31. Amber liq. **D.** 1.0284^{20}_{4}. **Soly.** dispersible w.; ∞al.; ∞et.

47 —, 1-monostearate (*α-monostearin*). $C_{17}H_{35}COOCH_2CHOHCH_2OH$, 358.33. Need. or waxlike solid. **D.** 0.9841^{20}_{4}, **m.p.** 81.1(57–8). **Soly.** dispersible w.; sl.s.c., v.s.h.al.; sl.s.c., v.s.h.et.

48 —, 1-octadecyl ether. See *1, 2 Propanediol, 3-octadecyloxy-**.

49 —, 1-sodium derivative (*sodium glycerolate; sodium glycerate* (so called)) $CH_2OHCHOHCH_2ONa$, 114.05. Wh powd. **m.p.** d. 245. **Soly.** d.w.; s.al.

50 —, triacetate (*triacetin*). $C_3H_5(OOC$-$CH_3)_3$, 218.11. Col.liq. **D.** 1.161^{20}_{4} **m.p.** -78, **b.p.** 259. **Soly.** 7.17w. ∞al.; ∞et.

51 —, tribenzoate (*tribenzoin*). C_3H_5-$(OOCC_6H_5)_3$, 404.16. Need.f.me.al **D.** 1.228^{12}_{4}, **m.p.** 76.5, **b.p.** d. **Soly.** i.w.; s.h.al.; v.s.et.

52 —, tribromohydrin. See *Propane 1, 2, 3-tribromo-**.

53 —, tributyrate (*butyrin; tributyrin*) $(CH_3CH_2CH_2CO)_3C_3H_5O_3$, 302.20. Col oily liq., *n* 1.4359. **D.** 1.0350^{20}_{4} **m.p.** <-75, **b.p.** 315(203–4^{25}) **Soly.** i.w.; v.s.al.; v.s.et.

54 —, trichlorohydrin. See *Propane 1, 2, 3-trichloro-**.

55 —, trilaurate (*trilaurin; laurin*). $(C_{11}$-$H_{23}COO)_3C_3H_5$, 638.58. Col.need. **D.** 0.8944^{60}_{4}, **m.p.** 46.4. **Soly.** i.w.; s.al.; s.et.; v.s.bz.

56 —, trimyristate (*myristin; trimyristin*) $(C_{13}H_{27}COO)_3C_3H_5$, 722.67. Glit.need. f.et., *n* 1.4429^{60}. **D.** 0.885^{60}_{4}, **m.p.** 56.5. **Soly.** i.w.; s.al.; s.et.; v.s.chl. s.bz.

57 —, trinitrate. See *Nitroglycerin*.

58 —, trinitrite. $C_3H_5(ONO)_3$, 179.06. Yel.liq. **D.** 1.291^{10}_{0}, **b.p.** 150 sl.d. **Soly.** i.w.; d.al.; s.et.; s.chl., bz.; i.CS_2.

59 —, trioleate (*triolein; olein; glyceryl oleate*). $(C_{17}H_{33}COO)_3C_3H_5$, 884.81. Col. oil. **D.** 0.915^{20}_{4}, **m.p.** -17; frz. -6, **b.p.** 240^{18}. **Soly.** i.w.; sl.s.al.; v.s.et.; s.chl.

60 —, tripalmitate (*tripalmitin; palmitin*). $(C_{15}H_{31}COO)_3C_3H_5$, 806.76. Col.need. f.et., *n* 1.4381^{80}. **D.** 0.866^{80}_{4}, **m.p.** 65.1; 46, **b.p.** 310–20. **Soly.** i.w.; $.004^{21}$al.; v.s.et.; s.chl.

61 —, tristearate (*stearin; tristearin*). $(C_{17}H_{35}COO)_3C_3H_5$, 890.86. Col.cr.f. et., *n* 1.4399^{80}. **D.** 0.862^{80}_{4}, **m.p.** 54.5; 70.8. **Soly.** i.w.; v.sl.s.al.; s.et.

62 —, **1-thio-** (*3-mercapto-1, 2-propanediol**). $(HO)_2C_3H_5SH$, 108.12. Thick liq. **D.** 1.295^{14}_{4}, **b.p.** d. **Soly.** v.sl.s.w.; ∞al.; i.et.

63 Glycerol ether (of Berthelot and de Luca) (*glyceryl ether*). $C_6H_{10}O_3$, 130.08. Col.liq. **D.** 1.091^{20}_{4}, **b.p.** 173. **Soly.** ∞w.; ∞al.; ∞et.

* Name approved by the International Union of Chemistry.

64 **Glycerophosphoric acid** (*glycerolphosphoric acid*). $C_3H_5(OH)_2OPO_3H_2$. 172.09. Col. oily liq. **D.** 1.59^{14}_{4}. **m.p.** −20. **Soly.** ∞w.; ∞al.

65 **Glyceryl α-chlorohydrin.** See 1, 2-*Propanediol, 3-chloro-**.

Glyceryl esters. See under *Glycerol*.

66 **Glyceryl ether.** See *Glycerol ether (of Berthelot and de Luca)*.

67 **Glyceryl nitrate.** See *Nitroglycerin*.

68 **Glycidol** (2, *3-epoxy-1-propanol*; epihydric alcohol; glycide*). OCH_2CHCH_2OH, 74.05. Col.liq. **D.** 1.165^{0}_{4}, **b.p.** 162 d. **Soly.** ∞w.; ∞al.; ∞et.

69 **Glycine** (*aminoacetic acid; aminoethanoic acid*; glycocoll*). NH_2CH_2COOH, 75.05. Wh.monocl., *n* 1.495, 1.615, 1.650. **D.** 1.1607^{20}_{4}. **m.p.** 233 d.; (225–30), **b.p.** 289–92 d. **Soly.** 25.3^{25}, 57.5^{75}w.; 0.043^{25} 90% al.; 0.61^{20}pyr.

70 —, methyl ester (*methyl aminoethanoate**). $NH_2CH_2COOCH_3$, 89.06. Col.liq. **b.p.** *ca.* 130 d.

71 —, ***N*-(*p*-acetamidophenyl)-** ((*p-acetamidoanilino*)*acetic acid*). $CH_3CONHC_6H_4NHCH_2COOH$, 208.11. **m.p.** 241–2.

72 —, ***N*-acetyl-.** See *Aceturic acid*.

73 —, ***N*-(*p*-aminophenyl)-** ((*p-aminoanilino*)*acetic acid*). $NH_2C_6H_4NHCH_2COOH$, 166.09. Leaf. **m.p.** 222–3 d. **Soly.** sl.s.w.

74 —, ***N*-benzoyl-.** See *Hippuric acid*.

75 —, ***N*-carbamyl-.** See *Hydantoic acid*.

76 —, ***N*-ethyl-** ((*ethylamino*)*ethanoic acid*; (ethylamino)acetic acid; N-ethylglycocoll*). $C_2H_5NHCH_2COOH$, 103.08. Leaf.f.al. **m.p.** >160 d. **Soly.** s.w.; s.al.

77 —, ***N*-*dl*-leucyl-.** $(CH_3)_2CHCH_2CH(NH_2)CONHCH_2COOH$, 188.14. Cr.f.w. **m.p.** 243 d. **Soly.** 6.6h.w.; v.sl.s.al.; v.sl.s.et.

78 —, ***N*-methyl-.** See *Sarcosine*.

79 —, ***N*-*o*-nitrophenyl-.** $NO_2C_6H_4NHCH_2COOH$, 196.08. Dk.red cr.f.al. **m.p.** 192–3 d. **Soly.** v.sl.s.w.; v.s.h.al.; sl.s.et.

80 —, ***N*-phenyl-** (*anilinoacetic acid*). $C_6H_5NHCH_2COOH$, 151.08. Col.cr. **m.p.** 127. **Soly.** s.w.; s.al.; sl.s.et.

81 —, —, *o*-carboxylic acid. See *Anthranilic acid, N-(carboxymethyl)-*.

82 **Glycine anhydride** (*2, 5-piperazinedione; α, γ-diacipiperazine; diglycolyl diamide*). $NHCOCH_2NHCOCH_2$, 114.06. Tab. **m.p.** 275 d., **b.p.** subl. **Soly.** s.h.w.; v.s.al.

83 **Glycocholic acid.** $C_{24}H_{39}O_4NHCH_2COOH$, 465.34. Col.need. **m.p.** 134. **Soly.** 0.33c.w.; v.s.al.; 0.09^{20}et.

84 **Glycocoll.** See *Glycine*.

85 **Glycocyamidine, 1-methyl-.** See *Creatinine*.

86 **Glycocyamine** (*guanidoacetic acid*). $NH_2C(:NH)NHCH_2COOH$, 117.08. Leaf. or need.f.w. **m.p.** d. **Soly.** 0.45^{15}w.; v.sl.s.al.; v.sl.s.et.

87 —, **methyl-.** See *Creatine*.

88 **Glycogen** (*animal starch*). $(C_6H_{10}O_5)_x$, $(162.08)_x$. Wh.amor. **m.p.** 240. **Soly.** v.s.w.; i.c., s.h.al.; i.et..

89 **Glycogenic acid.** See D-*Gluconic acid*.

90 **Glycol** (1, *2-ethanediol*; ethylene glycol*). CH_2OHCH_2OH, 62.05. Col. liq., *n* 1.4274. **D.** 1.1155^{20}_{4}. **m.p.** −17.4(−12), **b.p.** 197.2(198–200). **Soly.** ∞w.; ∞al.; 7.89et.

91 —. For derivatives see also 1, 2-*Ethanediol*.

92 —, cyanohydrin. See *Hydracrylonitrile*.

93 —, diacetate (*ethylene acetate*). $(CH_2OOCCH_3)_2$, 146.08. Col.liq., *n* 1.415. **D.** 1.128^{0}_{4}; 1.104^{20}_{4}, **m.p.** −31, **b.p.** 186(190.5). **Soly.** 14.3w.; ∞al.; ∞et.

94 —, dibenzoate (*ethylene benzoate; ethylene dibenzoate*). $(C_6H_5COO)_2C_2H_4$, 270.11. Rhomb.pr.f.et. **m.p.** 73–4. **b.p.** d. 360. **Soly.** i.w.; s.et.

95 —, dibromide. See *Ethylene bromide*.

96 —, dibutyrate (*ethylene butyrate*). $(CH_2OOCCH_2CH_2CH_3)_2$, 202.14. Liq. **D.** 1.024^{0}_{4}, **b.p.** 240. **Soly.** i.w.; v.s.al.; v.s.et.

97 —, dichloride. See *Ethylene chloride*.

98 —, diformate (*ethylene formate*). $HCOOCH_2CH_2OOCH$, 118.05. *n* 1.35800. **D.** 1.193^{0}_{4}, **b.p.** 174. **Soly.** sl.s.w.; s.al.; s.et.

99 —, diiodide. See *Ethylene iodide*.

00 —, dilaurate (*ethylene laurate*). $(C_{11}H_{23}COOCH_2)_2$, 426.39. **m.p.** 50–2, **b.p.** 188^{20}. **Soly.** i.w.; v.s.al., v.s.et.

01 —, dimyristate (*ethylene myristate*). $(C_{13}H_{27}COOCH_2)_2$, 482.45. Cr. **m.p.** 62–3.

02 —, dinitrate (*ethylene nitrate*). $C_2H_4(ONO_2)_2$, 152.05. Yel.liq. **D.** 1.483^{5}, **m.p.** −20. **b.p.** exp. 114–6. **Soly.** i.w.; s.al.; d.alk.

03 —, dinitrite (*ethylene nitrite*). $C_2H_4(ONO)_2$, 120.05. Liq. **D.** 1.2156^{0}_{4}, **m.p.** <−15, **b.p.** 98. **Soly.** i.w.; s.al., s.et.; d.alk.

For explanations and abbreviations see beginning of table.

04 **Glycol,** dipalmitate (*ethylene palmitate*). $(C_{15}H_{31}COOCH_2)_2$, 538.51. Leaf. or need. **D.** $0.8594^{77.9}$, **m.p.** 68.7(69–72), **b.p.** 226. **Soly.** i.w.; 0.31^{38}al.; s.h.et.

05 —, diphenyl ether. See *Ethane, 1, 2-diphenoxy-**.

06 —, dipropionate (*ethylene propionate*). $(CH_3CH_2COOCH_2)_2$, 174.11. Liq. **D.** 1.0544^{15}, **b.p.** 211; $90–2^{8}$. **Soly.** sl.s.w.; ∞al.; ∞et.

07 —, distearate (*ethylene stearate*). $[CH_3(CH_2)_{16}COOCH_2\cdot]_2$, 594.58. Leaf. **D.** 0.8581^{78}, **m.p.** 76–7, **b.p.** 241^{20}. **Soly.** i.w.; 0.122^{40}al.; v.s.et.

08 —, dithiocyanate (*ethylene (di)thiocyanate*). $(CH_2SCN)_2$, 144.17. Col. rhomb. pl. or need. **m.p.** 90, **b.p.** d. **Soly.** s.w.; s.al.; s.et.

09 —, ethylene ether. See *p-Dioxane*.

10 —, ethylidene diether. See 1, 3-*Dioxolane, 2-methyl-*.

11 —, monoacetate. $CH_3COOCH_2CH_2OH$, 104.06. Col.liq. **D.** 1.108^{15}, **b.p.** 182. **Soly.** ∞w.; ∞al.; ∞et.

12 —, monobenzyl ether. See *Ethanol, 2-benzyloxy-*.

13 —, monobutyl ether. See *Ethanol, 2-butoxy-**.

14 —, monoethyl ether. See *Ethanol, 2-ethoxy-**.

15 —, monoformate (*β-hydroxyethyl formate*). $HCOOCH_2CH_2OH$, 90.05. Liq. **D.** 1.199^{15}_{4}, **b.p.** 180; 88^{25}. **Soly.** ∞w.; ∞al.; ∞et.

16 —, monomethyl ether. See *Ethanol, 2-methoxy-**.

17 —, monomethyl ether acetate. See *Ethanol, 2-methoxy-*, acetate*.

18 —, monopalmitate. $C_{15}H_{31}COOCH_2CH_2OH$, 300.28. Cr. **D.** $0.8786^{62.5}_{4}$, **m.p.** 51.5. **Soly.** 24.08^{25}al.; s.h.et.

19 —, monostearate. $C_{17}H_{35}COOCH_2CH_2OH$, 328.31. Cr. **D.** 0.8780^{60}_{4}, **m.p.** 58.5. **Soly.** 10.61^{29}al.; s.h.et.

20 —, **decamethylene.** See 1, 10-*Decanediol**.

21 —, **diethylene.** See *Diethylene glycol*.

22 —, *sym*-**dimethyl-.** See 2, 3-*Butanediol**.

23 —, *uns*-**dimethyl-.** See 1, 2-*Propanediol, 2-methyl-**.

24 —, **dithio-.** See 1, 2-*Ethanedithiol**.

25 —, **ethyl-.** See 1, 2-*Butanediol**.

26 —, **ethylene.** See *Glycol*.

27 —, **ethyl methyl.** See 2, 3-*Pentanediol**.

28 —, **heptamethylene.** See 1, 7-*Heptanediol**.

29 —, **isopropyl-.** See 1, 2-*Butanediol, 3-methyl-**.

30 —, **nonamethylene.** See 1, 9-*Nonanediol**.

31 —, **octamethylene.** See 1, 8-*Octanediol**.

32 —, **octylene.** See 4, 5-*Octanediol**.

33 —, **pentamethylene.** See 1, 5-*Pentanediol**.

34 —, **γ-pentylene.** See 1, 4-*Pentanediol**.

35 —, **tetraethyl-.** See 3, 4-*Hexanediol, 3, 4-diethyl-**.

36 —, **tetramethyl-.** See *Pinacol*.

37 —, **tetramethylene.** See 1, 4-*Butanediol**.

38 —, **tetraphenyl-.** See *Benzopinacol*.

39 —, **thiodi-.** See *Ethanol, 2, 2′-thiodi-*.

40 —, **triethylene.** See *Triethylene glycol*.

41 —, **trimethyl-.** See 2, 3-*Butanediol, 2-methyl-**.

42 —, **xylylene.** See *Xylylene glycol*.

43 **Glycolaldehyde** (*hydroxyethanal*; glycolic aldehyde*). CH_2OHCHO. 60.03. Col.pl. **m.p.** 97. **Soly.** v.s.w.; v.s.h.al.; sl.s.et.

44 **Glycolamide** (*2-hydroxyethanamide*; hydroxyacetamide*). $CH_2OHCONH_2$, 75.05. Col.rhomb. **m.p.** 120. **Soly.** v.s.w.; sl.s.al.; sl.s.et.

45 **Glycoleucine.** See *Norleucine*.

46 **Glycolic acid** (*hydroxyethanoic acid*; hydroxyacetic acid*). $HOCH_2COOH$, 76.03. Rhomb.leaf.f.et. **m.p.** α63; β79, **b.p.** d. **Soly.** s.w.; s.al.; s.et.

47 —, ethyl ester (*ethyl hydroxyethanoate**). $CH_2OHCOOC_2H_5$, 104.06. Col.liq. **D.** 1.0826^{23}_{4}, **b.p.** 160. **Soly.** v.s.al.; v.s.et.

48 —, ethyl ether. See *Acetic acid, ethoxy-*.

49 —, methyl ester (*methyl hydroxyethanoate*; methyl glycolate*). $CH_2OHCOOCH_3$, 90.05. Col.liq. **D.** 1.168^{18}_{4}, **b.p.** 151.2. **Soly.** s.w.; ∞al.; ∞et.

50 —, phenyl ether. See *Acetic acid, phenoxy-*.

51 —, **benzoyl-** (*α-hydroxy-β-ketohydrocinnamic acid; 2-hydroxy-3-oxo-3-phenylpropanoic acid*). $C_6H_5COCH(OH)COOH$, 180.06. Lng.pr. **m.p.** 125. **Soly.** sl.s.c.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

52 **Glycolic acid, diphenyl-.** See *Benzilic acid.*

53 **—, phenyl-.** See *Mandelic acid.*

54 **—, styryl-.** See *3-Butenoic acid, 2-hydroxy-4-phenyl-.*

55 **—, thio-.** See *Acetic acid, mercapto-.*

56 **Glycolic aldehyde.** See *Glycolaldehyde.*

57 **Glycolic anhydride.** $(CH_2OHCO)_2O$, 134.05. Cr.powd. **m.p.** 130, **b.p.** d. **Soly.** i.c., s.h.w.; i.al.; i.et.

58 **Glycolide** (*2, 5-p-dioxanedione; diglycolide*). $OCOCH_2OCOCH_2$, 116.03. Col.leaf.f.al. **m.p.** 86–7. **Soly.** s.h.w; sl.s.al.; sl.s.et.; s.ac.a., h.chl.

59 **Glycoluric acid.** See *Hydantoic acid.*

60 **Glycoluril** (*acetylenediurein*). C_2H_2-$(CON_2H_2)_2$, 142.08. Wh.need.f.w. **Soly.** 1.333^{15}w.; s.al.; s.et.

61 **Glyconic acid.** See *Gluconic acid.*

62 **Glycosterin.** See *Diethylene glycol, distearate.*

63 **Glyoxal** (*ethanedial*; oxalaldehyde; biformyl*). CHOCHO, 58.02. Yel. cr., n 1.3828. **D.** 1.14^{20}_{4}, **m.p.** 15, **b.p.** 50.4. **Soly.** v.s.w.; s.al.; s.et.

64 —, dioxime. See *Glyoxime.*

65 **—, di-2-furyl-.** See *Furil.*

66 **—, dimethyl-.** See *2, 3-Butanedione*.*

67 **—, diphenyl-.** See *Benzil.*

68 **Glyoxalic acid.** See *Glyoxylic acid.*

69 **Glyoxaline.** See *Imidazole.*

70 **Glyoxime** (*glyoxal dioxime*). HON:-CHCH:NOH, 88.05. Rhomb.tab.f.w. **m.p.** 178. **Soly.** v.s.h.w.; s.al.; s.et.

71 **—, dimethyl-** (*2, 3-butanedione dioxime*; diacetyl dioxime*). CH_3C-$(:NOH)C(:NOH)CH_3$, 116.08. Col. cr.f.dil.al. **m.p.** 234.5(246). **Soly.** i.w.; v.s.al.; v.s.et.

72 **Glyoxyldiureide.** See *Allantoin.*

73 **Glyoxylic acid** (*oxoethanoic acid*; glyoxalic acid; oxaldehydic acid*). HCOCOOH, 74.02. Col.rhomb. **m.p.** d. **Soly.** v.s.w.; s.al.

74 **—, o-aminophenyl-.** See *Isatic acid.*

75 **—, o-carboxyphenyl-.** See *Phthalonic acid.*

76 **—, o-nitrophenyl-** (*o-nitrobenzoylformic acid*). $NO_2C_6H_4COCOOH$, 195.05. Need.f.w. **m.p.** 46–7. **Soly.** v.s.h.w.

77 **—, phenyl-** (*benzoylformic acid*). $C_6H_5COCOOH$, 150.05. Col.cr.f. CCl_4, **m.p.** 66, **b.p.** $147–51^{12}$. **Soly.** s.w.; s.al.; s.et.; i.CS_2.

78 **—, 2-thienyl-.** See *2-Thiopheneacetic acid, α-keto-.*

79 **Gnoscopine** (*dl-narcotine*). $C_{22}H_{23}$-NO_7 413.19. Lng.need. **m.p.** 229. **Soly.** .06al.; s.chl., bz.; i.alk.

80 **Gommelin.** See *Dextrin*

81 **Granatonine, methyl-.** See *Pseudopelletierine.*

82 **Grape sugar.** See *D-Glucose.*

83 **Guaiacol** (*o-methoxyphenol; pyrocatechol monomethyl ether; o-hydroxyanisole*). $CH_3OC_6H_4OH(OH = 1)$, 124.06. Col.hex.pr., n 1.569, 1.666. **D.** 1.140^{15}_{15}; 1.1293^{25}_{4}; 1.1230^{48}_{0}, **m.p.** 28.2(32), **b.p.** 205. **Soly.** 1.6^{15}w.; s.al.; s.et.; s.chl., glac.ac.a.

84 **—, 4-allyl-.** See *Eugenol.*

85 **—, 5-allyl-.** See *Chavibetol.*

86 **—, 4-methyl-.** See *Creosol.*

87 **—, 4-propenyl-.** See *Isoeugenol.*

88 **—, 5-vinyl-.** See *Hesperetol.*

89 **Guaiene** (*2, 3-dimethylnaphthalene**). $C_{10}H_6(CH_3)_2$, 156.09. Leaf.f.al. **D.** 1.008^{20}_{4}, **m.p.** −20, **b.p.** 266 subl. **Soly.** i.w.; v.s.al.; ∞et.

90 **Guaiole.** See *Tiglaldehyde.*

91 **Guanidine** (*aminomethanamidine*; carbamamidine; aminoformamidine*). $NH:C(NH_2)_2$, 59.06. Col.cr. **Soly.** v.s.w.; v.s.al.

92 **—, 1-amino-** (*guanylhydrazine*). $NH_2NHC(:NH)NH_2$, 74.08. Cr. **m.p.** d. **Soly.** s.w.; s.al.; i.et

93 **—, 1-carbamyl-.** See *Urea, guanyl-.*

94 **—, 1-cyano-** (*dicyan(o)diamide; param*). $NH_2C(:NH)NHCN$, 84.06. Rhomb.leaf. **D.** 1.40^{14}_{4}, **m.p.** 205 (207), **b.p.** d. **Soly.** 2.26^{13}w.; 1.26^{13} al.; 0.01^{13}et.; i.bz.

95 **—, diphenyl-** (*melaniline*). NH:C-$[NHC_6H_5]_2$ or $C_6H_5NHC(:NC_6H_5)$-NH_2, 211.13. Monocl.need.f.al. **D.** 1.13^{20}_{4}, **m.p.** 147–8, **b.p.** d. >170. **Soly.** sl.s.w.; 9.1^{20} 90%, 5^{16} al.; v.sl.s. et.; s.CCl_4, chl., h.bz., h.tol., dil.min.a.

96 —, —, mercaptide with 2-benzothiazolethiol. See under *2-Benzothiazolethiol.*

97 **—, di-o-tolyl-.** $C_{15}H_{17}N_3$, 239.16. Wh.cr. **D.** 1.10^{20}_{4}, **m.p.** 179. **Soly.** v.sl.s.w.; sl.s.c., s.h.al.; sl.s.et.

98 **—, guanyl-.** See *Biguanide.*

99 **—, nitro-*.** $NH_2C(:NH)NHNO_2$(?). 104.06. Yelsh.need.f.w. **m.p.** 246–7 (231). **Soly.** $0.26^{18.3}$w.; sl.s.al.; i.et.; s.sol.KOH.

For explanations and abbreviations see beginning of table.

00 **Guanidine, phenyl-*o*-tolyl-.** $C_{14}H_{15}N_3$, 225.14. Wh.cr. **m.p.** 129.5–30. **Soly.** v.sl.s.w.; sl.s.c., s.h.al.; sl.s.et.

01 —, **1, 1, 3, 3-tetraphenyl-*.** $NH{:}C[N(C_6H_5)_2]_2$, 363.19. Rhomb.f.lgr. **m.p.** 130. **Soly.** i.w.; s.al.; s.et.; v.s.bz.

02 —, **1, 1, 3-triphenyl-*** (*β-triphenylguanidine*). $HN{:}C(NHC_6H_5)N(C_6H_5)_2$, 287.16. Regular tab. **m.p.** 131. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; sl.s.bz.

03 —, **1, 2, 3-triphenyl-*** (*α-triphenylguanidine*). $C_6H_5N{:}C(NHC_6H_5)_2$, 287.16. Wh.need. or pr.f.al. **D.** 1.13^{20}_{4}, **m.p.** 145, **b.p.** d. **Soly.** v.sl.s.w.; 3.55c.al.; s.et.; s.chl.

04 **Guanine** (*2-aminohypoxanthine*). $C_5H_5N_5O$, 151.08. Col.need. **m.p.** 360 d. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; s.KOH; v.sl.s.NH_4OH.

05 **Guncotton.** See *Cellulose hexanitrate.*

06 **Guvacine.** $C_6H_9NO_2$, 127.08. Lust. sc. **m.p.** 271–2 d. **Soly.** s.w.; s.al.; i.et.

07 —, **1-methyl-.** See *Arecaidine.*

08 **H acid.** See 1-*Naphthol*-3, 6-*disulfonic acid, 8-amino-.*

Haem-. See *Hem-.*

09 **Harmaline.** $C_{13}H_{14}N_2O$, 214.13. Rhomb.pr.f.al.+bz. **m.p.** 250 d. (238). **Soly.** v.sl.s.w.; sl.s.al.; sl.s.et.

10 **Harmine.** $C_{13}H_{12}N_2O$, 212.11. Monocl. or rhomb.pr.f.al. **m.p.** 257–9 d. **Soly.** 2.5^{20}w.; sl.s.al.; sl.s.et.

11 **Helenin** (*alantolactone*). $C_{15}H_{20}O_2$, 232.16. Wh.need.f.al.+w. **m.p.** 76, **b.p.** 275; 192^{10}. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.bz., chl.

12 *l*-**Helicin** (*salicylaldehyde glucoside*). $C_6H_4(OC_6H_{11}O_5)CHO$, 284.12. Fine need. **m.p.** 175. **Soly.** 60c., v.s.h.w.; s.al.; i.et.

13 **Heliotropin.** See *Piperonal.*

14 **Hematein** (*haematein; hematin*). $C_{16}H_{12}O_6$, 300.09. Br.pl. **m.p.** 250 d. **Soly.** 0.6^{20}w.; sl.s.al.; 0.0093^{20}et.; s.alk.; i.bz., chl.

15 **Hematin** (*haematin*). $C_{32}H_{32}FeN_4O_4$, 592.12. Br.powd. **m.p.** >200. **Soly.** i.w.; i.c., s.h.al.; i.et.; s.alk.; i.chl.

16 **Hematoxylin** (*haematoxylin*). $C_{16}H_{14}O_6{\cdot}3H_2O$, 356.16. Col.-yelsh.tetr. cr.f.dil.$(NH_4)_2SO_3$. **m.p.** anh. 140, **b.p.** $-H_2O$, 100–20. **Soly.** v.sl.s.w.; s.al.; s.et.; s.NH_4OH, glyc., caustic alk.

17 **Hemellitene.** See *Hemimellitene.*

18 **Hemellitic acid** (*2, 3-dimethylbenzoic acid; 2, 3-xylic acid; vic-o-xylic acid*). $(CH_3)_2C_6H_3COOH$, 150.08. Col.pr.f.al. **m.p.** 144. **Soly.** v.sl.s.h.w.; s.al.; s.et.

19 **Hemimellitene** (*1, 2, 3-trimethylbenzene; vic-trimethylbenzene; hemellitene*). $(CH_3)_3C_6H_3$, 120.09. Col.liq., *n* $1.51335^{19.55}$. **D.** 0.895^{20}_{4}, **m.p.** <−15, **b.p.** 176.5. **Soly.** i.w.; s.al.; s.et.

20 —, **4, 5, 6-trinitro-.** $(NO_2)_3C_6(CH_3)_3$, 255.09. Pr.f.al. **m.p.** 209. **Soly.** i.w.; s.al.

21 **Hemimellitic acid** (*1, 2, 3-benzenetricarboxylic acid**). $C_6H_3(COOH)_3$, 210.05. Col.need. **m.p.** 190, **b.p.** d. **Soly.** 3.15^{19}w.; s.et.

22 **Hemipic acid** (*3, 4-dimethoxyphthalic acid; hemipinic acid; narcotine hemipic acid*). $(CH_3O)_2C_6H_2(COOH)_2$, 226.08. Monocl.cr. **m.p.** 186–8; 159–60anh., **b.p.** subl. **Soly.** sl.s.w.; sl.s.al.; 0.7et.

23 **Hemiterpene.** See *Isoprene.*

24 **Hendecanal*** (*undecanal*; n-undecylaldehyde*). $CH_3(CH_2)_9CHO$, 170.17. Liq., *n* 1.4334. **D.** 0.830^{23}_{4}, **m.p.** −4, **b.p.** 117^{18}. **Soly.** i.w.; s.al.; s.et.

25 —, oxime. $CH_3(CH_2)_9CH{:}NOH$, 185.19. Need.f.me.al. **m.p.** 72. **Soly.** s.w.; s.al.; s.et.

26 **Hendecane*** (*undecane**). $CH_3(CH_2)_9CH_3$, 156.19. Col.liq., *n* 1.4184. **D.** 0.741^{20}_{4}, **m.p.** −26.5, **b.p.** 195.84 (197). **Soly.** i.w.; ∞al.; ∞et.

27 —, **1-amino-.** See *Hendecylamine*.*

28 **Hendecanoic acid*** (*undecanoic acid*; n-undecylic acid*). $CH_3(CH_2)_9COOH$, 186.17. Col.sc., *n* $1.4294^{45.2}$. **D.** 0.9905^{25}_{4}; 0.8889^{30}_{4}, **m.p.** 29.3, **b.p.** 228^{160}. **Soly.** i.w.; sl.s.al.; s.et.

29 **1-Hendecanol*** (*1-undecanol*; pri-n-undecyl alcohol*). $CH_3(CH_2)_9CH_2OH$, 172.19. Cr. or liq., *n* 1.4404. **D.** 0.8334^{23}_{4}, **m.p.** 11(19), **b.p.** 131^{15}. **Soly.** i.w.; s.al.; v.s.et.

30 **2-Hendecanol*** (*2-undecanol*; methylnonylcarbinol*). $CH_3(CH_2)_8CHOHCH_3$, 172.19. Liq. **D.** 0.8268^{19}_{4}, **m.p.** 12, **b.p.** 228–9. **Soly.** i.w.; s.al.; s.et.

31 **2-Hendecanone*** (*2-undecanone*; methyl nonyl ketone*). $CH_3CO(CH_2)_8CH_3$, 170.17. Col.arom.liq., *n* $1.43002^{17.3}$. **D.** 0.826^{20}_{4}, **m.p.** 15; (12.1); frz. 6, **b.p.** 228(226). **Soly.** i.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

32 **3-Hendecanone*** (*3-undecanone*; *ethyl octyl ketone*). $C_2H_5CO(CH_2)_7CH_3$, 170.17. Liq. **m.p.** 4.5, **b.p.** 104–6(227). **Soly.** i.w.; s.al.; s.et.

33 **6-Hendecanone*** (*6-undecanone*; *diamyl ketone; dipentyl ketone; (n)-caprone*). $CH_3(CH_2)_4CO(CH_2)_4CH_3$. 170.17. Leaf. **D.** 0.8262^{20}_{4}, **m.p.** 14–5, **b.p.** 226. **Soly.** i.w.; v.s.al.; v.s.et.

34 **2-Hendecene*** (*2-undecene*; *β-undecylene*). $CH_3CH{:}CH(CH_2)_7CH_3$. 154.17. Col.liq., *n* 1.4333. **D.** 0.7729^{20}_{4}, **b.p.** 193. **Soly.** i.w.; ∞al.; ∞et.

35 **9-Hendecenoic acid*** (*9-undecenoic acid*; *θ-undecylenic acid*). $CH_2CH{:}CH(CH_2)_7COOH$, 184.16. Wh.cr. mass or col. to yelsh.liq. **D.** 0.9075^{24}_{4}, **m.p.** 24.5, **b.p.** 295. **Soly.** i.w.; ∞al.; ∞et.; s.chl.

36 **Hendecylamine*** (*pri-n-undecylamine; 1-aminohendecane*). $CH_3(CH_2)_{10}NH_2$, 171.20. **m.p.** 16.5, **b.p.** 234.

37 **Heneicosane**. $CH_3(CH_2)_{19}CH_3$. 296.34. Cr., *n* $1.4344^{45.3}$. **D.** 0.778^{40}_{4}. **m.p.** 40, **b.p.** 215^{15}.

38 **Hentriacontane*** (*n-hentriacontane*). $CH_3(CH_2)_{29}CH_3$, 436.50. Cr. **D.** 0.781^{68}_{4}, **m.p.** 68.1, **b.p.** 302^{15}. **Soly.** sl.s.et.

39 **16-Hentriacontanone*** (*dipentadecyl ketone; palmitone*). $(C_{15}H_{31})_2CO$, 450.48. Leaf.f.al., *n* $1.4297^{83.5}$. **D.** liq. 0.795^{91}_{4}, **m.p.** 82.8. **Soly.** i.w.; s.al.; s.et.

40 **Heptacosane*** (*n-heptacosane*). $CH_3(CH_2)_{25}CH_3$, 380.44. Cr. **D.** 0.780^{60}_{4}, **m.p.** 59.5, **b.p.** 270^{15}. **Soly.** i.w. v.s.al.; sl.s.et.

41 **Heptadecane*** (*n-heptadecane*). $CH_3(CH_2)_{15}CH_3$. 240.28. Hex.leaf., *n* 1.437. **D.** 0.778^{22}_{4}, **m.p.** 22.5, **b.p.** 303. **Soly.** i.w.; sl.s.al.; s.et.

42 **9-Heptadecanecarboxylic acid***. See *Capric acid, α-octyl-*.

43 **Heptadecanenitrile***. See *Margaronitrile*.

44 **Heptadecanoic acid***. See *Margaric acid*.

45 **1-Heptadecanol*** (*pri-n-heptadecyl alcohol*). $CH_3(CH_2)_{16}OH$, 256.28. Cr. **m.p.** 53.31(54). **Soly.** i.w.; s.al.; s.et.

46 **9-Heptadecanone*** (*di-n-octyl ketone; pelargone; nonylone*). $(C_8H_{17})_2CO$, 254.27. Pl.f.me.al. **m.p.** 53(50.5?). **Soly.** sl.s.al.; s.me.al.

47 *n*-**Heptadecoic acid**. See *Margaric acid*.

48 *pri-n*-**Heptadecyl alcohol**. See *1-Heptadecanol**.

49 *n*-**Heptadecylic acid**. See *Margaric acid*.

50 **2,4-Heptadiene***. $CH_3CH{:}CHCH{:}CHCH_2CH_3$. 96.09. Liq. **D.** $0.733^{21.5}_{4}$. **b.p.** 107 (104–6).

51 **1,6-Heptadiene-3,5-dione, 1,7-bis(4-hydroxy-3-methoxyphenyl)-***. See *Curcumin*.

52 **2,5-Heptadien-4-one, 2,6-dimethyl-**. See *Phorone*.

53 *n*-**Heptaldehyde**. See *Enanthaldehyde*.

54 *n*-**Heptaldoxime**. See *Enanthaldehyde, oxime*.

55 **Heptamethylene**. See *Cycloheptane**.

56 **Heptamethylene glycol**. See *1,7-Heptanediol**.

57 **Heptanal***. See *Enanthaldehyde*.

58 **Heptane*** (*n-heptane*). $CH_3(CH_2)_5CH_3$. 100.12. Col.liq., *n* 1.3867^{20}. **D.** 0.684^{20}_{4}. **m.p.** −90.5, **b.p.** 98.4. **Soly.** $0.0052^{15.5}$w.; 100al.; ∞et.; ∞chl.

59 —, **1-bromo-*** (*n-heptyl bromide*). $CH_3(CH_2)_6Br$. 179.03. Col.liq. **D.** 1.133^{16}_{4}, **m.p.** −58.86, **b.p.** 178.8. **Soly.** i.w.; v.s.al.; v.s.et.

60 —, **1-chloro-*** (*n-heptyl chloride*). $CH_3(CH_2)_6Cl$. 134.57. Liq., *n* 1.42844. **D.** 0.8725^{20}_{0}, **m.p.** −69.5, **b.p.** 159.5. **Soly.** i.w.; ∞al.; ∞et.

61 —, **2,6-dimethyl-*** (*diisobutylmethane; isobutylisoamyl*). $(CH_3)_2CH(CH_2)_3CH(CH_3)_2$, 128.16. Col. liq. **D.** 0.7247^{0}_{4}; 0.712^{20}_{0}, **b.p.** 132–3 **Soly.** i.w.; i.al.; s.et.

62 **Heptane, 1-ethoxy-***. See *Ether, ethyl heptyl*.

63 —, **4-ethyl-*** (*ethyldipropylmethane*). $CH_3(CH_2)_2CH(C_2H_5)(CH_2)_2CH_3$, 128.16. Col.liq., *n* 1.408 **D.** 0.741^{15}_{4}, **b.p.** 139. **Soly.** i.w.; i.al.; s.et.

64 —, **1-heptyloxy-***. See *Heptyl ether*.

65 —, **1-iodo-*** (*n-heptyl iodide*). $CH_3(CH_2)_5CH_2I$. 226.04. Liq. **D.** 1.403^{0}_{4}; 1.366^{21}_{4}, **m.p.** −48.2, **b.p.** 203.95; $91–3^{20}$. **Soly.** i.w.; s.al.; s.et.

66 —, **1-methoxy-***. See *Ether, heptyl methyl*.

67 —, **2-methyl-*** (*amyldimethylmethane; isooctane*). $(CH_3)_2CH(CH_2)_4CH_3$. 114.14. Col.liq., *n* 1.3935. **D.** 0.7029^{20}_{4}, **b.p.** 116.0. **Soly.** i.w.; sl.s.al.; s.et.

For explanations and abbreviations see beginning of table.

68 **Heptane, 3-methyl-*** (*butylethylmethylmethane*). $CH_3CH_2CH(CH_3)(CH_2)_3CH_3$, 114.14. Liq. **D.** 0.7161, **b.p.** 122.2. **Soly.** i.w.; sl.s.al.; s.et.

69 —, **4-methyl-*** (*methyldipropylmethane*). $CH_3(CH_2)_2CH(CH_3)$-$(CH_2)_2CH_3$, 114.14. Col.liq., n 1.398^{15}. **D.** 0.7211^{20}_{4} **b.p.** 118.0. **Soly.** i.w.; sl.s.al.; s.et.

70 —, **1-phenoxy-***. See *Ether, heptyl phenyl.*

71 **3-Heptanecarboxylic acid.** See *Caproic acid, α-ethyl-.*

72 **1, 7-Heptanedicarboxylic acid.** See *Azelaic acid.*

73 **Heptanedioic acid***. See *Pimelic acid.*

74 **Heptanedioic acid, 4-oxo-***. See *Acetonediacetic acid.*

75 **1, 7-Heptanediol*** (*heptamethylene glycol*). $CH_2OH(CH_2)_5CH_2OH$, 132.12. Cr. **m.p.** 12, **b.p.** 259; $143\text{–}6^{8}$. **Soly.** s.w.; s.al.; i.et.

76 **1-Heptanethiol*** (*n-heptyl mercaptan*). $CH_3(CH_2)_5CH_2SH$, 132.18. Liq. **D.** 0.8389^{20}_{4}, **m.p.** −43.4, **b.p.** 176.2(174–5). **Soly.** i.w.; ∞al.; ∞et.

77 **Heptanoic acid***. See *Enanthic acid.*

78 **1-Heptanol*** (*n-heptyl alcohol*). $CH_3(CH_2)_5CH_2OH$, 116.12. Col.liq., n $1.42326^{22.4}$ **D.** 0.8185^{20}_{4}, **m.p.** −34.6, **b.p.** 176.3(175.8). **Soly.** 0.09^{18}, 0.28^{100}w.; ∞al.; ∞et.

79 —, esters of organic acids. See "heptyl ester" under the names of the acids.

80 —, nitrite. See *Heptyl nitrite.*

81 **2-Heptanol*** (*amylmethylcarbinol*). $CH_3CHOH(CH_2)_4CH_3$, 116.12. Liq., n 1.4213, 1.4190^{25}. **D.** 0.8193, **b.p.** 158–7(160–2). **Soly.** i.w.; s.al.; s.et.

82 —, **2-methyl-*** (*amyldimethylcarbinol*). $(CH_3)_2COH(CH_2)_4CH_3$, 130.14. Col.liq., n 1.4303. **D.** 0.879^{20}_{4}, **b.p.** 162. **Soly.** i.w.; s.al.; s.et.

83 **3-Heptanol, 3-methyl-*** (*butylethylmethylcarbinol*). CH_3CH_2COH-$(CH_3)(CH_2)_3CH_3$, 130.14. Col.liq., n 1.4270. **D.** 0.8273^{19}_{0}, **b.p.** 160.6 $(161\text{–}2^{763})$. **Soly.** i.w.; s.al.; s.et.

84 **4-Heptanol*** (*dipropylcarbinol*). CH_3-$(CH_2)_2CHOH(CH_2)_2CH_3$, 116.12. Liq., n 1.4205. **D.** 0.820^{20}_{4}, **m.p.** −41.5, **b.p.** 155.4. **Soly.** i.w.; s.al.; s.et.

85 —, **2, 6-dimethyl-*** (*diisobutylcarbinol*). $[(CH_3)_2CHCH_2]_2CHOH$, 144.16. Col.liq., n 1.423^{21}. **D.** 0.8237^{0}_{0}; 0.8155^{15}_{4}, **b.p.** $172\text{–}4^{750}$. **Soly.** i.w.; s.al.; s.et.

86 —, **4-ethyl-*** (*ethyldipropylcarbinol*). $CH_3CH_2COH(CH_2CH_2CH_3)_2$, 144.16. Liq. **D.** 0.8349^{20}_{4}, **b.p.** 179.5. **Soly.** i.w.; s.al.; s.et.

87 —, **4-methyl-*** (*methyldipropylcarbinol*). $CH_3(CH_2)_2COH(CH_3)$-$(CH_2)_2CH_3$, 130.14. Col.liq., n 1.427. **D.** 0.8248^{20}_{4}, **b.p.** 161.5. **Soly.** i.w.; s.al.; s.et.

88 —, **4-propyl-*** (*tripropylcarbinol; tert-decyl alcohol*). $(C_3H_7)_3COH$, 158.17. Col.oil. **D.** 0.8338^{21}_{0}, **b.p.** 190–2. **Soly.** i.w.; s.al.

89 **2-Heptanone*** (*amyl methyl ketone*). $CH_3CO(CH_2)_4CH_3$ 114.11. Col.liq. **D.** 0.822^{15}_{4}, **b.p.** 150. **Soly.** v.sl.s.w.; s.al.; s.et.

90 **3-Heptanone*** (*ethyl butyl ketone*). $C_2H_5CO(CH_2)_3CH_3$, 114.11. Col.liq. **D.** 0.8183^{20}_{4}, **m.p.** −39.0, **b.p.** 148.5. **Soly.** i.w.; ∞al.; ∞et.

91 —, **6-methyl-*** (*ethyl isoamyl ketone*). $C_2H_5COCH_2CH_2CH$-$(CH_3)_2$, 128.12. Liq. **b.p.** 163.5. **Soly.** i.w.; s.al.; s.et.

92 **4-Heptanone*** (*dipropyl ketone; butyrone*). $C_3H_7COC_3H_7$, 114.11. Col. liq., n $1.40732^{21.7}$. **D.** 0.8205^{15}_{4}; 0.8175^{20}_{4}, **m.p.** −32.6(−34), **b.p.** 144. **Soly.** 0.43w.; ∞al.; ∞et.

93 —, **2, 6-dimethyl-*** (*diisobutyl ketone; s-diisopropylacetone; isovalerone; valerone*). $[(CH_3)_2CHCH_2]_2$-CO, 142.14. Col. oil, n 1.412^{21}. **D.** 0.806^{20}_{4}, **b.p.** 168(165–6). **Soly.** i.w.; ∞al.; ∞et.

94 —, **2-methyl-*** (*isobutyl propyl ketone*). $CH_3CH_2CH_2COCH_2CH$-$(CH_3)_2$, 128.12. Liq. **D.** 0.813, **b.p.** 155. **Soly.** i.w.; s.al.; s.et.

95 **1-Heptene*** (*α-heptylene*). CH_2:-$CH(CH_2)_4CH_3$, 98.11. Col.liq. **D.** 0.6993^{20}_{4}, **m.p.** −10, **b.p.** 94.9 (95–100). **Soly.** i.w.; s.al.; s.et.

96 **2-Heptene*** (*1-butyl-2-methylethylene; β-heptylene*). $CH_3CH{:}CH(CH_2)_3$-CH_3, 98.11. **D.** 0.7034^{20}_{4}, **b.p.** 98.1–8.4.

97 **3-Heptene*** (*1-ethyl-2-propylethylene; γ-heptylene*). $CH_3CH_2CH{:}CHCH_2$-CH_2CH_3, 98.11. **D.** 0.7043^{20}_{4}, **b.p.** 95.8–6.1.

98 **5-Hepten-2-one, 6-methyl-***. $(CH_3)_2C{:}CH(CH_2)_2COCH_3$, 126.11. Col.liq. **D.** 0.860^{20}_{4}, **m.p.** −67.3, **b.p.** 174. **Soly.** i.w.; ∞al.; ∞et.

99 **Heptine.** See *Heptyne**.

00 ***n*-Heptoic acid.** See *Enanthic acid.*

01 ***pri-n*-Heptyl alcohol.** See *1-Heptanol**.

* Name approved by the International Union of Chemistry.

02 ***n*-Heptyl aldehyde.** See *Enanthaldehyde.*

03 **Heptylamine*(*n*).** $CH_3(CH_2)_6NH_2$, 115.14. Col.liq., *n* 1.424. **D.** 0.777^{20}_{4}, **m.p.** −23, **b.p.** 155.1. **Soly.** v.sl. s.w.; ∞al.; ∞et.

04 **—, α-methyl-** (*2-aminoöctane; sec-n-octylamine; sec-n-caprylamine*). $CH_3(CH_2)_5CH(CH_3)NH_2$, 129.16. Liq., *n* 1.4254. **D.** 0.7721^{20}_{4}, **b.p.** 164–6. **Soly.** i.w.; v.s.al.; v.s.et.

05 ***n*-Heptyl bromide.** See *Heptane, 1-bromo-*.*

06 ***n*-Heptyl chloride.** See *Heptane, 1-chloro-*.*

07 ***n*-Heptyl cyanide.** See *Caprylonitrile.*

08 **Heptylene.** See *Heptene*.*

Heptyl esters of organic acids. See "heptyl ester," under the names of the acids.

09 **Heptyl ether** (*1-heptyloxyheptane*; di-n-heptyl ether*). $(C_7H_{15})_2O$, 214.23. Col.liq. **D.** 0.815^{0}_{4}, **b.p.** 260. **Soly.** i.w.; s.al.; s.et.

10 ***n*-Heptylic acid.** See *Enanthic acid.*

11 ***n*-Heptyl iodide.** See *Heptane, 1-iodo-*.*

12 ***n*-Heptyl mercaptan.** See 1-*Heptanethiol*.*

13 **Heptyl nitrite(*n*).** $CH_3(CH_2)_6ONO$, 145.13. Liq. **D.** 0.8939^{0}_{4}, **b.p.** 155. **Soly.** i.w.; s.et.

14 **Heptyl sulfate** (*di-n-heptyl sulfate*). $[CH_3(CH_2)_6]_2SO_4$, 294.29. Col.liq., *n* 1.4362^{25}. **D.** 0.9819^{25}_{25}, **m.p.** 11.4, **b.p.** $146.6^{1.5}$.

15 **1-Heptyne*** (*1-heptine; n-amylacetylene; enanthylidene*). $CH{:}C(CH_2)_4CH_3$, 96.09. Col.liq. **D.** $0.738^{12.6}_{4}$; 0.7288^{25}_{4}, **m.p.** > −70, **b.p.** 110.5(99). **Soly.** i.w.; s.al.; s.et.

16 **2-Heptyne*** (*butylmethylacetylene; 2-heptine*). $CH_3C{:}C(CH_2)_3CH_3$, 96.09. Col.liq. **D.** 0.750^{19}_{4}, **b.p.** 111–3. **Soly.** i.w.; s.al.; s.et.

17 **Herapathite.** See *Quinine, iodosulfate.*

18 **Heroin.** See *Morphine, diacetyl-.*

19 **Hesperetic acid.** See *Isoferulic acid.*

20 **Hesperetol** (*5-vinylguaiacol; 3-hydroxy-4-methoxystyrene*). $CH_2{:}CHC_6H_3(OCH_3)OH$, 150.08. Cr. **m.p.** 57. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

21 **Hesperidene.** See *d-Limonene.*

22 **Hesperidin.** $C_{22}H_{26}O_{12}$, 482.20. Yel. hyg.need. **m.p.** 171, **b.p.** 251 d. **Soly.** 0.02h.w.; 0.5al.; i.et.; s.h.ac.a.; i.bz.

23 **Hexacosanoic acid*.** See *Cerotic acid.*

24 **1-Hexacosanol*.** See *Ceryl alcohol.*

25 ***n*-Hexacosyl alcohol.** See *Ceryl alcohol.*

26 **Hexadecanal,** oxime*. See *Palmitaldehyde, oxime.*

27 **Hexadecanamide*.** See *Palmitamide.*

28 **Hexadecane*** (*n-hexadecane; cetane; bioctyl*). $CH_3(CH_2)_{14}CH_3$, 226.27. Col. leaf. **D.** 0.7751^{20}_{4}, **m.p.** 20(16–17), **b.p.** 287.5. **Soly.** i.w.; ∞al.; ∞et.

29 **—, 1-hexadecyloxy-*.** See *Cetyl ether.*

30 **—, 1-iodo-*.** See *Cetyl iodide.*

31 **—, 1-phenoxy-*.** See *Ether, cetyl phenyl.*

32 **Hexadecanenitrile*.** See *Palmitonitrile.*

33 **Hexadecanoic acid*.** See *Palmitic acid.*

34 **1-Hexadecanol*.** See *Cetyl alcohol.*

35 **Hexadecanoyl chloride*.** See *Palmityl chloride.*

36 **7-Hexadecenoic acid.** See *Hypogeic acid (artificial).*

37 **2-Hexadecine.** See 2-*Hexadecyne*.*

***n*-Hexadecyl.** See *Cetyl.*

38 ***n*-Hexadecylic acid.** See *Palmitic acid.*

39 **2-Hexadecyne*** (*2-hexadecine; cetylene*). $CH_3(CH_2)_{12}C{:}CCH_3$, 222.23. **m.p.** −25, **b.p.** 280–5.

40 **7-Hexadecynoic acid*.** See *Palmitolic acid.*

41 **1, 5-Hexadiene*** (*biallyl; diallyl*). $CH_2{:}CHCH_2CH_2CH{:}CH_2$, 82.08. Liq., *n* 1.4044. **D.** 0.6880^{20}_{4}, **m.p.** −141 **b.p.** 59.6. **Soly.** i.w.; s.et.

42 **2, 4-Hexadiene*** (*bipropenyl; dipropylene*). $CH_3CH{:}CHCH{:}CHCH_3$, 82.08. Col.liq., *n* 1.4384. **D.** 0.7108^{20}_{4}, **b.p.** 82. **Soly.** i.w.

43 **—, 2, 5-dimethyl-*** (*diisocrotyl*). $(CH_3)_2C{:}CHCH{:}C(CH_3)_2$, 101.11. Col. liq. **D.** 0.7158^{21}_{4}, **m.p.** −91.3, **b.p.** 102.5^{756}. **Soly.** i.w.; s.al.; s.et.

44 **2, 4-Hexadienedioic acid*.** See *Muconic acid.*

45 **2, 4 Hexadienoic acid*.** See *Sorbic acid.*

46 **1, 5-Hexadien-3-yne*** (*divinylacetylene*). $CH_2{:}CHC{:}CCH{:}CH_2$, 78.05. Col.liq., *n* 1.504. **D.** 0.7851^{20}_{4}, **b.p.** 83.5.

For explanations and abbreviations see beginning of table.

47 **1, 5-Hexadiyne*** (*bipropargyl; 1, 5-hexadiine; dipropargyl*). $CH{:}CCH_2CH_2C{:}CH$, 78.05. Col.liq., *n* $1.44132^{23.8}$. **D.** 0.8049^{20}_{4}, **m.p.** frz. −6, **b.p.** 86(85.4). **Soly.** i.w.; s.al.; v.s.et.; s.ord.org.solv.

48 **Hexalin.** See *Cyclohexanol**.

49 **Hexamethylene.** See *Cyclohexane**.

50 **Hexamethylenediamine.** See *1, 6-Hexanediamine**.

51 **Hexamethylene glycol.** See *1, 6-Hexanediol**.

52 **Hexamethylenetetramine** (*methenamine; formamine; hexamine; urotropine*). $(CH_2)_6N_4$, 140.13. Rhomb. f.al. **m.p.** 263, **b.p.** subl. 263 d. **Soly.** 150^{20}w.; 3al.; i.et.; s.H_2SO_4.

53 **Hexamine.** See *Hexamethylenetetramine.*

54 **Hexanal*.** See *Caproaldehyde.*

55 **Hexanamide*.** See *Caproamide.*

56 **Hexane*** (*n-hexane*). $CH_3(CH_2)_4CH_3$, 86.11. Col.liq., *n* 1.37536. **D.** 0.6603^{20}_{4}, **m.p.** −94.3, **b.p.** 69.0. **Soly.** $0.0138^{15.5}$w.; 50^{33}al.; s.et.; s.chl.

57 **—, 1-amino-.** See *Hexylamine.*

58 **—, 2-amino-.** See *Amylamine, α-methyl-.*

59 **—, 1-bromo-*** (*n-hexyl bromide*). $CH_3(CH_2)_4CH_2Br$, 165.02. Liq., *n* 1.4478. **D.** 1.1705^{20}_{4}, **m.p.** −85.0, **b.p.** 156.0. **Soly.** i.w.; ∞al.; ∞et.

60 **—, 1-chloro-*** (*n-hexyl chloride*). $CH_3(CH_2)_4CH_2Cl$, 120.56. Col.liq., *n* 1.4194. **D.** 0.8719^{20}_{4}, **m.p.** −83, **b.p.** 132.4. **Soly.** i.w.

61 **—, 2-chloro-*.** $CH_3CHCl(CH_2)_3CH_3$, 120.56. *n* 1.4142^{23}. **D.** 0.876^{4}_{4}, **b.p.** 123(125–6).

62 **—, dihydroxy-.** See *Hexanediol**.

63 **—, 1, 6-diiodo-*** (*1, 6-hexylene iodide*). $ICH_2(CH_2)_4CH_2I$, 337.93. Col.need. or liq., *n* 1.5899^{16}. **D.** 2.05^{1}_{4}, **m.p.** 9.5(6–7), **b.p.** 163^{17} d. **Soly.** i.w.; v.s.al.; v.s.et.

64 **—, 2, 3-dimethyl-*** (*isopropylmethylpropylmethane*). $CH_3CH(CH_3)CH(CH_3)CH_2CH_2CH_3$, 114.14. Col.liq., *n* 1.4093. **D.** 0.7240^{20}_{4}, **b.p.** 113.9. **Soly.** i.w.; sl.s.al.; s.et.

65 **—, 2, 4-dimethyl-*** (*ethylisobutylmethylmethane*). $(CH_3)_2CHCH_2CH(CH_3)CH_2CH_3$, 114.14. Col.liq., *n* 1.4026. **D.** 0.7077^{20}_{4}, **b.p.** 110.0. **Soly.** i.w.; sl.s.al.; s.et.

66 **—, 2, 5-dimethyl-*** (*biisobutyl*). $(CH_3)_2CH(CH_2)_2CH(CH_3)_2$, 114.14. Col.liq., *n* 1.3929. **D.** 0.6985^{20}_{4}, **m.p.** −91, **b.p.** 108.25. **Soly.** i.w.; sl.s.al.; s.et.

67 **—, 3, 4-dimethyl-*** (*bi-sec-butyl; sec-butylethylmethylmethane*). $CH_3CH_2CH(CH_3)CH(CH_3)CH_2CH_3$, 114.14. Liq., *n* 1.4058. **D.** 0.721^{20}_{4}, **b.p.** 116.5. **Soly.** i.w.; sl.s.al.; s.et.

68 **—, 1-ethoxy-*.** See *Ether, ethyl hexyl.*

69 **—, 3-ethyl-*** (*diethylpropylmethane*). $(CH_3CH_2)_2CHCH_2CH_2CH_3$, 114.14. Col.liq., *n* 1.4016. **D.** 0.7169^{20}_{4}, **b.p.** 118.9. **Soly.** i.w.; sl.s.al.; s.et.

70 **—, 1-iodo-*** (*n-hexyl iodide*). $CH_3(CH_2)_4CH_2I$, 212.02. Col.liq., *n* 1.4929. **D.** 1.441^{20}_{4}, **b.p.** 180.

71 **—, 2-methyl-*** (*ethylisobutylmethane*). $(CH_3)_2CH(CH_2)_2CH_2CH_3$, 100.12. Col. liq. **D.** 0.6789^{20}_{4}, **m.p.** −119.1, **b.p.** 90.0. **Soly.** i.w.; s.al.; s.et.

72 **—, 3-methyl-*** (*ethylmethylpropylmethane*). $CH_3CH_2CH(CH_3)CH_2CH_2CH_3$, 100.12. Col.liq. **D.** 0.6957^{20}_{4} (0.6870^{20}_{4}). **m.p.** −119.4, **b.p.** 89.4 (91.8). **Soly.** i.w.; s.al.; s.et.

73 **—, 3-methylene-*.** See *1-Pentene, 2-ethyl-**.

74 **—, 1-phenoxy-*.** See *Ether, hexyl phenyl.*

75 **3-Hexanecarboxylic acid.** See *Valeric acid, α-ethyl-.*

76 **Hexanedial*.** See *Adipaldehyde.*

77 **Hexanediamide*.** See *Adipamide.*

78 **1, 6-Hexanediamine*** (*hexamethylenediamine*). $NH_2(CH_2)_6NH_2$, 116.14. Silk leaf. **m.p.** 39–40, **b.p.** 196; (204–5) subl. **Soly.** v.s.w.; sl.s.al.; sl.s.bz.

79 **Hexanedioic acid*.** See *Adipic acid.*

80 **—, 2, 3, 4, 5-tetrahydroxy-.** See *Mucic acid; Saccharic acid.*

81 **1, 6-Hexanediol*** (*hexamethylene glycol*). $CH_2OH(CH_2)_4CH_2OH$, 118.11. Need.f.w. **m.p.** 42, **b.p.** 250. **Soly.** s.w.; s.al.; sl.s.h.et.

82 **2, 3-Hexanediol*** (*2, 3-dihydroxyhexane*). $CH_3(CH_2)_2(CHOH)_2CH_3$, 118.11. **D.** 0.9669^{0}_{4}, **b.p.** 207. **Soly.** ∞w.; s.al.; s.et.

83 **3, 4-Hexanediol, 3, 4-diethyl-*** (*tetraethylethylene glycol*). $(C_2H_5)_2COHCOHC(C_2H_5)_2$, 186.17. **m.p.** 27–8, **b.p.** 230; $116\text{–}9^{17}$. **Soly.** i.w.; v.s.al.; v.s.et.

84 **2, 3-Hexanedione,** 3-oxime* (*α-isonitrosobutyl methyl ketone*). $CH_3COC({:}NOH)(CH_2)_2CH_3$, 129.09. Leaf. **m.p.** 49.5.

85 **2, 5-Hexanedione*** (*acetonylacetone, sym-diacetylethane*). $CH_3CO(CH_2)_2COCH_3$, 114.08. Col.liq., *n* 1.449. **D.** 0.970^{20}_{4}, **m.p.** −9, **b.p.** 192–4. **Soly.** ∞w.; ∞al.; ∞et.; i.KOH, K_2CO_3.

* Name approved by the International Union of Chemistry.

86 **Hexanedioyl chloride***. See *Adipyl chloride*.

87 **1, 2, 3, 4, 5, 6-Hexanehexol***. See *Dulcitol; Sorbitol*.

88 **Hexanenitrile***. See *Capronitrile*.

89 **1, 2, 3, 4, 5-Hexanepentol***. See *Rhamnitol*.

90 **1-Hexanethiol*** (*pri-n-hexyl mercaptan*). $CH_3(CH_2)_5SH$, 118.17. Col.liq. **D.** 0.849^{20}, **m.p.** −81.03, **b.p.** $149–50^{768}$. **Soly.** i.w.; ∞al.; ∞et.

91 **Hexanoic acid***. See *Caproic acid*.

92 **Hexanoic anhydride***. See *Caproic anhydride*.

93 **1-Hexanol*** (*n-hexyl alcohol; amylcarbinol*). $CH_3(CH_2)_4CH_2OH$, 102.11. Col.liq., *n* 1.4161^{25}. **D.** 0.8189^{20}_{4} (0.820^{20}_{4}), **m.p.** −51.6, **b.p.** 156.4. **Soly.** 0.59^{20}w.; s.al.; ∞et.

94 —, esters of organic acids. See "hexyl ester" under the names of the acids.

95 —, nitrite. See *Hexyl nitrite*.

96 —, **2-ethyl-***. $C_4H_9CH(C_2H_5)CH_2OH$, 130.14. Col.liq. **D.** 0.833^{20}_{4}, **m.p.** < −76, **b.p.** 184.6. **Soly.** 0.07^{25}w.; s.al.; s.et.

97 —, —, acetate (*β-ethylhexyl acetate*). $C_4H_9CH(C_2H_5)CH_2OOCCH_3$, 172.16. Col.liq., *n* 1.420. **D.** 0.872^{20}_{4}, **m.p.** −93, **b.p.** 199.3. **Soly.** 0.01^{43}w.

98 —, **3-isopropyl-5-methyl-*** (*isocapric alcohol; β-isoamylisoamyl alcohol; diamyl alcohol*). $(CH_3)_2CHCH(CH_2OH)(CH_2)_2CH(CH_3)_2$, 158.17. Col. oil. **D.** 0.8569^{0}_{4}, **b.p.** 211(203.3^{764}). **Soly.** i.w.; s.al.

99 —, **2-methyl-***. $CH_3(CH_2)_3CH(CH_3)CH_2OH$, 116.13. Liq. **D.** 0.831^{13}_{4}, **b.p.** $162–4^{760}$. **Soly.** i.w.; ∞al.; ∞et.

00 —, **5-methyl-*** (*isoheptyl alcohol; isohexylcarbinol*). $(CH_3)_2CH(CH_2)_3CH_2OH$, 116.12. Liq., *n* 1.4254. **D.** 0.8311^{0}_{4}; $0.825^{11.5}_{4}$, **b.p.** 167–9. **Soly.** v.sl.s.w.; s.al.; s.et.

01 **2-Hexanol*** (*butylmethylcarbinol*). $CH_3CHOH(CH_2)_3CH_3$, 102.11. Col. liq., *n* 1.4126. **D.** 0.8287^{0}_{4}; 0.80977^{20}_{4}; 0.8044^{25}_{4}, **b.p.** 140–0.4(136–9). **Soly.** v.sl.s.w.; s.al.; ∞et.

02 —, **2-methyl-*** (*butyldimethylcarbinol*). $CH_3COH(CH_3)(CH_2)_3CH_3$, 116.12. **b.p.** $58–60^{20}$.

03 —, **5-methyl-*** (*isoamylmethylcarbinol*). $CH_3CHOH(CH_2)_2CH(CH_3)_2$, 116.12. Liq. **D.** 0.8185^{17}_{4}, **b.p.** 148–50. **Soly.** i.w.; s.al.; s.et.

04 **3-Hexanol*** (*ethylpropylcarbinol*). $CH_3CH_2CHOH(CH_2)_2CH_3$, 102.11. Col.liq. **D.** 0.8188^{20}_{4}, **b.p.** 135. **Soly.** v.sl.s.w.; s.al.; ∞et.

05 —, **3-ethyl-*** (*diethylpropylcarbinol*). $CH_3CH_2COH(C_2H_5)(CH_2)_2CH_3$, 130.14. Col.liq., *n* 1.433. **D.** 0.8379^{20}_{0}, **b.p.** 160.5. **Soly.** i.w.; s.al.; s.et.

06 —, **3-ethyl-5-methyl-*** (*diethylisobutylcarbinol*). $(C_2H_5)_2COHCH_2CH(CH_3)_2$, 144.16. Liq. **D.** 0.8396^{22}_{4}, **b.p.** 172. **Soly.** i.w.; s.al.; s.et.

07 —, **3-methyl-*** (*ethylmethylpropylcarbinol*). $CH_3(CH_2)_2COH(CH_3)CH_2CH_3$, 116.12. Col.liq., *n* 1.423. **D.** 0.8234^{20}_{4}, **b.p.** 141. **Soly.** i.w.; s.al.; s.et.

08 —, **5-methyl-*** (*ethylisobutylcarbinol*). $CH_3CH_2CHOHCH_2CH(CH_3)_2$, 116.12. Liq. **b.p.** 148.2. **Soly.** i.w.; s.al.; s.et.

09 —, **2, 2, 5, 5-tetramethyl-***. $(CH_3)_3CCH_2CHOHC(CH_3)_3$, 158.17. Cr. **m.p.** 52–3, **b.p.** 173–4. **Soly.** i.w.; s.al.; s.et.

10 **2-Hexanone*** (*butyl methyl ketone*). $CH_3CO(CH_2)_3CH_3$, 100.09. Col.liq., *n* $1.39694^{17.4}$. **D.** 0.830^{0}_{4}, **m.p.** −56.9, **b.p.** 127.2. **Soly.** v.sl.s.w.; ∞al.; ∞et.

11 —, **5-methyl-*** (*isoamyl methyl ketone*). $CH_3COCH_2CH_2CH(CH_3)_2$, 114.11. Col.liq. **D.** 0.818^{17}_{4}, **b.p.** 144. **Soly.** v.sl.s.w.; ∞al.; ∞et.

12 —, **5-methyl-,** oxime. $CH_3C(:NOH)C_5H_{11}$, 129.13. Col.-yel.oil. **D.** 0.888^{20}_{4}, **b.p.** 195–6 d.

13 —, **1, 3, 4, 5, 6-pentahydroxy-***. See *Sorbose*.

14 **3-Hexanone*** (*ethyl propyl ketone*). $C_2H_5CO(CH_2)_2CH_3$, 100.09. Col.liq., *n* 1.39899^{22}. **D.** $0.813^{22.8}_{4}$, **b.p.** 124. **Soly.** v.sl.s.w.; ∞al.; ∞et.

15 —, **5-methyl-*** (*ethyl isobutyl ketone*). $C_2H_5COCH_2CH(CH_3)_2$, 114.11. Col. liq. **D.** 0.815^{17}_{0}, **b.p.** 136. **Soly.** i.w.; ∞al.; ∞et.

16 **Hexanoyl chloride***. See *Caproyl chloride*.

17 **2-Hexenal, 2-ethyl-*** (*α-ethyl-β-propylacrolein*). $CH_3(CH_2)_2CH:C(C_2H_5)CHO$, 126.11. Col.liq. **D.** 0.848^{20}_{4}, **b.p.** 175. **Soly.** i.w.; s.al.; s.et.

18 **1-Hexene*** (*butylethylene*). $CH_2:CH(CH_2)_3CH_3$, 84.09. Col.liq., *n* 1.3821. **D.** 0.6732^{20}_{4}, **m.p.** −98.5, **b.p.** 64.1. **Soly.** i.w.; ∞al.; ∞et.

19 —, **2-methyl-*** (*1-butyl-1-methylethylene*). $CH_2:C(CH_3)CH_2CH_2CH_2CH_3$, 98.11. **D.** 0.7000^{20}_{4}, **b.p.** 91.1–1.5.

For explanations and abbreviations see beginning of table.

20 1-Hexene, 3-methyl-*. CH_2:CH-CH(CH_3)$CH_2CH_2CH_3$, 98.11. **D.** 0.6953^{20}_{4}, **b.p.** 84.0.

21 —, 4-methyl-*. CH_2:CHCH_2CH-(CH_3)CH_2CH_3, 98.11. **D.** 0.6969^{20}_{4}, **b.p.** 87.2–7.5.

22 —, 5-methyl-* (*isoamylethylene*). CH_2:CHCH_2CH_2CH(CH_3)$_2$, 98.11. **D.** 0.6936^{20}_{4}, **b.p.** 84.7.

23 2-Hexene* (*β-hexylene; 1-methyl-2-propylethylene*). CH_3CH:CH(CH_2)$_2$-CH_3, 84.09. **D.** 0.6813^{20}_{4}, **b.p.** 67.9–8.1. **Soly.** s.dil.H_2SO_4.

24 —, 2-methyl-* (*1, 1-dimethyl-2-propylethylene*). (CH_3)$_2$C:CHCH_2CH_2-CH_3, 98.11. **D.** 0.7089^{20}_{4}, **b.p.** 94.4–4.6.

25 —, 3-methyl-* (*1, 2-dimethyl-1-propylethylene*). CH_3CH:C(CH_3)CH_2CH_2-CH_3, 98.11. **D.** 0.7120^{20}_{4}, **b.p.** 93.1–3.3.

26 —, 4-methyl-* (*1-sec-butyl-2-methylethylene*). CH_3CH:CHCH(CH_3)CH_2-CH_3, 98.11. (1) **D.** 0.7007^{20}_{4}, **b.p.** 87.1–7.6. (2) **D.** 0.6981^{20}_{4}, **b.p.** 85.1–5.6.

27 —, 5-methyl-* (*1-isobutyl-2-methylethylene*). CH_3CH:CHCH_2CH(CH_3)$_2$, 98.11. (1) **D.** 0.6990^{20}_{4}, **b.p.** 91.1–1.6. (2) **D.** 0.7020^{20}_{4}, **b.p.** 85.6–6.1.

28 3-Hexene* (*sym-diethylethylene; γ-hexylene*). CH_3CH_2CH:CHCH_2CH_3, 84.09. (1) **D.** 0.722^{15}_{4}, **b.p.** 67.5. (2) **D.** 0.693^{20}_{20}, **b.p.** 70–1.

29 —, 2, 5-dimethyl-* (*sym-diisopropylethylene*). (CH_3)$_2$CHCH:CHCH-(CH_3)$_2$, 112.12. **b.p.** 116–20.

30 —, 2-methyl-* (*1-ethyl-2-isopropylethylene*). (CH_3)$_2$CHCH:CHCH_2-CH_3, 98.11. **D.** 0.6942^{20}_{4}, **b.p.** 86.4–6.9.

31 2-Hexenoic acid* (*β-propylacrylic acid*). $CH_3CH_2CH_2$CH:CHCOOH, 114.08. Need.f.w., n 1.4467^{40}. **D.** 0.965^{20}_{4}, **m.p.** 32, **b.p.** 217. **Soly.** sl.s.w.; s.al.; v.s.et.

32 —, 5-methyl-* (*α, β-isoheptenic acid*). (CH_3)$_2$CHCH_2CH:CHCOOH, 128.09. n 1.4524. **D.** 0.942^{20}_{4}, **m.p.** 16.5, **b.p.** 227. **Soly.** s.al.

33 5-Hexen-3-ol, 3-ethyl-* (*allyldiethylcarbinol*). CH_2:CHCH_2COH(C_2H_5)-CH_2CH_3, 128.12. **b.p.** 156.

34 5-Hexen-2-one* (*allylacetone*). CH_2:-CH$CH_2CH_2COCH_3$, 98.08. Col.liq., n $1.42126^{15.4}$. **D.** 0.846^{20}_{4}, **b.p.** 129.5. **Soly.** i.w.; ∞al.; ∞et.

35 Hexine. See *Hexyne**.

36 *n*-Hexoic acid. See *Caproic acid.*

37 *n*-Hexoic aldehyde. See *Caproaldehyde.*

38 Hexoylene. See *2-Hexyne**.

39 Hexyl alcohol, active. See *1-Pentanol, 3-methyl-**.

40 *n*-Hexyl alcohol. See *1-Hexanol**.

41 Hexylamine*(*n*). CH_3(CH_2)$_4CH_2$-NH_2, 101.13. Col.liq. **D.** 0.763^{20}_{4}, **m.p.** −19, **b.p.** 128–30. **Soly.** v.sl.s.w.; ∞al.; ∞et.

42 *n*-Hexyl bromide. See *Hexane, 1-bromo-**.

43 *n*-Hexyl chloride. See *Hexane, 1-chloro-**.

44 Hexylene. See *Hexene**.

45 1, 6-Hexylene iodide. See *Hexane, 1, 6-diiodo-**.

Hexyl esters of organic acids. See "hexyl ester" under the names of the acids.

46 *n*-Hexyl iodide. See *Hexane, 1-iodo-**.

47 *pri-n*-Hexyl mercaptan. See *1-Hexanethiol**.

48 Hexyl nitrite(*n*). CH_3(CH_2)$_5$ONO, 131.11. Yel.liq. **D.** 0.8851^{20}_{4}, **b.p.** 129–30. **Soly.** i.w.; s.al.; s.et.

49 Hexyl sulfate (*di-n-hexyl sulfate*). [CH_3(CH_2)$_5$]$_2SO_4$, 266.26. n 1.4344^{25}. **D.** 1.0039^{25}_{25}, **b.p.** 125.3^{2}.

50 1-Hexyne* (*butylacetylene; 1-hexine*). HC:C(CH_2)$_3CH_3$, 82.08. Col.liq. **D.** 0.736^{0}_{4}; 0.7120^{20}_{4}, **m.p.** −150, **b.p.** 71.5. **Soly.** i.w.; s.al.; s.et.

51 2-Hexyne* (*2-hexine; methylpropylacetylene; hexoylene*). CH_3C:C(CH_2)$_2$-CH_3, 82.08. Liq. **D.** 0.7494^{5}; 0.7377^{15}_{4}, **b.p.** 84. **Soly.** i.w.; ∞al.; ∞et.

52 Hippuric acid (*N-benzoylglycine; benzamidoacetic acid*). C_6H_5CONHCH_2-COOH, 179.08. Col.rhomb., n 1.535, 1.592, 1.760. **D.** 1.371^{20}_{4}, **m.p.** 187.5 (189–90), **b.p.** d. **Soly.** 0.33^{20}w.; sl.s.al.; sl.s.et.; 0.11 chl.; i.bz., pet.et.

53 —, p-phenylphenacyl ester. C_6H_5-CONHCH_2COOCH_2CO$C_6H_4C_6H_5$, 373.16. **m.p.** 163.

54 *dl*-Histidine (*dl-α-amino-5-imidazolepropionic acid*). $C_3H_3N_2CH_2$CH(NH_2)-COOH, 155.09. Tetr.pr. **m.p.** 285–6 d., **b.p.** d. **Soly.** s.w.; i.al.; i.et.; i.acet., chl.

55 *d*-Histidine. $C_3H_3N_2CH_2$CH(NH_2)-COOH, 155.09. Lng.pl. **m.p.** 287–8. **Soly.** i.al.; i.et.; i.acet., chl.

* Name approved by the International Union of Chemistry.

56 ***l*-Histidine.** $C_3H_3N_2CH_2CH(NH_2)$-COOH, 155.09. Leaf.f.w. **m.p.** 277 d., **b.p.** d. 209[18]. **Soly.** s.w.; v.sl.s.al.; i.et.

57 —, diflavianate. $C_6H_9N_3O_2(C_{10}H_6N_2$-$O_8S)_2$, 783.34. Need. **m.p.** 251–2 d. **Soly.** sl.s.w.; i.al.; i.et.

58 —, dihydrochloride. $C_6H_9N_3O_2 \cdot 2HCl$, 228.02. Rhomb.pl. **m.p.** 245 d. **Soly.** v.s., d.w.; s.al.; i.et.; v.sl.s. conc.HCl.

59 **Homatropine** (*mandelyltropeine; homoatropine*). $C_{16}H_{21}NO_3$, 275.17. Deliq.pr.f.et.; glist.pr.f.al. **m.p.** 95.5–8.5. **Soly.** v.sl.s.w.; s.al.; s.et.; s. acet., dil.a., bz., chl.

60 —, hydrobromide. $C_{16}H_{21}NO_3 \cdot HBr$, 356.10. Col.rhomb.pr. **m.p.** 212 d. **Soly.** 17.5[25]w.; 3.3.al.; i.et.; s.chl.

61 —, hydrochloride. $C_{16}H_{21}NO_3 \cdot HCl$, 311.64. Sm.wh.cr., **m.p.** 216–7. **Soly.** s.w.; s.al.

62 **Homoanthranilonitrile.** See *p-Tolunitrile, 2-amino-.*

63 **Homoatropine.** See *Homatropine.*

64 **Homocinchonidine.** $C_{19}H_{22}N_2O$, 294.19. Pr. **m.p.** 207.6. **Soly.** i.w.; 4.8al.; s.chl.

65 **Homohydroquinone.** See *Toluhydroquinone.*

66 **Homophthalic acid** (*α, 2-toluenedicarboxylic acid*) $C_6H_4(CH_2COOH)$-COOH, 180.06. Cr.f.w. **m.p.** 175. **Soly.** s.h.w.; v.s.al.; sl.s.et.

67 **4-Homopyrocatechol** (*4-methylpyrocatechol*). $CH_3C_6H_3(OH)_2$, 124.06. Col., n 1.5425[74]. **D.** 1.129_4^{74}, **m.p.** 65, **b.p.** 252. **Soly.** v.s.w.; v.s.al.; v.s.et.

68 ***o*-Homosalicylic acid.** See *2, 3-Cresotic acid.*

69 ***m*-Homosalicylic acid** (α). See *2, 4-Cresotic acid.*

70 ***m*-Homosalicylic acid** (β). See *2, 6-Cresotic acid.*

71 ***p*-Homosalicylic acid.** See *2, 5-Cresotic acid.*

72 **Hordenine** (*p-hydroxy-N, N-dimethylphenethylamine*). $C_{10}H_{15}NO$, 165.13. Rhomb.pr. **m.p.** 117.8 subl., **b.p.** 140–50. **Soly.** s.w.; v.s.al.; v.s.et.; s.chl.; sl.s.bz.

73 —, sulfate. $(C_{10}H_{15}NO)_2H_2SO_4 \cdot H_2O$, 446.34. Col.cr. **m.p.** 208–10. **Soly.** s.w.; sl.s.al.; i.et.

74 **Hydantoic acid** (*N-carbamylglycine; ureidoacetic acid; glycoluric acid; urea-acetic acid*). $NH_2CONHCH_2COOH$, 118.06. Monocl.pr. **m.p.** 171. **Soly.** 3[20]w.; 0.39[20]al.; v.sl.s.et.

75 **Hydantoin** (*glycolylurea*). $NHCONHCOCH_2$, 100.05. Need. **m.p.** 220. **Soly.** s.h.w.; s.al.

76 —, **1-methyl-** (*β-methylhydantoin*). $N(CH_3)CONHCOCH_2$, 114.06. Pr. **m.p.** 157–8, **b.p.** subl. **Soly.** s.w.; s.al.

77 —, **5-methyl-** (*α-lactylurea*). $NHCONHCOCH(CH_3)$, 114.06. Rhomb. **m.p.** anh. 145. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.

78 —, **2-thio-** (*glycolylthiourea*). $C_3H_4N_2OS$, 116.11. Need.f.h.w. **m.p.** d. 200. **Soly.** s.h.w.; i.al.; i.et.

79 —, **5-ureido-.** See *Allantoin.*

80 **Hydracetin.** See *Hydrazine, 1-acetyl-2-phenyl-.*

81 **Hydracrylic acid** (*3-hydroxypropanoic acid*; β-hydroxypropionic acid; ethylene lactic acid*). CH_2OHCH_2COOH, 90.05. Syrup, **b.p.** d. **Soly.** v.s.w.; s.al.; ∞et.

82 —, **α-phenyl-.** See *Tropic acid.*

83 **Hydracrylonitrile** (*3-hydroxypropanenitrile*; ethylene cyanohydrin; glycol cyanohydrin; β-hydroxypropionitrile*). $HOCH_2CH_2CN$, 71.05. Col.liq. **D.** 1.059_4^0, **b.p.** 221. **Soly.** ∞w.; ∞al.; 1.64[15]et.

84 **Hydrastine.** $C_{21}H_{21}NO_6$, 383.17. Col. rhomb.pr., $[\alpha] -67.8°_D^{17}$ in chl. **m.p.** 132. **Soly.** 0.025[80]w.; 0.74[25]al.; 0.8[25]et.; s.chl.

85 —, hydrochloride. $C_{21}H_{21}NO_6 \cdot HCl$, 419.64. Wh.hyg.powd. **m.p.** 210(116). **Soly.** s.w.; s.al.; v.sl.s.et.; sl.s.chl.

86 **Hydrastinine.** $C_{11}H_{13}NO_3$, 207.11. Wh.-ylsh.need.f.lgr. **m.p.** 116–7. **Soly.** sl.s.w.; s.al.; s.et.; s.chl., s.; d.bz.

87 —, bisulfate. $C_{11}H_{11}NO_2 \cdot H_2SO_4$, 287.17. Grn.fluores.cr. **m.p.** 216 d. **Soly.** s.w.; s.al.

88 —, hydrochloride (*i*). $C_{11}H_{11}NO_2$-HCl, 225.56. Yel.need.; aq.sol.bl. fluoresc. **m.p.** 212 d. **Soly.** v.s.w.; v.s.al.; 0.077et.; s.chl.

89 **Hydratropic acid** (*α-methyl-α-toluic acid; α-phenylpropionic acid*). $C_6H_5CH(CH_3)COOH$, 150.08. Col.liq. **D.** 1.1_4^0, **m.p.** <-20, **b.p.** 265. **Soly.** sl.s.w.

90 —, **α-hydroxy-.** See *Atrolactic acid.*

For explanations and abbreviations see beginning of table.

91 **Hydrazine, 1-acetyl-2-phenyl-** (*acetic acid β-phenylhydrazide; hydracetin; pyrodin*). $CH_3CONHNHC_6H_5$, 150.09. Col.hex. **m.p.** 128. **Soly.** v.sl.s.c., v.s.h.w.; s.al.; sl.s.et.; s.bz., chl.

92 —, **benzal-.** See *Benzaldehyde, hydrazone.*

93 —, **benzalphenyl-.** See *Benzaldehyde, phenylhydrazone.*

94 —, **benzoyl-.** See *Benzoic acid, hydrazide.*

95 —, **1-benzoyl-2-phenyl-.** See *Benzoic acid, phenylhydrazide.*

96 —, **benzyl-.** $C_6H_5CH_2NHNH_2$, 122.09. Col.oil. **m.p.** 26, **b.p.** 103^{41}. **Soly.** ∞w.; ∞al.; ∞et.

97 —, **benzylidene-.** See *Benzaldehyde, hydrazone.*

98 —, **benzylidenephenyl-.** See *Benzaldehyde, phenylhydrazone.*

99 —, **p-bromophenyl-.** $BrC_6H_4NH-NH_2$, 186.99. Need. or leaf.f.al. or lgr. **m.p.** 106. **Soly.** i.w.; s.al.; s.et.; s.bz.

00 —, **1-butylidene-2-phenyl-.** See *Butyraldehyde, phenylhydrazone.*

01 —, **carbamyl-.** See *Semicarbazide.*

02 —, **dibenzal-.** See *Benzaldehyde, azine.*

03 —, **diisopropylidene-.** See *Acetone, azine.*

04 —, **(dimethylphenyl)-.** See *Hydrazine, xylyl-.*

05 —, **1, 2-di-1-naphthyl-** (*1, 1'-hydrazonaphthalene*). $C_{10}H_7NHNHC_{10}H_7$, 284.14. Col.leaf.f.bz. **m.p.** 271; 274. **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

06 —, **1, 2-di-2-naphthyl-** (*2, 2'-hydrazonaphthalene*). $C_{10}H_7NHNHC_{10}H_7$, 284.14. Col.flocks. **m.p.** 164. **Soly.** i.w.; sl.s.al.; v.s.et.

07 —, **2, 4-dinitrophenyl-*.** $(NO_2)_2-C_6H_3NHNH_2$, 198.08. Purp.-red pr.f. al.; vlt.fluores. **m.p.** 194(198 d.), **b.p.** exp. **Soly.** i.w.; v.sl.s.al.; i.(sl.s.)et.; s.aniline. h.ethyl acetate; sl.s.chl., CS_2, bz.

08 —, **1, 1-diphenyl-*** (*uns-diphenylhydrazine*). $(C_6H_5)_2NNH_2$, 184.11. Ylsh.-br.liq. or pl.f.lgr. **D.** 1.190^{16}_{4}, **m.p.** 34.5; 44, **b.p.** 220^{50}. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.conc.H_2SO_4.

09 —, **1, 2-diphenyl-*** (*hydrazobenzene; sym-diphenylhydrazine*). $C_6H_5-NHNHC_6H_5$, 184.11. Col.-yelsh. rhomb.tab.f.al. **D.** 1.158^{16}_{4}, **m.p.** 131(126), **b.p.** d. **Soly.** v.sl.s.w.; 3.95^{16}al.; s.et.

10 —, **1, 2-di-o-tolyl-** (*o-hydrazotoluene*). $CH_3C_6H_4NHNHC_6H_4CH_3$, 212.14. Col.leaf.f.al. **m.p.** 165, **b.p.** d. **Soly.** v.sl.s.w.; s.al.; s.et.; s.bz.

11 —, **1, 2-di-m-tolyl-** (*m-hydrazotoluene*). $CH_3C_6H_4NHNHC_6H_4CH_3$, 212.14. Col.oil. **Soly.** i.w.; s.al.

12 —, **1, 2-di-p-tolyl-** (*p-hydrazotoluene*). $CH_3C_6H_4NHNHC_6H_4CH_3$, 212.14. Col.monocl.pl.f.al.-et. **D.** 0.957^{20}_{4}, **m.p.** 133–4(126), **b.p.** d. **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

13 —, **ethyl-.** $NH_2NHC_2H_5$, 60.08. Col. liq. **b.p.** 101.5. **Soly.** v.s.w.; v.s.al.; v.s.et.

14 —, **1-ethylidene-2-phenyl-.** See *Acetaldehyde, phenylhydrazone.*

15 —, **1-ethyl-1-phenyl-.** $C_6H_5(C_2H_5)-NNH_2$, 136.11. Liq. **D.** 1.018^{15}_{4}, **b.p.** 237.

16 —, **1-ethyl-2-phenyl-.** $C_6H_5-NHNHC_2H_5$, 136.11. Liq., n $1.57108^{20.8}_{He}$. **D.** 1.004^{18}_{18}, **b.p.** 240; 104^{10}. **Soly.** sl.s.w.; s.al.; s.et.

17 —, **formyl-.** See *Formohydrazide*.*

18 —, **guanyl-.** See *Guanidine, 1-amino-.*

19 —, **1-isoamyl-1-phenyl-.** $C_6H_5N-(C_5H_{11})NH_2$, 178.16. Liq. **b.p.** 173–5^{50}.

20 —, **1-isobutyl-1-phenyl-** (*1-(β-methylpropyl)-1-phenylhydrazine**). $C_4H_9-(C_6H_5)NNH_2$, 164.14. **D.** 0.9633^{20}_{4}, **b.p.** 245.

21 —, **methyl-*.** CH_3NHNH_2, 46.06. Col.hyg.liq. **b.p.** 87.5. **Soly.** v.s.w.; ∞al.; ∞et.

22 —, **1-methyl-1-phenyl-.** $C_6H_5N-(CH_3)NH_2$, 122.09. Yel.liq., n 1.583. **D.** 1.040^{20}_{4}, **b.p.** 227.5. **Soly.** sl.s.w.; ∞al.; ∞et.

23 —, **1-methyl-2-m-tolyl-** (*m-methylhydrazobenzene*). $CH_3C_6H_4NHNHC_6-H_5$, 198.13. Col.-lt.yel.pr.f.lgr. **m.p.** 59–61. **Soly.** i.w.; v.s.al.; sl.s.et.; s.bz.

24 —, **1-methyl-2-p-tolyl-** (*p-methylhydrazobenzene*). $CH_3C_6H_4NHNHC_6-H_5$, 198.13. Col.sc.f.lgr. **m.p.** 86–7. **Soly.** v.s.al.; v.s.et.; v.s.bz.

25 —, **(1-naphthyl)-.** $C_{10}H_7NHNH_2$, 158.09. Col.leaf. **m.p.** 116, **b.p.** 203^{20}. **Soly.** v.sl.s.c.w.; v.s.h.al.; sl.s.et.; v.s.chl.

26 —, **(2-naphthyl)-.** $C_{10}H_7NHNH_2$, 158.09. Col.leaf.f.w. **m.p.** 124–5. **Soly.** sl.s.h.w.; v.s.h.al.; sl.s.et.; s.chl., bz.

* Name approved by the International Union of Chemistry.

27 **Hydrazine, *o*-nitrophenyl-.** $NO_2C_6H_4NHNH_2$, 153.08. Brick red need. **m.p.** 90. **Soly.** i.w.; sl.s.al.; sl.s.et.

28 —, *m*-**nitrophenyl-.** $NO_2C_6H_4NHNH_2$, 153.08. Yel.need. **m.p.** 93. **Soly.** sl.s.w.; sl.s.al.

29 —, *p*-**nitrophenyl-.** $NO_2C_6H_4NHNH_2$, 153.08. Or-red leaf. or need. **m.p.** 157, **b.p.** d. **Soly.** sl.s.w.; s.al.; s.et.; s.chl., ethyl acetate; v.sl.s.bz.

30 —, **phenyl-*.** $C_6H_5NHNH_2$, 108.08. Yel.monocl. or oil. **D.** 1.0978^{20}_{4}, **m.p.** 19.6, **b.p.** sl.d. **Soly.** 12.6^{20}, 23^{50}w.; ∞al.; ∞et.

31 —, —, hydrochloride. $C_6H_5NHNH_2 \cdot HCl$, 144.54. Leaf.f.al. **m.p.** 240–1. **Soly.** v.s.w.; s.al.; i.et.

33 —, **1-phenyl-2-*o*-tolyl-** (*o-methylhydrazobenzene*). $CH_3C_6H_4NHNHC_6H_5$, 198.13. Col.leaf.f.al. **m.p.** 101–2. **Soly.** i.w.; sl.s.c.al.; s.et.

34 —, **picryl-** (*2, 4, 6-trinitrophenylhydrazine*). $(NO_2)_3C_6H_2NHNH_2$, 243.08. Yel.need. **m.p.** 186–7, **b.p.** d. **Soly.** i.w.; sl.s.al.; sl.s.et.

35 —, **tetraphenyl-*.** $(C_6H_5)_2NN(C_6H_5)_2$, 336.17. Rhomb.pr.f.al. + chl. **m.p.** 147. **Soly.** i.w.; v.sl.s.h.al.; s.bz., chl., acet., H_2SO_4, blue color.

36 —, *o*-**tolyl-.** $CH_3C_6H_4NHNH_2$, 122.09. Col.tab.f.lgr. **m.p.** 56. **Soly.** v.s.al.; v.s.et.; v.s.chl.; sl.s.lgr.

37 —, *m*-**tolyl-.** $CH_3C_6H_4NHNH_2$, 122.09. Liq. **b.p.** 224.

38 —, *p*-**tolyl-.** $CH_3C_6H_4NHNH_2$, 122.09. Col.rhomb.leaf. **m.p.** 61, **b.p.** 240–4 d. **Soly.** sl.s.w.; v.s.al.; v.s.et.; v.s.bz.

39 —, **2, 4, 6-trinitrophenyl-.** See *Hydrazine, picryl-.*

40 —, **triphenyl-*.** $(C_6H_5)_2NNHC_6H_5$, 260.14. Need.f.bz. **D.** 0.869^{70}_{4}, **m.p.** 142 d. **Soly.** i.w.; s.al.; sl.s.et.; v.s.bz.

41 —, **2, 3-xylyl-**((*2, 3-dimethylphenyl*)-*hydrazine*). $(CH_3)_2C_6H_3NHNH_2$, 136.11. Col.need. **m.p.** 149–50. **Soly.** s.al.; s.et.

42 —, **2, 5-xylyl-**((*2, 5-dimethylphenyl*)-*hydrazine*). $(CH_3)_2C_6H_3NHNH_2$, 136.11. Need.f.et. **m.p.** 85, **b.p.** d. **Soly.** v.sl.s.w.; v.s.al.; s.et.

43 **Hydrazobenzene.** See *Hydrazine, 1, 2-diphenyl-*.*

44 —, **4, 4′-diamino-** (*p, p′-hydrazodianiline; diphenine*). $NH_2C_6H_4NHNHC_6H_4NH_2$, 214.14. Yel.cr. **m.p.** 145. **Soly.** s.h.w.; s.al.; s.et.

45 —, **methyl-.** See *Hydrazine, 1-phenyl-2-tolyl-.*

46 ***o*-Hydrazobenzoic acid** (*o, o′-hydrazodibenzoic acid*). $(COOHC_6H_4NH)_2$, 272.11. Col.leaf.f.al. **m.p.** 205. **Soly.** i.w.; s.al.; s.alk.

47 ***m*-Hydrazobenzoic acid** (*m, m′-hydrazodibenzoic acid*). $(COOHC_6H_4NH)_2$, 272.11. Yel.cr.f.al. **Soly.** i.w.; sl.s.h.al.; s.alk.

48 ***p*-Hydrazobenzoic acid** (*p, p′-hydrazodibenzoic acid*). $(COOHC_6H_4NH)_2$, 272.11. Sm.need.f.al. **Soly.** i.w.; sl.s.al.; s.KOH.

49 **Hydrazonaphthalene.** See *Hydrazine, dinaphthyl-.*

50 **Hydrazophenylene.** See *Phenazine, 5, 10-dihydro-.*

51 **Hydrazotoluene.** See *Hydrazine, ditolyl-.*

52 **Hydrindene.** See *Indan.*

53 **α-Hydrindone.** See 1-*Indanone*

54 **β-Hydrindone.** See 2-*Indanone.*

55 **Hydroanthranol.** See *Anthranol, 9, 10-dihydro-.*

56 **Hydrobenzamide** (*tribenzaldiamine; N, N′-dibenzal-α, α-toluenediamine*). $(C_6H_5CH)_3N_2$, 298.16. Col.pr.f.al. **m.p.** 101(110), **b.p.** 130. **Soly.** i.w.; v.s.al.; v.s.et.

57 **Hydrobenzoin** (*1, 2-diphenyl-1, 2-ethanediol*(one form); *tolylene glycol*). $C_6H_5CHOHCHOHC_6H_5$, 214.11. Monocl.leaf.f.al. **D.** 0.927^{134}, **m.p.** 139, **b.p.** >300. **Soly.** 0.25c., 1.25h. w.; v.s.al.

58 —, **α, α′-dimethyl-.** See *2, 3-Butanediol, 2, 3-diphenyl-.*

59 —, **dodecahydro-.** See *1, 2-Ethanediol, 1, 2-dicyclohexyl-.*

60 **Hydroberberine** (*tetrahydroberberine*). $C_{20}H_{21}NO_4$, 339.17. Wh.need. or pa. yel.octahdr.cr. **m.p.** 167. **Soly.** i.w.; s.al.; s.chl., CS_2.

61 **Hydrocarbostyril** (*3, 4-dihydro-2(1)-quinolone; o-aminohydrocinnamic acid lactam*). $C_6H_4NHCOCH_2CH_2$, 147.08. Col.pr.f.al. *n* 1.479, 1.710, 1.810. **m.p.** 163. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

62 **Hydrocerulignone** (*4, 4′-dihydroxy-3,3′, 5,5′-tetramethoxybiphenyl*). $C_{12}H_4(OH)_2(OCH_3)_4$, 306.14. Monocl.pr.f.al. **m.p.** 190, **b.p.** d. **Soly.** sl.s.w.; s.al.; sl.s.et.; i.CS_2.

63 **Hydrocinchonidine** (*cinchamidine*). $C_{19}H_{24}N_2O$, 296.20. Leaf. **m.p.** 230. **Soly.** i.w.; sl.s.al.; sl.s.et.

64 **Hydrocinchonine.** See *Cinchotine.*

For explanations and abbreviations see beginning of table.

65 **Hydrocinnamaldehyde** (*3-phenylpropanal*). $C_6H_5CH_2CH_2CHO$, 134.08. Col.monocl.pr.f.al. **m.p.** 47, **b.p.** 280. **Soly.** i.w.; 17al.; ∞et.

66 **Hydrocinnamic acid** (*β-phenylpropionic acid; benzenepropionic acid*). $C_6H_5CH_2CH_2COOH$, 150.08. Col. moncol.need.f.al. **D.** 1.071^{49}_{4}, **m.p.** 48.6, **b.p.** 279.8. **Soly.** 0.59^{20}w.; 372^{20}al., s.et.

67 —, ethyl ester (*ethyl benzenepropanoate; ethyl β-phenyl propionate*). $C_6H_5CH_2CH_2COOC_2H_5$, 178.11. Col. liq., *n* 1.49542. **D.** 1.015^{20}_{4}, **b.p.** 249. **Soly.** i.w.; s.al.; s.et.

68 —, piperazinium salt. $C_4H_{10}N_2 \cdot 2C_9H_{10}O_2$, 386.25. Wh.cr. **m.p.** 150.5–1.5. **Soly.** sl.s.w.; s.h.al.; i.et.

69 —, **α-acetyl-**, ethyl ester (*ethyl α-benzylacetoacetate*). $C_6H_5CH_2CH(COCH_3)COOC_2H_5$, 220.12. Col.liq. **D.** 1.061^{25}_{25}, **b.p.** 290 d. **Soly.** i.w.; ∞al.; ∞et.

70 —, **o-amino-**, lactam. See *Hydrocarbostyril.*

71 —, **α-amino-**. See *Alanine, β-phenyl-.*

72 —, **β-amino-**. $C_6H_5CH(NH_2)CH_2COOH$, 165.09. Monocl.f.w. **m.p.** 231 d. **Soly.** sl.s.c.w.; s.al.; sl.s.et.

73 —, **α-amino-p-hydroxy-**. See *Tyrosine.*

74 —, **α, β-dibromo-(i)** (*i-cinnamic acid dibromide*). $C_6H_5CHBrCHBrCOOH$, 307.87. Monocl.pr. **m.p.** 203–4. **Soly.** d.h.w.; s.al.; s.et.; $s.CS_2$.

75 —, **β, β-dibromo-** (*3, 3-dibromo-3-phenylpropanoic acid**). $C_6H_5CBr_2CH_2COOH$, 307.89. Need.f.w. **m.p.** 136, **b.p.** $138^{0.6}$. **Soly.** i.w.; s.al.; s.et.; s.chl.; sl.s.pet.eth.

76 —, **o-hydroxy-**. See *Melilotic acid.*

77 —, **p-hydroxy-**. See *Phloretic acid.*

78 —, **α-hydroxy-β-keto-**. See *Glycolic acid, benzoyl-.*

79 **Hydrocinnamonitrile, β-keto-**. See *Acetonitrile, benzoyl-.*

80 **Hydrocinnamyl alcohol.** See *1-Propanol, 3-phenyl-.*

81 **Hydrocotarnine.** $C_{12}H_{15}NO_3 \cdot \frac{1}{2}H_2O$, 230.13. Monocl.pr.f.al. **m.p.** 55–6. **Soly.** v.s.al.; v.s.et.; v.s.chl., bz.; s.alk.

82 *o*-**Hydrocoumaric acid.** See *Melilotic acid.*

83 **Hydrocyanic acid** (*hydrogen cyanide; prussic acid*). HCN, 27.02. Col. pois. liq., *n* 1.2675^{10}. **D.** 0.6876^{20}_{4}, **m.p.** −14, **b.p.** 26. **Soly.** ∞w.; ∞al.; ∞et.

84 **Hydrofuramide.** See *Furfural, hydramide.*

85 **Hydrogen cyanide.** See *Hydrocyanic acid.*

86 **Hydrogen methyl sulfate.** See *Methylsulfuric acid.*

87 **Hydrohydrastinine.** $C_{11}H_{13}NO_2$, 191.11. Wh.cr. **m.p.** 66. **Soly.** v.s. al.; v.s.et.

88 **α-Hydronaphthoquinone.** See *1, 4-Naphthalenediol**.

89 **Hydrophlorone.** See *Hydroquinone, 2, 5-dimethyl-.*

90 **Hydroquinine.** $C_{20}H_{26}N_2O_2$, 326.22. $+2H_2O$, need.f.chl. or et. **m.p.** 168; 172 anh. **Soly.** sl.s.w.; s.al.; s.et.; s.chl., acet., NH_4OH.

91 **Hydroquinone.** (*1, 4-benzenediol*; quinol; hydroquinol; p-dihydroxybenzene*). $C_6H_4(OH)_2$, 110.05. Col.hex. pr.f.w., *n* 1.633, 1.626. **D.** 1.358^{20}_{4}, **m.p.** 170.5(173.1), **b.p.** 286.2. **Soly.** 5.9^{15} w.; v.s.al.; v.s.et.

92 —, diacetate (*quinol diacetate; p-phenylene diacetate; diacetylhydroquinone*). $C_6H_4(OOCCH_3)_2$, 194.08. Pl or leaf.f.al. **m.p.** 124. **Soly.** sl.s.h.w.; sl.s.al.; v.s.et.; s.chl.

93 —, diethyl ether. See *Benzene, 1, 4-diethoxy-**.

94 —, dimethyl ether. See *Benzene, 1, 4-dimethoxy-**.

95 —, monoamyl ether. See *Phenol, p-amoxy-.*

96 —, monobutyl ether. See *Phenol, p-butoxy-.*

97 —, monoethyl ether. See *Phenol, p-ethoxy-**.

98 —, monoheptyl ether. See *Phenol, p-heptyloxy-.*

99 —, monohexyl ether. See *Phenol, p-hexyloxy-.*

00 —, monomethyl ether. See *Phenol, p-methoxy-.*

01 —, monoöctyl ether. See *Phenol, p-octyloxy-.*

02 —, monopropyl ether. See *Phenol p-propoxy-.*

03 —, **2-acetyl-**. See *Acetophenone, 2, 5-dihydroxy-.*

* Name approved by the International Union of Chemistry.

04 **Hydroquinone, bromo-** (2-*bromo*-1, 4-*benzenediol**). $BrC_6H_3(OH)_2$, 188.96. Leaf.f.pet.eth. **m.p.** 110–1(113–5), **b.p.** subl. **Soly.** s.w.; s.al.; s.et.; s.bz., ac.a., chl., lgr.

05 —, **chloro-** (2-*chloro*-1, 4-*benzenediol**; *chloroquinol*). $ClC_6H_3(OH)_2$, 144.50. Monocl.leaf.f.chl. **m.p.** 106, **b.p.** 263. **Soly.** v.s.w.; v.s.al.; s.et.; s.h.chl.

06 —, **2, 3-dimethyl-** (2, 3-*dimethyl*-1, 4-*benzenediol**; *o-xylohydroquinone;* 3, 6-*dihydroxy-o-xylene*). $(CH_3)_2C_6H_2(OH)_2$, 138.08. Cr.f.w. **m.p.** 221 d. **Soly.** s.w.; s.al.; s.et.

07 —, **2, 5-dimethyl-** (2, 5-*dimethyl*-1, 4-*benzenediol**; *p-xylohydroquinone; hydrophlorone; hydro-p-xyloquinone;* 2, 5-*dihydroxy-p-xylene*). $(CH_3)_2C_6H_2(OH)_2$, 138.08. Leaf.f.w. **m.p.** 217 (212), **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; sl.s.CS_2, ac.a., chl.; v.sl.s.bz.

08 —, **2, 6-dimethyl-** (2, 6-*dimethyl*-1, 4-*benzenediol**; 2, 5-*dihydroxy-m-xylene*). $(CH_3)_2(OH)_2C_6H_2$, 138.08. Need.f.xylene. **m.p.** 149–51. **Soly.** s.al.; s.et.

09 —, **dithio-** (1, 4-*benzenedithiol**; *p-phenylene dimercaptan*). $C_6H_4(SH)_2$, 142.17. Hex.leaf.f.dil.al. **m.p.** 98. **Soly.** sl.s.w.; s.al.; s.et.; v.s.ac.a.; s.bz., lgr.

10 —, **hydroxy-.** See 1, 2, 4-*Benzenetriol**.

11 —, **2-isopropyl-5-methyl-.** See *Thymoquinone.*

12 —, **2-methyl-.** See *Toluhydroquinone.*

13 —, **tetrachloro-** (*tetrachloro*-1, 4-*benzenediol**). $C_6Cl_4(OH)_2$, 247.84. Col. monocl.f.bz. **m.p.** 232, **b.p.** subl.d. **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

14 —, **trichloro-.** $Cl_3C_6H(OH)_2$, 213.39. Col.pr.f.w. **m.p.** 134 (138), **b.p.** subl. **Soly.** 0.6^{15}w.; v.s.al.; v.s.et.

15 **Hydroquinonecarboxylic acid.** See *Gentisic acid.*

16 **Hydroquinone-2-carboxylic acid, 5-hydroxy-.** See *Benzoic acid,* 2, 4, 5-*trihydroxy-.*

17 **2, 5-Hydroquinonedicarboxylic acid.** See *Terephthalic acid,* 2, 5-*dihydroxy-.*

18 **Hydroquinonephthalein** (2, 7-*dihydroxyfluoran*). $C_{20}H_{12}O_5$, 332.09. Need. f.et. **m.p.** 232–4, **b.p.** d. **Soly.** v.sl.s.h.w.; s.al.; s.et.; s.alk.; i.lgr.

19 **Hydroresorcinol.** See 1, 3-*Cyclohexanedione**.

20 **Hydrotoluquinone.** See *Toluhydroquinone.*

Hydroxy-. See the parent compounds (e.g., for hydroxybenzoic acid see *Benzoic acid, hydroxy-;* for hydroxypropane see *Propanol*).

21 **Hydroxylamine, benzyl-*** (β(*or N*)-*benzylhydroxylamine*). $C_6H_5CH_2NHOH$, 123.08. Need.f.lgr. **m.p.** 57. **Soly.** s.w.

22 —, α(or *O*)**-benzyl-.** See *Benzyloxyamine**.

23 —, **ethyl-*** (β-*ethylhydroxylamine*). C_2H_5NHOH, 61.06. Col.leaf. or need. f.lgr., n $1.41519^{63.9}$, **D.** 0.908^{20}_{4}, **m.p.** 59 d. **Soly.** v.s.w.; v.s.al.; sl.s.et.

24 —, α**-ethyl-.** See *Ethoxyamine**.

25 —, **methyl-***(β-*methylhydroxylamine*). CH_3NHOH, 47.05. Hyg.pr., n 1.41638. **D.** 1.0003^{20}_{4}, **m.p.** 42, **b.p.** 62.5^{15}. **Soly.** v.s.w.; v.s.al.; sl.s.et.

26 —, α**-methyl-.** See *Methoxyamine**.

27 —, **phenyl-*** (β-*phenylhydroxylamine*). C_6H_5NHOH, 109.06. Col.need. **m.p.** 82. **Soly.** 2c., 10h.w.; v.s.al.; v.s.et.; v.sl.s.lgr.

28 —, **propyl-*.** $CH_3CH_2CH_2NHOH$, 75.08. Need.f.et. **m.p.** *ca.* 46. **Soly.** v.s.w.; s.al.; s.et.; i.lgr.

29 —, **o-tolyl-** (β(*or N*)-*o-tolylhydroxylamine*). $CH_3C_6H_4NHOH$, 123.08. Col.need.f.bz., et. **m.p.** 44. **Soly.** i.w.; v.s.al.; v.s.et.; sl.s.lgr.

30 —, ***m*-tolyl.** $CH_3C_6H_4NHOH$, 123.08. Leaf.f.bz., et. **m.p.** 68. **Soly.** sl.s.h. w.; s.al.; s.et.; sl.s.lgr.

31 —, ***p*-tolyl-.** $CH_3C_6H_4NHOH$, 123.08. Col.leaf.f.bz. **m.p.** 94. **Soly.** 1c, 50h., d.w.; v.s.al.; v.s.et.; sl.s.bz.

32 **Hyenic acid.** $C_{24}H_{49}COOH$, 382.39. Cr.f.et. **m.p.** 78. **Soly.** i.w.; sl.s.al.; s.et.

33 **Hyoscine** (*l-scopolamine*). $C_{17}H_{21}NO_4$, 303.17. Col.syrup, $[\alpha] - 33.1°_D$ **m.p.** 55. **Soly.** 10.5^{15}w.; v.s.al.; v.s.et.; s.chl.; sl.s.bz.

34 —, hydrobromide. $C_{17}H_{21}NO_4 \cdot HBr \cdot 3H_2O$, 438.14. Col.rhomb.cr.f.w., $[\alpha] -32.9°^{15}_{D}$, **m.p.** anh. 194. **Soly.** 66.6^{25}w.; 6.3^{25}al.; i.et.; 0.13chl.

35 —, sulfate (*l-scopolamine sulfate*). $(C_{17}H_{21}NO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$, 740.45. Wh.micr.need.f.w. **Soly.** v.s.w.; v.s.al.

36 **Hyoscyamine** (*l-hyoscyamine; daturine; duboisine*). $C_{17}H_{23}NO_3$, 289.19. Wh.need. **m.p.** 106–8. **Soly.** s.al.; s.et.; s.chl.

37 —, hydrobromde. $C_{17}H_{23}NO_3 \cdot HBr$, 370.11. Wh.deliq.pr. **m.p.** 152. **Soly.** v.s.w.; 50al.; 0.06et.

For explanations and abbreviations see beginning of table.

38 **Hyoscyamine,** hydrochloride. $C_{17}H_{23}NO_3 \cdot HCl$, 325.65. Wh.cr. **m.p.** 149–51. **Soly.** s.w.; s.al.

39 —, sulfate. $(C_{17}H_{23}O_3N)_2 \cdot H_2SO_4 \cdot 2H_2O$, 712.48. Need.f.al., [α] − 28.6°D, **m.p.** anh. 206. **Soly.** v.s.w.; 15.6al.; 0.04 et.; s.chl.

40 ***dl*-Hyoscyamine.** See *Atropine.*

41 ***d*-Hyoscyamine.** $C_{17}H_{23}NO_3$, 289.19 Silky need.f.w. + al., [α] − $20.3°^{15}_{D}$. **m.p.** 106. **Soly.** 5w.; v.s.al.; s.et.; s.chl., bz.

42 ***d*-Hypaphorine.** $C_{14}H_{18}N_2O_2 \cdot 2H_2O$, 282.19. Lg.monocl.cr.f.w. **m.p.** anh. 255.

44 **Hypnal** (*antipyrine chloral hydrate; chloral-antipyrine*). $C_{11}H_{12}N_2O \cdot CCl_3-CH(OH)_2$, 353.50. Rhomb.cr. **m.p.** 68. **Soly.** 12w.; sl.s.al.; sl.s.et.

45 **Hypogeic acid** (artificial). (*7-hexadecenoic acid*). $CH_3(CH_2)_7CH:CH-(CH_2)_5COOH$, 254.23. Col.need. **m.p.** 33, **b.p.** 236^{15}. **Soly.** i.w.; v.s.al.; s.et.

46 **Hypoxanthine** (*6(1)-purinone; 6-oxypurine; sarcine*). $C_5H_4N_4O$, 136.06. Need. **m.p.** d. 150. **Soly.** 0.07^{19}, 1.4^{100}w.; sl.s.al.; s.et.; s.alk.

47 —, **2-amino-.** See *Guanine.*

48 **Hystazarin** (*2, 3-dihydroxyanthraquinone; hystazin*). $C_6H_4(CO)_2C_6H_2-(OH)_2$, 240.06. Yel.need.f.ac.a. **m.p.** 260. **Soly.** sl.s.al.; sl.s.et.; s.H_2SO_4.

49 **Idryl.** See *Fluoranthene.*

50 **Imesatin** (*3-iminoöxindole*). $C_6H_4-NHCOC:NH$, 146.06. Yel.pr. **Soly.** i.w.; s.al.; sl.s.et.

51 **Imidazole** (*glyoxaline; iminazole*). NHCH:NCH:CH, 68.05. Col.pr. **m.p.** 90, **b.p.** 256. **Soly.** v.s.w.; v.s.al.; s.et.

52 —, **4, 5-dihydro-2, 4, 5-triphenyl-.** See *Amarine.*

53 —, **1-methyl-** (*N-methylglyoxaline*). N(CH₃)CH:NCH:CH, 82.06. **D.** 1.036^{20}_{4}, **m.p.** −6, **b.p.** 197–9. **Soly.** ∞ w.

54 —, **2, 4, 5-triphenyl-.** See *Lophine.*

55 **4-Imidazolecarboxylic acid, tetrahydro-4-hydroxy-2, 5-diketo-.** See *Alloxanic acid.*

56 **2, 4-Imidazoledione, 5-hydroxy-.** See *Allanturic acid.*

57 **5-Imidazolepropionic acid, α-amino-.** See *Histidine.*

58 **2(3)-Imidazolone, dihydro-.** See *Urea, ethylene-.*

59 **Imidazolo [4, 5-*d*] pyrimidine.** See *Purine.*

60 **Imperatorin.** See *Peucedanin.*

61 **Indaconitine** (*acetylbenzoylpseudaconine*). $C_{34}H_{47}NO_{10}$, 629.37. Cr. **m.p.** 202–3 d. **Soly.** i.w.; s.al.; s.et.

62 **Indan** (*hydrindene; 2, 3-dihydroindene*). $C_6H_4CH_2CH_2CH_2$, 118.08. Col.liq., *n* $1.53877^{16.4}$. **D.** 0.965^{20}_{4}, **b.p.** 176.5. **Soly.** i.w.; ∞al.; ∞et.

63 **1-Indanone** (*1-ketoindan; α-hydrindone*). $C_6H_4COCH_2CH_2$, 132.06. Rhomb.need.f.w., *n* $1.56084^{44.75}$. **D.** 1.101^{45}_{4}, **m.p.** 41, **b.p.** 244. **Soly.** v.sl.s.w.; v.s.al.; s.et.

64 **2-Indanone** (*2-ketoindan; β-hydrindone*). $C_6H_4CH_2COCH_2$, 132.06. Need.f.al., *n* 1.5377^{66}. **D.** 1.071^{67}_{4}, **m.p.** 61, **b.p.** 225 d. **Soly.** i.w.; v.s.al.; v.s.et.

65 **Indanthrene** (*N, N′-dihydroanthraquinonazine*). $C_{28}H_{14}N_2O_4$, 442.13. Bl.powd. **m.p.** 470–500 d. **Soly.** i.w.; i.al.; i.et.; s.dil.alk.sol.

66 **Indene.** $C_6H_4CH_2CH:CH$, 116.06. Col.liq., *n* $1.57107^{12.7}$. **D.** 1.006^{20}_{4}, **m.p.** −2, **b.p.** 182.4. **Soly.** i.w.; ∞al.; ∞et.; s.pyr., CCl_4, acet., CS_2, turpentine.

67 —, **2, 3-dihydro-.** See *Indan.*

68 **Indican** (of plants). $C_{14}H_{17}NO_6 \cdot 3H_2O$, 349.19. Br.rhomb. **m.p.** 51–7; anh. 100–2, **b.p.** d. **Soly.** v.s.w. v.s.al.; s.et.; sl.s.bz.

69 **Indigo, Indigo blue.** See *Indigotin.*

70 —, **soluble.** See *5, 5′-indigotindisulfonic acid, disodium salt.*

71 **Indigo carmine.** See *5, 5′-Indigotindisulfonic acid, disodium salt.*

72 **Indigopurpurin.** See *Indirubin.*

73 **Indigo red.** See *Indirubin.*

74 **Indigotin** (*indigo; indigo blue*). $C_{16}H_{10}N_2O_2$, 262.09. Rhomb., purp. **D.** 1.35^{20}_{4}, **m.p.** 392 d., **b.p.** subl. **Soly.** i.w.; i.al.; i.et.; s.h.chl., h.anil.

76 **4, 4′-Indigotindicarboxylic acid.** $C_{18}H_{10}N_2O_6$, 350.09. Blue powd. **Soly.** i.w.; i.al.; i.et.; s.H_2SO_4; i.chl.

77 **5, 5′-Indigotindisulfonic acid.** $C_{16}H_{10}N_2O_8S_2$, 422.21. Blue amor. **Soly.** s.w.; s.al.

78 —, disodium salt (*indigo carmine; soluble indigo*). $C_{16}H_8N_2Na_2O_8S_2$, 466.19. Blue powd. **Soly.** s.w.; sl.s. al.

* Name approved by the International Union of Chemistry.

78₁ **Indigotinsulfonic acid.** $C_{16}H_{10}N_2O_5S$, 342.15. Purp. **m.p.** 200 d. **Soly.** s.w.; s.al.

79 **Indigo white** (*leucoindigo*). $C_{16}H_{12}N_2O_2$, 264.11. Wh.powd. **Soly.** i.w.; s.al.; s.et.; s.alk.

80 **Indirubin** (*indigo red; indigopurpurin*). $C_{16}H_{10}N_2O_2$, 262.09. Br. need. **b.p.** subl. **Soly.** i.w.; s.al.; s.et.

81 **Indole** (*benzo[b]pyrrole*). $C_6H_4NHCH{:}CH$, 117.06. Col.leaf.f.w. **m.p.** 52.5, **b.p.** 254. **Soly.** s.h.w.; v.s.al.; v.s.et.; s.bz., lgr.

82 —, **1-acetyl-.** $CH_3CONCH{:}CHC_6H_4$. 159.08. Liq. **b.p.** 152–3^{14}.

83 —, **2-methyl-** (*α-methylindole; methylketole*). $CH_3NC_8H_6$, 131.08. Need. or leaf. **D.** 1.07$^{20}_{4}$, **m.p.** 59, **b.p.** 272.3. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.H_2SO_4.

84 —, **3-methyl-.** See *Skatole.*

85 **2-Indolecarboxylic acid, 3-hydroxy-.** See *Indoxylic acid.*

86 **3-Indolepropionic acid, α-amino-.** See *Tryptophan.*

87 **2, 3-Indolinedione.** See *Isatin.*

88 **3-Indolol.** See *Indoxyl.*

89 **2(3)-Indolone.** See *Oxindole.*

90 **Indophenin.** $(C_{12}H_7NOS)_x$, $(213.12)_x$. Bl.need. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.H_2SO_4; i.bz.

91 **Indoxyl** (*3-indolol*). $C_6H_4NHCH{:}COH$, 133.06. Oil, **m.p.** 85, **b.p.** 110. **Soly.** s.alk.

92 —, **1-nitroso-** (*isatoxime*). $C_6H_4N(NO)CH{:}COH$, 162.06. Yel.need. **m.p.** 202. **Soly.** sl.s.w.; s.al.; s.KOH.

93 **Indoxylic acid** (*3-hydroxy-2-indolecarboxylic acid*). $C_6H_4NHC(COOH)COH$, 177.06. Tricl. **b.p.** subl. 123. **Soly.** sl.s., d.h.w.

94 *i*-**Inositol** (1, 2, 3, 4, 5, 6-*cyclohexanehexol**; *i-inosite; phaseomannitol; dambose*). $C_6H_6(OH)_6$, 180.09. Col. monocl.f.w. **D.** 1.524$^{15}_{4}$, **m.p.** anh. 225. **b.p.** 319^{15}. d. **Soly.** 4.5^{15}w.; i.al.; i.et.

95 **Inulin.** $(C_6H_{10}O_5)_6{\cdot}H_2O$, 990.48. Col. hyg.cr. **D.** anh. 1.35$^{20}_{4}$, **m.p.** 178 d. (160). **Soly.** 0.01^{0}w.; 0.02^{16}al.

96 **Iodeosin B.** See *Erythrosin (dye).*

97 **Iodine cyanide.** See *Cyanogen iodide.*

Iodo-. See the parent compounds (e.g., for iodobenzene see *Benzene, iodo-*).

98 **Iodoform** (*triiodomethane*). CHI_3, 393.77. Yel.hex., *n* 1.800, 1.750. **D.** 4.008$^{20}_{4}$, **m.p.** 119, **b.p.** subl.; 210 exp. **Soly.** 0.01^{25}w.; 1.3^{18}, 7.8^{78}al.; 13.6^{25}et.; s.chl., glyc., CS_2.

99 —, **methyl-.** See *Ethane,* **1, 1, 1-***triiodo-**.

00 *dl*-**Iodogorgoic acid** (3, 5-*dl-diiodotyrosine*). $HOC_6H_2I_2CH_2CH(NH_2)COOH$, 432.92. Rect.pr. **m.p.** 204 d. **Soly.** 0.062^{25}, 0.56^{75}w.

01 *d*-**Iodogorgoic acid** (*d*-3, 5-*diiodotyrosine*). $C_9H_9I_2NO_3$, 432.92. Need. **m.p.** 194 d.

02 **Iodol.** See *Pyrrole, 2, 3, 4, 5-tetraiodo-.*

03 **Iodonium iodide, diphenyl-.** $(C_6H_5)_2II$, 407.92. Yel.need.f.al. **m.p.** 182. **Soly.** s.h.al.

04 **Iodophen.** See *Phenolphthalein, 3′, 3″, 5′, 5″-tetraiodo-.*

05 *α*-**Ionone** (4-(2, 6, 6-*trimethyl-2-cyclohexenyl)-3-buten-2-one*). $C_{13}H_{20}O$, 192.16. Col.liq., *n* 1.49842$^{22.3}$. **D.** 0.930, **b.p.** 147.5^{28}. **Soly.** v.sl.s.w.; ∞al.; ∞et.; s.chl.

06 —, semicarbazone. $C_{13}H_{20}{:}NNHCONH_2$, 249.20. Col.cr.f.bz., lgr. **m.p.** 110. **Soly.** s.al.

07 *β*-**Ionone** (4-(2, 6, 6-*trimethyl-1-cyclohexenyl)-3-buten-2-one*). $C_{13}H_{20}O$, 192.16. Col.liq., *n* 1.51977$^{18.9}$. **D.** 0.944, **b.p.** 140^{18}. **Soly.** v.sl.s.w.; ∞al.; ∞et.

08 —, semicarbazone. $C_{13}H_{20}{:}NNHCONH_2$, 249.20. Need.f.al. **m.p.** 148. **Soly.** i.w.; s.al.; s.et.; s.bz.

09 *β*-**Irone** (*natural irone; 4-(2, 2, 6-trimethyl-3-cyclohexenyl)-3-buten-2-one*). $C_{13}H_{20}O$, 192.16. Col.liq., *n* 1.5011. **D.** 0.939, **b.p.** 144^{16}. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

10 **Isatic acid** (*o-aminophenylglyoxylic acid; o-aminobenzoylformic acid; isatinic acid*). $NH_2C_6H_4COCOOH$, 165.06. Wh.powd. **m.p.** d. **Soly.** sl.s.w.

11 —, lactam. See *Isatin.*

For explanations and abbreviations see beginning of table.

12 **Isatin** (2, 3-*indolinedione; isatic acid lactam*). $C_6H_4NHCOCO$, 147.05. Red monocl.need.f.al. **m.p.** 201 (198–9), **b.p.** subl. **Soly.** v.sl.s.c., s.h.w.; s.al.; sl.s.et.; s.alk.

13 —, **acetyl-.** See *Pseudoisatin*, 1-*acetyl-*.

14 —, **1-methyl-** (*N-methylisatin*). $C_6H_4N(CH_3)COCO$, 161.06. Red need. **m.p.** 134.

15 —, **5-methyl-** (*p-methylisatin*). $CH_3C_6H_3NHCOCO$, 161.06. Red leaf.f.w. **m.p.** 187. **Soly.** sl.s.c.w.; sl.s.al.; sl.s.et.; s.alk., h.HCl.

16 —, **nitro-.** $C_6H_3(NO_2)NHCOCO$, 192.05. Need.f.al. **m.p.** 230. **Soly.** sl.s.w.; v.s.al.; s.alk.

17 —, **thio-.** See *Thionaphthenequinone.*

18 **Isatin chloride** (2-*chloro*-3-*pseudoindolone*). $C_6H_4N{:}CClCO$, 165.50. Br.need. **m.p.** 180 d. **Soly.** i.w.; s.al.; v.s.et.

19 **Isatoic anhydride** (*N-carboxyanthranilic acid anhydride*). $C_6H_4COOCONH$, 163.05. Monocl.f.acet. **m.p.** 240 d. **Soly.** 0.7^{100}w.; 3^{78}al.; sl.s.et.; 1.3h.acet.

20 **Isatoxime.** See *Indoxyl*, 1-*nitroso-*.

21 α-**Isatropic acid** (1, 2, 3, 4-*tetrahydro*-1-*phenyl*-1, 4-*naphthalenedicarboxylic acid*(one form)). $C_{18}H_{16}O_4$, 296.12. Cr. **m.p.** 237. **Soly.** v.sl.s. w.; sl.s.al.; i.et.; i.bz., CS_2.

22 **Isethionic acid** (2-*hydroxyethanesulfonic acid*). $CH_2OHCH_2SO_3H$, 126.11. **b.p.** 100 d. **Soly.** v.s.w.; i.al.

Isoamyl. For isoamyl derivatives see the parent compounds (e.g., for isoamylbenzene see *Benzene, isoamyl-*). For isoamyl esters of organic acids see the acids.

23 **Isoamyl alcohol** (*isobutylcarbinol*; 3-*methyl*-1-*butanol**). $(CH_3)_2CHCH_2CH_2OH$, 88.09. Col.liq., *n* $1.4084^{17.8}$. **D.** 0.812, **m.p.** −117.2, **b.p.** 130.5 (130 2). **Soly.** 2.672^{22}w.; ∞al.; ∞et.

24 *sec*-**Isoamyl alcohol.** See 2-*Butanol*, 3-*methyl-**.

25 **Isoamyl aldehyde.** See *Isovaleraldehyde.*

26 **Isoamylamine** (1-*amino*-3-*methylbutane*). $(CH_3)_2CHCH_2CH_2NH_2$, 87.11. Col.liq. **D.** 0.7505^{20}_{4}, **b.p.** 95. **Soly.** s.w.; ∞al.; ∞et.; s.chl.

27 **Isoamyl borate** (*triisoamyl borate*). $B(OC_5H_{11})_3$, 272.08. Col.liq., *n*. 1.421. **D.** 0.872^{0}_{4}, **b.p.** 255. **Soly.** d.w.; ∞al.; ∞et.

28 **Isoamyl bromide** (1-*bromo*-3-*methylbutane**). $(CH_3)_2CHCH_2CH_2Br$, 151.00. Col.liq., *n* 1.4412. **D.** 1.215, **m.p.** −111.9, **b.p.** 120.65. **Soly.** $0.02^{16.5}$w.; s.al.; s.et.

29 **Isoamyl chloride** (1-*chloro*-3-*methylbutane**). $(CH_3)_2CHCH_2CH_2Cl$, 106.54. Col.liq. **D.** 0.893, **b.p.** 98.9. **Soly.** i.w.; ∞al.; ∞et.

30 **Isoamyl cyanide.** See *Isocapronitrile.*

31 **Isoamyl disulfide** (*diisoamyl disulfide*). $C_5H_{11}S_2C_5H_{11}$, 206.29. Liq. **D.** 0.918^{19}, **b.p.** 250; $122–5^{10}$. **Soly.** d.w.

32 α-**Isoamylene.** See 1-*Butene*, 3-*methyl-**.

33 β-**Isoamylene.** See 2-*Butene*, 3-*methyl-**.

34 α-**Isoamylene glycol.** See 1, 2-*Butanediol*, 3-*methyl-**.

35 β-**Isoamylene glycol.** See 2, 3-*Butanediol*, 2-*methyl-**.

36 γ-**Isoamylene glycol.** See 1, 3-*Butanediol*, 3-*methyl-**.

37 **Isoamyl ether** (3-*methyl*-1-(γ-*methylbutoxy*)*butane**; *diisoamyl ether*). $(CH_3)_2CH(CH_2)_2O(CH_2)_2CH(CH_3)_2$, 158.17. Col.liq., *n* 1.408. **D.** 0.78073^{15}_{15}, **b.p.** 172.5–3.0. **Soly.** i.w.; ∞al.; ∞et.

38 **Isoamyl iodide** (1-*iodo*-3-*methylbutane**). $(CH_3)_2CHCH_2CH_2I$, 198.01. Col.liq. **D.** 1.510, **b.p.** 148. **Soly.** i.w.; s.al.; ∞et.

39 **Isoamyl isocyanide** (γ-*methylbutyl isocyanide; isoamylcarbylamine*). $(CH_3)_2CH(CH_2)_2NC$, 97.09. Liq. **b.p.** 137. **Soly.** i.w.; s.al.; s.et.

40 **Isoamyl mercaptan.** See 1-*Butanethiol*, 3-*methyl-**.

41 **Isoamyl nitrate** γ-*methylbutyl nitrate**). $(CH_3)_2CHCH_2CH_2ONO_2$, 133.09. Col.liq., *n* $1.41219^{21.7}$. **D.** 0.996^{22}, **b.p.** 148. **Soly.** v.sl.s.w.; s.al.; v.s.et.

42 **Isoamyl nitrite** (γ-*methylbutyl nitrite**). $(CH_3)_2CHCH_2CH_2ONO$, 117.09. Ylsh.inflam.liq., *n* $1.38708^{20.7}$. **D.** 0.872, **b.p.** 99. **Soly.** v.sl.s.w.; ∞al.; ∞et.

43 **Isoamyl sulfate** (*diisoamyl sulfate*). $[(CH_3)_2CH_2CH_2CH_2]_2SO_4$, 240.25. **B.p.** $149–51^{12}$.

* Name approved by the International Union of Chemistry.

44 Isoamyl sulfide (*diisoamyl sulfide; 3-methyl-1-(γ-methylbutylthio)-butane**). $[(CH_3)_2CH(CH_2)_2]_2S$, 174.23. Col.liq., *n* 1.45238. **D.** 0.84314^{20}_{4}, **b.p.** 209–11(216). **Soly.** i.w.; v.s.al.; v.s.et.

45 Isoamyl urethan. See *Carbamic acid, isoamyl ester.*

46 Isoanthraflavic acid (*2, 7-dihydroxyanthraquinone*). $HOC_6H_3(CO)_2C_6H_3OH$, 240.06. Lng.yel.need. f.dil.al. **m.p.** 330 subl., **b.p.** d. $-H_2O$, 100. **Soly.** s.al.; v.sl.s.et.; s.alk., H_2SO_4.

47 Isobenzamarone (*α, α′-benzalbis-desoxybenzoin; 1, 2, 3, 4, 5-pentaphenyl-1, 5-pentanedione* (one form)). $C_6H_5CH[CH(C_6H_5)COC_6H_5]_2$, 480.22. Cr. **m.p.** 179–80. **Soly.** 4.1^{12}bz.

48 1(3)-Isobenzofuranone. See *Phthalide.*

49 Isobornyl chloride (*2-chlorocamphane* (one form); *camphene hydrochloride; bornyl chloride* (incorrect). $C_{10}H_{17}Cl$, 172.59. Col.feath.cr. **m.p.** 148–50 (157). **Soly.** i.w.; s.al.; s.et.

50 Isobutane (*2-methylpropane*; trimethylmethane*). $(CH_3)_3CH$, 58.08. Col.gas. **D.** liq. 0.603^0, **m.p.** −145, **b.p.** −10.2. **Soly.** 13^{17}_{772} cm³ w.; 1320^{17}_{776} cm³ al.; 2790^{17}_{773} cm³ et.

Isobutyl. For isobutyl derivatives see the parent compounds (e.g., for isobutylbenzene see *Benzene, isobutyl-*). For isobutyl esters of organic acids see the acids.

51 Isobutyl alcohol (*2-methyl-1-propanol*; isopropylcarbinol*). $(CH_3)_2CHCH_2OH$, 74.08. Col.inflam. liq., *n* $1.3968^{17.5}$. **D.** 0.8169(.802) **m.p.** −108, **b.p.** 108.39 (106–8). **Soly.** 9.5^{18}w.; ∞al.; ∞et.

52 Isobutyl aldehyde. See *Isobutyraldehyde.*

53 Isobutylamine (*1-amino-2-methylpropane*). $(CH_3)_2CHCH_2NH_2$, 73.09. Col.liq., *n* $1.39878^{17.0}$. **D.** 0.736, **m.p.** −85.5, **b.p.** 68(67–9). **Soly.** ∞w.; ∞al.; ∞et.

54 —, ***N*-methyl-.** $CH_3NHCH_2CH(CH_3)_2$, 87.11. Col.liq. **D.** 0.722^{18}, **b.p.** 76–8.

55 Isobutyl arsenite (*triisobutyl (ortho)arsenite*). $As[OCH_2CH(CH_3)_2]_3$, 294.14. **b.p.** 242.

56 Isobutyl borate (*triisobutyl borate*). $B(OC_4H_9)_3$, 230.03. Col.liq., *n* 1.408. **D.** 0.864^0_4, **b.p.** 212. **Soly.** d.w.; ∞al.; ∞et.

57 Isobutyl bromide (*1-bromo-2-methylpropane**). $(CH_3)_2CHCH_2Br$, 136.99. Col.liq., *n*. 1.436. **D.** 1.264, **m.p.** −118.5, **b.p.** 91.5. **Soly.** 0.0589^{16}w.; ∞al.; ∞et.

58 Isobutyl chloride (*1-chloro-2-methylpropane**). $(CH_3)_2CHCH_2Cl$, 92.53. Col.liq., *n* 1.3960. **D.** 0.875, **m.p.** −131.2, **b.p.** 68.9. **Soly.** $0.092^{12.5}$w.; ∞al.; ∞et.

59 Isobutyl cyanide. See *Isovaleronitrile.*

60 Isobutylene. See *Propene, 2-methyl-*.*

61 Isobutylene glycol. See *1, 2-Propanediol, 2-methyl-*.*

62 Isobutylene oxide. See *Ethylene oxide, α, α-dimethyl-.*

63 Isobutyl ether (*2-methyl-1-(β-methylpropoxy)propane*; diisobutyl ether*). $[(CH_3)_2CHCH_2]_2O$, 130.14. Col.liq. **D.** 0.7616^{15}_{4}, **b.p.** 122.5. **Soly.** sl.s.w.; ∞al.; ∞et.

64 Isobutyl fluoride (*1-fluoro-2-methylpropane**). $(CH_3)_2CHCH_2F$, 76.07. Gas. **b.p.** 16.

65 Isobutylidene bromide. See *Propane, 1, 1-dibromo-2-methyl-*.*

66 Isobutyl iodide (*1-iodo-2-methylpropane**). $(CH_3)_2CHCH_2I$, 183.99. Col.liq., *n* 1.49597. **D.** 1.605, **m.p.** −93.5, **b.p.** 120.4. **Soly.** i.w.; ∞al.; ∞et.

67 Isobutyl isocyanide (*β-methylpropylcarbylamine**). $(CH_3)_2CHCH_2NC$, 83.08. Col.liq. **D.** 0.7873^4, **m.p.** <-60, **b.p.** 114–7. **Soly.** sl.s.w.; s.al.; s.et.

68 Isobutyl mercaptan. See *1-Propanethiol, 2-methyl*-.*

69 Isobutyl mustard oil. See *Isothiocyanic acid, isobutyl ester.*

70 Isobutyl nitrate (*β-methylpropyl nitrate**). $(CH_3)_2CHCH_2ONO_2$, 119.08. Col.liq., *n* $1.40130^{23.3}$. **D.** 1.0168^{20}_{20}, **b.p.** 122.9. **Soly.** i.w.; ∞al.; ∞et.

71 Isobutyl nitrite (*β-methylpropyl nitrite**). $(CH_3)_2CHCH_2ONO$, 103.08. Liq., *n* $1.37151^{22.1}$. **D.** 0.8702^{20}_{20}, **b.p.** 67. **Soly.** i.w.; s.al.; s.et.

72 Isobutyl sulfate (*diisobutyl sulfate*). $[(CH_3)_2CHCH_2]_2SO_4$, 210.20. *n* 1.415. **D.** 1.042^{23}, **b.p.** 133–4^{19}.

73 Isobutyl sulfide (*diisobutyl sulfide; 2-methyl-1-(β-methylpropylthio)propane**). $[(CH_3)_2CHCH_2]_2S$, 146.20. Col.liq. **D.** 0.8386^{14}_{4}, **b.p.** 172–3. **Soly.** i.w.; v.s.al.; v.s.et.

For explanations and abbreviations see beginning of table.

74 **Isobutyraldehyde** (*2-methylpropanal*; isobutyl aldehyde*). $(CH_3)_2$-$CHCHO$, 72.06. Col.liq., *n* 1.37302. **D.** 0.7938, **m.p.** −65.9, **b.p.** 61 (61.5–3.5). **Soly.** 11w.; ∞al.; ∞et.

75 —, oxime (*2-methylpropanal oxime; isobutyraldoxime*). $(CH_3)_2CHCH$:-NOH, 87.08. Col. oil, *n* $1.43022^{20.5}$. **D.** 0.8943^{20}_{4}, **m.p.** <−80, **b.p.** 139. **Soly.** sl.s.w.

76 **Isobutyraldoxime.** See *Isobutyraldehyde, oxime.*

77 **Isobutyramide** (*2-methylpropanamide*; isobutyric amide*). $(CH_3)_2$-$CHCONH_2$, 87.08. Col.monocl.f.bz. or chl. **D.** 1.013, **m.p.** 129(123–4), **b.p.** 220. **Soly.** v.s.w.; v.s.al.; sl.s.et.

78 **Isobutyric acid** (*2-methylpropanoic acid*; dimethylacetic acid; α-methylpropionic acid*). $(CH_3)_2CHCOOH$, 88.06. Col.liq., *n* 1.39300. **D.** 0.949^{20}_{4}, **m.p.** −47.0, **b.p.** 154.4. **Soly.** 20^{20}w.; ∞al.; ∞et.

79 —, allyl ester (*allyl isobutyrate; 2-propenyl 2-methylpropanoate**). $(CH_3)_2$-$CHCOOC_3H_5$, 128.09. Liq. **b.p.** 133.5. **Soly.** v.sl.s.w.: ∞al.; ∞et.

80 —, amyl ester (*pentyl 2-methylpropanoate**). $(CH_3)_2CHCOO(CH_2)_4$-CH_3, 158.14. Liq., *n* 1.4076. **D.** 0.8592^{13}, **b.p.** 155. **Soly.** sl.s.w.; ∞al.; ∞et.

81 —, ethyl ester (*ethyl isobutyrate; ethyl 2-methylpropanoate**). $(CH_3)_2$-$CHCOOC_2H_5$, 116.09. Col.liq., *n* 1.3903. **D.** 0.86930^{20}_{4}, **m.p.** −88.2. **b.p.** 111.7. **Soly.** sl.s.w.; ∞al.; ∞et.

82 —, isoamyl ester (*γ-methylbutyl 2-methylpropanoate**). $(CH_3)_2$-$CHCOOC_5H_{11}$, 158.14. Col.liq. **D.** 0.876^{0}_{4}, **b.p.** 168.8. **Soly.** v.sl.s.w.; s.al.; s.et.

83 —, isobutyl ester (*β-methylpropyl 2-methylpropanoate**). $(CH_3)_2$-$CHCOOCH_2CH(CH_3)_2$, 144.12. Col. liq., *n* 1.3999. **D.** 0.875^{0}_{4}, **m.p.** −80.7, **b.p.** 148.7. **Soly.** v.sl.s.w.; s.al.; ∞et.

84 —, isopropyl ester. $(CH_3)_2$-$CHCOOCH(CH_3)_2$, 130.11. Col.liq. **D.** 0.869^{0}_{4}, **b.p.** 120.8. **Soly.** i.w.; s.al.; s.et.

85 —, methyl ester (*methyl 2-methylpropanoate*; methyl isobutyrate*). $(CH_3)_2CHCOOCH_3$, 102.08. Col.liq., *n* 1.3840. **D.** 0.891, **m.p.** −84.7. **b.p.** 92.6. **Soly.** sl.s.w.; ∞al.; ∞et.

86 —, piperazinium salt. $C_4H_{10}N_2$-$2C_3H_7COOH$, 262.22. Wh.cr. **m.p.** 121–2. **Soly.** s.w.; s.al.; i.et.; s.h. dioxane.

87 —, propyl ester (*n-propyl isobutyrate*). $(CH_3)_2CHCOOC_3H_7$, 130.11. Col.liq. **D.** 0.884^{0}_{4}, **b.p.** 135.4. **Soly.** v.sl.s.w.

88 —, α-**amino-** (*2-amino-2-methylpropanoic acid**). $(CH_3)_2C(NH_2)$-$COOH$, 103.08. Col.monocl.pl. or pr. **m.p.** 203 d., **b.p.** subl. 280. **Soly.** s.w.; sl.s.al.; i.et.

89 —, α-**bromo-** (*2-bromo-2-methylpropanoic acid**). $(CH_3)_2CBrCOOH$, 166.97. Pl. **D.** liq. 1.5255^{60}, **m.p.** 48, **b.p.** 198–200. **Soly.** v.s.w.; s.al.; s.et.

90 —, —, ethyl ester (*ethyl 2-bromo-2-methylpropanoate**). $(CH_3)_2$-$CBrCOOC_2H_5$, 195.00. Col.liq. **D.** $1.311^{2.5}_{4}$, **b.p.** 164 d. **Soly.** i.w.; s.al.; ∞et.

91 —, α-**hydroxy-** (*2-hydroxy-2-methylpropanoic acid*; acetonic acid*). $(CH_3)_2COHCOOH$, 104.06. Col.hyg. pr.f.bz. **m.p.** 79, **b.p.** 212. **Soly.** v.s.w.; v.s.al.; v.s.et.; v.sl.s.bz.

92 —, α-**methoxy-,** 3-p-menthyl ester (*menthol α-methoxyisobutyrate*). $(CH_3)_2C(OCH_3)COOC_{10}H_{19}$, 256.22. Liq. **D.** 0.9466, **b.p.** $124–6^{10}$. **Soly.** s.al.; s.et.

93 **Isobutyric amide.** See *Isobutyramide.*

94 **Isobutyric anhydride.** $[(CH_3)_2$-$CHCO]_2O$, 158.11. Col.liq. **D.** 0.950, **m.p.** −53.5, **b.p.** 182.5. **Soly.** d.w.; d.al.; ∞et.

95 **Isobutyronitrile** (*2-methylpropanenitrile*; isopropyl cyanide*). $(CH_3)_2$-$CHCN$, 69.06. Col.liq. **D.** 0.773, **b.p.** 107–8. **Soly.** sl.s.w.; v.s.al.; v.s.et.

96 —, α-**hydroxy-** (*2-hydroxy-2-methylpropanenitrile*; acetone cyanohydrin*). $(CH_3)_2C(OH)CN$, 85.06. Col.liq., *n* 1.3996. **D.** 0.932^{19}, **m.p.** −19, **b.p.** 120; 82^{23}. **Soly.** v.s.w.; v.s.al.; v.s.et.; v.sl.s.pet.eth.

97 **Isobutyrophenone** (*isopropyl phenyl ketone*). $(CH_3)_2CHCOC_6H_5$, 148.09. Col.liq., *n* $1.51919^{16.5}$. **D.** 0.984, **b.p.** 217. **Soly.** i.w.; s.al.; s.et.

98 —, α-**bromo-2, 4, 6-trimethyl-** (*α-bromoisopropyl 2-mesityl ketone; α-bromoisobutyrylmesitylene*). $(CH_3)_2$-$CBrCOC_6H_2(CH_3)_3$, 269.05. Cr. **m.p.** 27, **b.p.** $160–70^{24}$. **Soly.** s.et.

99 **Isobutyryl bromide** (*2-methylpropanoyl bromide**). $(CH_3)_2CHCOBr$, 150.97. **D.** 1.4067^{15}, **b.p.** 116–8.

* Name approved by the International Union of Chemistry.

00 **Isobutyryl chloride** (*2-methylpropanoyl chloride**). $(CH_3)_2CHCOCl$, 106.51. Col.liq., *n* 1.4079. **D.** 1.017^{20}_{4}, **m.p.** −90.0, **b.p.** 92. **Soly.** d.w.; d.al.; s.et.

01 **Isocalycanthine.** $C_{11}H_{14}N_2 \cdot \frac{1}{2}H_2O$, 183.13 Rhomb., **m.p.** 235. **Soly.** s.al.

02 **Isocamphane** (2, 2, 3-*trimethylnorcamphane; isohydrocamphene;* 2, 2, 3-*trimethylbicyclo*-[2, 2, 1]*heptane*). $C_{10}H_{18}$, 138.14. **D.** 0.8276^{20}_{4}, **m.p.** 64.5, **b.p.** 164.

03 *dl*-**Isocamphoric acid** (*dl-trans*-1, 2, 2-*trimethyl*-1,3-*cyclopentanedicarboxylic acid*). $C_5H_{14}(COOH)_2$, 200.12. Cr. **m.p.** 191. **Soly.** v.s.al.; v.s.et.

04 **Isocapric alcohol.** See 1-*Hexanol, 3-isopropyl-5-methyl-**.

05 **Isocaproic acid** (*4-methylpentanoic acid*; isobutylacetic acid*). $(CH_3)_2CH(CH_2)_2COOH$, 116.09. Col. oily liq. **D.** 0.925^{20}_{4}, **m.p.** −35, **b.p.** 207.7(110–1[25]). **Soly.** sl.s.w.; s.al.; s.et.

06 —, *α*-**amino-.** See *Leucine*.

07 —, *α*-**hydroxy-.** See *Leucic acid*.

08 **Isocaprone.** See 5-*Nonanone*, 2, 8-*dimethyl-**.

09 **Isocapronitrile** (*4-methylpentanenitrile*; isoamyl cyanide; isobutylacetonitrile*). $(CH_3)_2CH(CH_2)_2CN$, 97.09. Col.liq., *n* 1.406. **D.** 0.806^{20}_{4}, **m.p.** −51.1, **b.p.** 155.5. **Soly.** i.w.; s.al.; ∞et.

10 **Isocaprophenone** (*isoamyl phenyl ketone*). $(CH_3)_2CH(CH_2)_2COC_6H_5$, 176.12. Col.liq. **D.** 0.962^{15}_{4}, **m.p.** 24.7, **b.p.** 242.5. **Soly.** i.w.; v.s.al.; v.s.et.

11 **Isocaprylic acid, α-hydroxy-** (*2-hydroxy-6-methylheptanoic acid**). $(CH_3)_2CH(CH_2)_3CHOHCOOH$, 160.12. Need.f.et. **m.p.** 152–3 d. (110–1), **b.p.** 192–3 d. **Soly.** sl.s.w.; s.al.; s.et.

12 **Isocarbostyril** (*1-isoquinolinol* or *1 (2)-isoquinolone*). C_9H_7NO, 145.06. Col.monocl.f.bz. **m.p.** 208–9, **b.p.** subl. **Soly.** sl.s.w.; v.s.al.; sl.s.et.; s.chl.; sl.s.bz.

13 **Isocholesterol** (*isocholesterin*). $C_{27}H_{45}OH$, 386.36. Need.f.et. **m.p.** 138. **Soly.** s.al.; s.et.; s.h.ac.a.

14 —, benzoate. $C_6H_5COOC_{27}H_{45}$, 490.39. Need. **m.p.** 191–5. **Soly.** s.al.; v.s.et.

15 **Isochrysene.** See *Triphenylene*.

16 **Isocinchomeronic acid** (2, 5-*pyridinedicarboxylic acid**). $C_5H_3N(COOH)_2 \cdot H_2O$, 185.06. Col.leaf.f.w. **m.p.** 236–7(anh.), **b.p.** subl. **Soly.** v.sl.s.w.; v.sl.s.al.; v.sl.s.et.; s.h.HCl.

18 **Isocinnamic acid** (of Liebermann) (*cis-β-phenylacrylic acid* (one form); *cis-benzenepropenoic acid* (one form)). $C_6H_5CH{:}CHCOOH$, 148.06. Lng. monocl.pr.f.lgr. **m.p.** 58(42), **b.p.** 265→*trans* form. **Soly.** 0.937[25]w.; s.al.; v.s.et.; s.chl., lgr., ac.a.

19 **Isocitric acid** (*1-hydroxy-1, 2, 3-propanetricarboxylic acid*; α-hydroxytricarballylic acid*). $COOHCH(OH)CH(COOH)CH_2COOH$, 192.06. Pr. **m.p.** d. 100. **Soly.** v.sl.s.w.; v.sl.s.al.; v.sl.s.et.

20 **Isocodeine.** $C_{18}H_{21}NO_3$, 299.17. *n* 1.607, 1.642, 1.675. **m.p.** 144, **b.p.** d.

21 **Isocorybulbine.** $C_{21}H_{25}NO_4$, 355.20. Col.leaf. **m.p.** 180. **Soly.** i.w.; s.al.

22 **Isocorydaline.** $C_{22}H_{27}NO_4$, 369.22. **m.p.** 136.

23 **Isocotoin** (2, 4-*dihydroxy-6-methoxybenzophenone*). $C_{14}H_{12}O_4$, 244.09. **m.p.** 162.

24 **Isocoumarin** (2, 1-*benzopyrone; o-β-hydroxyvinylbenzoic acid lactone*). $C_6H_4COOCH{:}CH$, 146.05. Pl.f.bz. **m.p.** 47, **b.p.** 286. **Soly.** i.w.; s.al.; s.et.; v.s.bz.; s.CS_2.

25 **Isocrotonic acid** (*cis(?)-2-butenoic acid*; β-(or liquid)crotonic acid; allocrotonic acid; cis(?)-β-methylacrylic acid; quartenylic acid*). $CH_3CH{:}CHCOOH$, 86.05. Col.need.f.pet.eth., *n* 1.4457. **D.** 1.0312^{15}_{4}, **m.p.** 14–5, **b.p.** 171.9 d. **Soly.** 40w.; s.al.

26 —, *α*-**methyl-.** See *Angelic acid*.

27 **Isocyanic acid,** ethyl ester. C_2H_5NCO, 71.05. Liq., *n* 1.3794_{He}. **D.** 0.898^{20}_{4}, **b.p.** 60. **Soly.** i.w.; ∞al.; ∞et.

28 —, phenyl ester (*phenyl isocyanate; phenylcarbonimide; carbanil*). $C_6H_5N{:}CO$, 119.05. Liq., *n* $1.53684^{19.6}$. **D.** 1.095^{20}_{4}, **b.p.** 165.6. **Soly.** d.w.; d.al.; v.s.et.

29 —, o-tolyl ester (*o-tolylcarbonimide*). $CH_3C_6H_4NCO$, 133.06. Liq. **b.p.** 186. **Soly.** i., d.h.w.; d.h.al.; s.et.

Isocyanides. See *Ethyl isocyanide, Methyl isocyanide*, etc.

30 **Isocyanuric acid.** See *Fulminuric acid*.

31 —, trimethyl ester (*tricarbonimide trimethyl ester*). $C_3O_3(NCH_3)_3$, 171.09. Pr. **m.p.** 175, **b.p.** 295.

For explanations and abbreviations see beginning of table.

32 Isocymene. See *m-Cymene.*

33 Isoderritol. $C_{20}H_{20}O_6$, 352.16. **m.p.** 149.

34 Isodextrosamine. See *D-Fructosamine.*

35 Isodibutol. See *2-Pentanol, 2, 4, 4-trimethyl-.*

36 Isodurene (1, 2, 3, 5-*tetramethylbenzene*). $(CH_3)_4C_6H_2$, 134.11. Liq. **D.** 0.896^{0}_{4}, **m.p.** −24, **b.p.** 197. **Soly.** i.w.; s.al.; v.s.et.

37 —, 4-amino-. See *Isoduridine.*

38 Isodurenol (2, 3, 4, 6-*tetramethylphenol(?)*; *4-hydroxyisodurene(?)*). $(CH_3)_4$-C_6HOH, 150.11. Cr. **m.p.** 79–81, **b.p.** 230–50. **Soly.** s.al.; s.et.

39 Isoduridine (2, 3, 4, 6-*tetramethylaniline; 4-aminoisodurene*). $(CH_3)_4C_6$-HNH_2, 149.13. Cr. **D.** 0.978^{24}, **m.p.** 23–4, **b.p.** 255. **Soly.** s.al.

40 α-Isodurylic acid (3, 4, 5-*trimethylbenzoic acid*). $(CH_3)_3C_6H_2COOH$, 164.09. Need.f.w. **m.p.** 215. **Soly.** v.sl.s.h.w.; s.al.; s.et.

41 β-Isodurylic acid (2, 4, 6-*trimethylbenzoic acid; mesitylene-eso-carboxylic acid*). $(CH_3)_3C_6H_2COOH$, 164.09. Col.cr.f.al. **m.p.** 152. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.chl.

42 γ-Isodurylic acid (2, 3, 5-*trimethylbenzoic acid*). $(CH_3)_3C_6H_2COOH$, 164.09. Pl.f.lgr. **m.p.** 127. **Soly.** s.al.

43 Isoephedrine. See *Pseudoephedrine.*

44 Isoerucic acid. See *Brassidic acid.*

45 Isoeugenol (*4-propenylguaiacol*). $CH_3CH{:}CHC_6H_3(OCH_3)OH$, 164.09. Pa.yel.liq., *n* 1.5680^{18}. **D.** 1.0839^{20}_{20}; 1.0852^{20}_{4}, **m.p.** −10, **b.p.** 267.5. **Soly.** sl.s.w.; s.al.; s.et.

46 —, acetate. $CH_3CH{:}CHC_6H_3(OCH_3)$-$OOCCH_3$, 206.11. Need.f.bz. **m.p.** 79–80, **b.p.** 282–3. **Soly.** i.w.; s.et.

47 —, benzyl ether (*1-benzyloxy-2-methoxy-4-propenylbenzene*). $CH_3CH{:}$-$CHC_6H_3(OCH_3)OC_7H_7$, 254.14. Need.f.al. **m.p.** 58–9. **Soly.** i.w.; s.al.; s.et.

48 —, ethyl ether (*1-ethoxy-2-methoxy-4-propenylbenzene*). $CH_3CH{:}CHC_6H_3$-$(OCH_3)OC_2H_5$, 192.12. Cr.f.dil.al. **m.p.** 64. **Soly.** i.w.; s.al.; v.s.et.; v.s.bz.

49 —, methyl ether. See *Veratrole, 4-propenyl-.*

50 —, γ-hydroxy-. See *Coniferyl alcohol.*

51 l-Isofenchyl alcohol (*l-6-fenchanol*). $C_{10}H_{17}OH$, 154.14. Need. **D.** 0.961^{15}_{4}, **m.p.** 62, **b.p.** 204. **Soly.** i.w.; v.s.al.; v.s.et.

52 Isoferulic acid (*3-hydroxy-4-methoxycinnamic acid; hesperetic acid*). HO-$(CH_3O)C_6H_3CH{:}CHCOOH$, 194.08. Wh.need. **m.p.** 228. **Soly.** sl.s.c., s.h.w.; s.al.; s.et.; i.lgr.

53 Isoglucosamine. See *D-Fructosamine.*

54 α, β-Isoheptenic acid. See *2-Hexenoic acid, 5-methyl-*.*

55 Isoheptyl alcohol. See *1-Hexanol, 5-methyl-*.*

56 Isoheptylic acid. See *Caproic acid, 5-methyl-.*

57 Isohexacosane. See *Cerane.*

58 α-Isohexenic acid. See *2-Pentenoic acid, 4-methyl-*.*

59 Isohexylamine (*(4-methylamyl)amine; 1-amino-4-methylpentane*). $(CH_3)_2CH$-$(CH_2)_3NH_2$, 101.13. Wh.-yel.liq. **D.** 0.758^{25}_{4}, **m.p.** −94.4, **b.p.** 123.9. **Soly.** sl.s.w.; ∞al.; ∞et.

60 Isohydrobenzoin (1, 2-*diphenyl*-1, 2-*ethanediol*(one form)). $C_{14}H_{12}(OH)_2$, 214.11. Col.monocl.f.al. **m.p.** 121, **b.p.** $133^{0.02}$. **Soly.** 0.19^{15}w.; v.s.al.; v.s.et.

61 Isohydrocamphene. See *Isocamphane.*

62 1, 3-Isoindoledione. See *Phthalimide.*

63 1-Isoindolinone. See *Phthalimidine.*

65 dl-Isoleucine (*dl-α-amino-β-methylvaleric acid; dl-2-amino-3-methylpentanoic acid**). $CH_3CH_2CH(CH_3)CH$-$(NH_2)COOH$, 131.11. Rhomb. or monocl.pl.f.dil.al. **m.p.** 292 d. **Soly.** 2.19^{25}, 4.83^{75}w.; s.h.al.; i.et.; s.h.ac.a.

66 d-Isoleucine (*d-2-amino-3-methylpentanoic acid*; d-α-amino-β-methylvaleric acid*). $CH_3CH_2CH(CH_3)CH$-$(NH_2)COOH$, 131.11. Greasy rhomb. leaf.f.al. **m.p.** 283–4 d. **Soly.** 4.12^{25}, 6.08^{75} w.; i., sl.s.h.al.; i.et.; s.h.ac.a.

67 d-allo-Isoleucine (*d-allo-α-amino-β-methylvaleric acid*). CH_3CH_2CH-$(CH_3)CH(NH_2)COOH$, 131.11. Greasy leaf. **m.p.** 280–1 d. **Soly.** 2.9^{20}w.; i.et.

68 l-allo-Isoleucine (*l-allo-α-amino-β-methylvaleric acid*). CH_3CH_2CH-$(CH_3)CH(NH_2)COOH$, 131.11. Greasy leaf. **m.p.** 278 d. **Soly.** 0.82^{20} 80 %, 0.12^{20}al.

* Name approved by the International Union of Chemistry.

69 **α-Isomalic acid** (*2-hydroxy-2-methylpropanedioic acid*; α-hydroxyisosuccinic acid*). $CH_3C(OH)(CCOH)_2$, 134.05. Col.cr. **m.p.** 160 d.(142), **b.p.** d. 170±. **Soly.** v.s.w.; v.s.al.; v.s.et.

70 **Isomannide.** $C_6H_{10}O_4$, 146.08. Col. monocl. **m.p.** 87, **b.p.** 274 d. **Soly.** v.s.w.; sl.s.al.; i.et.

71 **α-Isomorphine.** $C_{17}H_{19}NO_3$, 285.16. **m.p.** 247.

72 **Isonaphthazarin.** (2, 3(or 3, 4)-*dihydroxy*-1, 4-*naphthoquinone*). $C_{10}H_4$-$O_2(OH)_2$, 190.05. Or-red leaf. **m.p.** 280, **b.p.** subl. **Soly.** sl.s.w.; s.al.; sl.s.et.; s.alk., acet.; sl.s.chl., bz.

73 **Isonicoteine.** $C_{10}H_{12}N_2$, 160.11. Liq., *n* 1.5749. **D.** 1.098^{20}_{4}, **b.p.** 293. **Soly.** ∞ w.; ∞ et.

74 **Isonicotine.** $C_{10}H_{14}N_2$, 162.13. Cr. **m.p.** 78, **b.p.** 260 d.

75 **Isonicotinic acid** (4-*pyridinecarboxylic acid**). C_5H_4NCOOH, 123.05. Col.need. **m.p.** 317, **b.p.** subl., d. **Soly.** sl.s.c., v.s.h.w.; v.sl.s.al.; v.sl.s. et.

76 **Isonicotinic anhydride.** $(C_5H_4$-$NCO)_2O$, 228.08. **m.p.** 103–4.

Isonitriles. See *Ethyl isocyanide, Methyl isocyanide*, etc.

77 **Isoöctane.** See *Nos.* 4467, 6511.

78 **Isopentane.** See *Butane, 2-methyl-**.

79 **Isophthalaldehyde** (1, 3-*benzenedicarbonal*; m-phthalic aldehyde*). C_6-$H_4(CHO)_2$, 134.05. Need. **m.p.** 89.5. **Soly.** sl.s.w.; v.s.al.; i.pet.eth.

80 **Isophthalaldehydic acid** (*m-formylbenzoic acid*). $CHOC_6H_4COOH$, 150.05. Need.f.w. **m.p.** 175(164–6). **Soly.** $4.94^{99.7}$w.; v.s.al.; v.s.et.

81 —, **2-hydroxy-** (*3-formyl-2-hydroxybenzoic acid*). $CHOC_6H_3(OH)COOH$, 166.05. Need. **m.p.** 179. **Soly.** 6^{100} w.; s.al.

82 —, **4-hydroxy-** (*3-formyl-4-hydroxybenzoic acid*). $CHOC_6H_3(OH)COOH$, 166.05. Pr. **m.p.** 243–4, **b.p.** subl. **Soly.** s.h.w.; s.al.; s.et.

83 —, **6-hydroxy-** (*5-formyl-2-hydroxybenzoic acid*). $CHOC_6H_3(OH)COOH$, 166.05. Need. **m.p.** 248–9. **Soly.** 0.7^{100}w.; s.al.; s.et.

84 **Isophthalic acid** (1, 3-*benzenedicarboxylic acid*; m-phthalic acid*). C_6-$H_4(COOH)_2$, 166.05. Col.need.f.h.w. **m.p.** 330: 312–4, **b.p.** subl. **Soly.** 0.013^{25}, 0.22h.w.; s.al.; i.bz.

85 —, diethyl ester (*ethyl m-phthalate*). $C_6H_4(COOC_2H_5)_2$, 222.11. Col.liq. **b.p.** 285.

86 —, dimethyl ester (*dimethyl* 1, 3-*benzenedicarboxylate*; methyl isophthalate*). $C_6H_4(COOCH_3)_2$, 194.08 Col.need.f.dil.al. **m.p.** 68. **Soly.** i.w.

87 —, **4, 6-dimethyl-.** See *α-Cumidic acid.*

88 —, **2-hydroxy-.** $HOC_6H_3(COOH)_2$, 182.05. Col.need.f.w. **m.p.** hyd. 239; anh. 244. **Soly.** 0.14, 2.5^{100}w.; v.s.al.; v.s.et.; sl.s.chl.

89 —, **4-hydroxy-.** $HOC_6H_3(COOH)_2$, 182.05. Col.need.f.w. **m.p.** 310(306), **b.p.** d. **Soly.** 0.3^{24}w.; v.s.al.; v.s.et.; s.h.ac.a.; i.chl.

90 —, **5-hydroxy-.** $HOC_6H_3(COOH)_2$, 182.05. Need.f.w. **m.p.** hyd. $-2H_2O$ 100; anh. 288. **Soly.** 0.06, 18^{100}w.; v.s.al.; v.s.et.; s.bz.

91 —, **5-methyl-.** See *Uvitic acid.*

92 —, **5-nitro-.** $NO_2C_6H_3(COOH)_2 \cdot 1\frac{1}{2}H_2O$, 238.07. Col.-grn.leaf. **m.p.** 255sl.d. **Soly.** 0.22^{25}w.; v.s.al.; v.s.et.

93 **Isophthalonitrile** (1, 3-*benzenedicarbonitrile**; 1, 3-*dicyanobenzene*). $C_6H_4(CN)_2$, 128.05. Col.need. **m.p.** 161, **b.p.** subl. **Soly.** sl.s.w.; s.h.al.; s.et.; i.lgr.

94 **Isophthalyl chloride** (1, 3-*benzenedicarbonyl chloride*; m-phthalyl dichloride*). $C_6H_4(COCl)_2$, 202.95. Cr. **m.p.** 41, **b.p.** 276. **Soly.** d.w.; d.al.; s.et.

95 **Isoprene** (*2-methyl*-1, 3-*butadiene*; β-methylbivinyl; hemiterpene*). CH_2:-$CHC(CH_3)$:CH_2, 68.06. Col.liq., *n* $1.4221^{18.3}$. **D.** 0.6806^{20}_{4}, **m.p.** −120, **b.p.** 34. **Soly.** i.w.; ∞ al.; ∞ et.

96 **Isopropenyl bromide.** See *Propene, 2-bromo-**.

97 **Isopropenyl chloride.** See *Propene 2-chloro-**.

Isopropyl. For isopropyl derivatives see the parent compounds (e.g., for isopropylbenzene see *Benzene, isopropyl-*). For isopropyl esters of organic acids see the acids.

98 **Isopropyl alcohol** (*2-propanol*; dimethylcarbinol*). $CH_3CHOHCH_3$, 60.06. Col.liq., *n* 1.37757. **D.** 0.7854^{20}_{4}, **m.p.** 88.5, **b.p.** 82.3. **Soly.** ∞ w.; ∞ al.; ∞ et.

99 **Isopropylamine.** $(CH_3)_2CHNH_2$, 59.08. Col.liq., *n* $1.37698^{15.4}$. **D.** 0.694^{15}_{4}; 0.690^{20}_{4}, **m.p.** −101.2, **b.p.** 34. **Soly.** ∞ w.; ∞ al.; ∞ et.

00 **Isopropyl bromide** (*2-bromopropane**). $CH_3CHBrCH_3$, 122.97. Col. liq., *n* 1.42508. **D.** 1.310^{20}_{4}, **m.p.** −89, **b.p.** 59.6. **Soly.** 0.32^{20}w.; ∞al.; ∞et.

01 **Isopropyl chloride** (*2-chloropropane**). $CH_3CHClCH_3$, 78.51. Col. liq. **D.** 0.8590^{20}_{4}, **m.p.** −117, **b.p.** 35.4(34.8)(36.5). **Soly.** $0.344^{12.5}$w.; ∞al.; ∞et.

02 **Isopropyl cyanide.** See *Isobutyronitrile.*

03 **Isopropyl ether** (*2-isopropoxypropane*; diisopropyl ether*). $(CH_3)_2CHOCH(CH_3)_2$, 102.11. Col.liq. **D.** 0.7258^{20}_{4}, **m.p.** −60, **b.p.** 67.5 (68.5–9.0). **Soly.** 0.2w.; ∞al.; ∞et.

04 **Isopropyl fluoride** (*2-fluoropropane**). CH_3CHFCH_3, 62.05. Gas, **b.p.** −11.

05 **Isopropylidene chloride.** See *Propane, 2, 2-dichloro-**.

06 **Isopropyl iodide** (*2-iodopropane**). CH_3CHICH_3, 169.97. Liq., *n* 1.49969. **D.** 1.703^{20}_{4}, **m.p.** −90.8, **b.p.** 89.5. **Soly.** 0.14^{20}w.; ∞al.; ∞et.

07 **Isopropyl isocyanide.** $(CH_3)_2CHNC$, 69.06. Col.liq. **D.** 0.7596^{0}_{4}, **b.p.** 87. **Soly.** i.w.; ∞al.; ∞et.

08 **Isopropyl mercaptan.** See *2-Propanethiol**.

09 **Isopropyl mustard oil.** See *Isothiocyanic acid, isopropyl ester.*

10 **Isopropyl nitrate** (*2-propanol nitrate*). $(CH_3)_2CHNO_3$, 105.06. Liq. **D.** 1.036^{20}_{4}, **b.p.** 102.

11 **Isopropyl nitrite** (*2-propanol nitrite*). $(CH_3)_2CHONO$, 89.06. Liq. **D.** 0.844^{25}_{4}, **b.p.** 45.

12 **Isopropyl sulfide** (*2-(isopropylthio)-propane*; diisopropyl sulfide*) $(CH_3)_2CHSCH(CH_3)_2$, 118.17. Liq. **b.p.** 120.4. **Soly.** i.w.; s.al.; s.et.

13 **Isopurpurin.** See *Anthrapurpurin.*

14 **Isoquinoline** (*benzo[c]pyridine; 2-benzazine; leucoline*). $C_6H_4CH{:}NCH{:}CH$ (ring), 129.06. Col.pl. or liq., *n* $1.62233^{25.1}$. **D.** 1.0986^{20}_{4}, **m.p.** 23, **b.p.** 243. **Soly.** v.sl.s.w.

15 —, **nitro-.** $NO_2C_9H_6N$, 174.06. Need.f.w. **m.p.** 110. **Soly.** s.h.w.; s.al.

16 —, **1, 2, 3, 4-tetrahydro-6-methoxy-1-methyl-7, 8-methylenedioxy-.** See *Anhalonine.*

17 **1-Isoquinolinol, 1(2)-Isoquinolone.** See *Isocarbostyril.*

18 **Isosaccharic acid** (*tetrahydro-3, 4-dihydroxy-2, 5-furandicarboxylic acid*). $COOHCH(CHOH)_2CHCOOH$ (O bridge), 192.06. Rhomb. **m.p.** 185, **b.p.** d. **Soly.** s.w.; s.al.; v.sl.s.et.

19 **Isosafrole** (*3, 4-methylenedioxy-1-propenylbenzene*). $CH_2(O_2)C_6H_3CH{:}CHCH_3$, 162.08. *cis:* *n* 1.5632^{15}. **D.** 1.107^{15}_{4}, **m.p.** <−18, **b.p.** 242–3. **Soly.** i.w.; s.al. *trans:* *n* 1.5736^{15}. **D.** 1.123^{15}_{4}, **b.p.** 248–52. **Soly.** i.w.; s.al.

20 **Isosuccinic acid** (*2-methylpropanedioic acid*; methylmalonic acid*). $CH_3CH(COOH)_2$, 118.05. Col.pr. or need. **D.** 1.455^{20}_{4}, **m.p.** 135 d. (129). **Soly.** 44.3^0, 66^{20} w.; v.s.al.; v.s.et.

21 —, **α-hydroxy-.** See *α-Isomalic acid.*

22 **Isothebaine(*d*).** $C_{19}H_{21}NO_3$, 311.17. Rhomb.f.al. or et. **m.p.** 203–4.

23 —, sulfate. $(C_{19}H_{21}NO_3)_2{\cdot}H_2SO_4$, 720.42. **m.p.** 120–1 d.

24 **Isothiocyanic acid,** allyl ester (*2-propenyl isothiocyanate*; allyl mustard oil*). $CH_2{:}CHCH_2NCS$, 99.11. Col. oil, *n* 1.52212^{24}. **D.** 1.0155^{15}_{4}, **m.p.** −100, **b.p.** 150.7. **Soly.** 0.2w.; v.s.al.; v.s.et.; s.bz., CS_2.

25 —, amyl ester (*n-amyl mustard oil*). $CH_3(CH_2)_4NCS$, 129.15. Liq. **b.p.** 193.4. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

26 —, benzyl ester (*benzyl mustard oil*). $C_6H_5CH_2NCS$, 149.12. Liq. **D.** 1.125^{15}_{4}, **b.p.** 243; 125^{12}. **Soly.** i w.; ∞al.; s.et.

27 —, *p*-biphenylyl ester. See "xenyl ester," below.

28 —, butyl ester (*butyl mustard oil*). $CH_3(CH_2)_2CH_2NCS$, 115.14. Liq. **D.** 0.946^{20}_{4}, **b.p.** 167. **Soly.** i.w.; v.s.al.; v.s.et.

29 —, *sec*-butyl ester (*α-methylpropyl isothiocyanate*; sec-butyl mustard oil*). $C_2H_5CH(CH_3)NCS$, 115.14. Liq. **D.** 0.944^{12}_{4}, **b.p.** 159.5(159–63). **Soly.** i.w.; s.al.; s.et. *d* form: $[\alpha]^{20}_{D}$ 61.88°. **D.** 0.943^{20}_{4}.

30 —, *tert*-butyl ester (*α, α-dimethylethyl isothiocyanate*; tert-butyl mustard oil*). $(CH_3)_3CNCS$, 115.14. Liq. **D.** 0.9187^{10}_{4}, **m.p.** 10.5, **b.p.** 140^{770}. **Soly.** i.w.; s.al.; s.et.

31 —, ethyl ester (*ethyl mustard oil*). C_2H_5NCS, 87.11. Col.liq., *n* 1.5134. **D.** 1.004^{18}_{4}; 0.995^{20}_{4}, **m.p.** −5.9, **b.p.** 132(131.2^{733}). **Soly.** i.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

32 Isothiocyanic acid, isoamyl ester (*γ-methylbutyl isothiocyanate**). $C_5H_{11}NCS$, 129.15. Yel.liq. **D.** 0.942^{20}_{4}, **b.p.** 182. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

33 —, isobutyl ester (*isobutyl mustard oil; β-methylpropyl isothiocyanate**). $(CH_3)_2CHCH_2NCS$, 115.14. Liq. **D.** 0.943^{20}_{4}, **b.p.** 162. **Soly.** i.w.; s.al.; s.et.

34 —, isopropyl ester (*isopropyl mustard oil*). $(CH_3)_2CHNCS$, 101.12. Liq. **b.p.** 137–7.5.

35 —, methyl ester (*methyl mustard oil*). $CH_3N{:}CS$, 73.09. Col.cr., *n* $1.5258^{37.2}$. **D.** 1.069^{37}_{4}, **m.p.** 35, **b.p.** 119. **Soly.** v.sl.s.w.; ∞al.; v.s.et.

36 —, phenyl ester (*phenyl mustard oil*). C_6H_5NCS, 135.11. Col.liq., *n* $1.64918^{23.4}$. **D.** 1.135^{16}_{4}; 1.1297^{24}_{4}, **m.p.** −21, **b.p.** 218.5. **Soly.** i.w.; s.al.; s.et.

37 —, propyl ester (*n-propyl mustard oil*). $CH_3CH_2CH_2NCS$, 101.12. Liq. **D.** 0.9909^{0}_{4}; 0.978^{16}_{4}, **b.p.** 152.7^{743}. **Soly.** v.sl.s.w.; ∞al.; ∞et.

38 —, *o*-tolyl ester (*o-tolyl mustard oil*). $CH_3C_6H_4NCS$, 149.12. Col. oil. **D.** 1.104^{25}_{25}, **b.p.** 239. **Soly.** i.w.; v.s.al.; ∞et.

39 —, *p*-tolyl ester (*p-tolyl mustard oil*). $CH_3C_6H_4NCS$, 149.12. Need.f.et. **D.** 1.087^{25}_{25}, **m.p.** 26, **b.p.** 237. **Soly.** i., d.h.w.; v.s., d.h.al.; v.s.et.

40 —, xenyl ester (*xenyl mustard oil; p-biphenylyl isothiocyanate; p-biphenylyl mustard oil*). $C_6H_5C_6H_4NCS$, 211.14. Need.f.et. **m.p.** 58. **Soly.** v.s.et.

41 Isovaleraldehyde (*3-methylbutanal*; isoamyl aldehyde*). $(CH_3)_2CHCH_2CHO$, 86.08. Col.liq., *n* 1.3902. **D.** 0.803^{17}_{4}; 0.7845^{20}_{20}, **m.p.** −51, **b.p.** 92.5. **Soly.** sl.s.w.; s.al.; s.et.

42 —, oxime (*3-methylbutanal oxime**). $(CH_3)_2CHCH_2CH{:}NOH$, 101.09. *n* $1.43645^{22.1}$. **D.** 0.8934^{20}_{4}, **m.p.** 48.5, **b.p.** 164–5.

42₁ Isovaleramide (*3-methylbutanamide*; isopropylacetamide*). $(CH_3)_2CHCH_2CONH_2$, 101.09. Monocl.pl.f.al. **D.** 0.965^{20}_{4}, **m.p.** 135, **b.p.** 230–2. **Soly.** s.w.; s.al.; s.et.

43 Isovaleric acid (*3-methylbutanoic acid*; isopropylacetic acid*). $(CH_3)_2CHCH_2COOH$, 102.08. Col.liq., *n* $1.40178^{22.4}$. **D.** 0.937^{15}_{4}, **m.p.** −37.6 (−51), **b.p.** 176.7. **Soly.** 4.2^{20}w.; ∞al.; ∞et.; s.chl.

44 —, allyl ester (*allyl isovalerate; 2-propenyl 3-methylbutanoate**). $(CH_3)_2CHCH_2CO_2C_3H_5$, 142.11. Liq. **b.p.** 155. **Soly.** v.sl.s.w.; ∞al.; ∞et.

45 —, ethyl ester. $(CH_3)_2CHCH_2COOC_2H_5$, 130.11. Col.liq., *n* $1.39671^{18.3}$. **D.** 0.8657^{20}_{4}, **m.p.** −99.3, **b.p.** 135. **Soly.** 0.17^{20}w.; ∞al.; ∞et.; ∞bz.

46 —, isoamyl ester (*isoamyl isovalerate; γ-methylbutyl 3-methylbutanoate**). $(CH_3)_2CHCH_2COOC_5H_{11}$, 172.16. Col. liq., *n* 1.41311^{19}. **D.** 0.8584^{12}_{0} (0.870^{0}), **b.p.** 194. **Soly.** v.sl.s.w.; s.al.; s.et.

47 —, isobutyl ester (*isobutyl isovalerate; β-methylpropyl 3-methylbutanoate**). $(CH_3)_2CHCH_2COOCH_2CH(CH_3)_2$, 158.14. Col.liq. *n* 1.4060. **D.** 0.854^{20}_{4}, **b.p.** 168.5. **Soly.** i.w.; ∞al.; ∞et.

48 —, methyl ester (*methyl 3-methylbutanoate*; methyl isovalerate*). $(CH_3)_2CHCH_2COOCH_3$, 116.09. Col. liq. **D.** 0.881^{20}_{4}, **b.p.** 116.7. **Soly.** v.sl.s.w.; ∞al.; ∞et.

49 —, *p*-phenylphenacyl ester. $(CH_3)_2CHCH_2COOCH_2COC_6H_4C_6H_5$, 296.16. **m.p.** 76.

50 —, piperazinium salt. $C_4H_{10}N_2{\cdot}2C_4H_9COOH$, 290.25. Wh.cr. **m.p.** 139–40. **Soly.** s.w.; s.al.; i.et.; s.h.acet.

51 —, propyl ester (*n-propyl isovalerate*). $(CH_3)_2CHCH_2COOC_3H_7$, 144.12. Col. liq., *n* 1.4036. **D.** 0.863^{20}_{4}, **b.p.** 155.9. **Soly.** i.w.; ∞al.; ∞et.

52 —, **α-amino-.** See *Valine.*

53 —, **β-amino-** (*3-amino-3-methylbutanoic acid**). $(CH_3)_2C(NH_2)CH_2COOH$, 117.09. Pr. **m.p.** 217, **b.p.** subl. >180. **Soly.** s.w.; sl.s.al.; i.et.

54 —, **α-bromo-** (*2-bromo-3-methylbutanoic acid**). $(CH_3)_2CHCHBrCOOH$, 180.99. Col.pr. **m.p.** 44, **b.p.** 230; 150^{40}. **Soly.** 70–80c.w.; v.s.al.; s.et.

55 —, **α-hydroxy-**(*i*) (*2-hydroxy-3-methylbutanoic acid**). $(CH_3)_2CHCHOHCOOH$, 118.08. Rhomb. **m.p.** 86, **b.p.** subl. **Soly.** v.s.w.; v.s.al.; v.s.et.

56 —, **β-hydroxy-** (*3-hydroxy-3-methyl butanoic acid**). $(CH_3)_2COHCH_2COOH$, 118.08. Syrup. **m.p.** <−32. **Soly.** v.s.w.; v.s.al.; v.s.et.

57 Isovalerone. See *4-Heptanone, 2, 6-dimethyl-**.

58 Isovaleronitrile (*3-methylbutanenitrile*; isobutyl cyanide*). $(CH_3)_2CHCH_2CN$, 83.08. Col.liq. **D.** 0.802, **b.p.** 129.3. **Soly.** sl.s.w.; ∞al.; ∞et.

For explanations and abbreviations see beginning of table.

59 Isovalerophenone (*isobutyl phenyl ketone; 3-methyl-1-phenyl-1-butanone*). $(CH_3)_2CHCH_2COC_6H_5$, 162.11. Col. liq., *n* $1.51385^{15.3}$. **D.** 0.967, **b.p.** 225. **Soly.** i.w.; ∞al.; ∞et.

60 Isovaleryl chloride (*3-methylbutanoyl chloride**). $(CH_3)_2CHCH_2$-COCl, 120.53. Col.liq., *n* $1.41361^{24.3}$. **D.** 0.989^{20}_{4}, 0.9854^{24}_{4}, **b.p.** 113. **Soly.** d.w.; d.al.; s.et.

61 *dl*-Isovaline (*dl-α-amino-α-methylbutyric acid; dl-2-amino-2-methylbutanoic acid**). $CH_3CH_2C(NH_2)$-$(CH_3)COOH$, 117.09. Monocl.pr. **m.p.** 307–8 (closed tube), **b.p.** subl. 300. **Soly.** 39w.; 6.6h.al.; i.et.

62 Isovanillin (*3-hydroxyanisaldehyde; protocatechualdehyde 4-methyl ether*). $CH_3O(OH)C_6H_3CHO$, 152.06. Monocl. pr. or pl. **D.** 1.196, **m.p.** 116, **b.p.** 179_{15}. **Soly.** s.h.w.; s.al.; s.et.; v.s. chl.; sl.s.CS_2.

63 Isoxylic acid (2, 5-*dimethylbenzoic acid; 2, 5-xylic acid; p-xylic acid*). $(CH_3)_2C_6H_3COOH$, 150.08. Col.need. f.al. **D.** 1.069^{20}_{4}, **m.p.** 132(104), **b.p.** 268 (270–5) subl. **Soly.** v.sl.s.h. w.; v.s.al.; s.et.; s.acet., bz.

64 Isuretin. See *Formamide, oxime.*

65 Itaconic acid (*methylenebutanedioic acid*; methylenesuccinic acid*). $HOOCC(:CH_2)CH_2COOH$, 130.05. Rhomb. **D.** 1.632, **m.p.** 161 d., **b.p.** d. **Soly.** 8.33^{20}w.; 19.73^{15}, 88 %al.; sl.s.et.; v.sl.s.bz., chl., pet.eth.

66 —, γ, γ-dimethyl-. See *Teraconic acid.*

67 Itamalic acid, γ-lactone. See *Paraconic acid.*

68 Japaconine, acetylbenzoyl-. See *Japaconitine.*

69 Japaconitine (*acetylbenzoyl, japaconine; same as aconitine?*). $C_{34}H_{47}$-NO_{11}, 645.37. Col.need.f.al., et., or chl. $[\alpha]+17.3°_D$ in chl. **m.p.** 204.2 d. **Soly.** i.w.; s.h.al.; s.h.et.; v.s.acet.; s.chl.; v.sl.s.pet.eth.

70 Japan camphor. See *d-Camphor.*

71 Jervine. $C_{26}H_{37}NO_3 \cdot 2H_2O$, 447.33. Lng. grouped pr. **m.p.** 238–42. **Soly.** i.w.; s.al.; sl.s.et.; s.chl., acet.

72 Juglone (*5-hydroxy-1, 4-naphthoquinone; nucin*). $C_{10}H_5O_2(OH)$, 174.05. Red-br.pr.f.chl. **m.p.** 153–4, **b.p.** d. **Soly.** i.w.; sl.s.c.al.; sl.s.et.; v.s.chl.; s.h.ac.a.

73 Kairoline (*1-methyl-1, 2, 3, 4-tetrahydroquinoline*). $C_9H_{10}NCH_3$, 147.11 Liq., *n* $1.4802^{23.1}$. **D.** 1.021, **b.p.** 245.5. **Soly.** v.s.al.; sl.s.et.

74 Ketazine, dimethyl-. See *Acetone, azine.*

75 Ketene (*ethenone; carbomethene; keten*). $CH_2:CO$, 42.02. Col.gas. **m.p.** −151, **b.p.** −56(−41). **Soly.** d.w.; d.al.; s.et.; s.acet.

76 Ketine (2, 5-*dimethylpyrazine*). $N:C(CH_3)CH:NC(CH_3):CH$, 108.08. Col.liq. *n* $1.49921^{23.6}$ **D.** 0.990, **m.p.** 15, **b.p.** 155. **Soly.** ∞w.; ∞al.; ∞et.

77 Ketone, aminophenyl methyl. See *Acetophenone, amino-.*

78 —, aminophenyl phenyl. See *Benzophenone, amino-.*

79 —, amyl ethyl. See *3-Octanone*.*

80 —, amyl methyl. See *2-Heptanone*.*

81 —, *p*-anisyl methyl. See *Acetophenone, p-methoxy-.*

82 —, benzyl ethyl. See *2-Butanone, 1-phenyl-.*

83 —, benzyl methyl. See *2-Propanone, 1-phenyl-.*

84 —, benzyl 1-naphthyl (*α-phenyl-1-acetonaphthone*). $C_6H_5CH_2COC_{10}H_7$, 246.11. Pl.f.al. **m.p.** 66–7. **Soly.** i.w.; s.al.; s.et.

85 —, benzyl 2-naphthyl. $C_6H_5CH_2$-$COC_{10}H_7$, 246.11. Col.need.f.al. **m.p.** 99.5. **Soly.** s.al.; s.et.; s.chl., bz.

86 —, benzyl phenyl. See *Desoxybenzoin.*

87 —, bisaminophenyl. See *Benzophenone, diamino-.*

88 —, bischloromethyl. See *2-Propanone, 1, 3-dichloro-*.*

89 —, bishydroxyphenyl. See *Benzophenone, dihydroxy-.*

90 —, α-bromoisopropyl 2-mesityl. See *Isobutyrophenone, α-bromo-2, 4, 6-trimethyl-.*

91 —, 5-bromo-2-thienyl methyl (*2-acetyl-5-bromothiophene*). CH_3COC_4-H_2BrS, 205.02. Col.need. **m.p.** 94. **Soly.** sl.s.c., v.s.h.al.

92 —, butyl methyl. See *2-Hexanone*.*

93 —, *sec*-butyl methyl. See *2-Pentanone, 3-methyl-*.*

94 —, *tert*-butyl methyl. See *Pinacolin.*

95 —, butyl phenyl. See *Valerophenone.*

96 —, carvacryl methyl. See *Acetophenone, 5-isopropyl-2-methyl-.*

* Name approved by the International Union of Chemistry.

97 Ketone, 5-chloro-2-thienyl methyl (*2-acetyl-5-chlorothiophene*). CH_3CO-C_4H_2ClS, 160.56. Pl. **m.p.** 52. **Soly.** v.s.al.; v.s.et.

98 —, **cinnamyl methyl.** See *Acetone, benzal-*.

99 —, **cyclobutyl phenyl** (*benzoylcyclobutane; benzoyltetramethylene*). $C_6H_5COCH(CH_2)_3$, 160.09. **b.p.** 258.

00 —, **dibenzyl.** See *2-Propanone, 1, 3-diphenyl-**.

01 —, **dibutyl.** See *5-Nonanone**.

02 —, **dichloromethyl methyl.** See *2-Propanone, 1, 1-dichloro-**.

03 —, **dicinnamyl.** See *Styryl ketone.*

04 —, **diethyl.** See *3-Pentanone**.

05 —, **dihendecyl.** See *12-Tricosanone**.

06 —, **diheptadecyl.** See *18-Pentatriacontanone**.

07 —, **diheptyl.** See *8-Pentadecanone**.

08 —, **dihexyl.** See *7-Tridecanone**.

09 —, **2, 5-dihydroxyphenyl phenyl.** See *Benzophenone, 2, 5-dihydroxy-*.

10 —, **diisoamyl.** See *5-Nonanone, 2, 8-dimethyl-**.

11 —, **diisobutyl.** See *4-Heptanone, 2, 6-dimethyl-**.

12 —, **diisopropyl.** See *3-Pentanone, 2, 4-dimethyl-**.

13 —, **dimethyl.** See *Acetone.*

14 —, **dinaphthyl.** See *Naphthyl ketone.*

15 —, **dinonyl.** See *10-Nonadecanone**.

16 —, **di-*n*-octyl.** See *9-Heptadecanone**.

17 —, **dipentadecyl.** See *16-Hentriacontanone**.

18 —, **dipentyl.** See *6-Hendecanone**.

19 —, **diphenyl.** See *Benzophenone.*

20 —, **diphenylene.** See *9-Fluorenone**.

21 —, **dipropyl.** See *4-Heptanone**.

22 —, **distyryl.** See *Styryl ketone.*

23 —, **2, 2′-dithienyl-.** See *2-Thienyl ketone.*

24 —, **di-*p*-tolyl.** See *Benzophenone, 4, 4′-dimethyl-*.

25 —, **diundecyl.** See *12-Tricosanone**.

26 —, **ethyl butyl.** See *3-Heptanone**.

27 —, **ethyl heptyl.** See *3-Decanone**.

28 —, **ethyl hexyl.** See *3-Nonanone**.

29 —, **ethyl isoamyl.** See *3-Heptanone, 6-methyl-**.

30 —, **ethyl isobutyl.** See *3-Hexanone, 5-methyl-**.

31 —, **ethyl isopropyl.** See *3-Pentanone, 2-methyl-**.

32 —, **ethyl methyl.** See *2-Butanone**

33 —, **ethyl naphthyl.** See *Propionaphthone.*

34 —, **ethyl octyl.** See *3-Hendecanone**.

35 —, **ethyl phenyl.** See *Propiophenone.*

36 —, **ethyl propyl.** See *3-Hexanone**.

37 —, **2-furyl methyl** (*2-acetylfuran*). $C_4H_3O\cdot COCH_3$, 110.05. Col.cr.f.pet. eth. **m.p.** 33. **b.p.** 173. **Soly.** i.w.; s.al.; s.et.

38 —, **2-furyl phenyl** (*2-benzoylfuran*). $C_4H_3O\cdot COC_6H_5$, 172.06. Liq. **D.** $1.1839\frac{18}{8}$, **b.p.** 285. **Soly.** i.w.; s.al.; s.et.

39 —, **hendecyl methyl.** See *2-Tridecanone**.

40 —, **heptyl methyl.** See *2-Nonanone**.

41 —, **hexyl methyl.** See *2-Octanone**.

42 —, **hexyl propyl.** See *4-Decanone**.

43 —, **1-hydroxy-2-naphthyl methyl.** See *2-Acetonaphthone, 1-hydroxy-*.

44 —, **1-hydroxy-2-naphthyl propyl.** See *2-Butyronaphthone, 1-hydroxy-*.

45 —, **1-hydroxy-2-naphthyl styryl.** See *2-Acrylonaphthone, 1-hydroxy-β-phenyl-*.

46 —, **hydroxyphenyl hydroxyphenyl.** See *Benzophenone, dihydroxy-*.

47 —, **isoamyl methyl.** See *2-Hexanone, 5-methyl-**.

48 —, **isoamyl phenyl.** See *Isocaprophenone.*

49 —, **isobutyl methyl.** See *2-Pentanone, 4-methyl-**.

50 —, **isobutyl phenyl.** See *Isovalerophenone.*

51 —, **isobutyl propyl.** See *4-Heptanone, 2-methyl-**.

52 —, **α-isonitrosobutyl methyl.** See *2, 3-Hexanedione, 3-oxime**.

53 —, **α-isonitrosoethyl methyl.** See *2, 3-Butanedione, mono-oxime**.

54 —, **α-isonitrosopropyl methyl.** See *2, 3-Pentanedione, 3-oxime**.

55 —, **isopropyl methyl.** See *2-Butanone, 3-methyl-**.

56 —, **isopropyl phenyl.** See *Isobutyrophenone.*

57 —, **methyl naphthyl.** See *Acetonaphthone.*

58 —, **methyl nonyl.** See *2-Hendecanone**.

For explanations and abbreviations see beginning of table.

59 **Ketone, methyl octyl.** See 2-*Decanone**.

60 —, **methyl phenacyl.** See *Acetone, benzoyl-*.

61 —, **methyl phenyl.** See *Acetophenone*.

62 —, **methyl propyl.** See 2-*Pentanone**.

63 —, **methyl styryl.** See *Acetone, benzal-*.

64 —, **methyl 2-thienyl** (*2-acetylthiophene; α-acetothienone*). $CH_3COC_4H_3S$, 126.11. Col.oil. **D.** 1.167^{24}, **m.p.** 9, **b.p.** 213.5. **Soly.** v.s.et.

65 —, **methyl *p*-tolyl.** See *Acetophenone, p-methyl-*.

66 —, **1-naphthyl phenyl.** $C_{10}H_7COC_6H_5$, 232.09. Rhomb.f.al. **m.p.** 75.5, **b.p.** 385. **Soly.** i.w.; 2.4^{12}al.

67 —, **2-naphthyl phenyl.** $C_{10}H_7COC_6H_5$, 232.09. Rhomb.need.f.al. **m.p.** 82, **b.p.** 398^{754}. **Soly.** i.w.; 2.01^{12}al.

68 —, **nitrophenyl phenyl.** See *Benzophenone, nitro-*.

69 —, **phenyl propyl.** See *Butyrophenone*.

70 —, **phenyl styryl.** See *Chalcone*.

71 —, **phenyl *o*-tolyl.** $C_6H_5COC_6H_4CH_3$, 196.09. Col.liq. **m.p.** < -18, **b.p.** 316. **Soly.** i.w.; ∞al.; ∞et.

72 —, **phenyl *m*-tolyl.** $C_6H_5COC_6H_4CH_3$, 196.09. Col.liq. **D.** 1.088^{18}, **b.p.** 316.5. **Soly.** i.w.; ∞al.; ∞et.; ∞chl., bz.

73 —, **phenyl *p*-tolyl** $C_6H_5COC_6H_4CH_3$, 196.09 Monocl., n 1.717, 1.563. **m.p.** 60, **b.p.** 326.5. **Soly.** i.w.; s.al.; v.s.et.; v.s.bz.

74 —, **phenyl trityl.** See *β-Benzopinacolin*.

75 **Ketoxime, methyl ethyl.** See 2-*Butanone**, *oxime*.

76 —, **methyl isopropyl.** See 2-*Butanone*, 3-*methyl-**, *oxime*.

77 —, **methyl propyl.** See 2-*Pentanone**, *oxime*.

78 **Kojic acid** (*5-hydroxy-2-(hydroxymethyl)-1, 4-pyrone*). $OC(CH_2OH)$:CHCOC(OH):CH, 142.05. Col.prismatic need. **m.p.** 152–4. **Soly.** 3.95^{20}, 6.90^{35}w.; s.al.; sl.s.et.

79 **Kynurenic acid** (*4-hydroxyquinaldic acid*). $C_9H_5N(OH)COOH$, 189.06. Need. **m.p.** ($-H_2O$, 140–5) anh. 257–8. **Soly.** 0.9^{100}w.; s.h.al.; sl.s.et.

80 **Kynurine.** See 4-*Quinolinol*.

81 **Labordin.** See *Analgen*.

82 **Lactamide** (*2-hydroxypropanamide*; lactic amide*). $CH_3CHOHCONH_2$, 89.06. Col.hyg.cr. **D.** 1.138^{80}_{4}, **m.p.** 74. **Soly.** v.s.w.; v.s.al.

83 **Lactic acid** (*dl*) (*ordinary lactic acid; lactic acid of fermentation; 2-hydroxypropanoic acid*; α-hydroxypropionic acid*). $CH_3CHOHCOOH$, 90.05. Col. hyg.syrup., n 1.4414. **D.** 1.249^{15}, **m.p.** 18, **b.p.** 122^{15}. **Soly.** ∞w.; ∞al.; ∞et.

84 —, benzoate (*O-benzoyllactic acid*). $CH_3CH(OOCC_6H_5)COOH$, 194.08. Pl. **m.p.** 112. **Soly.** 0.25c., s.h.w.; s.al.; s.et.; hyd. by h.dil.H_2SO_4.

85 —, butyl ester (*butyl lactate*). $CH_3CHOHCOOC_4H_9$, 146.11. Liq. **D.** 0.968, **b.p.** 160–90(75–77^{6}). **Soly.** sl.s.w.; ∞al.; ∞et.

86 —, ethyl ester (*ethyl 2-hydroxypropanoate*; ethyl lactate*). $CH_3CHOHCOOC_2H_5$, 118.08. Col.liq. **D.** 1.031^{20}_{4}, **b.p.** 154 (150–2). **Soly.** ∞w.; v.s.al.; v.s.et.

87 —, methyl ester (*methyl 2-hydroxypropanoate*; methyl lactate*). $CH_3CHOHCOOCH_3$. 104.06. Col.liq., n 1.4156^{16}. **D.** 1.118^{0}_{4}; 1.08^{16}, **b.p.** 144.8. **Soly.** s.d.w.; s.al.; s.et.

88 —, *p*-phenylphenacyl ester. $CH_3CHOHCOOCH_2COC_6H_4C_6H_5$, 284.12. **m.p.** 145.

89 —, piperazinium salt. $C_4H_{10}N_2{\cdot}2C_3H_6O_3$, 266.19. Wh.cr. **m.p.** 96–6.5. **Soly.** s.w.; s.h.al.; i.et.; s.h.cellosolve.

90 **Lactic acid** (*d*) (*d-2-hydroxypropanoic acid*; d-α-hydroxypropionic acid; sarcolactic acid; paralactic acid*). $CH_3CHOHCOOH$, 90.05. Hyg.pr. or syrupy liq. **D.** 1.2485, **m.p.** 26, **b.p.** d. **Soly.** ∞w.; ∞al.; ∞et.

91 —, **benzal-.** See 3-*Butenoic acid, 2-hydroxy-4-phenyl-*.

92 —, ***O*-benzoyl-.** See *Lactic acid, benzoate*.

93 —, ***α*-phenyl-.** See *Atrolactic acid*.

94 —, ***β, β, β*-trichloro-.** $CCl_3CHOHCOOH$, 193.39. Pr.f.et. **m.p.** 124, **b.p.** 170^{45}. **Soly.** v.s.w.; v.s.al.; v.s.et.; s.chl.

95 **Lactic amide.** See *Lactamide*.

96 **Lactic anhydride** (*2-hydroxypropanoic anhydride**). $(CH_3CHOHCO)_2O$, 162.08. Lt.yel.amor. **m.p.** 260 d., **b.p.** d. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

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97 **Lactide** (*3, 6-dimethyl-2, 5-p-dioxandione*). $OCOCH(CH_3)OCOCH(CH_3)$, 144.06. Col.monocl.tab.f.al. **D.** 0.862^{20}_{4}, **m.p.** 125, **b.p.** 255. **Soly.** v.sl.s.c.w.; v.sl.s.al.

98 **Lactobiose.** See *Lactose.*

99 **Lactonic acid.** See *Galactonic acid.*

00 **Lactonitrile** (*2-hydroxypropanenitrile*; acetaldehyde cyanohydrin; ethylidene cyanohydrin*). $CH_3CH(OH)CN$, 71.05. Col.liq. **D.** 0.992, **m.p.** −40, **b.p.** 182–4sl.d. **Soly.** s.w.; s.al.; s.et.; i.pet.eth.

01 **Lactose** (*milk sugar; lactobiose*). $C_{12}H_{22}O_{11}\cdot H_2O$, 360.19. Col.rhomb., *n* 1.517, 1.542, 1.555. **D.** 1.525^{20}_{4}, **m.p.** anh.201.6, **b.p.** d. **Soly.** 17c., 40h.w.; i.al.; i.et.; i.chl.

02 **Lanthopine.** $C_{20}H_{25}NO_4$, 343.20. Cr. **m.p.** 200. **Soly.** sl.s.al.; sl.s.et.

03 **Lappaconatine.** $C_{34}H_{48}N_2O_8$ or $C_{32}H_{42}N_2O_9$, 612.39 or 598.34. Hex.cr. **m.p.** 205. **Soly.** sl.s.w.; s.al.; s.et.

04 **Laudanidine** (*l-laudanine; tritopine*). $C_{20}H_{25}NO_4$, 343.20. Hex.pr.f.w.+al. **m.p.** 166. **Soly.** i.w.; s.al.; sl.s.et.; s.bz., chl.

05 *dl*-**Laudanine** $C_{20}H_{25}NO_4$, 343.20. Sm.trim.ylsh.wh.pr. **m.p.** 166. **Soly.** sl.s.al.; 0.154^{18}et.; s.chl., bz.

06 *l*-**Laudanine.** See *Laudanidine.*

07 *d*-**Laudanosine.** $C_{21}H_{27}NO_4$, 357.22. Need.f.bz., $[\alpha]^{15}_{D}+103.23°$. **m.p.** 89–90. **Soly.** i.w.; s.al.; 5.18^{16}et.; s.chl., h.bz.

08 **Lauraldehyde** (*dodecanal**). $CH_3(CH_2)_{10}CHO$, 184.19. Col.leaf. **D.** 0.8352^{15}_{4}, **m.p.** 44.5, **b.p.** 185^{100}. **Soly.** i.w.; s.al.; s.et.

09 **Laurel camphor.** See *d-Camphor.*

10 **Laurent's acid.** See *1-Naphthylamine-5-sulfonic acid.*

11 **Lauric acid** (*dodecanoic acid**). $CH_3(CH_2)_{10}COOH$, 200.19. Col.need.f.al. *n* $1.4183^{82.1}$. **D.** 0.883; 0.8679^{50}_{4}, **m.p.** 44 (48), **b.p.** 225^{100}. **Soly.** i.w.; 26°, 134^{21}al.; v.s.et.; 142^{21}me.al.; s.bz.

12 —, benzyl ester. $C_{11}H_{23}COOCH_2C_6H_5$, 290.23. Liq. **D.** 0.9457^{25}_{25}, **m.p.** 8.5, **b.p.** 209–11^{12}. **Soly.** i.w.; s.al.; v.s.et.

13 —, ethyl ester (*ethyl dodecanoate*; ethyl laurate*) $CH_3(CH_2)_{10}COOC_2H_5$, 228.22. Oil, *n* 1.4321. **D.** 0.8615^{20}_{4}, **m.p.** −10.7(−1.68), **b.p.** 269. **Soly.** i.w.; v.s.al.; ∞et.

14 —, ethylene ester. See *Glycol, dilaurate.*

15 —, *p*-phenylphenacyl ester. $CH_3(CH_2)_{10}COOCH_2COC_6H_4C_6H_5$, 394.27. **m.p.** 84.

16 **Lauric anhydride** (*dodecanoic anhydride**). $(C_{11}H_{23}CO)_2O$, 382.36. Col. cr. **m.p.** 41, **b.p.** 166. **Soly.** i., d.w.; s., d.al.; v.s.et.

17 **Laurin.** See *Glycerol, trilaurate.*

18 **Laurone.** See 12-*Tricosanone*.*

19 **Lauronitrile** (*dodecanenitrile*; n-undecyl cyanide*). $CH_3(CH_2)_{10}CN$, 181.19. Oil. **D.** 0.8373^{15}, **m.p.** 4, **b.p.** 198^{100}. **Soly.** i.w.; sl.s.al.; v.s.et.

20 **Lauryl alcohol.** See 1-*Dodecanol*.*

21 **Lauryl bromide.** See *Dodecane, 1-bromo-*.*

22 **Lauryl chloride** (*dodecanoyl chloride**). $CH_3(CH_2)_{10}COCl$, 218.64. Col.liq. **m.p.** −17, **b.p.** 145^{18}. **Soly.** d.w.; d.al.; s.et.

23 **Lauryl ketone.** See 12-*Tricosanone*.*

24 **Lauth's violet.** See *Thionine.*

25 **Lead, hexaethyldi-** (*hexaethyldiplumbane; diplumbic hexaethyl; lead triethide*). $Pb_2(C_2H_5)_6$, 588.67. Liq. **D.** 1.471, **b.p.** d. **Soly.** i.w.

26 —, **tetraethyl-*** (*lead tetraethide*). $Pb(C_2H_5)_4$, 323.38. Col.liq., *n* 1.5218^{18}. **D.** 1.659^{18}, **b.p.** 198–202. **Soly.** i.w.; ∞al.; ∞et.; s. in all org.solv.; i.dil.ac., dil.alk.

27 —, **tetramethyl-*** (*tetramethylplumbane; lead tetramethyl*). $Pb(CH_3)_4$, 267.31. Col.liq., *n* 1.5128. **D.** 1.9951^{20}_{4}, **m.p.** −27.5, **b.p.** 110. **Soly.** i.w.; ∞al.; ∞et.

28 —, **tetraphenyl-*** (*tetraphenylplumbane*). $(C_6H_5)_4Pb$, 515.38. Wh.need. **m.p.** 227.7. **Soly.** s.bz.

29 **Lead triethide.** See *Lead, hexaethyldi-.*

30 **Lecanoric acid,** monomethyl ether. See *Evernic acid.*

32 **Lepidine** (*4-methylquinoline*). $CH_3C_9H_6N$, 143.08. Col.liq. **D.** 1.086^{20}_{4}, **m.p.** <0, **b.p.** 258–63. **Soly.** v.sl.s.w.; ∞al.; ∞et.; s.bz.

33 —, **2-(*p*-aminophenyl)-.** See *Flavaniline.*

34 **2(1)-Lepidone.** See *Carbostyril, 4-methyl-.*

35 *op₂*-**Leucaniline** (*o, p′, p″-methenyltrianiline; o, p′, p″-triaminotriphenylmethane; 2, 4′, 4″-triaminotritan*). $CH(C_6H_4NH_2)_3$, 289.17. Col.cr.f.al. **m.p.** 165. **Soly.** v.sl.s.h.w.; v.s.al.; v.sl.s.et.

For explanations and abbreviations see beginning of table.

36 ***mp*$_2$-Leucaniline** (*m, p′, p″-methenyltrianiline; m, p′, p″-triaminotriphenylmethane; 3, 4′, 4″-triaminotritan; pseudoleucaniline*). $CH(C_6H_4NH_2)_3$, 289.17. Rosettes f.et. **m.p.** 150. **Soly.** i.w.; s.al.; s.et.; v.sl.s.lgr.

37 ***p*$_3$-Leucaniline** (*paraleucaniline; p, p′, p″-methenyltrianiline; p, p′, p″-triaminotriphenylmethane; 4, 4′, 4″-triaminotritan*). $CH(C_6H_4NH_2)_3$, 289.17. Col.leaf.f.w. **m.p.** 148(207). **Soly.** i.w.; s.al.; s.bz.

38 **—, *N, N, N′, N′*-tetramethyl-** (*4-amino-4′, 4″-bisdimethylaminotriphenylmethane*). $[(CH_3)_2NC_6H_4]_2$-$CHC_6H_4NH_2$, 345.23. Glit.cr.f.al. **m.p.** 151–2. **Soly.** v.sl.s.al.

39 **Leucaurin** (*p, p′, p″-methenyltriphenol; leucoaurin*). $CH(C_6H_4OH)_3$, 292.12. Col.need.f.ac.a. **Soly.** sl.s.w.; s.al.; s.ac.a., alk.

40 ***l*-Leucic acid** (*2-hydroxy-4-methylpentanoic acid*; α-hydroxyisocaproic acid; leucinic acid*). $(CH_3)_2CHCH_2$-CHOHCOOH, 132.09. Need. or pl. f.et. + pet.eth. **m.p.** 72.5; (*dl*, 76–7), **b.p.** subl. 100. **Soly.** v.s.w.; v.s.al.; v.s.et.

41 ***dl*-Leucine** (*dl-α-aminoisocaproic acid*). $(CH_3)_2CHCH_2CH(NH_2)$-COOH, 131.11. Leaf.f.w. **m.p.** 332 d. (290). **Soly.** 0.99^{25}, 2.28^{75}w.; 0.176^{25} 75 %, 0.13^{25} 90 %al.

42 ***l*-Leucine** (*l-2-amino-4-methylpentanoic acid*; l-α-aminoisocaproic acid*). $(CH_3)_2CHCH_2CH(NH_2)$-COOH, 131.11. Hex.col.leaf.f.w., *n* 1.525, 1.535, 1.560. **D.** 1.293^{18}_{4}, **m.p.** 295; (*d.* 280 d.), **b.p.** subl. **Soly.** 2.43^{25}, 3.82^{75}w.; 0.072^{17} 99 %al.; i.et.; 10.9gl.ac.a.

43 **Leucoindigo.** See *Indigo white*.

44 **Leucoline.** See *Isoquinoline*.

45 **Leucomalachite green.** See *Aniline, p, p′-benzalbis-N, N-dimethyl-*.

46 **Levulin** (synthetic) (*fructosin; levulosin*). $(C_6H_{10}O_5)_x$, $(162.08)_x$. Deliq.amor. **m.p.** 140–5 d. **Soly.** ∞w.; 10^{22} 84 %, v.sl.s.al.; i.et.

47 **Levulinaldehyde** (*4-oxopentanal*; γ-ketovaleraldehyde; levulinic aldehyde*). $CH_3COCH_2CH_2CHO$, 100.06. Col.liq., *n* 1.4263. **D.** 1.018^{21}_{4}, **m.p.** < −21, **b.p.** 186–8 d. **Soly.** ∞w.; ∞al.; ∞et.

48 **Levulinic acid** (*4-oxopentanoic acid*; γ-ketovaleric acid; acetopropionic acid*). $CH_3COCH_2CH_2COOH$, 116.06. Col.leaf. **D.** 1.1395^{21}_{4}, **m.p.** 37.2, **b.p.** 246, 154^{14}. **Soly.** v.s.w.; v.s.al.; v.s.et.

49 **—, ethyl ester.** $CH_3CO(CH_2)_2COOC_2$-H_5 144.09. Col.liq. **D.** 1.01346^{21}_{4}, **b.p.** 205.2^{756}. **Soly.** v.s.w.; ∞al.; ∞et.

50 **Levulose.** See D-*Fructose*.

51 **Levulosin.** See *Levulin (synthetic)*.

52 **Licareol,** esters. See under *l-Linaloöl*.

53 **Lichenin** (*moss starch*). $(C_6H_{10}O_5)_x$, $(162.08)_x$. Wh.amor.powd. **Soly.** s.h.w.; i.al.; i.et.; s.conc.HCl.

54 **Lignoceric acid.** $C_{23}H_{47}CO_2H$, 368.37. Col.need.f.al. **D.** 0.8207, **m.p.** 81. **Soly.** s.al.; s.et.; s.bz., CS_2, ac.a.

55 ***dl*-Limonene** (*dipentene; dl-1, 8(9)-p-menthadiene*). $C_{10}H_{16}$, 136.12. Col. liq., *n* 1.473. **D.** 0.865^{18}; 0.845^{20}, **b.p.** 176(178–80). **Soly.** i.w.; s.al.; s.et.

56 ***d*-Limonene** (*d-1, 8(9)-p-menthadiene; citrene; carvene; hesperidene*). $C_{10}H_{16}$, 136.12. Col.liq., *n* $1.47489^{14.7}$. **D.** 0.842^{20}_{4}, **m.p.** −96.9, **b.p.** 177. **Soly.** i.w.; ∞al.; ∞et.

57 ***d*-Linaloöl** (*d-3, 7-dimethyl-1, 6-octadien-3-ol*; coriandrol*). $C_{10}H_{18}O$, 154.14. Col.liq., *n* 1.4623. **D.** 0.8622^{20}_{4}; *d.* 0.8702^{20}_{4}, **b.p.** 198.3. **Soly.** v.sl.s.w.; ∞al.; ∞et.

58 ***l*-Linaloöl,** acetate (*linalyl acetate; licareol acetate*). $CH_3COO(C_{10}H_{17})$, 196.16. Col.liq., *n* 1.4460. **D.** 0.895^{20}_{4}, **b.p.** 220. **Soly.** v.sl.s.w.; ∞al.; ∞et.

59 **—,** formate (*l-linalyl formate*). $HCOOC_{10}H_{17}$, 182.14. **b.p.** $100\text{–}3^{10}$. **Soly.** i.w.; s.al.; s.et.

60 **Linalyl esters.** See under *Linaloöl*.

61 **Linoleic acid** (*9, 12-octadecadienoic acid*; linolic acid*). $C_{18}H_{32}O_2$, 280.25. Col.-yel. oil. **D.** 0.9025^{20}_{4}, **m.p.** −11, **b.p.** 230^{16}. **Soly.** i.w.; ∞al.; ∞et.

62 **—,** ethyl ester (*ethyl linoleate; ethyl linolate*). $C_{17}H_{31}COOC_2H_5$, 308.28. Col-yel. oil. **D.** 0.8865^{20}, **b.p.** $270\text{–}5^{180}$. **Soly.** i.w.; s.al.; s.et.

63 **—,** methyl ester (*methyl linolate*). C_{17}-$H_{31}COOCH_3$, 294.27. Col.-yel. oil. **D.** 0.889^{18}, **b.p.** $207\text{–}8^{11}$. **Soly.** i.w.; s.al.; v.s.et.

64 **—,** tetrabromide. See *Stearic acid, θ, ι, λ, μ-tetrabromo-*.

65 **Linolenic acid,** ethyl ester. C_{17}-$H_{29}COOC_2H_5$, 306.27. Oil. **D.** 0.8919, **b.p.** $123\text{–}33^{.001}$. **Soly.** i.w.; s.al.; s.et.

66 ***α*-Linolenic acid** (*9, 12, 15-octadecatrienoic acid**(one form)). $C_{17}H_{29}$-COOH, 278.23. Col.liq. **D.** 0.905^{20}_{4}, **b.p.** $230\text{–}2^{17}$. **Soly.** i.w.; ∞al.; ∞et.

67 **—,** hexabromide. See *Stearic acid θ, ι, λ, μ, ξ, o-hexabromo-*.

* Name approved by the International Union of Chemistry.

69 Lithofellic acid (*lithofellinic acid*). $C_{20}H_{36}O_4$, 340.28. Micr.cr. **m.p.** 206, **b.p.** d. **Soly.** i.w.; s.al.

70 Lobeline. $C_{21}H_{23}NO_2$, 321.19. Yel. syrup. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.chl., bz.

71 ***l*-Lobeline.** $C_{22}H_{27}NO_2$ or $C_{21}H_{23}NO_2$, 337.22 or 321.19. Col.need. **m.p.** 130–1. **Soly.** d.h.w.

72 Lophine (2, 4, 5-*triphenylimidazole*). $C_{21}H_{16}N_2$, 296.14. Need. **m.p.** 275. **Soly.** i.w.; 0.88^{21}al.; 0.32^{20}et.

73 Luminal. See *Phenobarbital*.

74 Luminol (*5-amino-2, 3-dihydro-1, 4-phthalazinedione; 3-aminophthalhydrazide*). $NH_2C_6H_3CONHNHCO$, 177.08. Yel. **m.p.** *ca.* 280. **Soly.** i. w.; sl.s.al.; sl.s. et.

75 ***dl*-Lupanine.** $C_{15}H_{24}N_2O$, 248.20. Need.f.pet.eth. **m.p.** 99. **Soly.** v.s. w.; v.s.al.; v.s.et.; s.chl.

76 ***d*-Lupanine.** $C_{15}H_{24}N_2O$, 248.20. Col.need. **m.p.** 44. **Soly.** s.w.; v.s.al.; v.s.et.; s.chl., lgr.

77 Lupinidine. See *Sparteine*.

78 Lupinine. $C_{21}H_{40}N_2O_2$, 352.33. Col.rhomb. $[\alpha]-19°^{17}_{D}$. **m.p.** 68.5–9.2, **b.p.** 256. **Soly.** s.c.w.; s.al.; s.et.; s.chl.

79 —, hydrochloride. $C_{10}H_{19}NO\cdot HCl$, 205.62. Lg.rhomb.cr., $[\alpha]-14°_D$. **m.p.** 212–3. **Soly.** s.w.; s.al.

80 —, **methyl-.** $C_{10}H_{18}NO\cdot CH_3$, 183.17. Oily liq. **b.p.** $145–6^{15}$. **Soly.** s.al.; s.et.

81 2, 4-Lutidine (*2, 4-dimethylpyridine*; αγ-lutidine*). $(CH_3)_2C_5H_3N$, 107.08. Col.liq. **D.** 0.9493^0_4, **b.p.** 157.1(159). **Soly.** 20w.; s.al.; s.et.

82 2, 6-Lutidine (*2, 6-dimethylpyridine*; αα′-lutidine*). $(CH_3)_2C_5H_3N$, 107.08. Col.liq. **D.** 0.942^0_4, **b.p.** 143. **Soly.** ∞c., less s.h.w.; s.al.; s.et.

83 3, 4-Lutidine (*3, 4-dimethylpyridine*; βγ-lutidine*). $(CH_3)_2C_5H_3N$, 107.08. Col.liq. **b.p.** 163.5–4.5. **Soly.** s.al., s.et.

84 Lutidinic acid (*2, 4-pyridinedicarboxylic acid**). $C_5H_3N(COOH)_2$, 167.05. Leaf. or pr.f.w. **D.** 0.942, **m.p.** 248–50. **Soly.** s.w.; s.al.; i.et.

85 —, **6-methyl-.** See *Uvitonic acid*.

87 Lyaconitine. $C_{27}H_{34}N_2O_6\cdot 2H_2O$, 518.31. Ylsh.-wh. resinous. **m.p.** 112–5. **Soly.** sl.s.w.; s.al.; sl.s.et.; s.chl., CS_2, pet.eth.

88 Lycine. See *Betaine*.

89 ***l*-Lycorine.** $C_{16}H_{17}NO_4$, 287.14. Col.pr. **m.p.** 250 d. **Soly.** i.w.; sl.s. al.; sl.s.et.; s.a.; sl.s.chl.

90 ***d*-Lysine** (*d-α, ε-diaminocaproic acid; d-2, 6-diaminohexanoic acid**). $NH_2(CH_2)_4CH(NH_2)COOH$, 146.13. Need. or hex. pl.f.al. **m.p.** 224 d.

91 ***l*-Lysine** (*l-2, 6-diaminohexanoic acid*; l-α, ε-diaminocaproic acid*). $NH_2(CH_2)_4CH(NH_2)COOH$, 146.13. Flat need.f.w., hex.pl.f.al. **m.p.** 224 d. **Soly.** v.s.w.; v.sl.s.al.; i.et.

92 —, picrate. $C_6H_{14}N_2O_2\cdot C_6H_3N_3O_7$, 375.17. Need. **m.p.** 266 exp. **Soly.** 0.54c.w.; i.al.; i.et.

93 Maclurin (*2, 4, 6, 3′, 4′-pentahydroxybenzophenone; moringatannic acid; moringatannin*). $C_{13}H_{10}O_6\cdot H_2O$, 280.09. Col.-yel.pr.f.w. **m.p.** 220 d., **b.p.** d. **Soly.** 0.5^{15}w.; s.al.; s.et.

95 Malachite green, leuco. See *Aniline, p, p′-benzalbis-N, N-dimethyl-*.

96 Malamide (*2-hydroxybutanediamide*; malic amide*). $C_2H_3(OH)(CONH_2)_2$, 132.08. Pr.f.w. **m.p.** 156–8. **Soly.** s.w.

97 Malay camphor. See *d-Borneol*.

98 Maleamic acid (*maleamidic acid; maleic acid monoamide*). $H_2NCOCH:CHCOOH$, 115.05. Pl. **m.p.** 152–3. **Soly.** v.s.w.; s.h.al.; i.et.

99 Maleic acid (*cis-butenedioic acid*; cis-1, 2-ethylenedicarboxylic acid*). $HOOCCH:CHCOOH$, 116.03. Col. monocl.pr. **D.** 1.590^{20}_{4}, **m.p.** 130.5, **b.p.** 135 d. **Soly.** 78.8^{25}, $392.6^{97.5}$w.; $69.9^{29.7}$al.; 8^{25}et.; s.glac.ac.a., acet.; v.sl.s.bz.

00 —, diethyl ester (*diethyl maleate; ethyl maleate*). $(:CHCOOC_2H_5)_2$, 172.09. Col.liq. **D.** $1.064^{25.2}$, **b.p.** 225; $105–6^{14}$. **Soly.** i.w.; s.al.; s.et.

01 —, dimethyl ester (*methyl maleate*) $(:CHCOOCH_3)_2$, 144.06. Col.liq. **D.** 1.1606^{20}_{4}. **m.p.** −19, **b.p.** 205; 102^{17}. **Soly.** i.w.; s.et.

02 —, monoamide. See *Maleamic acid*.

03 —, *p*-phenylphenacyl ester. $(:CHCOOCH_2COC_6H_4C_6H_5)_2$, 504.19. **m.p.** 168.

04 —, **bromo-.** $BrC(COOH):CHCOOH$, 194.94. Need. or pr. **m.p.** 128; 138–41, **b.p.** d. **Soly.** v.s.w.; v.s.al.; v.s.et.

05 —, **chloro-.** $ClC(COOH):CHCOOH$, 150.48. Col.pr.f.et.-chl. **m.p.** 108 (114); sinters 96. **Soly.** s.h.w.; v.s.al., v.s.et.; s.ac.a.; sl.s.bz., chl.; i.pet.eth.

06 —, **methyl-.** See *Citraconic acid*.

For explanations and abbreviations see beginning of table.

07 **Maleic anhydride** (*cis-butenedioic anhydride*; 2,5-furandione*). OCOCH:CHCO, 98.02. Col.rhomb. need.f.chl. **D.** 0.934^{20}_{4}, **m.p.** 53 (57–60), **b.p.** 202 (196). **Soly.** $16.32^{29.7}$ w.; v.sl.s.al.; v.sl.s.CCl_4.

08 —, **bromo-.** OCOCBr:CHCO, 176.92. Liq. **b.p.** 215.

09 —, **chloro-.** OCOCCl:CHCO, 132.46. Liq. **D.** 1.54^{25}_{25}, **m.p.** 33, **b.p.** 196.3; 95^{25}.

10 —, **methyl-.** See *Citraconic anhydride.*

11 **Malic acid** (*dl*). HOOCCH(OH)-CH_2COOH, 134.05. Col.cr. **D.** 1.601^{20}_{4}, **m.p.** 128.5, **b.p.** 150 d. **Soly.** 144^{26}, 411^{79}w.; v.s.al.; v.s.et.

12 **Malic acid** (*l*) (*ordinary malic acid; l-hydroxybutanedioic acid; l-hydroxysuccinic acid*). HOOCCH(OH)CH_2-COOH, 134.05. Col.need. **D.** 1.595, **m.p.** 100, **b.p.** 140 d. **Soly.** v.s.w.; sl.s.al.; 6.0c.et.

13 —, acetate (*acetoxysuccinic acid; O-acetylmalic acid*). CH_3COOCH-(COOH)CH_2COOH, 176.06. Cr. **m.p.** 134, **b.p.** d. **Soly.** s., d.h.w.; i.bz.

14 —, diethyl ester (*diethyl hydroxybutanedioate*; ethyl malate*). CH_2-$(COOC_2H_5)CHOHCOOC_2H_5$, 190.11. Col.liq., *n* 1.4362. **D.** 1.128, **b.p.** 253. **Soly.** s.w.; ∞al. ∞et.

15 —, dimethyl ester (*methyl malate; methyl hydroxysuccinate*). CH_3OOC-CH(OH)CH_2COOCH_3, 162.08. Col. liq., *n* 1.4425. **D.** 1.2226^{20}_{4}, **b.p.** 242. **Soly.** v.s.w.; ∞al. ∞et.

16 —, dipropyl ester (*dipropyl hydroxybutanedioate*; propyl malate*). C_3H_7-$OOCCHOHCH_2COOC_3H_7$, 218.14. Liq., *n* 1.4380. **D.** 1.075, **m.p.** 10.5, **b.p.** 151^{10}.

17 —, **O-acetyl-.** See *Malic acid, acetate.*

18 —, **α-methyl-.** See *Citramalic acid.*

19 **Malic amide.** See *Malamide.*

20 **Malonamide** (*propanediamide*; malonic diamide*). $CH_2(CONH_2)_2$, 102.06. Col.monocl.need. **m.p.** 170. **Soly.** 8.3^{8}w.; i.al.; i.et.

21 **Malonic acid** (*propanedioic acid*; methanedicarboxylic acid*). HOOC-CH_2COOH, 104.03. Col.tricl. **D.** 1.631^{15}_{4}, **m.p.** 135.6, **b.p.** d. **Soly.** 61.1^{0}, 73.5^{20}, 92.6^{50}w.; 57^{20}al.; 5.7^{15}et.

22 —, diethyl ester (*diethyl propanedioate*; ethyl malonate; malonic ester*). $CH_2(COOC_2H_5)_2$, 160.09. Col.liq., *n* 1.41428. **D.** 1.0550^{20}_{4}; 1.054^{15}_{15}, **m.p.** −49.9, **b.p.** 198.9 ($94–6^{18}$). **Soly.** 2.08^{20}w.; ∞al.; ∞et.; s.chl., bz.

23 —, dimethyl ester (*methyl malonate; dimethyl propanedioate**). $CH_2(COO$-$CH_3)_2$, 132.06. Col.liq., *n* 1.41490^{17}. **D.** 1.1544^{20}_{4}, **m.p.** −62, **b.p.** 181. **Soly.** v.sl.s.w.; ∞al.; ∞et.

24 —, dipropyl ester (*dipropyl propanedioate*; propyl malonate*). $CH_2(COO$-$C_3H_7)_2$, 188.12. Col.liq. **D.** 1.027^{0}_{4}, **b.p.** 228.3.

25 —, monoethyl ester, piperazinium salt. $C_4H_{10}N_2 \cdot 2HOOCCH_2COOC_2H_5$, 350.22. Wh.cr. **m.p.** 144. **Soly.** s.w.; s.h.al.; i.et.

26 —, piperazinium salt. $C_4H_{10}N_2 \cdot C_3H_4$-$O_4$, 190.13. Wh.cr. **m.p.** 180 (d.). **Soly.** s.w.; s.h.al.; i.et.

27 —, **acetyl-,** diethyl ester (*ethyl acetylmalonate; diethyl acetylpropanedioate**). $CH_3COCH(COOC_2H_5)_2$, 202.11. Liq. **D.** 1.080^{23}, **b.p.** 240 (120^{17}). **Soly.** s.Na_2CO_3sol.

28 —, **allyl-** (*2-propenylpropanedioic acid*; 3-butene-1, 1-dicarboxylic acid*). $COOHCH(CH_2CH:CH_2)COOH$, 144.06. Tricl.f.et. **m.p.** 103–5, **b.p.** d. 180. **Soly.** s.w.; s.al.; s.et.; s.bz.

29 —, —, diethyl ester (*ethyl allylmalonate; diethyl (2-propenyl)propanedioate*; diethyl 3-butene-1, 1-dicarboxylate**). $CH_2:CHCH_2CH(COOC_2H_5)_2$, 200.12. Col.liq. **D.** 1.01475^{14}, **b.p.** 222–3 ($110–2^{14}$). **Soly.** i.w.; v.s.al.; v.s.et.

30 —, **amino-** (*2-aminopropanedioic acid**). $COOHCH(NH_2)COOH$, 119.05. Col.cr.(+$1H_2O$)f.w. **m.p.** 109 d. **Soly.** sl.s.w.; sl.s.al.

31 —, **amyl-,** diethyl ester (*ethyl amylmalonate*). $CH_3(CH_2)_4CH(COOC_2H_5)_2$, 230.17. Col.liq., *n* 1.4253. **b.p.** $121–3^{6}$. **Soly.** i.w.; v.s.al.; v.s.et.

32 —, **anilino-,** ethyl ester (*anilinomalonic ester; diethyl anilinomalonate*). $C_6H_5NHCH(COOC_2H_5)_2$, 251.14 Need. **m.p.** 44–5. **Soly.** v.s.al.; s.et.

33 —, **benzal-,** (*2-phenyl-1, 1-ethylenedicarboxylic acid*). $C_6H_5CH:C(COOH)_2$, 192.06. Pr.f.w. **m.p.** d 195 to cinnamic acid. **Soly.** s.h.w. s.al.; sl.s.et.; s.acet., ethyl acetate sl.s.CS_2, ac.a., chl., bz., lgr.

34 —, **benzyl-,** diethyl ester (*diethyl benzylpropanedioate*; ethyl benzylmalonate*). $C_6H_5CH_2CH(COOC_2H_5)_2$, 250.14. Liq. **D.** 1.077^{15}_{15}, **b.p.** 296–8 **Soly.** i.w.

* Name approved by the International Union of Chemistry.

35 **Malonic acid, bromo-,** (*bromopropanedioic acid**). $BrCH(COOH)_2$, 182.94. Need.f.et. **m.p.** 112–3d. **Soly.** v.s.al.; v.s.et.

36 —, —, diethyl ester (*diethyl bromopropanedioate**). $BrCH(COOC_2H_5)_2$, 239.00. Liq. **D.** 1.4022^{25}_{4}. **m.p.** −54, **b.p.** 235($125–7^{15}$). **Soly.** i.w.; ∞al.; ∞et.

37 —, **butyl-,** diethyl ester (*ethyl n-butylmalonate*). $CH_3(CH_2)_3CH(COOC_2H_5)_2$, 216.16. Col.liq., *n* 1.425. **b.p.** 235–40; $130–5^{20}$. **Soly.** i.w.; v.s.al.; v.s.et.

38 —, ***sec*-butyl-,** diethyl ester (*ethyl sec-butylmalonate*). $C_2H_5(CH_3)CHCH(COOC_2H_5)_2$, 216.16. Col.liq., *n* 1.4248. **D.** 0.988^{15}, **b.p.** 224–5; $94–5^{3}$. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

39 —, **chloro-,** (*chloropropanedioic acid**). $CHCl(COOH)_2$, 138.48. Pr. **m.p.** 133. **Soly.** v.s.w.; v.s.al.; v.s.et.

40 —, **dibenzyl-,** diethyl ester (*diethyl 1, 3-diphenyl-2, 2-propanedicarboxylate*). $(C_6H_5CH_2)_2C(COOC_2H_5)_2$, 340.19. Thk.oil. **D.** 1.093, **m.p.** 13, **b.p.** $243–6^{16}$. **Soly.** s.al.; s.et.

41 —, **dibromo-,** diethyl ester (*diethyl dibromopropanedioate**). $CBr_2(COOC_2H_5)_2$, 317.91. Liq. **b.p.** 250–6 d. ($103–6^{4}$).

42 —, **diethyl-,** diethyl ester (*diethyl diethylpropanedioate**). $(C_2H_5)_2C(COOC_2H_5)_2$, 216.16. Col.liq., *n* $1.42516^{16.6}$. **D.** 0.985^{20}_{4} (0.990). **b.p.** 223. **Soly.** v.sl.s.(i.)w.; ∞al.; ∞et.

43 —, —, piperazinium salt. $C_4H_{10}N_2 \cdot (C_2H_5)_2C(COOH)_2$, 246.19. Wh.cr. **m.p.** 80–1. **Soly.** s.w.; s.al.; i.et.; s.h.acet.

44 —, **dihydroxy-.** See *Mesoxalic acid.*

45 —, **dimethyl-,** diethyl ester (*diethyl dimethylpropanedioate**). $(CH_3)_2C(COOC_2H_5)_2$, 188.12. Col.liq., *n* $1.41049^{24.1}$. **D.** 0.9910^{25}_{4}, **b.p.** 196.5^{753}. **Soly.** i.w.; ∞al.; ∞et.

46 —, **ethyl-** (*ethylpropanedioic acid**; *1, 1-propanedicarboxylic acid**). $C_2H_5CH(COOH)_2$, 132.06. Col.rhomb. cr. **m.p.** 111.5, **b.p.** 160 d. **Soly.** s.w.; s.al.; s.et.; s.bz., chl., ethyl acetate.

47 —, —, diethyl ester (*ethyl ethylmalonate; ethylmalonic ester*). $C_2H_5CH(COOC_2H_5)_2$, 188.12. Col.liq., *n* $1.41802^{14.8}_{\alpha}$. **D.** 1.004^{20}_{20} **b.p.** 211^{743}; $95–7^{15}$. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

48 —, **ethylene-.** See *Vinaconic Acid*

49 —, (*α*-**ethylpropyl**)**-,** diethyl ester (*ethyl sec-amylmalonate*). $(C_2H_5)_2CHCH(COOC_2H_5)_2$, 230.17. Col.liq., *n* 1.4275. **b.p.** 242–5; 130^{16}. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

50 —, **heptyl-** (*heptylpropanedioic acid**; *1, 1-octanedicarboxylic acid*). $CH_3(CH_2)_6CH(COOH)_2$, 202.14. Cr. f.bz. **m.p.** 95. **Soly.** i.w.; v.s.al.; v.s. et.; v.s.acet.

51 —, **hydroxy-.** See *Tartronic acid.*

52 —, **isoamyl-,** diethyl ester (*ethyl isoamylmalonate*). $(CH_3)_2CH(CH_2)_2CH(COOC_2H_5)_2$, 230.17. Col. liq., *n* 1.4255. **b.p.** 240–2; $160–5^{44}$. **Soly.** i.w.; v.s.al.; v.s.et.

53 —, **isobutyl-** (*3-methyl-1, 1-butanedicarboxylic acid**). $(CH_3)_2CHCH_2CH(COOH)_2$, 160.09. Cr. **m.p.** 107. **Soly.** v.s.w.; v.s.al.; v.s.et.

54 —, —, diethyl ester (*ethyl isobutylmalonate*). $(CH_3)_2CHCH_2CH(COOC_2H_5)_2$, 216.16. Col.liq. **D.** 0.983^{17}, **b.p.** 225; $113–6^{16}$. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

55 —, **isopropyl-,** diethyl ester (*ethyl isopropylmalonate*). $(CH_3)_2CHCH(COOC_2H_5)_2$, 202.14. Col.liq., *n* 1.418. **D.** 0.984^{25}_{4}. **b.p.** 211–5. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

56 —, **keto-.** See *Mesoxalic acid.*

57 —, **methyl-.** See *Isosuccinic acid.*

58 —, —, diethyl ester (*ethyl isosuccinate*). $CH_3CH(COOC_2H_5)_2$, 174.11. Col. liq., *n* $1.41369^{13.7}$. **D.** 1.0192^{18}_{4}. **b.p.** 201.4. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

59 —, —, dimethyl ester (*dimethyl methylpropanedioate**; *methyl isosuccinate*). $CH_3CH(COOCH_3)_2$, 146.08. Col.liq. **D.** $1.028^{?}_{?}$. **b.p.** 179. **Soly.** v.sl.s.w.; ∞al.; ∞et.

60 —, **propyl-** (*propylpropanedioic acid**; *1, 1-butanedicarboxylic acid**). $C_3H_7CH(COOH)_2$, 146.08. Pl.f.bz. **m.p.** 96 **b.p.** d. **Soly.** 45.6^{0}w.; s.al.; s.et.; s.chl.; sl.s.bz.

61 —, —, diethyl ester. $C_3H_7CH(COOC_2H_5)_2$, 202.14. Col.liq. **D.** 0.993. **b.p.** 221. **Soly.** v.sl.s.w.; v.s. al.; v.s.et.

62 **Malonic anhydride** (so-called). See *Carbon suboxide.*

63 **Malonic diamide.** See *Malonamide.*

64 **Malonic dinitrile.** See *Malononitrile.*

65 **Malonic ester, anilino-.** See *Malonic acid, anilino-, ethyl ester.*

66 —, **ethyl-.** See *Malonic acid, ethyl-, diethyl ester.*

For explanations and abbreviations see beginning of table.

67 **Malonic mononitrile.** See *Acetic acid, cyano-*.

68 —, **methyl-.** See *Propionic acid, α-cyano-*.

69 **Malononitrile** (*propanedinitrile*; methylene cyanide; malonic dinitrile*) $CH_2(CN)_2$, 66.03. Col.cr., *n* $1.41463^{34.2}$. **D.** 1.049^{34}. **m.p.** 32.1 **b.p.** 220. **Soly.** 13.3w.; 40al.; 20et.; 6.7bz.

70 **Malourea.** See *Barbital.*

71 **Maltobiose.** See *Maltose.*

72 **Maltonic acid.** See D-*Gluconic acid.*

73 **Maltose** (*malt sugar; maltobiose*). $C_{12}H_{22}O_{11}·H_2O$, 360.19. Fine col. need. **D.** 1.540, **m.p.** 102.5 d., **Soly.** 108^{25}w.; v.sl.s.c.al.; i.et.

74 **Malt sugar.** See *Maltose.*

75 **Mandelic acid** (*dl*) (*dl-phenylglycolic acid; dl-α-hydroxy-α-toluic acid*). $C_6H_5CH(OH)(COOH)$, 152.06. Col. rhomb.f.bz. **D.** 1.361^{4}; 1.300^{20}_{4}. **m.p.** 118.1, **b.p.** d. **Soly.** 16^{20}w.; $53.6^{16.5}$al.; s.et.

76 —, gentiobioside. See *Amygdalic acid.*

77 —, *o*-**amino-,** lactam. See *Oxindole, 3-hydroxy-*.

78 —, *p*-**isopropyl-**(*i*) (*i-p-isopropylphenylglycolic acid*). $(CH_3)_2CHC_6H_4CHOHCOOH$, 194.11. **m.p.** 158.

79 **Mandelonitrile** (*dl*) (*dl-benzaldehyde cyanohydrin*) $C_6H_5CH(OH)CN$, 133.06. Yel. oily liq. **D.** 1.124, **m.p.** −10 (22), **b.p.** d. 170. **Soly.** i.w.; s.al.; s.et.

80 —, gentiobioside. See *Amygdalin.*

81 D-**Mannitol** (*d-mannite*). $CH_2OH(CHOH)_4CH_2OH$, 182.11. Col.rhomb. need. **D.** 1.489^{20}_{4}, **m.p.** 166.1, **b.p.** $295^{3.5}$. **Soly.** 15.6^{18}w.; 0.06^{14}al.; i.et.

82 —, hexanitrate (*nitromannite*). $C_6H_8(NO_3)_6$, 452.11. Need. **D.** 1.604^{0}, **m.p.** 112, **b.p.** exp. 120. **Soly.** i.w.; 2.9^{13}al.; 2.86^{9}et.

83 D-**Mannoheptitol.** See *Perseitol.*

84 D-**Mannoheptose.** $C_6H_7(OH)_6CHO$, 210.11. Need. **m.p.** 134–5. **Soly.** v.s.w.; sl.s.al.

85 D-**Mannose** (*seminose; carubinose*). $CH_2OH(CHOH)_4CHO$, 180.09. Col. rhomb.pr.f.al. **D.** 1.539, **m.p.** 132. **Soly.** 248^{17}w.; v.sl.s.al.; i.et.

86 —, phenylhydrazone. $C_6H_{12}O_5NNHC_6H_5$, 270.16. Nearly col. **m.p.** 186–8. **Soly.** i.w.; s.h.al.

87 **Margaric acid** (*heptadecanoic acid*; n-heptadecoic acid; n-heptadecylic acid*). $CH_3(CH_2)_{15}COOH$, 270.27. Col.pl. **D.** 0.8578^{60}_{4}, **m.p.** 60.66 (58–9), **b.p.** 227^{100}. **Soly.** i.w.; 25.2^{23}al.; v.s.et.

88 **Margaronitrile** (*heptadecanenitrile*; cetyl cyanide; n-hexadecyl cyanide*). $CH_3(CH_2)_{15}CN$, 251.27. Cr. **m.p.** 53. **Soly.** v.s.h.al.; s.et.

89 **Marsh gas.** See *Methane*.*

90 **Meconic acid** (*3-hydroxy-4-keto-1, 4-pyran-2, 6-dicarboxylic acid*). $C_7H_4O_7·3H_2O$, 254.08. Rhomb.tab. **m.p.** $-3H_2O$, 100, **b.p.** d. **Soly.** 25^{100}w.; sl.s.al.; sl.s.et.; v.sl.s.chl.

91 **Meconidine.** $C_{21}H_{23}NO_4$, 353.19. Yel.amor. **m.p.** 58. **Soly.** i.w.

92 **Meconin** (*5, 6-dimethoxyphthalide*). $C_{10}H_{10}O_4$, 194.08. Col.need. **m.p.** 101, **b.p.** 155 subl. **Soly.** 0.14c.; 4.5h.w.; s.al.; s.et.; s.bz., chl., amyl.al.

93 **Melam.** $C_6H_9N_{11}$, 235.16. Or.powd. **m.p.** d. **Soly.** i.w.; sl.s.al.; s.KOH.

94 **Melamine** (*2, 4, 6-triamino-s-triazine; cyanurotriamide*). $N{:}C(NH_2)N{:}C(NH_2)N{:}C(NH_2)$, 126.09. Monocl. pr., *n*. 1.490, 1.743, 1.872. **D.** 1.573^{250}, **m.p.** <250, **b.p.** subl. **Soly.** sl.s.w.; v.sl.s.h.al.; i.et.

95 **Melampyrin.** See *Dulcitol.*

96 **Melaniline.** See *Guanidine, diphenyl-*.

97 **Melene.** $C_{30}H_{60}$, 420.47. Col. **D.** 0.890, **m.p.** 63, **b.p.** 380. **Soly.** i.w.; 3.6^{78}al.; v.sl.s.et.; v.sl.s.bz.

98 **Meletin.** See *Quercetin.*

99 **Melilotic acid** (*o-hydroxyhydrocinnamic acid; o-hydrocoumaric acid*). $HOC_6H_4CH_2CH_2COOH$, 166.08. Pr. f.w. **m.p.** 83. **Soly.** 5^{18}w.; s.al.; s.et.

00 **Melissic acid.** $C_{30}H_{61}COOH$, 466.48. Col.sc. or need.f.al. **m.p.** 91.9–2.1 **Soly.** i.w.; sl.s.c., s.h.al.; v.sl.s.et.

01 **Melissyl alcohol.** See *Myricyl alcohol.*

02 **Mellitic acid** (*benzenehexacarboxylic acid**). $C_6(COOH)_6$, 342.05. Col need.f.al. **m.p.** 286, **b.p.** d. **Soly.** v.s.w.; s.al.; s.H_2SO_4.

03 —, **hexahydro-.** See 1, 2, 3, 4, 5, 6-*Cyclohexanehexacarboxylic acid**.

04 **Mellophanic acid** (1, 2, 3, 4-*benzenetetracarboxylic acid**). $C_6H_2(COOH)_4$, 254.05. Cr.f.w. **m.p.** 238 d. **Soly.** s.w.

* Name approved by the International Union of Chemistry.

05 **1, 8(9)-*m*-Menthadiene.** See *Sylvestrene.*

06 **1, 3-*p*-Menthadiene.** See *α-Terpinene.*

07 **1, 4(8)-*p*-Menthadiene.** See *Terpinolene.*

08 **1, 5-*p*-Menthadiene.** See *α-Phellandrene.*

09 **1(7), 2-*p*-Menthadiene.** See *β-Phellandrene.*

10 **1, 8(9)-*p*-Menthadiene.** See *Limonene.*

11 **3, 6-*p*-Menthadiene-2, 5-dione.** See *Thymoquinone.*

12 **6, 8(9)-*p*-Menthadien-2-one.** See *Carvone.*

13 ***p*-Menthane** (*4-isopropyl-1-methylcyclohexane; hexahydro-p-cymene; terpane; menthonaphthene*). $CH_3C_6H_{10}CH(CH_3)_2$, 140.16. Col.liq. *n* 1.437. **D.** 0.793^{20}_{0}, **b.p.** 169–70 (164–7). **Soly.** i.w.; v.s.al.; v.s.et.

14 ***p*-Menthane, 1, 4-epoxy-.** See 1. 4-*Cineole.*

15 ***p*-Menthane, 1, 8-epoxy-.** See *Cineole.*

16 **1, 8-*p*-Menthanediol.** See *Terpinol.*

17 **2-*p*-Menthanol.** See *Carvomenthol.*

18 **3-*p*-Menthanol.** See *Menthol.*

19 **3-*p*-Menthanone.** See *Menthone.*

20 ***d*-Menthene** (*d-3-p-menthene; d-4-isopropyl-1-methyl-3-cyclohexene*) $C_{10}H_{18}$, 138.14. Col.liq., *n* $1.44813^{20.4}$. **D.** 0.8073, **b.p.** 168. **Soly.** s.al.; s.et.; s.bz.

21 **1-*p*-Menthene.** See *Carvomenthene.*

22 **—, 6, 8-epoxy-.** See *dl-Pinol.*

23 ***i*-1-*p*-Menthene-6, 8-diol.** See *Pinol, hydrate.*

24 **1-*p*-Menthen-8-ol.** See *α-Terpineol.*

25 **8(9)-*p*-Menthen-2-ol.** See *Carveol dihydro.*

26 **3-*p*-Menthen-2-one.** See *Carvenone.*

27 **8(9)-*p*-Menthen-2-one.** See *Carvone, dihydro-.*

28 **4(8)-*p*-Menthen-3-one.** See *Pulegone.*

29 **Menthol,** α-methoxyisobutyrate. See *Isobutyric acid, α-methoxy-, 3-p-menthyl ester.*

30 ***l*-Menthol** (*l-3-p-menthanol; l-hexahydrothymol*). $C_{10}H_{19}OH$, 156.16. Col.trim., *n* liq. 1.460^{22}; *n* solid 1.497, 1.476. **D.** 0.890^{15}_{5}, **m.p.** 35.5; 42.5. **b.p.** 215. **Soly.** 0.04 c.w.; v.s.al.; v.s.et.; s.chl., pet.eth., glac. ac.a.

31 **Menthonaphthene.** See *p-Menthane.*

32 ***l*-Menthone** (*l-3-p-menthanone*). $C_{10}H_{18}O$, 154.14. Col.liq. **D.** 0.896., **m.p.** −6.6, **b.p.** 207. **Soly.** sl.s.w.; ∞al.; ∞et.; ∞CS_2+bz.

33 **Mercurochrome 220 soluble** (*dibromohydroxymercurifluorescein disodium salt*). $C_{20}H_8Br_2HgNa_2O_6 \cdot 3H_2O$, 804.55. Irid.grn.sc. **Soly.** s.w.; 0.015 al.; i.et., chl.

34 **Mercury, diethyl-*** (*mercury diethyl; mercury ethyl*). $Hg(C_2H_5)_2$, 258.69. Col.liq., *n* $1.5399^{23.2}$. **D.** 2.444, **b.p.** 159. **Soly.** i.w.; sl.s.al.; s.et.

35 —, ***di-2-furyl-*** (*2, 2′-mercuridifuran*). $C_4H_3O \cdot Hg \cdot C_4H_3O$, 334.66. Col.cr.f.w.-acet. **m.p.** 114, **b.p.** 156^{7}. **Soly.** s.h.w.+acet.

36 —, **diisobutyl-.** $[(CH_3)_2CHCH_2]_2Hg$, 314.75. Col.liq. **D.** 1.835^{15}, **m.p.** volat. 100, **b.p.** 205–7. **Soly.** v.sl.s.w.; s.al.; s.et.

37 —, **dimethyl-*** (*mercury methyl*). $Hg(CH_3)_2$, 230.66. Col.liq., *n* $1.5327^{22.2}$. **D.** 3.069, **b.p.** 93–6. **Soly.** v.v.sl.s.w.; v.s.al.; v.s.et.

38 —, **di-1-naphthyl-*** (*mercury di-α-naphthyl*). $Hg(C_{10}H_7)_2$, 454.72. Leaf.f.bz. **D.** 1.944, **m.p.** 243, **b.p.** d. **Soly.** i.w.; sl.s.h.al.; sl.s.et.; s.chl., CS_2.

39 —, **diphenyl-*** (*mercury diphenyl; mercury phenyl*). $(C_6H_5)_2Hg$, 354.69. Rhomb.need. **D.** 2.318, **m.p.** 121.8, **b.p.** 204^{10} >306 d. **Soly.** i.w.; sl.s.h.al.; sl.s.et.; s.chl., bz., CS_2.

40 —, **dipropyl-*.** $(CH_3CH_2CH_2)_2Hg$, 286.72. Col.mobile liq. **D.** 2.124^{16}, **b.p.** 189–91. **Soly.** i.w.; s.al.; v.s.et.

41 —, **di-*o*-tolyl-.** $(CH_3C_6H_4)_2Hg$, 382.72. Tricl.f.bz. **m.p.** 107, **b.p.** 219^{14}. **Soly.** s.h.bz.

42 —, **di-*p*-tolyl-.** $Hg(C_6H_4CH_3)_2$, 382.72. Col.need.f.bz. **m.p.** 235–9, **b.p.** d. **Soly.** i.w.; sl.s.al.; i.et.; s.CS_2, h.bz.

43 **Mercury chloride, ethyl-*** (*ethylmercuric chloride*). C_2H_5HgCl, 265.11. Silv.irid.leaf. **D.** 3.5, **m.p.** 192.5. **Soly.** i.w.; sl.s.c., v.s.h.al.; s.et.

44 —, **methyl-*.** CH_3HgCl, 251.09. Wh.cr., disagreeable odor. **D.** 4.063, **m.p.** 170, **b.p.** volat. 100.

45 —, **phenyl-*** (*chloromercuribenzene*). C_6H_5HgCl, 313.11. Wh. satiny leaf. **m.p.** 251. **Soly.** sl.s.h.al.; sl.s.et.; sl.s.bz., pyr.

For explanations and abbreviations see beginning of table.

46 **Mercury chloride, p-tolyl-** (*p-chloromercuritoluene*) $CH_3C_6H_4HgCl$, 327.12. Rhomb. silky tab. **m.p.** 233. **Soly.** i.w.; sl.s.h.al.; i.et.; sl.s.bz., chl., acet., pyr.

47 **Mercury mercaptide.** $Hg(SC_2H_5)_2$, 322.81. Leaf.f.al. **m.p.** 76, **b.p.** d. **Soly.** v.sl.s.w.; 5.29h.al.; 6.7^{36}et.

48 **Mesaconic acid** (*methylfumaric acid*) HOOC(CH_3)C:CHCOOH, 130.05. Col.need.f.w. or al. **D.** 1.466. **m.p.** 202–4, **b.p.** 250 d. **Soly.** 2.7^{18}, 118^{100}w.; 24.14^{17} 90% al.; s.et.; v.sl.s. bz., chl., CS_2, pet.eth.

49 **Mescaline** (*mezcaline*). $C_{11}H_{17}NO_3$, 211.14. Col.alk.oil. **b.p.** 180^{12}. **Soly.** s.w.; s.al.; i.et.; s.chl., bz.

50 **Mesidine** (2, 4, 6-*trimethylaniline*). $(CH_3)_3C_6H_2NH_2$, 135.11. Liq. **D.** 0.963, **m.p.** < −15, **b.p.** 233.

51 **Mesitol** (2, 4, 6-*trimethylphenol*; 2-*hydroxymesitylene*). $(CH_3)_3C_6H_2OH$, 136.09. Need. **m.p.** 69 (72), **b.p.** 220. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

52 **Mesitylene** (1, 3, 5-*trimethylbenzene*; *sym-trmethylbenzene*). $(CH_3)_3C_6H_3$, 120.09. Rhomb.col.liq., *n* 1.4967. **D.** 0.8634^{20}_{4}, **m.p.** −52.7, **b.p.** 164.6. **Soly.** i.w.; s.al.; s.et.

53 —, **α-bromoisobutyryl-.** See *Isobutyrophenone, α-bromo-2, 4, 6-trimethyl-.*

54 —, **2, 4-dihydroxy-.** See *Mesorcinol.*

55 —, **2, 4-dinitro-** (1, 3, 5-*trimethyl-2, 4-dinitrobenzene*). $(NO_2)_2C_6H(CH_3)_3$, 210.09. Rhomb.f.al. **m.p.** 86. **Soly.** i.w.; s.h.al.

56 —, **hexahydro-.** See *Cyclohexane, 1, 3, 5-trimethyl-.*

57 —, **2-hydroxy-.** See *Mesitol.*

58 —, **2-nitro-** (1, 3, 5-*trimethyl-2-nitrobenzene*). $(CH_3)_3C_6H_2NO_2$, 165.09. Rhomb.pr.f.al. **m.p.** 44, **b.p.** 255. **Soly.** v.s.h.al.

59 —, **2, 4, 6-tribromo.** $Br_3C_6(CH_3)_3$, 356.82. Tricl.need.f.al. **m.p.** 224. **Soly.** i.w.; v.sl.s.h.al.; s.bz.

60 —, **2, 4, 6-trinitro-.** $(NO_2)_3C_6(CH_3)_3$, 255.09. Tricl.need.f.al. **m.p.** 230–2, **b.p.** exp. 415. **Soly.** i.c., sl.s.h.al.; sl.s.h.et.; sl.s.acet.

61 **Mesitylene-*eso*-carboxylic acid.** See *β-Isodurylic acid.*

62 **Mesitylenic acid** (3, 5-*dimethylbenzoic acid*; 3, 5-*xylic acid*; *sym-m-xylic acid*). $(CH_3)_2C_6H_3COOH$, 150.08. Monocl.f.al. **m.p.** 166, **b.p.** subl. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

63 **Mesityl oxide** (4-*methyl-3-penten-2-one**; *isopropylideneacetone*). $(CH_3)_2$-C:CHCOCH$_3$, 98.08. Col. oily liq., *n* 1.446^{16}. **D.** 0.8539^{20}_{4}, **m.p.** −59, **b.p.** 128.7 (131.4). **Soly.** 3.0w.; ∞al.; ∞et.

64 **Mesocystine.** See *Cystine, meso-.*

65 **Mesorcinol** (2, 4, 6-*trimethylresorcinol*; 2, 4-*dihydroxymesitylene*). $(CH_3)_3$-$C_6H(OH)_2$, 152.09. Leaf. **m.p.** 150, **b.p.** 275.5. **Soly.** sl.s.c.w.; v.s.al.; v.s.et.

66 **Mesotartaric acid.** See *i-Tartaric acid.*

67 **Mesoxalic acid** (*dihydroxy-* or *oxopropanedioic acid**; *dihydroxy-* or *ketomalonic acid*). $(HO)_2C(COOH)_2$ or $OC(COOH)_2$, 136.03 or 118.02. Col.deliq.need. **m.p.** 121 sl.d. **Soly.** v.s.w.; s.al.; s.et.

68 —, diethyl ester (*diethyl oxopropanedioate**; *ethyl ketomalonate*; *ethyl mesoxalate*). $CO(COOC_2H_5)_2$, 174.08. Lt.yel.grn.oil, *n* $1.41865^{15.6}$. **D.** 1.119^{18}_{18}, **m.p.** *ca.* −30, **b.p.** *ca.* 220; 115^{29}. **Soly.** s.et.

69 —, diethyl ester hydrate (*diethyl dihydroxypropanedioate**; *ethyl dihydroxymalonate*). $(HO)_2C(COOC_2H_5)_2$, 192.09. Col.pl.f.bz. **m.p.** 57, **b.p.** 200.

70 **Metaacetaldehyde.** See *Metaldehyde.*

72 **Metacrolein.** $(C_3H_4O)_3$, 168.09. Need. **m.p.** 46, **b.p.** 170. **Soly.** v.sl.s. h.w.; s.al.; s.et.

73 **Metadiazine.** See *Pyrimidine.*

74 **Metaformaldehyde.** See *Polyoxymethylene.*

75 **Metaldehyde** (*metaacetaldehyde*). $(C_2H_4O)_x$, $(44.03)_x$. Col.tetr.need., *n* 1.530, 1.430. **m.p.** 246.2 (sealed tube), **b.p.** subl. 112–5. **Soly.** i.w.; 1.8^{70}al.; 0.5^{35}et.

76 **Metanilic acid** (*m-aminobenzenesulfonic acid*; *m-anilinesulfonic acid*) $NH_2C_6H_4SO_3H \cdot 1\frac{1}{2}H_2O$, 200.15. Need (anh.); tricl.pr. **m.p.** d. **Soly.** 0.67^{2} w.; $2.92^{12.5}$al.; v.sl.s.et.

77 **Metastyrene.** $(C_8H_8)_x$, $(104.06)_x$ Vitreous. **D.** 1.054^{13}, **m.p.** d. **Soly** i.w.; i.al.; v.sl.s.et.

78 **Metathiazole.** See *Thiazole.*

79 **Methacetin.** See *p-Acetanisidc.*

80 **Methacrylic acid** (2-*methylpropenoic acid**; *α-methylacrylic acid*). CH_2:C(CH_3)COOH, 86.05. Col.pr., *n* 1.43143. **D.** 1.015^{20}_{4}, **m.p.** 16, **b.p.** 163. **Soly.** s.w.; ∞al.; ∞et.

* Name approved by the International Union of Chemistry.

81 **Methanal*.** See *Formaldehyde.*

82 **Methanamide*.** See *Formamide.*

83 **Methanamidine, amino-*.** See *Guanidine.*

84 **Methane*** (*marsh gas; methyl hydride*). CH_4, 16.03. Col.gas. **D.** 0.415^{-164}; 0.7168^0g/l, **m.p.** −184, **b.p.** 161.5. **Soly.** 9^{20}cm³w.; 60cm³al.; 91^{20}cm³et.

85 —, **acetylbenzoyl-.** See *Acetone, benzoyl-.*

86 —, **amino-.** See *Methylamine*.*

87 —, **4-amino-4′, 4″-bisdimethylaminotriphenyl-.** See *p_3-Leucaniline, N. N′, N″, N′-tetramethyl-.*

88 —, **aminodiphenyl-.** See *Aniline, benzyl-.*

89 —, **α-aminodiphenyl-.** See *Benzohydrylamine.*

90 —, **aminotriphenyl-.** See *Aniline, benzohydryl-.*

91 —, **amyldimethyl-.** See *Heptane, 2-methyl-*.*

92 —, **amylethylmethyl-.** See *Octane, 3-methyl-*.*

93 —, **benzoyltriphenyl-.** See *β-Benzopinacolin.*

94 —, **benzyltriphenyl-.** See *Ethane, 1, 1, 1, 2-tetraphenyl-.*

95 —, **4, 4′-bisdimethylaminotriphenyl-.** See *Aniline, p, p′-benzalbis-(N, N-dimethyl-.*

96 —, **bis(2, 4,-dinitrophenyl)-** (*2, 2′, 4, 4′-tetranitroditan*). $[(NO_2)_2C_6H_3]_2CH_2$, 348.09. Yel.pr.f.glac.ac.a. **m.p.** 172. **Soly.** i.al.; i.et.; s.alk.; sl.s.bz.

97 —, **bromo-*.** See *Methyl bromide.*

98 —, **bromotrichloro-*.** $CBrCl_3$, 198.29. Col.liq., *n* 1.5300. **D.** 1.959^{15}, **m.p.** −21, **b.p.** 104.07. **Soly.** i.w.; ∞al.; ∞et.

99 —, **butylethylmethyl-.** See *Heptane, 3-methyl-*.*

00 —, ***sec*-butylethylmethyl-.** See *Hexane, 3, 4-dimethyl-*.*

01 —, ***tert*-butyltrimethyl-.** See *Butane, 2, 2, 3, 3-tetramethyl-*.*

02 —, **isobutyltrimethyl-.** See *Pentane, 2, 2, 4-trimethyl-*.*

03 —, **chloro-*.** See *Methyl chloride.*

04 —, **chloro(chloromethoxy)-*.** See *Ether, bischloromethyl.*

05 —, **chloroethylmethyl-.** See *sec-Butyl chloride.*

06 —, **chloromethoxy-*.** See *Ether. chloromethyl methyl.*

07 —, **chlorotrimethyl-.** See *tert-Butyl chloride.*

08 —, **chlorotriphenyl-.** $(C_6H_5)_3CCl$, 278.57. Col.need. **m.p.** 112 (106–9), **b.p.** 310. **Soly.** i., d.w.; sl.s.al.; sl.s.et.; v.s.CS_2, bz.

09 —, **cyclohexyl-.** See *Cyclohexane, methyl-.*

10 —, **4, 4′-diaminodiphenyl-.** See *Aniline, p, p′-methylenedi-.*

11 —, **p, p′-diaminotriphenyl-** (*p, p′-benzaldianiline; 4, 4′-diaminotritan*). $C_6H_5CH(C_6H_4NH_2)_2$, 274.16. Col.cr. f.et. **m.p.** 139(136–7). **Soly.** v.sl. s.w.; v.s.al.; v.s.et.; s.chl., lgr.

13 —, **diazo-*** (*azimethylene*). CH_2N_2, 42.03. Yel.pois. gas at ord.temp. **m.p.** −145, **b.p.** −23; exp. 200. **Soly.** d.w.; s.al.; s.et.

14 —, **dibenzoyl-** (*1, 3-diphenyl-1, 3-propanedione*). $(C_6H_5CO)_2CH_2$, 224.09. Rhomb. **m.p.** 72–3; 78., **b.p.** $219–21^{18}$. **Soly.** v.sl.s.w.; $4.43^{19.5}$ al.; v.s.et.; s.chl.

15 —, **dibromo-*.** See *Methylene bromide.*

16 —, **dichloro-*.** See *Methylene chloride.*

17 —, **dichlorodifluoro-*** (*difluorodichloromethane**). CCl_2F_2, 120.91. Col gas. **D.** 1.486^{-30}, **b.p.** −29.2. **Soly.** i.w.; s.al.; s.et.

18 —, **dichlorodimethyl-.** See *Propane, 2, 2-dichloro-*.*

19 —, **dichlorofluoro-*.** $CHCl_2F$, 102.92. Liq. or gas. **D.** 1.413^0, **b.p.** 14.5 (8.9). **Soly.** i.w.; s.al.; s.et.

20 —, **diethoxy-*** (*formaldehyde diethylacetal; methylene diethyl ether*). $CH_2(OC_2H_5)_2$, 104.09. **D.** 0.851^0; 0.83465^{15}, **m.p.** −66.5, **b.p.** 88.0. **Soly.** 9.1^{18}w.; ∞al.; ∞et.

21 —, **diethyldimethyl-.** See *Pentane, 3, 3-dimethyl-*.*

22 —, **diethylisopropyl-.** See *Pentane, 3-ethyl-3-methyl-*.*

23 —, **diethylmethyl-.** See *Pentane, 3-methyl-*.*

24 —, **diethylpropyl-.** See *Hexane, 3-ethyl-*.*

25 —, **4, 4′-dihydroxydiphenyl-** (*p, p′-methylenediphenol*). $HOC_6H_4CH_2C_6H_4OH$, 200.09. Leaf. or need.f.h.w. **m.p.** 158, **b.p.** subl. **Soly.** s.al.; s.et.; s.alk., chl.; i.CS_2.

26 —, **diisobutyl-.** See *Heptane, 2. 6-dimethyl-*.*

For explanations and abbreviations see beginning of table.

27 **Methane, diisopropyl-.** See *Pentane, 2, 4-dimethyl-**.

28 —, **dimethoxy-*** (*formaldehyde dimethylacetal; methylene dimethyl ether; formal; methylal*). $CH_2(OCH_3)_2$, 76.06. Col.liq., *n* 1.35344. **D.** 0.8560, **m.p.** −104.8, **b.p.** 44. **Soly.** v.s.w.; ∞al.; ∞et.

29 —, **dimethyl-.** See *Propane**.

30 —, **dimethylene-.** See *Propadiene**.

31 —, **dimethylpropyl-.** See *Pentane, 2-methyl-**.

32 —, **di-1-naphthyl-.** $(C_{10}H_7)_2CH_2$, 268.12. Sm.pr.f.al. **m.p.** 109(107–8), **b.p.** 270^{14}; dist. > 360. **Soly.** 0.83, 6.67^{78}al.; s.et.; s.chl., bz.

33 —, **di-2-naphthyl-.** $(C_{10}H_7)_2CH_2$, 268.12. Need.f.al. or et. **m.p.** 93. **Soly.** i.w.; v.s.al.; s.bz.

34 —, **dinitro-*.** $CH_2(NO_2)_2$, 106.03. Yel.unst.oil. **m.p.** liq. at −15, **b.p.** 100 exp. **Soly.** s.w.; s.al.; s.et.

35 —, **diphenyl-** (*benzylbenzene; ditan*). $(C_6H_5)_2CH_2$, 168.09. Col.rhomb.need., *n* 1.57884^{17}. **D.** 1.0008^{26}_{4}, **m.p.** 26–7, **b.p.** 261–2 (264.7). **Soly.** i.w.; s.al.; s.et.; s.chl.

36 —, —, *o*-carboxylic acid. See *Benzoic acid, o-benzyl-*.

37 —, **diphenylene-.** See *Fluorene*.

38 —, **diphenyl-*m*-tolyl-** (*3-methyltritan*). $CH_3C_6H_4CH(C_6H_5)_2$, 258.14. Pr. f.al. **D.** 1.07^{16}, **m.p.** 62, **b.p.** 354^{706}. **Soly.** sl.s.al.; v.s.et.; s.bz., chl., ac.a., lgr.

39 —, **diphenyl-*p*-tolyl-** (*4-methyltritan*). $CH_3C_6H_4CH(C_6H_5)_2$, 258.14. Pr. f.me.al. **m.p.** 71, **b.p.** 360. **Soly.** i.w.; s.al.; v.s.et.; v.s.bz., ac.a.; s.lgr.

40 —, **dipropoxy-*** (*formaldehyde dipropyl acetal; methylenedipropyl ether*). $CH_2(OC_3H_7)_2$, 132.12. **D.** 0.835^{20}_{4}, **b.p.** 137–40.

41 —, **ethyldimethyl-.** See *Butane, 2-methyl-**.

42 —, *p*-**ethyldiphenyl-.** See *Benzene, 1-benzyl-4-ethyl-*.

43 —, **ethyldipropyl-.** See *Heptane, 4-ethyl-**.

44 —, **ethylisobutyl-.** See *Hexane, 2-methyl-**.

45 —, **ethylisobutylmethyl-.** See *Hexane, 2, 4-dimethyl-**.

46 —, **ethylisopropylmethyl-.** See *Pentane, 2, 3-dimethyl-**.

47 —, **ethylmethylpropyl-.** See *Hexane, 3-methyl-**.

48 —, **ethyltrimethyl-.** See *Butane, 2, 2-dimethyl-**.

49 —, **fluoro-*.** See *Methyl fluoride*.

50 —, *p*-**hydroxydiphenyl-.** See *Phenol, p-benzyl-*.

51 —, **iodo-*.** See *Methyl iodide*.

52 —, **isopropyldimethyl-.** See *Butane, 2, 3-dimethyl-**.

53 —, **isopropylmethylpropyl-.** See *Hexane, 2, 3-dimethyl-**.

54 —, **isopropyltrimethyl-.** See *Butane, 2, 2, 3-trimethyl-**.

55 —, **methoxy-*.** See *Methyl ether*.

56 —, **methyldipropyl-.** See *Heptane, 4-methyl-**.

57 —, **methyldithio-*.** See *Methyl disulfide*.

58 —, **methylthio-*.** See *Methyl sulfide*.

59 —, **1-naphthylphenyl-** (*1-benzylnaphthalene*). $C_{10}H_7CH_2C_6H_5$, 218.11. Monocl.leaf.f.al. **D.** 1.165^0, **m.p.** 59, **b.p.** 350. **Soly.** 1.26^{16}, 2.62^{78}al.; 35.7c.et.; s.bz., CS_2, chl.

60 —, **2-naphthylphenyl-** (*2-benzylnaphthalene*). $C_{10}H_7CH_2C_6H_5$, 218.11. Monocl.pr.f.al. **D.** 1.176, **m.p.** 35.5. **b.p.** 350. **Soly.** i.w.; 2.3^{15}al.; v.s.bz.

61 —, **nitro-*.** CH_3NO_2, 61.03. Col. liq., *n*. $1.38133^{21.6}$. **D.** 1.130^{24}_{4}, **m.p.** −29.2, **b.p.** 101.9. **Soly.** sl.s.w.; s.al.; s.et.; s.alk.

62 —, **oxo-.** See *Formaldehyde*.

63 —, **α-oxodiphenyl-.** See *Benzophenone*.

64 —, **phenyl-.** See *Toluene*.

65 —, **phenyldi-*p*-tolyl-** (*4, 4′-dimethyltritan*). $C_6H_5CH(C_6H_4CH_3)_2$, 272.16. Need.f.me.al. **m.p.** 56. **Soly.** s.al.; v.s.et.; v.s.CS_2, bz., chl.

66 —, **phenyl-*m*-tolyl-** (*m-benzyltoluene*). $C_6H_5CH_2C_6H_4CH_3$, 182.11. Liq. **D.** $0.997^{17.5}$, **b.p.** 275^{747}. **Soly.** s.al.; s.et.

67 —, **phenyl-*p*-tolyl-** (*p-benzyltoluene*). $C_6H_5CH_2C_6H_4CH_3$, 182.11. Liq. **D.** $0.995^{17.5}$, **m.p.** −30, **b.p.** 285–6 (279–80). **Soly.** s.al.; s.et.; v.s.chl.

68 —, **tetrabromo-*.** See *Carbon tetrabromide*.

69 —, **tetrachloro-*.** See *Carbon tetrachloride*.

70 —, **tetraethoxy-*.** See *Orthocarbonic acid, tetraethyl ester*.

71 —, **tetraiodo-*.** See *Carbon tetraiodide*.

* Name approved by the International Union of Chemistry.

72 **Methane, tetramethyl-.** See *Propane, 2, 2-dimethyl-**.

73 —, **p, p′-tetramethyldiaminodiphenyl-.** See *Aniline, p, p′-methylenebis [N, N-dimethyl-*.

74 —, ***p*-tetramethyldiaminotriphenyl-.** See *Leucomalachite green*.

75 —, **tetranitro-*.** $C(NO_2)_4$, 196.03. Col.liq., *n* $1.43976^{16.9}_{He}$. **D.** 1.650^{13}. **m.p.** 13, **b.p.** 125.7. **Soly.** i.w.; s.al.; s.et.

76 —, **tetraphenyl-.** $(C_6H_5)_4C$, 320.16. Col.rhomb.f.bz. **m.p.** 285, **b.p.** 431. **Soly.** i.w.; i.al.; i.et.; s.h.bz.; i.lgr., ac.a.

77 —, **tetrapropoxy-.** See *Orthocarbonic acid, tetrapropyl ester*.

78 —, **triaminotriphenyl-.** See *Leucaniline*.

79 —, **tribenzoyl-.** $(C_6H_5CO)_3CH$, 328.12. Need.f.al. **m.p.** 224–5, **b.p.** subl. **Soly.** v.sl.s.al.; v.sl.s.et.; s.CS_2; sl.s.acet.

80 —, **tribromo-*.** See *Bromoform*.

81 —, **tribromonitro-*.** See *Bromopicrin*.

82 —, **trichloro-*.** See *Chloroform*.

83 —, **trichlorofluoro-*.** $CFCl_3$, 137.37. Col.liq. **D.** $1.494^{17.2}$, **b.p.** 23.7. **Soly.** i.w.; s.al.; s.et.

84 —, **trichloronitro-*.** See *Chloropicrin*.

85 —, **triethoxy-*.** See *Orthoformic acid, triethyl ester*.

86 —, **triethyl-.** See *Pentane, 3-ethyl-**.

87 —, **triethylmethyl-.** See *Pentane, 3-ethyl-3-methyl-**.

88 —, **trifluoro-*.** See *Fluoroform*.

89 —, **triiodo-*.** See *Iodoform*.

90 —, **triisopropoxy-.** See *Orthoformic acid, triisopropyl ester*.

91 —, **trimethoxy-.** See *Orthoformic acid, trimethyl ester*.

92 —, **trimethyl-.** See *Isobutane*.

93 —, **trimethylpropyl-.** See *Pentane, 2, 2-dimethyl-**.

94 —, **trinitro-*.** See *Nitroform*.

95 —, ***p*$_3$-trinitrotriphenyl-.** See *Methane, tris(p-nitrophenyl)-*.

96 —, **triphenoxy-.** See *Orthoformic acid, triphenyl ester*.

97 —, **triphenyl-.** $(C_6H_5)_3CH$, 244.12. Col.rhomb.leaf., *n* 1.5839^{99}. **D.** 1.014^{99}_{4}. **m.p.** 92.5, **b.p.** 359.2. **Soly.** sl.s.c., v.s.h.al.; v.s.et.; s.bz., chl.

98 —, —, *o*-carboxylic acid. See *Benzoic acid, o-benzohydryl-*.

99 —, **tripropoxy-.** See *Orthoformic acid, tripropyl ester*.

00 —, **tris(*p*-nitrophenyl)-** (*p$_3$-trinitrotriphenylmethane*). $(NO_2C_6H_4)_3CH$, 379.13. Sc.f.bz. **m.p.** 212.5 (207). **Soly.** v.sl.s.et.; v.sl.s.glac.ac.a., bz.

01 **Methanearsonic acid** (*methylarsinic acid*). $CH_3AsO(OH)_2$, 139.97. Monocl. leaf.f.al. **m.p.** 161. **Soly.** s.w.; s.al.

02 **Methaneazobenzene.** See *Benzeneazomethane*.

03 **Methanecarbothiolic acid.** See *Acetic acid, thiol-*.

04 **Methanedicarboxylic acid.** See *Malonic acid*.

05 **Methanediol***, esters. See "methylene diester" under the different acids.

06 —, **2-furyl-,** diacetate. See *Furfural, diacetate*.

07 **Methanedisulfonic acid*.** See *Methionic acid*.

08 **Methane oxide, diphenyl-.** See *Xanthene*.

09 **Methanephosphonic acid** (*methylphosphinic acid*). $CH_3PO(OH)_2$, 96.06. **m.p.** 105.

10 **Methanesiliconic acid** (*silicoacetic acid*). CH_3SiOOH, 76.09. Amor. powd. **Soly.** i.w.; s.et.; s.conc.KOH.

11 **Methanestannonic acid** (*methylstannonic acid; methylstannic acid*). CH_3SnOOH, 166.73. Wh.amor.powd. **m.p.** infus. **Soly.** i.w.; s.a., alk.; i.org.solv.

12 **Methanesulfonic acid*** (*methylsulfonic acid*). CH_3SO_3H, 96.09. Col. liq. **D.** 1.481. **b.p.** 167^{10} d. **Soly.** v.s.w.; s.al.; v.s.et.

13 **Methanesulfonyl chloride*.** CH_3SO_2Cl, 114.54. Liq. **D.** 1.51, **b.p.** 160. **Soly.** i.w.; s.al.; s.et.

14 **Methanethial*.** See *Formaldehyde, thio-*.

15 **Methanethiol*** (*methyl mercaptan*). CH_3SH, 48.09. Liq. or gas. **D.** 0.868^{-20}_{4}; $0.8599^{2.5}_{4}$, **m.p.** −123.1 (−121), **b.p.** 7.6; 5.8^{752}. **Soly.** sl.s., d.w.; v.s.al.; v.s.et.

16 —, **2-furyl-.** See *Furfuryl mercaptan*.

17 **Methanethiolic acid, amino-*,** ethyl ester. See *Carbamic acid, thiol-, ethyl ester*.

18 **Methanoic acid*.** See *Formic acid*.

19 **Methanol*** (*methyl alcohol; carbinol; wood alcohol*). CH_3OH, 32.03. Col. liq., *n* $1.33118^{14.50}$. **D.** 0.79609^{15}; 0.7928^{20}_{4} (0.7917^{20}_{4}), **m.p.** −97.8, **b.p.** 64.65. **Soly.** ∞w.; ∞al.; ∞et.

20 **Methenamine.** See *Hexamethylenetetramine.*

21 **Methenyl amidoxime.** See *Formamide, oxime.*

22 **Methionic acid** (*methanedisulfonic acid*; methylenedisulfonic acid*). $CH_2(SO_3H)_2$, 176.15. Hyg.need. **Soly.** s.w.; s.al.

23 ***dl*-Methionine** (*dl-α-amino-γ-methylmercaptobutyric acid; dl-2-amino-4-methylthiobutanoic acid**). $CH_3SCH_2CH_2CH(NH_2)COOH$, 149.15. **m.p.** 281. **Soly.** 3.38^{25}, 10.52^{75}w.

24 ***l*-Methionine.** $CH_3SCH_2CH_2CH(NH_2)COOH$, 149.15. Hex.pl. **m.p.** 283 d. **Soly.** s.c.w.; i.et.

25 **Methoxyamine*** (*α-methylhydroxylamine*). CH_3ONH_2, 47.05. Cr. **b.p.** 49–50.

Methyl. For methyl derivatives see the parent compounds (e.g., for methylarsine see *Arsine, methyl-*). For methyl esters of organic acids see the acids.

26 **Methyl, triphenyl-** (*trityl*). $(C_6H_5)_3C-$, 243.12. Col.-yel.trans.cr. **m.p.** 145–7, **b.p.** d. **Soly.** i.w.; v.sl.s.al.; sl.s.et.; v.s.chl., CS_2.

27 **Methylal.** See *Methane, dimethoxy-**.

28 **Methyl alcohol.** See *Methanol**.

29 **Methylamine*** (*aminomethane*). CH_3NH_2, 31.05. Col.gas, *n* $1.432^{17.5}$. **D.** liq., 0.699^{-11}, **m.p.** −92.5, **b.p.** −6.5. **Soly.** 1150^{12}cm³w.; s.al.; ∞et.

30 —, **hydrochloride.** $CH_3NH_2 \cdot HCl$, 67.51. Deliq.leaf.f.al. **m.p.** 226, **b.p.** 230^{15}. **Soly.** v.s.w.; 23^{78}al.; i.et.

31 —, ***tert*-butyl-.** See *Propylamine, β, β-dimethyl-**.

32 —, **naphthyl-.** See *Naphthylamine, N-methyl-.*

33 **Methyl borate** (*trimethyl borate; trimethoxyboron*). $B(OCH_3)_3$, 103.89. Col. liq. **D.** 0.915, **b.p.** 65. **Soly.** d.w.; ∞al.; ∞et.

34 **Methyl bromide** (*bromomethane**). CH_3Br, 94.94. Col.liq. or gas. **D.** liq. 1.7328, **m.p.** −93, **b.p.** 4.6. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.chl., CS_2, bz.

35 —, ***tert*-butyl-.** See *Propane, 1-bromo-2, 2-dimethyl-**.

36 **Methyl carbitol.** See *Diethylene glycol, monomethyl ether.*

37 **Methyl cellosolve.** See *Ethanol, 2-methoxy-**.

38 **Methyl chloride** (*chloromethane**). CH_3Cl, 50.48. Col.gas. **D.** 0.991 ; 2.31^0 g/l, **m.p.** −97.6, **b.p.** −23.7. **Soly.** 400cm³w.; 3500cm³al.; s.et., s.chl., ac.a.

39 **Methyl cyanide.** See *Acetonitrile.*

40 —, **allyl-.** See *4-Pentenenitrile**.

41 **Methyl disulfide** (*methyldithiomethane*; dimethyl disulfide*). CH_3SSCH_3, 94.17. Liq. **D.** 1.057^{18}_{4}, **b.p.** 116–8. **Soly.** i.w.; ∞al.; ∞et.

42 **Methylene blue** (*3, 9-bisdimethylaminophenazothionium chloride*). $C_{16}H_{18}N_3SCl \cdot 3H_2O$, 373.73. Grn.cr.powd. **m.p.** $-2H_2O$ 100; $-3H_2O$ 150. **Soly.** s.w.; s.al.

43 **Methylene bromide** (*dibromomethane**). CH_2Br_2, 173.85. Col.liq. **D.** 2.4953^{20}_{4}, **m.p.** −52.8, **b.p.** 98.2. **Soly.** 1.15^{20}w.; ∞al.; ∞et.

44 **Methylene chloride** (*dichloromethane**). CH_2Cl_2, 84.93. Col.liq., *n* 1.4237. **D.** 1.336, **m.p.** −96.7, **b.p.** 40.1. **Soly.** 2^{20}w.; ∞al.; ∞et.

45 **Methylene cyanide.** See *Malononitrile.*

46 **Methylenedisulfonic acid.** See *Methionic acid.*

Methylene esters. See "methylene diester" under the different acids.

47 **Methylene iodide** (*diiodomethane**). CH_2I_2, 267.86. Col.liq., leaf. at 0°C, *n* $1.7559^{10.5}$. **D.** 3.325, **m.p.** 5–6, **b.p.** 180 d. **Soly.** 1.42^{20}w.; ∞al.; s.et.

48 **Methylenimine, bis (*p*-dimethylaminophenyl)-.** See *Auramine (base).*

49 **Methyl ether** (*methoxymethane*; dimethyl ether*). $(CH_3)_2O$, 46.05. Col. gas. **D.** 2.091 g/l, **m.p.** −138.5, **b.p.** −23.65. **Soly.** 3700^{18}cm³w.; s.al.; s.et.

50 **Methyl fluoride** (*fluoromethane**). CH_3F, 34.02. Gas. **b.p.** −78. **Soly.** 166^{15}cm³w.; v.s.al.; v.s.et.

51 **Methyl hydride.** See *Methane**.

52 **Methyl iodide** (*iodomethane**). CH_3I. 141.94. Col.-br.liq., *n*. $1.5293^{21.0}$. **D.** 2.279, **m.p.** −66.1, **b.p.** 42.5. **Soly.** 1.4^{20}w.; ∞al.; ∞et.

53 —, ***tert*-butyl-.** See *Propane, 1-iodo-2, 2.-dimethyl-**.

54 **Methyl isocyanide** (*methylcarbylamine; methyl isonitrile*). CH_3NC, 41.03. Col.liq. **D.** 0.756^4; 0.7464^{20}_{4}, **m.p.** −45, **b.p.** 59.6. **Soly.** 10^{15}w.; s.al.; ∞et.

55 **Methyl mercaptan.** See *Methanethiol**.

56 —, **perchloro-** (*thiocarbonyl tetrachloride; trichloromethylsulfur chloride*), CCl_3SCl, 185.89. Yel.liq. **D.** 1.700. **b.p.** 149 sl.d. **Soly.** i.w.

* Name approved by the International Union of Chemistry.

57 Methyl mustard oil. See *Isothiocyanic acid, methyl ester.*

58 Methyl nitrate. CH_3NO_3, 77.03. Liq. **D.** 1.217^{15}; 1.206^{20}_{4}, **b.p.** 65 exp. **Soly.** sl.s.w.; s.al.; s.et.

59 Methyl nitrite. CH_3ONO, 61.03. Gas. **D.** 0.991^{15}, **m.p.** −17.0, **b.p.** −12. **Soly.** s.al.; s.et.

60 Methyloglycolic acid. See *Acetic acid, methoxy-.*

61 Methyl orange (*p-(p-dimethylaminophenylazo)benzenesulfonic acid, sodium salt*). $(CH_3)_2NC_6H_4N{:}NC_6H_4SO_3Na$, 327.19. Or.yel.powd. **Soly.** v.s.w.; s.al.; i.et.

62 Methyl phosphate (*trimethyl phosphate*). $(CH_3)_3PO_4$, 140.09. Liq. **D.** 1.220^{15}, **b.p.** 193. **Soly.** 100^{25}w.; s.al.; s.et.

63 Methyl selenide (*dimethyl selenide*). $(CH_3)_2Se$, 109.25. Liq. **D.** $1.4077^{14.6}_{4}$, **b.p.** 58.2. **Soly.** i.w.; v.s.al.; v.s.et.

64 Methyl sulfate (*dimethyl sulfate*). $(CH_3)_2SO_4$, 126.11. Col.liq., *n* 1.3874. **D.** 1.3322^{20}_{4}, **m.p.** −31.8; frz. −27, **b.p.** 188. **Soly.** v.sl.s.w.; ∞al.; s.et.; s.bz.

65 —, acid. See *Methylsulfuric acid.*

66 Methyl sulfide (*methylthiomethane*; dimethyl sulfide*). $(CH_3)_2S$, 62.11. Col.liq. **D.** 0.8458^{21}_{4}, **m.p.** −83.2, **b.p.** 37.5–38. **Soly.** i.w.; s.al.; s.et.

67 Methyl sulfite (*dimethyl sulfite*). $(CH_3)_2SO_3$, 110.11. Col.liq. **D.** 1.242$^{0}_{}$. **b.p.** 126(122). **Soly.** s.d.w.; s.al.; s.et.

68 Methylsulfonic acid. See *Methanesulfonic acid*.*

69 Methylsulfuric acid (*hydrogen methyl sulfate; acid methyl sulfate*). CH_3HSO_4, 112.09. Oil. **m.p.** < −30. **b.p.** d. **Soly.** v.s.w.; s.al.; ∞et.

70 Methyl telluride (*dimethyl telluride*). $(CH_3)_2Te$, 157.55. Ylsh.liq. **b.p.** 82. **Soly.** i.w.; v.s.al.; v.s.et.

71 Metol. See *Phenol, p-methylamino-, sulfate.*

72 Mezcaline. See *Mescaline.*

73 Miazine. See *Pyrimidine.*

74 Michler's hydrol. See *Benzohydrol, p, p′-bisdimethylamino-.*

75 Michler's ketone. See *Benzophenone, p, p′-bisdimethylamino-.*

76 Milk sugar. See *Lactose.*

77 Monoacetin. See *Glycerol, monoacetate.*

78 α-Monolaurin. See *Glycerol, 1-monolaurate.*

78[1] **Monoölein.** See *Glycerol, 1-monoöleate.*

79 α-Monopalmitin. See *Glycerol, 1-monopalmitate.*

80 Monosilane. See *Silicane.*

81 α-Monostearin. See *Glycerol, 1-monostearate.*

82 Morin (*3, 5, 7, 2′, 4′-pentahydroxyflavone*). $C_{15}H_{10}O_7$, 302.08. Col. need. **m.p.** (anh.) 285. **Soly.** 0.025 w.; s.al.; sl.s.et.; s.ac.a., alk.

83 Moringatannic acid, Moringatannin. See *Maclurin.*

84 Morphine. $C_{17}H_{19}NO_3{\cdot}H_2O$, 303.17. Col.rhomb.pr., fine need. or cr.powd., *n* 1.580, 1.625, 1.645; $[\alpha]-130.9°^{23}_{D}$. **D.** 1.317, **m.p.** anh. 254 d. **b.p.** 191–3 vac. **Soly.** 0.03w.; 0.39al.; 0.02et.; s.chl.

85 —. acetate (*l*). $C_{17}H_{19}NO_3{\cdot}C_2H_4O_2{\cdot}3H_2O$, 399.23. Cr. or amor.powd. **m.p.** 200 d. **Soly.** 44.4w.; 4.63al.; i.et.; s.chl.

86 —. hydrochloride. $C_{17}H_{19}NO_3{\cdot}HCl{\cdot}3H_2O$, 375.67. Silky need.f.w., $[\alpha]-111.5°^{25}_{D}$. **m.p.** 250 d. **Soly.** 5.72w.; 2.38al.; i.et.; s.glyc.; i.chl.

87 —, methyl ether. See *Codeine.*

89 —, sulfate. $(C_{17}H_{19}NO_3)_2H_2SO_4{\cdot}5H_2O$, 758.47. Wh.need., cubic f.w. **m.p.** d. 250. **Soly.** 6.66w.; 0.22al.; i.et.; i.chl.

90 —, diacetyl- (*heroin*). $C_{17}H_{17}(OOCCH_3)_2NO$. 369.19. Wh.cr.powd., *n* 1.560. 1.600. 1.610. **m.p.** 171–2. **Soly.** 0.058w.; 4.0al.; 1.4et.; s.chl.

91 —, —, hydrochloride. $C_{21}H_{23}NO_5{\cdot}HCl{\cdot}H_2O$. 423.67. Wh.cr.powd. **m.p.** 230–1. **Soly.** 50w.; s.al.; i.et.; i.chl.

92 —, ethyl-, hydrochloride (*dionin*). $C_{19}H_{23}NO_3{\cdot}HCl{\cdot}2H_2O$, 385.68. Wh. micr.-cr.powd. **m.p.** 125 d. **Soly.** 14.3w.; 50al.; i.et.; sl.s.chl.

93 Morphol (*3, 4-phenanthrenediol*). $C_{14}H_8(OH)_2$, 210.08. Col.need. **m.p.** 143. **Soly.** i.w.; s.al.; s.et.; s.alk.

94 —, dimethyl ether. See *Phenanthrene, 3, 4-dimethoxy-*.*

95 Morpholine. (*tetrahydro-1, 4-oxazine; diethylenimide oxide*). $OCH_2CH_2NHCH_2CH_2$, 87.08. Col. liq. **D.** 0.9998. **b.p.** 128.3 (126–30). **Soly.** ∞w.; s.al.; s.et.

96 —, 4-(β-ethoxyethyl)- (*ethyl β-4-morpholylethyl ether*). $O(CH_2CH_2)_2NCH_2CH_2OC_2H_5$, 159.14. Col.liq. **D.** 0.963. **b.p.** 206. **Soly.** ∞w.

For explanations and abbreviations see beginning of table.

97 **4-Morpholineëthanol** (*diethylene oxide 2-imino-ethyl alcohol*). $O(CH_2CH_2)_2NCH_2CH_2OH$, 131.11. Col.liq. **D.** 1.071 **b.p.** 225.5. **Soly.** ∞ w.

98 **Moss starch.** See *Lichenin.*

99 **Mucic acid** (2, 3, 4, 5-*tetrahydroxyhexanedioic acid*(one form)). $COOH(CHOH)_4COOH$, 210.08. Col.cr. or wh.powd. **m.p.** 206 d. (213–4), **b.p.** 255. **Soly.** 0.33^{14}w.; i.al.; v.sl.s.et.; s.dil.alk.

00 —, *p*-phenylphenacyl ester. $C_{34}H_{30}O_{10}$, 598.23. **m.p.** 149.5 d.

01 **Muconic acid** (2, 4-*hexadienedioic acid**). $HOOCCH{:}CHCH{:}CHCOOH$, 142.05. Need.f.w. **m.p.** 298 d., **b.p.** ca. 320. **Soly.** 0.02w.; sl.s.al.; sl.s.et.; s.h.ac.a.

02 **Murexan.** See *Uramil.*

03 **Murexide** (*ammonium purpurate*). $C_8H_4O_6N_5NH_4{\cdot}H_2O$, 302.13. Purp. powd. **Soly.** sl.s.w.; i.al.; i.et.

04 **Musk, artificial.** See *Toluene*, 3-*tert-butyl*-2, 4, 6-*trinitro-*.

05 **Musk C, Musk ketone.** See *Acetophenone*, 4-*tert-butyl*-2-*methyl*-3, 6-*dinitro-*.

06 **Musk xylene.** See *Benzene*, 1-*tert-butyl*-3, 5-*dimethyl*-2, 4, 6-*trinitro-*.

07 **Mustard gas.** See *Sulfide*, β, β'-*dichloroethyl.*

08 **Mustard oil acetic acid.** See *Acetic acid, isothiocyano-*.

09 **Mustard oils.** See the different esters under *Isothiocyanic acid.*

10 **Myrcene** (2-*methyl*-6-*methylene*-2, 7-*octadiene*). $(CH_3)_2C{:}CHCH_2CH_2C({:}CH_2)CH{:}CH_2$, 136.12. Liq. **D.** 0.802, **b.p.** 167.

11 **Myricyl alcohol** (*melissyl alcohol*). $C_{31}H_{63}OH$, 452.50. Col.need.f.et. **D.** 0.777^{95}, **m.p.** 88. **Soly.** i.w.; s.h.al.; s.et.; v.s.bz.

12 —, palmitate. See *Palmitic acid, myricyl ester.*

13 **Myristaldehyde,** oxime (*tetradecanal oxime*; myristinaldoxime*). $C_{13}H_{27}CH{:}NOH$, 227.23. Need.f.al. **m.p.** 82. **Soly.** i.w.; s.al.; v.s.et.; v.s.chl.

14 **Myristamide** (*tetradecanamide*; myristic amide*). $CH_3(CH_2)_{12}CONH_2$, 227.23. Leaf. **m.p.** 103, **b.p.** 217^{12}. **Soly.** i.w.; sl.s.al.; sl.s.et.

15 **Myristic acid** (*tetradecanoic acid**). $CH_3(CH_2)_{12}COOH$, 228.22. Col.leaf., *n* 1.4308^{60}. **D.** 0.858^{60}, **m.p.** 58, **b.p.** 250.5^{100}. **Soly.** i.w.; 44.9^{21}al.; sl.s.et.; s.chl., glac.ac.a.

16 —, benzyl ester. $C_{13}H_{27}COOCH_2C_6H_5$, 318.27. Liq. **D.** 0.9321^{25}_{25}, **m.p.** 20.5 **b.p.** 229.31^{11}. **Soly.** i.w.; s.al.; v.s.et.

17 —, ethyl ester (*ethyl tetradecanoate**). $CH_3(CH_2)_{12}COOC_2H_5$, 256.25. Col. cr. **D.** 0.8589^{20}_{4}, **m.p.** 10.5 (11.93), **b.p.** 295. **Soly.** i.w.; s.al.; sl.s.et.

18 —, ethylene ester. See *Glycol, dimyristate.*

19 —, glyceryl ester. See *Glycerol, trimyristate.*

20 **Myristic alcohol.** See 1-*Tetradecanol**.

21 **Myristic anhydride** (*tetradecanoic anhydride**). $(C_{13}H_{27}CO)_2O$, 438.42. Col.cr. **D.** 0.8502^{70}, **m.p.** 53.4, **b.p.** 198. **Soly.** i.w.; s.al.; s.et.

22 **Myristicin** (5-*methoxysafrole*). $C_3H_5C_6H_2(O_2CH_2)OCH_3$, 192.09. Pa. yel. oil. **D.** 1.1425^{19}, **m.p.** < -20, **b.p.** 149.5^{15}. **Soly.** s.al.; s.et.

23 **Myristinaldoxime.** See *Myristaldehyde, oxime.*

24 **Myristonitrile** (*tetradecanenitrile**). $C_{13}H_{27}CN$, 209.22. Liq. or cr. **D.** 0.8281^{19}_{4}, **m.p.** 19, **b.p.** 226.5^{100}. **Soly.** i.w.; sl.s.al.; v.s.et.

25 **Myristyl chloride** (*tetradecanoyl chloride**). $CH_3(CH_2)_{12}COCl$, 246.67. Liq. **m.p.** −1, **b.p.** 168^{15} ($159\text{–}61^{11}$). **Soly.** d.w.; d.al.; s.et.

26 **Napelline.** See *Benzaconine.*

27 **Naphthacetol.** See 1-*Naphthol*, 4-*acetamido-*.

28 **Naphthalane.** See *Naphthalene, decahydro-**.

29 **1-Naphthaldehyde** (1-*naphthalenecarbonal; α-naphthoic aldehyde*) $C_{10}H_7CHO$, 156.06. Liq., *n* $1.65464^{19.3}$ **D.** 1.148^{20}_{4}, **b.p.** 291.6. **Soly.** i.w. s.al.; s.et.

30 —, **2-hydroxy-** (2-*hydroxy*-1-*naphthalenecarbonal*; β-naphthol*-1-*aldehyde*). $HOC_{10}H_6CHO$, 172.06 Br.need. **m.p.** 82, **b.p.** 192. **Soly** i.w.; s.al.; s.et.

31 **2-Naphthaldehyde** (2-*naphthalenecarbonal; β-naphthoic aldehyde*) $C_{10}H_7CHO$, 156.06. Col.leaf.f.w., *n* $1.6211^{99.4}$. **D.** 1.078^{99}, **m.p.** 60.5 **Soly.** s.h.w.; v.s.al.; v.s.et.

32 —, **1-hydroxy-** (1-*hydroxy*-2-*naphthalenecarbonal*; α-naphthol*-2-*aldehyde*). $HOC_{10}H_6CHO$, 172.06 Yel.grn.need. **m.p.** 59–60. **Soly.** i.w. s.al.; s.et.

* Name approved by the International Union of Chemistry.

33 Naphthalene. $C_{10}H_8$, 128.06. Col. monocl., *n* $1.58218^{99.6}$. **D.** 1.145., **m.p.** 80.22, **b.p.** 217.9. **Soly.** 0.003 w.; 4.18c.al.; v.s.et.; $40.21^{15.6}$bz.; v.s.chl., CS_2.

34 —, hexahydride. See *Naphthalene, hexahydro-*.

35 —, tetrachloride. See *Naphthalene,* 1, 2, 3, 4-*tetrachloro*-1, 2, 3, 4-*tetrahydro-*.

36 —, **1, 1'-azoxydi-.** See 1, 1'-*azoxynaphthalene*.

37 —, **1-benzyl-.** See *Methane,* 1-*naphthylphenyl-*.

38 —, **2-benzyl-.** See *Methane,* 2-*naphthylphenyl-*.

39 —, **2-benzyloxy-*.** See *Ether, benzyl* 2-*naphthyl*.

40 —, **1-bromo-*.** $C_{10}H_7Br$, 206.97. Col. oil or pr., *n* $1.65876^{19.4}$. **D.** 1.4875^{20}_{4}, **m.p.** 6.2; 0.2–0.7, **b.p.** 281.1 ($146–9^{16}$). **Soly.** s.h.w.; ∞al.; ∞et.; ∞bz.

41 —, **2-bromo-*.** $C_{10}H_7Br$, 206.97. Rhomb.leaf.f.al. **D.** 1.605^{0}, **m.p.** 59(56–7), **b.p.** 281–2. **Soly.** i.w.; 6al.; s.et.; s.CS_2, chl., bz.

42 —, **1-chloro-*.** $C_{10}H_7Cl$, 162.51. Col. liq., *n* 1.63321^{20}. **D.** 1.1938^{20}_{4}, **b.p.** 263(250–2). **Soly.** i.w.; s.al.; s.et.; s.bz., CS_2.

43 —, **2-chloro-*.** $C_{10}H_7Cl$, 162.51. Col.leaf.f.al. **D.** liq. 1.138^{70}_{4}, **m.p.** 55–6, **b.p.** 264–6. **Soly.** i.w.; s.al.; s.et.; s.chl., CS_2, bz.

44 —, **1-chlorodecahydro-*** (1-*chlorodecalin*). $C_{10}H_{17}Cl$, 172.59. **b.p.** $114–6^{20}$.

45 —, **1-chloro-4-nitro-*.** $C_{10}H_6Cl(NO_2)$, 207.51. Brnsh.-yel.need.f.al. **m.p.** 85. **Soly.** i.w.; s.al.; s.et.

46 —, **7-chloro-1-nitro-*.** $C_{10}H_6Cl(NO_2)$, 207.51. Yel.need.f.al. **m.p.** 116. **Soly.** i.w.; s.al.; s.et.

47 —, **decahydro-*** (*decalin; bicyclo-*[4, 4, 0]*decane; naphthalane; naphthane*). $C_{10}H_{18}$, 138.14. Col.liq.,
cis: *n* 1.4828. **D.** 0.8953^{20}_{4}, **m.p.** −125, **b.p.** 193^{768}. **Soly.** i.w.; s.al.; s.et.
trans: *n* 1.46994^{18}. **D.** 0.8703^{18}_{4}, **b.p.** 185.3.

48 —, **diamino-.** See *Naphthylenediamine*.

49 —, **diazoamino-.** See *Diazoaminonaphthalene*.

50 —, **1, 2-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Monocl.pl.f.al., *n* $1.63375^{48.5}$. **D.** liq. $1.315^{48.5}_{4}$, **m.p.** 35–7, **b.p.** 280–2. **Soly.** s.al.; s.et.

51 —, **1, 3-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Need.f.al. **m.p.** 61.5, **b.p.** 289. **Soly.** s.al.

52 —, **1, 4-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Need.f.al., *n* $1.62282^{75.9}$. **D.** 1.300^{76}, **m.p.** 67–8, **b.p.** 287.6. **Soly.** i.w.; s.al.; s.et.; s.acet., ac.a.

53 —, **1, 5-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Leaf.f.al. or ac.a. **m.p.** 107, **b.p.** subl. **Soly.** i.w.; s.al.; s.et.

54 —, **1, 6-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Need.f.al. **m.p.** 48, **b.p.** subl.

55 —, **1, 7-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Need.f.ac.a., *n* $1.60921^{99.5}$. **D.** 1.261^{100}, **m.p.** 63–4(62), **b.p.** 286. **Soly.** s.al.; s.et.; s.ac.a., bz.

56 —, **1, 8-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Cr.f.al., *n* $1.62357^{99.8}$. **D.** 1.292^{100}, **m.p.** 88(83), **b.p.** d.

57 —, **2, 3-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Lust.sc.f.al. **m.p.** 120. **Soly.** s.h.al.; s.et.

58 —, **2, 6-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Monocl.leaf.f.al. **m.p.** 140–1(135), **b.p.** 285. **Soly.** sl.s.al.; s.et.; s.chl., bz.

59 —, **2, 7-dichloro-*.** $C_{10}H_6Cl_2$, 196.96. Pl.f.al. **m.p.** 114. **Soly.** s.h.al.

60 —, **1, 4-dihydro-*.** $C_{10}H_{10}$, 130.08. Col.liq., *n* $1.58317^{18.3}$. **D.** 0.998, **m.p.** 24.5–25(15.5), **b.p.** 212(94.5^{17}). **Soly.** i.w.; v.s.al.; v.s.et.

61 —, **dihydrodiketo-.** See *Naphthoquinone*.

62 —, **dihydroxy-.** See *Naphthalenediol*.

63 —, **1, 4-dimethyl-*** (*α-dimethylnaphthalene*). $C_{10}H_6(CH_3)_2$, 156.09. Liq., *n* 1.6156^{716}. **D.** 1.016^{20}_{4}, **m.p.** < −18, **b.p.** 264.3. **Soly.** i.w.; v.s.al.; ∞et.

64 —, **2, 3-dimethyl-*.** See *Guaiene*.

65 —, **1, 3-dinitro-*.** $C_{10}H_6(NO_2)_2$, 218.06. Ylsh.need.f.bz. **m.p.** 144–5, **b.p.** subl. **Soly.** i.w.; s.al.

66 —, **1, 5-dinitro-*.** $C_{10}H_6(NO_2)_2$, 218.06. Hex.need.f.ac.a. **m.p.** 217.5 (216), **b.p.** subl. **Soly.** i.w.; sl.s.al.; v.s.et.; s.h.bz., h.pyr., ac.a.; v.sl.s.CS_2.

67 —, **1, 8-dinitro-*.** $C_{10}H_6(NO_2)_2$, 218.06. Yel.rhomb.pl.f.chl. **m.p.** 173–3.5(170), **b.p.** d. **Soly.** i.w.; 0.188^{19} 88%al.; 0.72^{19}bz.; s.pyr.; sl.s.chl.

68 —, **ethoxy-*.** See *Ether, ethyl naphthyl*.

69 —, **1-ethyl-** (*α-naphthylethane; α-ethylnaphthalene*). $C_{10}H_7C_2H_5$, 156.09. Col.liq. **D.** 1.018^{20}_{4}, **m.p.** < −14, **b.p.** 258 d. **Soly.** i.w.; ∞al.; ∞et.

For explanations and abbreviations see beginning of table.

70 **Naphthalene, 2-ethyl-** (*β-naphthylethane; β-ethylnaphthalene*). $C_{10}H_7C_2H_5$, 156.09. Col.liq. **D.** 1.008⁰, **m.p.** −19, **b.p.** 251. **Soly.** i.w.; ∞al.; ∞et.

71 —, **hexahydro-** (*naphthalene hexahydride*). $C_{10}H_{14}$, 134.11. Col.liq., *n* $1.53311^{18.4}$. **D.** 0.934, **b.p.** 205.5.

72 —, **hydrazodi-.** See *Hydrazine, dinaphthyl-.*

73 —, **hydroxy-.** See *Naphthol.*

74 —, **1-iodo-*.** $C_{10}H_7I$, 253.97. Oil., *n* 1.70540^{14}. **D.** 1.7344^{15}_{4}, **b.p.** 305. **Soly.** i.w.; ∞al.; ∞et.

75 —, **2-iodo-*.** $C_{10}H_7I$, 253.97. Cr. leaf., *n* $1.6617^{99.4}$. **m.p.** 54.5, **b.p.** 308–10. **Soly.** i.w.; v.s.al.; v.s.et.

76 —, **methoxy-.** See *Ether, methyl naphthyl.*

77 —, **1-methyl-** (*α-methylnaphthalene*). $C_{10}H_7CH_3$, 142.08. Col.liq., *n.* 1.618. **D.** 1.025, **m.p.** −22, **b.p.** 240–3. **Soly.** i.w.; v.s.al.; v.s.et.

78 —, **2-methyl-** (*β-methylnaphthalene*). $C_{10}H_7CH_3$, 142.08. Col.monocl.f.al., *n* $1.60263^{39.9}$. **D.** 1.029^{40}_{4}, **m.p.** 35.1, **b.p.** 245. **Soly.** i.w.; v.s.al.; v.s.et.

79 —, **1-(γ-methylbutoxy)-*.** See *Ether, isoamyl 1-naphthyl.*

80 —, **2-(γ-methylbutoxy)-*.** See *Ether, isoamyl 2-naphthyl.*

81 —, **naphthoxy-.** See *Naphthyl ether.*

82 —, **1-(2-naphthoyl)-.** See *1, 2′-Naphthyl ketone.*

83 —, **1-nitro-*** (*α-nitronaphthalene*). $C_{10}H_7NO_2$, 173.06. Yel.need.f.al. **D.** 1.331^{4}_{4}, **m.p.** 58.8(56–7), **b.p.** 304. **Soly.** i.w.; s.al.; v.s.et.; v.s.chl., CS_2.

84 —, **2-nitro-*** (*β-nitronaphthalene*). $C_{10}H_7NO_2$, 173.06. Col.rhomb.need.f.al. **m.p.** 79, **b.p.** 165^{15}. **Soly.** i.w.; v.s.al.; v.s.et.

85 —, **1-phenyl-.** $C_6H_5C_{10}H_7$, 204.09. Col.liq. or waxy solid. **m.p.** *ca.* 45, **b.p.** 325. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.bz.

86 —, **2-phenyl-.** $C_6H_5C_{10}H_7$, 204.09. Col.leaf.f.al. **m.p.** 102.5, **b.p.** 345. **Soly.** v.s.al.; v.s.et.; v.s.bz.

87 —, **2-(2-propenoxy)-*.** See *Ether, allyl 2-naphthyl.*

88 —, **propoxy-*.** See *Ether, naphthyl propyl.*

89 —, **1, 2, 3, 4-tetrachloro-1, 2, 3, 4-tetrahydro-*** (*naphthalene tetrachloride*). $C_{10}H_8Cl_4$, 269.89. Cr.f.et. **m.p.** 182 3. **Soly.** i.w.; v.sl.s.h.al.; s.h.et.

90 —, **1, 2, 3, 4-tetrahydro-*** (*tetralin; naphthalene 1, 2, 3, 4-tetrahydride*). $C_{10}H_{12}$, 132.09. Col.liq., *n* $1.54614^{20.2}$. **D.** 0.971, **m.p.** −30, **b.p.** 207.2 **Soly.** i.w.; v.s.al.; v.s.et.

91 —, **1, 3, 5, 8-tetranitro-*** (*γ-tetranitronaphthalene*). $C_{10}H_4(NO_2)_4$, 308.06. Yel.tetr.f.acet. **m.p.** 195. **Soly.** sl.s. al.; v.s.acet.; s.HNO_3; sl.s.chl.

92 —, **1, 3, 6, 8-tetranitro-*** (*β-tetranitronaphthalene*). $C_{10}H_4(NO_2)_4$, 308.06. Long need.f.al. **m.p.** 203, **b.p.** exp. **Soly.** i.w.; sl.s.al.

93 —, **1, 5, ?, ?-tetranitro-*** (*α-tetranitronaphthalene*). $C_{10}H_4(NO_2)_4$, 308.06. Lt.yel.need.f.chl. **m.p.** 259, **b.p.** exp. **Soly.** v.sl.s.w.; v.sl.s.al.; v.sl.s. et.

94 —, **1, 2, 5-trinitro-*.** $C_{10}H_5(NO_2)_3$, 263.06. Col.need.f.al. **m.p.** 113. **Soly.** s.al.

95 —, **1, 3, 5-trinitro-*.** $C_{10}H_5(NO_2)_3$, 263.06. Yel.rhomb.(monocl.)f.chl. **m.p.** 123. **Soly.** i.w.; v.s.al.; sl.s. et.; v.s.acet.; s.chl., ac.a.

96 —, **1, 3, 8-trinitro-*.** $C_{10}H_5(NO_2)_3$, 263.06. Monocl.f.chl. **m.p.** 218. **Soly.** i.w.; 0.046^{23} 88%al.; v.sl.s.et.; v.sl. s.chl.

97 —, **1, 4, 5-trinitro-*.** $C_{10}H_5(NO_2)_3$, 263.06. Yel.leaf. **m.p.** 247(154). **Soly.** i.w.; 0.12^{18}al.; 0.88^{18}et.; 0.64chl. s.bz.

98 **Naphthalenecarbonal.** See *Naphthaldehyde.*

99 **α-Naphthalenecarboxylic acid.** See *1-Naphthoic acid.*

00 **β-Naphthalenecarboxylic acid.** See *2-Naphthoic acid.*

01 **Naphthalenediamine*.** See *Naphthylenediamine.*

02 **1, 2-Naphthalenedicarboxylic acid** $C_{10}H_6(COOH)_2$, 216.06. Need.f.al **m.p.** 175 d. **Soly.** s.h.w.; i.al.; i.et.

03 **1, 4-Naphthalenedicarboxylic acid 1, 2, 3, 4-tetrahydro-1-phenyl-.** See *α-Isatropic acid.*

04 **1, 8-Naphthalenedicarboxylic acid** See *Naphthalic acid.*

05 **1, 2-Naphthalenediol*** (*1, 2-dihydroxynaphthalene; β-hydronaphthoquinone; β-naphthohydroquinone*). $C_{10}H_6(OH)_2$, 160.06. Col.leaf. or need.f CS_2; leaf. ($+1H_2O$) f.w. **m.p.** anh 103–4; $+1H_2O$, 58–60. **Soly.** sl.s.w. s.al.; s.et.; s.alk.

06 **1, 3-Naphthalenediol*** (*1, 3-dihydroxynaphthalene; naphthoresorcinol*) $C_{10}H_6(OH)_2$, 160.06. Leaf.f.w. **m.p.** 124. **Soly.** s.w.; s.al.; s.et.; s.ac.a sl.s.bz., lgr. Yel. in alk.sol.

* Name approved by the International Union of Chemistry.

07 **1, 4-Naphthalenediol*** (*1, 4-dihydroxynaphthalene; α-hydronaphthoquinone; α-naphthohydroquinone*). $C_{10}H_6(OH)_2$, 160.06. Lng.monocl.col.need. **m.p.** 176. **Soly.** s.h.w.; s.al.; s.et.; s.ac.a.; v.sl.s.CS_2, lgr., c.bz.

08 **1, 5-Naphthalenediol*** (*1, 5-dihydroxynaphthalene*). $C_{10}H_6(OH)_2$, 160.06. Sm.pr.f.w. **m.p.** 265(258), **b.p.** d. **Soly.** sl.s.w.; s.al.; s.et.; s.acet., ac.a.; i.bz., pet.eth.

09 **1, 6-Naphthalenediol*** (*1, 6-dihydroxynaphthalene*). $C_{10}H_6(OH)_2$, 160.06. Col.pr.f.bz. **m.p.** 138(135). **Soly.** sl.s.w.; sl.s.al.; v.s.et.; s.acet., bz.

10 **1, 7-Naphthalenediol*** (*1, 7-dihydroxynaphthalene*). $C_{10}H_6(OH)_2$, 160.06. Col.need.f.bz. **m.p.** 178. **Soly.** s.w.; v.s.al.; v.s.et.; s.bz.

11 **1, 8-Naphthalenediol*** (*1, 8-dihydroxynaphthalene*). $C_{10}H_6(OH)_2$, 160.06. Leaf. or need.f.w. **m.p.** 140. **Soly.** sl.s.h.w.; s.h.al.; v.s.et.; s.bz.; sl.s.lgr.

12 **2, 3-Naphthalenediol*** (*2, 3-dihydroxynaphthalene*). $C_{10}H_6(OH)_2$, 160.06. Monocl.(rhomb.)leaf.f.w. **m.p.** 160–1. **Soly.** s.h.w.; v.s.al.; v.s.et.; s.bz., lgr.

13 **2, 6-Naphthalenediol*** (*2, 6-dihydroxynaphthalene*). $C_{10}H_6(OH)_2$, 160.06. Rhomb.pl.f.w. **m.p.** 218, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; s.me.al., acet.; sl.s.bz.; i.lgr.

14 **2, 7-Naphthalenediol*** (*2, 7-dihydroxynaphthalene*). $C_{10}H_6(OH)_2$, 160.06. Need.f.w. **m.p.** 190. **b.p.** subl. **Soly.** s.w.; s.al.; s.et.; s.chl., bz.; i.lgr.

15 **1, 3-Naphthalenedisulfonic acid, 7-amino-.** See *2-Naphthylamine-6, 8-disulfonic acid.*

16 **1, 5-Naphthalenedisulfonic acid.** $C_{10}H_6(SO_3H)_2$, 288.18. Leaf., *n* 1.493, 1.675, 1.739. **m.p.** d. **Soly.** 102^{20}w.; s.al.; i.et.

17 **—, 3-amino-.** See *2-Naphthylamine-4, 8-disulfonic acid.*

18 **—, 4-amino-.** See *1-Naphthylamine-4, 8-disulfonic acid.*

19 **1, 6-Naphthalenedisulfonic acid.** $C_{10}H_6(SO_3H)_2$, 288.18. Cr. **m.p.** 125 d. **Soly.** 164^{20}w.; s.al.; i.et.

20 **2, 7-Naphthalenedisulfonic acid** (*α-naphthalenedisulfonic acid*). $C_{10}H_6(SO_3H)_2$, 288.18. Hyg.need. **Soly.** s.w.; sl.s.c.HCl.

21 **—, 4, 5-dihydroxy-.** See *Chromotropic acid.*

22 **Naphthalenesulfonic acid, amino-.** See *Naphthylaminesulfonic acid.*

23 **1-Naphthalenesulfonic acid** (*α-naphthalenesulfonic acid*). $C_{10}H_7SO_3H \cdot H_2O$, 226.14. Cr. **m.p.** 90. **Soly.** v.s.w.; s.al.; sl.s.et.

24 **—, 4-amino-.** See *Naphthionic acid.*

25 **2-Naphthalenesulfonic acid** (*β-naphthalenesulfonic acid*). $C_{10}H_7SO_3H$, 208.12. Col.-wh.deliq.pl. **m.p.** 102, **b.p.** d. **Soly.** 76.96^{30}w.; s.al.; s.et.; 0.2h.bz.

26 **1-Naphthalenesulfonyl chloride.** $C_{10}H_7SO_2Cl$, 226.57. Leaf.f.et. **m.p.** 68, **b.p.** 195^{13}. **Soly.** i.w.; s.al.; v.s.et.

27 **2-Naphthalenesulfonyl chloride.** $C_{10}H_7SO_2Cl$, 226.57. Wh.cr.powd. or leaf. **m.p.** 76, **b.p.** 201^{13}. **Soly.** i.w.; s.al.; v.s.et.; s.bz., chl., CS_2.

28 **Naphthalenethiol*.** See *Naphthol, thio-.*

29 **Naphthalic acid** (*1, 8-naphthalenedicarboxylic acid*). $C_{10}H_6(COOH)_2$, 216.06. Col.need.f.al. **m.p.** 270 d. **Soly.** v.s.w.; sl.s.al.; sl.s.et.

30 **1-Naphthamide** (*1-naphthalenecarbonamide*; α-naphthoamide*). $C_{10}H_7CONH_2$, 171.08. Col.need.f.al. **m.p.** 202. **Soly.** v.sl.s.w.; v.sl.s.al.

31 **2-Naphthamide** (*2-naphthalenecarbonamide*; β-naphthoamide*). $C_{10}H_7CONH_2$, 171.08. Col.tab.f.al. **m.p.** 192. **Soly.** sl.s.w.; sl.s.al.; s.et.; s.bz., chl.

32 **Naphthane.** See *Naphthalene, decahydro-*.*

33 **Naphthazarin** (*5, 8-dihydroxy-1, 4-naphthoquinone*). $C_{10}H_4O_2(OH)_2$, 190.05. Red br.need.f.al. **m.p.** 276–80. **b.p.** subl. **Soly.** sl.s.h.w.; s.al.; v.sl.s.et.; s.alk.; v.sl.s.bz.

34 **Naphthionic acid** (*1-naphthylamine-4-sulfonic acid; 4-amino-1-naphthalenesulfonic acid*). $NH_2C_{10}H_6SO_3H \cdot 1/2H_2O$, 232.15. Col.need.f.w. **m.p.** d. **Soly.** 0.026^0, 0.22^{100}w.; v.sl.s.al.; v.sl.s.et.

35 **α-Naphthoamide.** See *1-Naphthamide.*

36 **β-Naphthoamide.** See *2-Naphthamide.*

37 **α-Naphthohydroquinone.** See *1, 4-Naphthalenediol*.*

38 **β-Naphthohydroquinone.** See *1, 2-Naphthalenediol*.*

39 **1, 2-Naphthohydroquinone.** See *1, 2-Naphthalenediol.*

40 **1, 4-Naphthohydroquinone.** See *1, 4-Naphthalenediol.*

41 **1-Naphthoic acid** (*α-naphthalene-carboxylic acid; α-naphthoic acid*). $C_{10}H_7COOH$, 172.06. Col.need.f.dil. al. **m.p.** 160, **b.p.** 300. **Soly.** v.sl.s.h.w.; v.s.h.al.; s.et.; s.chl., NH_4OH.

42 —, **2-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Need.f.al. and et. **m.p.** 156–7 d. **Soly.** sl.s.h.w.; v.s.al.; v.s.et.; s.bz.

43 —, **5-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Lng.need.f.w. **m.p.** 234–7, **b.p.** subl. **Soly.** sl.s.h.w.; v.s.al.; s.et.; s.ac.a.

44 —, **6-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Sm.need.f.w. **m.p.** 187. **Soly.** s.h.w.; v.s.al.

45 —, **7-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Need.f.w. **m.p.** 245–7 d. **Soly.** s.h.w.; s.al.

46 —, **8-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Need.f.et. **m.p.** 169. **Soly.** s.h.w.; v.s.al.; s.et.

47 —, **8-nitro-.** $NO_2C_{10}H_6COOH$, 217.06. Pr.f.al. **m.p.** 215. **Soly.** 0.04c.w.; 4.6 al.; sl.s.et.; sl.s.bz.

48 **2-Naphthoic acid** (*β-naphthalene-carboxylic acid; β-naphthoic acid*). $C_{10}H_7COOH$, 172.06. Col.monocl. need.f.lgr. **D.** 1.077^{100}_{4}, **m.p.** 185, **b.p.** >300. **Soly.** 0.0068^{25}w.; v.s.al.; v.s.et.; s.NaOH sol.

49 —, **1-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Need.f.al. or et. **m.p.** 186–8. **Soly.** sl.s.w.; s.al.; s.et.; s.bz.

50 —, **3-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Yel.rhomb.need.f.w. **m.p.** 216 (211–4). **Soly.** s.h.w.; s.al.; s.et.; s.bz., chl.

51 —, **5-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Need.f.w. or al. **m.p.** 211–2. **Soly.** s.h.w.; s.al.

52 —, **7-hydroxy-.** $HOC_{10}H_6COOH$, 188.06. Leaf. **m.p.** 262. **Soly.** s.w.; s.al.; s.et.

53 **α-Naphthoic aldehyde.** See 1-*Naphthaldehyde*.

54 **β-Naphthoic aldehyde.** See 2-*Naphthaldehyde*.

55 **1-Naphthol** (*α-naphthol; 1-hydroxy-naphthalene*). $C_{10}H_7OH$, 144.06. Yel. monocl., n $1.6206^{98.7}$. **D.** 1.224^4; 1.099^{99}, **m.p.** 96, **b.p.** 288(280). **Soly.** sl.s.h., i.c.w.; v.s.al.; v.s.et.; s.bz.

56 —, acetate (*α-naphthyl acetate*). $CH_3COOC_{10}H_7$, 186.08. Need. or pl.f.al. **m.p.** 44.8. **Soly.** sl.s.h.w.; s.al.; v.s.et.

57 —, **4-acetamido-** (*N-(4-hydroxy-1-naphthyl)acetamide; naphthacetol*). $CH_3CONHC_{10}H_6OH$, 201.09. Need. f.al. **m.p.** 187. **Soly.** s.h.w.; s.al.; s.NH_4OH, Na_2CO_3.

58 —, **2-aceto-.** See 2-*Acetonaphthone, 1-hydroxy-*.

59 —, **2-acetyl-4-bromo-.** See 2-*Acetonaphthone, 4-bromo-1-hydroxy-*.

60 —, **2-amino-** (*1-hydroxy-2-naphthylamine*). $NH_2C_{10}H_6OH$, 159.08. Need. **Soly.** sl.s.w.

61 —, **4-amino-** (*4-hydroxy-1-naphthylamine*). $NH_2C_{10}H_6OH$, 159.08. Need. **Soly.** sl.s.w.; s.al.; s.et.

62 —, **5-amino-** (*5-hydroxy-1-naphthylamine*). $NH_2C_{10}H_6OH$, 159.08. Cr. **m.p.** 170 d. **Soly.** sl.s.w.; s.al.; s.et.

63 —, **7-amino-** (*8-hydroxy-2-naphthylamine*). $NH_2C_{10}H_6OH$, 159.08. Cr. (sc.)f.chl. **m.p.** 158. **Soly.** sl.s.w.; s.al.; s.et.

64 —, **8-amino-** (*8-hydroxy-1-naphthylamine*). $NH_2C_{10}H_6OH$, 159.08. Wh. need. **m.p.** 95–7 d. **Soly.** v.s.h., sl.s.c.w.; s.alk., HCl.

65 —, **4-bromo-2-propionyl-.** See 2-*Propionaphthone, 4-bromo-1-hydroxy-*.

66 —, **2-butyryl-.** See 2-*Butyronaphthone, 1-hydroxy-*.

67 —, **2-cinnamyl-.** See 2-*Acrylonaphthone, 1-hydroxy-β-phenyl-*.

68 —, **2, 4-dibromo-.** $Br_2C_{10}H_5OH$, 301.88. Wh.need.f.al. **m.p.** 105 (111). **Soly.** i.w.; s.al.; s.et.; s.ac.a.

69 —, **2, 4-dichloro-.** $Cl_2C_{10}H_5OH$, 212.96. Wh.need.f.al. or bz. **m.p.** 107 **b.p.** d. 180. **Soly.** i.w.; s.al.; s.et.; s.bz.

70 —, **2, 4-dinitro-.** $(NO_2)_2C_{10}H_5OH$, 234.06. Yel.need.f.h.al. or chl. **m.p.** 138. **Soly.** v.sl.s.h.w.; sl.s.al.; sl.s.et.; s.ac.a.; sl.s.bz.

71 —, **2-nitro-.** $NO_2C_{10}H_6OH$, 189.06. Yel.need. or leaf.f.al. **m.p.** 128 **Soly.** v.sl.s.w.; sl.s.al.

72 —, **4-nitro-.** $NO_2C_{10}H_6OH$, 189.06. Yel.need.f.w. **m.p.** 164. **Soly.** s.h.w.; v.s.al.; v.s.ac.a.

73 —, **2-nitroso-** (*1, 2-naphthoquinone 2-oxime*). $NOC_{10}H_6OH$ or $C_{10}H_6O(:NOH)$, 173.06. Yel.need.f.bz. **m.p.** 152. **Soly.** v.sl.s.c.w.; v.s.al.; s.et.

74 —, **4-nitroso-** (*1, 4-naphthoquinone 1-oxime*). $NOC_{10}H_6OH$ or $C_{10}H_6O(:NOH)$, 173.06. Yel.need. **m.p.** 194 d. **Soly.** i.w.; v.s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

75 **1-Naphthol, 1, 2, 3, 4-tetrahdyro-** (*α-naphthol* 1, 2, 3, 4-*tetrahydride; ac-tetrahydro-α-naphthol*). C_6H_4:C_4H_7OH, 148.09. Col.liq., *n* 1.5671[17]. **D.** 1.090, **b.p.** 140[17]. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

76 —, **5, 6, 7, 8-tetrahydro-** (*α-naphthol* 5, 6, 7, 8-*tetrahydride; ar-tetrahydro-α-naphthol*). C_4H_8:C_6H_3OH, 148.09. Wh. monocl.pl. **m.p.** 68, **b.p.** 265.3. **Soly.** sl.s.h.w.; v.s.al.; v.s.et.

77 —, **thio-** (1-*naphthalenethiol*; α-naphthyl mercaptan*). $C_{10}H_7SH$, 160.12. Liq. **D.** 1.155$^{20}_{4}$, **b.p.** 161[20]; 285 d. **Soly.** i.w.; v.s.al.; v.s.et.

78 **2-Naphthol** (*β-naphthol; 2-hydroxy-naphthalene*). $C_{10}H_7OH$, 144.06. Col. monocl.leaf. **D.** 1.217[4], **m.p.** 122 **b.p.** 294.85(286). **Soly.** 0.074[25]w.; 12.5[25]al.; 76.9[25]et.; s.chl., oils, alk., glyc.

79 —, acetate (*β-naphthyl acetate*). CH_3-$COOC_{10}H_7$, 186.08. Sm.need.f.al. **m.p.** 68.5. **Soly.** i.w.; s.al.; s.et.; s.chl.

80 —, benzoate (*β-naphthyl benzoate*). $C_{10}H_7OOCC_6H_5$, 248.09. Need.f.al. **m.p.** 110(107–8). **Soly.** i.w.; v.s.h. al.; sl.s.et.

81 —, **1-acetamido-** (*N*-(2-*hydroxy*-1-*naphthyl*)*acetamide*). CH_3CONHC_{10}-H_6OH, 201.09. Leaf.f.w., al. **m.p.** 235 d. **b.p.** subl. **Soly.** s.al.; s.et.; v.s.NaOH; s.h.ac.a.; sl.s.bz.

82 —, **1-amino-** (2-*hydroxy*-1-*naphthyl-amine*). $NH_2C_{10}H_6OH$, 159.08. Leaf. unst. **Soly.** sl.s.h.w.; sl.s., fluores.et.

83 —, **3-amino-** (3-*hydroxy*-2-*naphthyl-amine*). $NH_2C_{10}H_6OH$, 159.08. Need. f.w. **m.p.** 234. **Soly.** s.w.; v.s.al.; sl.s.et.; sl.s.bz.

84 —, **5-amino-** (6-*hydroxy*-1-*naphthyl-amine*). $NH_2C_{10}H_6OH$, 159.08. Need. or sc.f.w. **m.p.** 186. **Soly.** s.w.; s.al.; s.et.,

85 —, **6-amino-** (6-*hydroxy*-2-*naphthyl-amine*). $NH_2C_{10}H_6OH$, 159.08. Sc.f.h.w. **m.p.** 190–5 d. **Soly.** s.w.; s.al.

86 —, **7-amino-** (7-*hydroxy*-2-*naphthyl-amine*). $NH_2C_{10}H_6OH$, 159.08. Need. f.al. **m.p.** 201. **Soly.** sl.s.w.; v.s.al.; v.s.et.

87 —, **8-amino-** (7-*hydroxy*-1-*naphthyl-amine*). $NH_2C_{10}H_6OH$, 159.08. Need. f.w. or et. **m.p.** 205–7. **Soly.** s.w.; s.al.; sl.s.et.

88 —, **1-bromo-.** $BrC_{10}H_6OH$, 222.97. Rhomb.pr. **m.p.** 84, **b.p.** d. 130. **Soly.** i.w.; s.al.; s.et.

89 —, **6-bromo-1-methyl-.** $CH_3C_{10}H_5$-$BrOH$, 236.99. Need. **m.p.** 129. **Soly.** i.w.; s.al.; s.et.

90 —, **1-chloro-.** $ClC_{10}H_6OH$, 178.51. Pl.f.w., or need.f.lgr. **m.p.** 70. **Soly.** sl.s.w.; s.al.; s.et.; s.chl., bz., ac.a.; sl.s.c.lgr.

91 —, **1, 6-dibromo-.** $Br_2C_{10}H_5OH$, 301.88. Need.f.ac.a. **m.p.** 106. **Soly.** i.w.; s.al.; s.et.

92 —, **1, 6-dinitro-.** $(NO_2)_2C_{10}H_5OH$, 234.06. Pa.yel.need. **m.p.** 195 d. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl.

93 —, **1-methyl-.** $CH_3C_{10}H_6OH$, 158.08. Need. **m.p.** 112. **Soly.** sl.s.w.; s.al.; s.et.

94 —, **1-nitro-.** $NO_2C_{10}H_6OH$, 189.06. Yel.need.f.al. **m.p.** 103 (98–100). **Soly.** v.sl.s.w.; sl.s.al.; v.s.et.

95 —, **5-nitro-.** $NO_2C_{10}H_6OH$, 189.06. Yel.need.f.w. **m.p.** 147. **Soly.** v.s.h. w.; v.s.al.; v.s.et.

96 —, **8-nitro-.** $NO_2C_{10}H_6OH$, 189.06. Yel.need.f.w. **m.p.** 145. **Soly.** s.w.. v.s.al.; s.et.; s.bz., chl.

97 —, **1-nitroso-** (1, 2-*naphthoquinone* 1-*oxime*). $NOC_{10}H_6OH$ or $C_{10}H_6O$-(:NOH), 173.06. Yel.need.f.bz. **m.p.** 110 (105–7). **Soly.** 0.02c.w.; 2.4[13], v.s.h.al.; v.s.et.; s.bz., glac.ac.a.

98 —, **1-*p*-phenylazo-** (*p-nitrobenzene-azo-β-naphthol; paranitraniline red*). $NO_2C_6H_4N$:$NC_{10}H_6OH$, 293.11. Or. to br.pl. **m.p.** 252. **Soly.** i.w.; i.al.

99 —, **1, 2, 3, 4-tetrahydro-** (*β-naphthol* 1, 2, 3, 4-*tetrahydride; ac-tetrahydro-β-naphthol*). C_6H_4:C_4H_7OH, 148.09. Oil. **D.** 1.071, **b.p.** 265.5. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

00 —, **5, 6, 7, 8-tetrahydro-** (*β-naphthol* 5, 6, 7, 8-*tetrahydride; ar-tetrahydro-α-naphthol*). C_4H_8:C_6H_3OH, 148.09. Need.f.al. **m.p.** 57.5, **b.p.** 276. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

01 —, **thio-** (2-*naphthalenethiol*; β-naphthyl mercaptan*). $C_{10}H_7SH$, 160.12. Glit.sc.f.al. **D.** 1.550, **m.p.** 81, **b.p.** 288 d. **Soly.** sl.s.w.; v.s.al.; v.s.et.

02 **Naphtholaldehyde.** See *Naphthaldehyde, hydroxy-*.

03 *β*-**Naphtholdisulfonic acid R.** See *2-Naphthol-3, 6-disulfonic acid*.

04 **1-Naphthol-3, 6-disulfonic acid, 8-amino-** (*H acid*). $H_2N(OH)C_{10}H_4$-$(SO_3H)_2$, 319.20. Col.cr. **Soly.** sl. s.w.

For explanations and abbreviations see beginning of table.

05 2-Naphthol-3, 6-disulfonic acid (*β-naphtholdisulfonic acid R; β-naphthol-α-disulfonic acid; R acid*). $HOC_{10}H_5(SO_3H)_2$, 304.18. Deliq.col.need. **m.p.** d. **Soly.** v.s.w.; v.s.al.; i.et.

06 2-Naphthol-6, 8-disulfonic acid (*β-naphthol-γ-disulfonic acid; G acid*). $HOC_{10}H_5(SO_3H)_2$, 304.18. **Soly.** s.w.

07 β-Naphthol-α-monosulfonic acid. See *Croceic acid.*

08 1-Naphthol-2-sulfonic acid (*α-naphtholsulfonic acid of Schaeffer*). $HOC_{10}H_6SO_3H$, 224.12. Col.rhomb. tab.f.w. **m.p.** > 250. **Soly.** s.w.; s.al.; i.et.

09 1-Naphthol-3-sulfonic acid. $HOC_{10}H_6SO_3H$, 224.12. Need. **Soly.** s.w.

10 1-Naphthol-4-sulfonic acid (*Nevile-Winther acid*). $HOC_{10}H_6SO_3H$, 224.12. Col.pl.f.w. **m.p.** 170 d. **Soly.** v.s.w.

11 1-Naphthol-5-sulfonic acid (*α-naphtholsulfonic acid L*). $HOC_{10}H_6SO_3H$, 224.12. Wh.hyg.cr. **m.p.** 120. **Soly.** s.w.

12 —, **8-amino-** (*S acid*). $C_{10}H_9NO_4S$, 239.14. Wh.need. **Soly.** sl.s.w.; i.al.; i.et.

13 1-Naphthol-7-sulfonic acid. $HOC_{10}H_6SO_3H$, 224.12. Cr. **Soly.** v.s.w.; v.s.al.

14 1-Naphthol-8-sulfonic acid (*α-naphtholsulfonic acid S*). $HOC_{10}H_6SO_3H$, 224.12. Cr. **m.p.** 107, **b.p.** $-H_2O$, 180. **Soly.** v.s.w.

15 —, inner anhydride (*naphthosulfone*). $C_{10}H_6OSO_2$, 206.11. Pr.f.bz. **m.p.** 154, **b.p.** 360. **Soly.** sl.s.w.; sl.s.al.; v.s.chl.; s.bz.; sl.s.CS_2.

16 2-Naphthol-6-sulfonic acid (*Schäffer's acid; β-naphtholsulfonic acid S*). $C_{10}H_6(OH)SO_3H$, 224.12. Col.leaf. **m.p.** 125. **Soly.** v.s.w.; v.s.al.; i.et.

17 —, **1-amino-**, sodium salt. (*eikonogen*). $H_2N(OH)C_{10}H_5SO_3Na$, 261.13. Wh.powd. **Soly.** s.w.

18 2-Naphthol-7-sulfonic acid (*β-naphtholsulfonic acid F*). $C_{10}H_6(OH)SO_3H$, 224.12. Need.f.HCl. **m.p.** 89, **b.p.** d. 150. **Soly.** v.s.w.; v.s.al.; i.et.; i.bz.

19 2-Naphthol-8-sulfonic acid. See *Croceic acid.*

20 1-Naphthonitrile (*1-naphthalenecarbonitrile*; α-naphthyl cyanide*). $C_{10}H_7CN$, 153.06. Col.need.f.lgr. **D.** 1.117[illegible], **m.p.** 33.5, **b.p.** 296.5. **Soly.** i.w.; v.s.al.; v.s.et.; s.lgr.

21 2-Naphthonitrile (*2-naphthalenecarbonitrile*; β-naphthyl cyanide*). $C_{10}H_7CN$, 153.06. Col.leaf.f.lgr. **D.** 1.094^{60}_{60}, **m.p.** 66.5, **b.p.** 305. **Soly.** i.w.; s.al.; s.et.; s.lgr.

22 αβ-Naphthophenazine. See *Benzo[a]phenazine.*

23 α-Naphthoquinaldine. See *Benzo[h]quinoline, 2-methyl-.*

24 β-Naphthoquinaldine. See *Benzo[f]quinoline, 3-methyl-.*

25 Naphtho[2, 3-f]quinoline (*α-anthraquinoline*). $C_{17}H_{11}N$, 229.09. Col.leaf. or tab. **m.p.** 170, **b.p.** 446. **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

26 α-Naphthoquinoline. See *Benzo[h]quinoline.*

27 β-Naphthoquinoline. See *Benzo[f]quinoline.*

28 1, 2-Naphthoquinone (*1, 2-dihydro-1, 2-diketonaphthalene; β-naphthoquinone*). $C_{10}H_6O_2$, 158.05. Yel.-red need. f.et. **m.p.** d. 115–20. **Soly.** s.w.; s.al.; s.et.; s.H_2SO_4, bz.

29 —, 1-oxime. See *2-Naphthol, 1-nitroso-.*

30 —, 2-oxime. See *1-Naphthol, 2-nitroso-.*

31 —, **6-hydroxy-.** $HOC_{10}H_5O_2$, 174.05. Brick red lvs.f.acet. **m.p.** 165 d. **Soly.** s.w.; s.al.; s.et.

32 —, **7-hydroxy-.** $HOC_{10}H_5O_2$, 174.05. Br.-red need. **m.p.** 194. **Soly.** s.al.; i.et.; s.ac.a.; i.bz.

33 1, 4-Naphthoquinone (*1, 4-dihydro-1, 4-diketonaphthalene; α-naphthoquinone*). $C_{10}H_6O_2$, 158.05. Yel.tricl.f.lgr. **D.** 1.422, **m.p.** 125, **b.p.** subl. 100. **Soly.** sl.s.w.; s.al.; v.s.et.; v.s.CS_2, glac.ac.a., s.bz., chl.

34 —, 1-oxime. See *1-Naphthol, 4-nitroso-.*

35 —, **2, 3**(or **3, 4**)**-dihydroxy-.** See *Isonaphthazarin.*

36 —, **5, 8-dihydroxy-.** See *Naphthazarin.*

37 —, **2-hydroxy-.** $HOC_{10}H_5O_2$, 174.05. Yel.need. **m.p.** 190 d., **b.p.** subl. **Soly.** sl.s.h.w.; s.al.; s.et.

38 —, **5-hydroxy-.** See *Juglone.*

39 2, 6-Naphthoquinone (*2, 6-dihydro-2, 6-diketonaphthalene; amphi-naphthoquinone*). $C_{10}H_6O_2$, 158.05. Or.pr. **m.p.** 135. **Soly.** s.al.; v.sl.s.et.; s.alk.

40 Naphthoresorcinol. See *1, 3-Naphthalenediol*.*

41 Naphthosulfone. See *1-Naphthol-8-sulfonic acid, inner anhydride.*

42 Naphthylamine, hydroxy-. See *Naphthol, amino-.*

* Name approved by the International Union of Chemistry.

43 1-Naphthylamine (*α-naphthylamine*). $C_{10}H_7NH_2$, 143.08. Col. rhomb.need.f.dil.al., *n* $1.6703^{51.2}$. **D.** 1.131, **m.p.** 50, **b.p.** 301. **Soly.** 0.17 w.; v.s.al.; v.s.et.

44 —, hydrochloride. $C_{10}H_7NH_2 \cdot HCl$, 179.54. Sm.need. **Soly.** 3.77^{20}w.; v.s.al.; s.et.

45 —, ***N*-acetyl-** (*N-1-naphthylacetamide; 1-acetonaphthalide*). $C_{10}H_7NHCOCH_3$, 185.09. Col.cr. **m.p.** 159. **Soly.** s.h.w.; 3.15^{25} al.; v.sl.s.et.

46 —, ***N*-acetyl-*N*-methyl-** (*N-methyl-N-1-naphthylacetamide*). $(CH_3CO)(CH_3)NC_{10}H_7$, 199.11. Pr. **m.p.** 95. **Soly.** sl.s.w.; s.al.; s.et.

47 —, ***N, N*-diethyl-.** $C_{10}H_7N(C_2H_5)_2$, 199.14. Col.liq., *n* $1.59331^{18.1}$. **D.** 1.005, **b.p.** 290(285). **Soly.** i.w.; ∞al.; ∞et.; s.bz.

48 —, ***N, N*-dimethyl-.** $C_{10}H_7N(CH_3)_2$, 171.11. Col.liq.with vlt.floures. **D.** 1.0446^{15}_{15}, **b.p.** 272–4. **Soly.** i.w.; s.al.; s.et.

49 —, ***N*-ethyl-.** $C_{10}H_7NHC_2H_5$, 171.11. Col.oil, *n* $1.64773^{15.1}$. **D.** 1.060^{20}_{4}, **b.p.** 305(187–90^{20}). **Soly.** i.w.; s.al.; s.et.

50 —, ***N*-methyl-** (*α-naphthylmethylamine*). $C_{10}H_7NHCH_3$, 157.09. Red oil. **b.p.** 293. **Soly.** i.w.; v.s.al.; v.s.et.; s.CS_2.

51 —, **4-(1-naphthylazo)-.** (*4-amino-1, 1′-azonaphthalene*). $C_{10}H_7N{:}NC_{10}H_6NH_2$, 297.14. Redsh.-br.need. **m.p.** 175(183). **Soly.** i.w.; sl.s.al.; sl.s.et.; sl.s.bz.

52 —, **6-nitro-.** $NO_2C_{10}H_6NH_2$, 188.08. Yel.pr.f.al. **m.p.** 143. **Soly.** s.al.

53 —, ***N*-phenyl-.** $C_{10}H_7NHC_6H_5$, 219.11. Col.leaf. or pr.f.al. **m.p.** 62, **b.p.** 335^{258}. **Soly.** 1.44^{25}w.; s.al.; v.s.et.; s.bz., chl., ac.a.

54 —, **4-phenyl-(4)-azo-.** (*4-benzeneazo-α-naphthylamine*). $C_6H_5N_2C_{10}H_6NH_2$, 247.13. Red need.f.al. **m.p.** 120 (123). **Soly.** s.al.; s.et.; s.bz.

55 —, ***N*-propyl-.** $C_{10}H_7NHCH_2CH_2CH_3$, 185.13. Oil. **b.p.** *ca.* 317. **Soly.** i.w.

56 —, **5, 6, 7, 8-tetrahydro-** (*α-naphthylamine 5, 6, 7, 8-tetrahydride; ar-tetrahydro-α-naphthylamine*). $C_4H_8{:}C_6H_3NH_2$, 147.11. Oil, *n* $1.58964^{23.1}$. **D.** 1.054^{23}, **b.p.** 276.8. **Soly.** v.sl.s.w.; s.al.; s.et.; s.dil.a.

57 —, ***N*-o-tolyl-** (*N-1-naphthyl-o-toluidine*). $C_{10}H_7NHC_6H_4CH_3$, 233.13. Need.f.lgr. **m.p.** 94–5. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.bz.

58 —, ***N*-*p*-tolyl-** (*N-1-naphthyl-p-toluidine*). $C_{10}H_7NHC_6H_4CH_3$, 233.13. Pr.f.al. **m.p.** 79, **b.p.** 230^{10}. **Soly.** i.w.; s.al.; v.s.et.; s.bz.; sl.s.h.pet.eth.

59 2-Naphthylamine (*β-naphthylamine*). $C_{10}H_7NH_2$, 143.08. Leaf.f.w., *n* $1.64927^{93.4}$. **D.** 1061^{98}_{4}, **m.p.** 110.2, **b.p.** 306.1. **Soly.** s.w.; s.al.; s.et.; s.bz.

60 —, hydrochloride. $C_{10}H_7NH_2 \cdot HCl$, 179.54. Leaf. **Soly.** v.s.w.; v.s.al.; s.et.; sl.s.HCl.

61 —, ***N*-acetyl-** (*N-2-naphthylacetamide; 2-acetonaphthalide*). $C_{10}H_7NHCOCH_3$, 185.09. Lng.flat need.f.w. **m.p.** 132. **Soly.** s.h.w.; s.al.; sl.s.et.

62 —, ***N, N*-dimethyl-.** $C_{10}H_7N(CH_3)_2$, 171.11. Col., *n* $1.64432^{53.2}$. **D.** 1.029^{53}_{4}; 1.045^{40}, **b.p.** 305. **Soly.** i.w.; s.al.; ∞et.

63 —, ***N*-ethyl-.** $C_{10}H_7NHC_2H_5$, 171.11. Col. oil, *n* $1.65440^{21.3}$. **D.** 1.057, **m.p.** < -15, **b.p.** 315–6(305–7). **Soly.** i.w.; s.al.; s.et.

64 —, ***N*-methyl-** (*β-naphthylmethylamine*). $C_{10}H_7NHCH_3$, 157.09. Oil. **b.p.** 308–10^{761} (298).

65 —, **1-nitro-.** $NO_2C_{10}H_6NH_2$, 188.08. Or.yel.need.f.al. **m.p.** 127(123–4). **Soly.** s.h.w.; v.s.al.; s.ac.a.

66 —, **5-nitro-.** $NO_2C_{10}H_6NH_2$, 188.08. Red need.f.al. **m.p.** 143. **Soly.** v.s.h.al.; s.bz.; i.lgr.

67 —, **8-nitro-.** $NO_2C_{10}H_6NH_2$, 188.08. Red need. **m.p.** 105. **Soly.** v.s.al.; s.et.; i.lgr.

68 —, **1-nitroso-.** $NOC_{10}H_6NH_2$, 172.08. Grn.need.f.al. **m.p.** 150–2. **Soly.** sl.s.h.w.; v.s.al.; v.s.et.

69 —, ***N*-phenyl-.** $C_{10}H_7NHC_6H_5$, 219.11. Rhomb.need.f.me.al. **m.p.** 108, **b.p.** 399.5. **Soly.** i.w.; s.al.; s.et.; v.s.chl.; s.h.bz.

70 —, **1, 2, 3, 4-tetrahydro-.** (*β-naphthylamine 1, 2, 3, 4-tetrahydride; ac-tetrahydro-β-naphthylamine*). $C_6H_4{:}C_4H_7NH_2$, 147.11. Liq., *n* $1.56039^{22.2}$. **D.** 1.029^{22}, **m.p.** 38, **b.p.** 278.5. **Soly.** s.h.w.; v.s.al.; v.s.et.

71 —, ***N*-o-tolyl-** (*N-2-naphthyl-o-toluidine*). $C_{10}H_7NHC_6H_4CH_3$, 233.13. Leaf.f.lgr. **m.p.** 95–6, **b.p.** 400–5. **Soly.** s.al.; s.et.; v.s.bz., lgr., chl., acet.

72 —, ***N*-*p*-tolyl-** (*N-2-naphthyl-p-toluidine*). $C_{10}H_7NHC_6H_4CH_3$, 233.13. Red leaf.f.al. **m.p.** 102–3. **Soly.** sl.s.al.; s.et.; s.bz.; sl.s.lgr.

For explanations and abbreviations see beginning of table.

73 **1-Naphthylamine-4, 8-disulfonic acid** (4-*amino*-1, 5-*naphthalenedisulfonic acid; α-naphthylaminedisulfonic acid S*). $NH_2C_{10}H_6(SO_3H)_2$, 303.20 Rhomb.cr. **Soly.** v.s.w.

74 **2-Naphthylamine-4, 8-disulfonic acid** (3-*amino*-1, 5-*naphthalenedisulfonic acid; β-naphthylaminedisulfonic acid; C acid; acid IV*). $H_2NC_{10}H_5(SO_3H)_2$, 303.20. **Soly.** s.w.

75 **2-Naphthylamine - 6, 8-disulfonic acid** (*amino G acid; 7-amino*-1, 3-*naphthalenedisulfonic acid*). $H_2NC_{10}H_5(SO_3H)_2$,303.20. Monocl.need. **Soly.** s.w.

76 **α-Naphthylaminemonosulfonic acid S.** See 1-*Naphthylamine*-8-*sulfonic acid.*

77 **β-Naphthylaminemonosulfonic acid I(of Dahl).** See 2-*Naphthylamine*-8-*sulfonic acid.*

78 **α-Naphthylaminesulfonic acid.** See 1-*Naphthylamine*-5-*sulfonic acid.*

79 **β-Naphthylaminesulfonic acid F.** See 2-*Naphthylamine*-7-*sulfonic acid.*

80 **β-Naphthylaminesulfonic acid III.** See 2-*Naphthylamine*-5-*sulfonic acid.*

81 **1-Naphthylamine-2-sulfonic acid** (1-*amino*-2-*naphthalenesulfonic acid*). $NH_2C_{10}H_6SO_3H$, 223.14. Need.f.w. **m.p.** 272 d. **Soly.** 0.41^{20}; 3.1^{100}w.; i.al.; i.bz.

82 **1-Naphthylamine-4-sulfonic acid.** See *Naphthionic acid.*

83 **1-Naphthylamine-5-sulfonic acid** (5-*amino*-1-*naphthalenesulfonic acid; α-naphthylaminesulfonic acid; Laurent's acid*). $NH_2C_{10}H_6SO_3H \cdot H_2O$, 241.15. Sm.pl. **m.p.** 189.5. **Soly.** sl.s.w.; v.sl.s.al.; v.sl.s.et.

84 **1-Naphthylamine-6-sulfonic acid** (5-*amino*-2-*naphthalenesulfonic acid*). $NH_2C_{10}H_6SO_3H$, 223.14. Col.pl.f.w. **m.p.** d. **Soly.** 0.03^{20}w.; i.al.; i.et.

85 **1-Naphthylamine-7-sulfonic acid** (8-*amino*-2-*naphthalenesulfonic acid*). $NH_2C_{10}H_6SO_3H \cdot H_2O$, 241.15. Col. need.f.w. **Soly.** 0.464^{25}w.; v.sl.s.al.; v.sl.s.et.

86 **1-Naphthylamine-8-sulfonic acid** (8-*amino*-1-*naphthalenesulfonic acid; α-naphthylaminemonosulfonic acid S; Schöllkopf's acid*). $NH_2C_{10}H_6SO_3H \cdot H_2O$, 241.15. Need. **m.p.** $-H_2O$, 130. **Soly.** 0.42^{100}, 0.02^{21}w.; v.sl.s.al.; v.sl.s. et.; s.ac.a.

87 **2-Naphthylamine-1-sulfonic acid** (*Tobias' acid; 2-amino*-1-*naphthalenesulfonic acid*). $NH_2C_{10}H_6SO_3H$, 223.14. Leaf.f.h.w. **Soly.** sl.s.c., s.h.w.; v.sl.s. al.; v.sl.s.et.

88 **2-Naphthylamine-4-sulfonic acid** (3-*amino*-1-*naphthalenesulfonic acid*). $NH_2C_{10}H_6SO_3H \cdot H_2O$, 241.15. Need.f. w. **Soly.** sl.s.c.w.; v.sl.s.al.; v.sl.s.et.

89 **2-Naphthylamine-5-sulfonic acid** (6-*amino*-1-*naphthalenesulfonic acid; β-naphthylaminesulfonic acid III*). $NH_2C_{10}H_6SO_3H$, 223.14. Need.f.w. **Soly.** 0.033^{20}w.; v.sl.s.al.; v.sl.s.et.

90 **2-Naphthylamine-6-sulfonic acid** (6-*amino*-2-*naphthalenesulfonic acid; Brönner's acid*). $NH_2C_{10}H_6SO_3H \cdot H_2O$, 241.15. Leaf. **Soly.** 0.013^{20}, 0.16^{100} w.; v.sl.s.al.; v.sl.s.et.

91 **2-Naphthylamine-7-sulfonic acid** (7-*amino*-2-*naphthalenesulfonic acid; β-naphthylaminesulfonic acid F*). $NH_2C_{10}H_6SO_3H \cdot H_2O$, 241.15. Col.need. **Soly.** 0.02^{20}, 0.28^{100}w.; v.sl.s.al.; v.sl.s. et.

92 **2-Naphthylamine-8-sulfonic acid** (7-*amino*-1-*naphthalenesulfonic acid; β-naphthylaminemonosulfonic acid I(of Dahl)*). $NH_2C_{10}H_6SO_3H$, 223.14. Pr. f.w. **Soly.** 0.06^{20}w.; sl.s.al.; v.sl.s.et.

93 **α-Naphthyl cyanide.** See 1-*Naphthonitrile.*

94 **β-Naphthyl cyanide.** See 2-*Naphthonitrile.*

95 **1, 2-Naphthylenediamine** (1, 2-*naphthalenediamine**; 1, 2-*diaminonaphthalene*). $C_{10}H_6(NH_2)_2$, 158.09. Leaf.f.w. **m.p.** 96, **b.p.** $150–1^{0.5}$. **Soly.** s.h.w.; v.s.al.; v.s.et.

96 **1, 4-Naphthylenediamine** (1, 4-*naphthalenediamine**; 1, 4-*diaminonaphthalene*). $C_{10}H_6(NH_2)_2$, 158.09. Pr.f.h.w. **m.p.** 120. **Soly.** sl.s.w.; v.s.al.; v.s.et.

97 **1, 5-Naphthylenediamine** (1, 5-*naphthalenediamine**; 1, 5-*diaminonaphthalene*). $C_{10}H_6(NH_2)_2$, 158.09. Col.pr.f.et. **m.p.** 189.5, **b.p.** subl. **Soly.** v.sl.s.c.w.; s.h.al.; v.s.et.; v.s. chl.

98 **1, 6-Naphthylenediamine** (1, 6-*naphthalenediamine**; 1, 6-*diaminonaphthalene*). $C_{10}H_6(NH_2)_2$, 158.09. Need.f.w., *n* $1.7083^{99.4}$. **D.** 1.147^{99}, **m.p.** 78. **Soly.** v.sl.s.c., s.h.w.; s.h.al.; sl.s.et.

99 **1, 7-Naphthylenediamine** (1, 7-*naphthalenediamine**; 1, 7-*diaminonaphthalene*). $C_{10}H_6(NH_2)_2$, 158.09. Leaf.f.bz.; need.f.w. **m.p.** 117.5. **Soly.** sl.s.w.; v.s.al.; v.sl.s.et.

00 **1, 8-Naphthylenediamine** (1, 8-*naphthalenediamine**; 1, 8-*diaminonaphthalene*). $C_{10}H_6(NH_2)_2$, 158.09. Col.cr.f.al., *n* $1.6828^{99.4}$. **D.** 1.127^{99}, **m.p.** 66.5, **b.p.** subl. 205^{12}. **Soly.** sl.s.w.; v.s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

01 **2, 3-Naphthylenediamine** (2, 3-*naphthalenediamine**; 2, 3-*diaminonaphthalene*). $C_{10}H_6(NH_2)_2$, 158.09. Leaf.f.et. **m.p.** 191. **Soly.** v.s.al.; s.et.

02 **2, 6-Naphthylenediamine** (2, 6-*naphthalenediamine**; 2, 6-*diaminonaphthalene*). $C_{10}H_6(NH_2)_2$, 158.09. Need.f.w. **m.p.** 216. **Soly.** v.sl.s.h.w.; v.sl.s.al.; v.sl.s.et.

Naphthyl esters. See "naphthyl ester," under the names of the acids.

03 **1-Naphthyl ether** (1-(1-*naphthoxy*)-*naphthalene**; *α-dinaphthyl ether*). $(C_{10}H_7)_2O$, 270.11. Col.leaf. **m.p.** 110, **b.p.** > 360. **Soly.** i.w.; s.h.al.; s.et.; s.bz., h.ac.a.

04 **1, 2′-Naphthyl ether** (*α, β′-dinaphthyl ether*; 1-(2-*naphthoxy*)*naphthalene*). $C_{10}H_7OC_{10}H_7$, 270.11. Need.f.al. + et. **m.p.** 81, **b.p.** 264^{15}. **Soly.** i.w.; sl.s.al.; s.et.; s.bz., chl.

05 **2-Naphthyl ether** (2-(2-*naphthoxy*)-*naphthalene**; *β-dinaphthyl ether*). $(C_{10}H_7)_2O$, 270.11. Col.need.f.al. **m.p.** 105, **b.p.** 250^{20} sl.d. **Soly.** i.w.; s.h.al.; v.s.et.; s.bz., h.ac.a.

06 **1-Naphthyl ketone** (*α, α-dinaphthyl ketone*). $C_{10}H_7COC_{10}H_7$, 282.11. Need.f.et. **m.p.** 104, **b.p.** subl. **Soly.** s.h.al.; sl.s.et.; v.s.bz.; s.H_2SO_4, chl.; sl.s.h.ac.a., lgr.

07 **1, 2′-Naphthyl ketone** (*α, β′-dinaphthyl ketone*). $C_{10}H_7COC_{10}H_7$, 282.11. Col.need.f.al. **m.p.** 136–7(135), **b.p.** subl. **Soly.** 1.3^{14}al.; v.s.et.; s.bz.

08 **2-Naphthyl ketone** (*β, β′-dinaphthyl ketone*). $C_{10}H_7COC_{10}H_7$, 282.11.
(1) Need.f.et. **m.p.** 125.5. **Soly.** i.w.; 0.37^{19}al.
(2) Leaf.f.chl. + et. **m.p.** 164.5. **Soly.** i.w.; 0.08^{19}al.; sl.s.et.; s.chl.

09 **Naphthyl mercaptan.** See *Naphthol, thio-*.

10 **2-Naphthyl salicylate.** See *Betol*.

11 **Narceine.** $C_{23}H_{27}NO_8 \cdot 3H_2O$, 499.27. Col.pr.f.w. **m.p.** anh. 170. **Soly.** 0.078^{13}w.; 0.1al.; i.et.; $0.011^{17}CCl_4$; s.alk., NH_4OH; sl.s.chl.; i.bz.

12 —, bisulfate. $C_{23}H_{27}NO_8 \cdot H_2SO_4 \cdot 10H_2O$, 723.45. Cr.powd. or need. **m.p.** d.→yel. **Soly.** s.w.; s.h.al.; s.chl.

13 —, hydrochloride. $C_{23}H_{27}NO_8 \cdot HCl \cdot 3H_2O$, 535.73. Yel.cr.f.HCl. **m.p.** anh. 192. **Soly.** sl.s.w.; s.al.; s.me.al.

14 **Narcotine.** $C_{22}H_{23}NO_7$, 413.19. Col. rhomb.need.f.al., $[\alpha] - 207.35°_D$. **D.** 1.374, **m.p.** 175, **b.p.** d. **Soly.** 0.004^{20}w.; 1^{20}al.; 0.8^4, 2.1^{35}et.; v.s.chl.; s.bz., CS_2, et.ac., acet., pet.eth.

15 —, hydrochloride. $C_{22}H_{23}NO_7 \cdot HCl \cdot H_2O$, 467.67. Wh.lust.cr. **m.p.** 197–8. **Soly.** s.w.; s.chl.

16 *dl*-**Narcotine.** See *Gnoscopine*.

17 **Narcotine hemipic acid.** See *Hemipic acid*.

18 **Naringin.** $C_{23}H_{28}O_{12}$(?), 496.22 (?). Sm.pr. **m.p.** anh. 171. **Soly.** sl.s.c., s.h.w.; v.s.h.al.; i.et.

19 **Neohexane.** See *Butane*, 2, 2-*dimethyl-**.

20 **Neopentane.** See *Propane*, 2, 2-*dimethyl-**.

21 **Neopentyl alcohol.** See 1-*Propanol*, 2, 2-*dimethyl-**.

22 **Neral.** See *Citral b*.

23 **Nerolin(new).** See *Ether, ethyl 2-naphthyl*.

24 **Nerolin(old).** See *Ether, methyl 2-naphthyl*.

25 **Neurine** (*trimethylvinylammonium hydroxide*). $CH_2{:}CHN(CH_3)_3OH$, 103.11. Syrup. **Soly.** s.w.; s.al.; s.et.

26 **Nevile-Winther acid.** See 1-*Naphthol-4-sulfonic acid*.

27 **Ngai camphor.** See *l-Borneol*.

28 **Nicoteine.** $C_{10}H_{12}N_2$, 160.11. **D.** 1.078^{12}, **b.p.** 267.

29 **Nicotine.** $C_{10}H_{14}N_2$, 162.13. Col.oil, n $1.52392^{22.4}$; $[\alpha] - 161.55°$. **D.** 1.00924^{20}_{4}, **m.p.** < −80, **b.p.** 247.3. **Soly.** ∞w.; ∞al.; ∞et.; v.s.chl., pet.eth., oils.

30 —, hydrochloride(*d*). $C_{10}H_{14}N_2 \cdot 2HCl$, 235.05. Deliq.cr. **Soly.** s.w.; s.al.

31 —, picrate. $C_{10}H_{14}N_2 \cdot 2C_6H_3N_3O_7$, 620.22. Yel.need. or pr. **m.p.** 218.

32 —, salicylate. $C_{10}H_{14}N_2 \cdot C_7H_6O_3$, 300.17. Wh.pl. **m.p.** 117.5. **Soly.** s.w.; s.al.; s.et.

33 —, tartrate (*nicotine bitartrate*). $C_{10}H_{14}N_2 \cdot 2C_4H_6O_6 \cdot 2H_2O$, 498.25. Redish-wh.cr. **m.p.** 88–90. **Soly.** v.s.w.; s.al.; s.et.

34 **Nicotinic acid** (3-*pyridinecarboxylic acid**). C_5H_4NCOOH, 123.05. Col. need. **m.p.** 229–30 (232), **b.p.** subl. **Soly.** sl.s.c., s.h.w.; 0.73^{25}al.; v.sl.s.et.

35 —, *N*-methylbetaine. See *Trigonelline*.

36 —, **2-hydroxy-.** $C_5H_3N(OH)COOH$, 139.05. Need.f.w. **m.p.** α 256; β 301–2 d., **b.p.** subl. **Soly.** sl.s.h.w.; sl.s.al.; sl.s.et.; v.sl.s.chl.

37 —, **1, 2, 5, 6-tetrahydro-1-methyl-.** See *Arecaidine*.

38 **Nicotyrine** (3-(1-*methyl-2-pyrryl*)*pyridine; dipyridine*). $C_{10}H_{10}N_2$, 158.09. Need.f.h.w. **D.** 1.124^{13}, **m.p.** 108, **b.p.** $286–90^{735}$ (280–1). **Soly.** sl.s.c., s.h.w.; s.al.; s.et.

39 **Niobe oil.** See *Benzoic acid, methyl ester.*

40 **Nitramine, diethyl-.** See *Diethylamine, N-nitro-.*

41 —, **dimethyl-.** See *Dimethylamine, N-nitro-.*

42 —, **methylpicryl-.** See *Tetryl.*

43 —, **phenyl-.** See *Aniline, N-nitro-.*

44 —, ***n*-propyl-.** See *Propylamine, N-nitro-.*

45 **Nitranilic acid** (2, 5-*dihydroxy*-3, 6-*dinitroquinone*). $(NO_2)_2C_6O_2(OH)_2$, 230.03. Lng.yel.pl.f.acet. **m.p.** 100, **b.p.** 170 d. **Soly.** v.s.w.; v.s.al.; i.et.

46 **Nitranilide.** See *Aniline, N-nitro-.*

47 **Nitric diethylamide.** See *Diethylamine, N-nitro-.*

48 **Nitric dimethylamide.** See *Dimethylamine, N-nitro-.*

49 **Nitric ether.** See *Ethyl nitrate.*

Nitro-. See the parent compounds (e.g., for nitrobenzene see *Benzene, nitro-*).

50 **Nitroerythrite.** See *Erythritol, tetranitrate.*

51 **Nitroform** (*trinitromethane*). $CH(NO_2)_3$, 151.03. Col.oil or wh.cr. **D.** $1.5967^{24}_{4}{}^{.3}$, **m.p.** 15, **b.p.** $45–7^{22}$ exp. **Soly.** s.w.; s.alk.

52 **Nitroglycerin** (*glycerol trinitrate; glyceryl nitrate; trinitrin; glonoin; etc.*). $C_3H_5(ONO_2)_3$, 227.06. Col.-yel.liq., n $1.482^{18.6}$. **D.** 1.601, **m.p.** 2.9; 13.2, **b.p.** exp.260. **Soly.** 0.18^{20}w.; 25al.; ∞et.; 7me.al.

53 **Nitrolic acid, ethyl-.** See *Acetonitrolic acid.*

54 —, **methyl-.** See *Formonitrolic acid.*

55 **Nitromannite.** See *Mannitol, hexanitrate.*

56 **Nitron** (4, 5-*dihydro*-1, 4-*diphenyl*-3, 5-*phenylimino*-1, 2, 4-*triazole*). $C_{20}H_{16}N_4$, 312.16. Yel.need. **m.p.** 189 d. **Soly.** i.w.; s.al.; sl.s.et.; s.bz., acet., chl., et.ac.

57 **Nitrosamine, diethyl-.** See *Diethylamine, N-nitroso-.*

58 —, **diisopropyl-.** See *Diisopropylamine, N-nitroso-.*

59 —, **dimethyl-.** See *Dimethylamine, N-nitroso-.*

60 —, **diphenyl-.** See *Diphenylamine, N-nitroso-.*

61 —, **dipropyl-.** See *Dipropylamine, N-nitroso-.*

62 —, **methylphenyl-.** See *Aniline, N-methyl-N-nitroso-.*

Nitroso-. See the parent compounds (e.g., for nitrosobenzene see *Benzene, nitroso-*).

63 **Nitrous diethylamide.** See *Diethylamine, N-nitroso-.*

64 **Nitrous diisopropylamide.** See *Diisopropylamine, N-nitroso-.*

65 **Nitrous dimethylamide.** See *Dimethylamine, N-nitroso-.*

66 **Nitrous diphenylamide.** See *Diphenylamine, N-nitroso-.*

67 **Nitrous dipropylamide.** See *Dipropylamine, N-nitroso-.*

68 **Nitrous ether.** See *Ethyl nitrite.*

69 **Nonadecane*** (*n-nonadecane*). $CH_3(CH_2)_{17}CH_3$, 268.31. Leaf., n $1.436^{34.6}$. **D.** 0.777^{32}, **m.p.** 32, **b.p.** 330. **Soly.** i.w.; sl.s.al.; s.et.

70 **Nonadecanoic acid*** (*n-nonadecylic acid*). $CH_3(CH_2)_{17}COOH$, 298.30. Glit.leaf.f.al. **m.p.** 66.5, **b.p.** 299^{100}. **Soly.** i.w.; sl.s.al.; s.et.

71 **1-Nonadecanol*** (*n-nonadecyl alcohol*). $CH_3(CH_2)_{18}OH$, 284.31. Opaque cr. **m.p.** 62.

72 **10-Nonadecanone*** (*caprinone; dinonyl ketone*). $(C_9H_{19})_2CO$, 282.30. Leaf.f.al. **m.p.** 58, **b.p.** >350. **Soly.** i.w.; s.h.al.; s.et.

73 ***n*-Nonadecyl alcohol.** See 1-*Nonadecanol**.

74 ***n*-Nonadecylic acid.** See *Nonadecanoic acid**.

75 **Nonamethylene glycol.** See 1, 9-*Nonanediol**.

76 **Nonanal,** oxime. See *Pelargonaldehyde, oxime.*

77 **Nonanamide*.** See *Pelargonamide.*

78 **Nonane*** (*n-nonane*). $CH_3(CH_2)_7CH_3$, 128.16. Col.liq., n 1.4056. **D.** 0.7177^{20}, **m.p.** 53.7 (−51.0), **b.p.** 150.72. **Soly.** i.w.; v.s.al.; v.s.et.

79 **Nonanedioic acid*.** See *Azelaic acid.*

80 **1, 9-Nonanediol*** (*nonamethylene glycol; enneamethylene glycol*). $CH_2OH(CH_2)_7CH_2OH$, 160.16. **b.p.** $147–50^{2}$. **Soly.** sl.s.w.; s.al.; i.et.

81 **Nonanenitrile*.** See *Pelargononitrile.*

82 **Nonanoic acid*.** See *Pelargonic acid.*

* Name approved by the International Union of Chemistry.

83 **1-Nonanol*** (*n-nonyl alcohol*). $CH_3(CH_2)_7CH_2OH$, 144.16. Col.liq., *n* 1.4320^{25}. **D.** 0.8279^{20}_{4}, **m.p.** −5, **b.p.** 213.5(215). **Soly.** i.w.; ∞al.; ∞et.

84 —, **2-methyl-*** (*2-heptyl-2-methylethanol*). $CH_3(CH_2)_6CH(CH_3)CH_2OH$, 158.17. Liq. **D.** 0.849^{0}_{4}, **b.p.** 118^{15}. **Soly.** i.w.; s.al.; s.et.

85 **2-Nonanol*** (*heptylmethylcarbinol*). $CH_3CHOH(CH_2)_6CH_3$, 144.16. Col. liq., *n* 1.4290^{25}. **D.** 0.8190^{25}_{4}; 0.8471^{20}_{4}, **m.p.** −35, **b.p.** 193–4 (198.3). **Soly.** i.w.; s.al.; s.et.

86 **3-Nonanol*** (*ethylhexylcarbinol*). $CH_3CH_2CHOH(CH_2)_5CH_3$, 144.16. Liq. **D.** 0.825^{20}_{4}, **m.p.** −22, **b.p.** $194–5^{750}$. **Soly.** i.w.; s.al.; s.et.

87 **4-Nonanol*** (*amylpropylcarbinol*). $CH_3(CH_2)_2CHOH(CH_2)_4CH_3$, 144.16. Liq. **D.** 0.8282, **b.p.** 192–3. **Soly.** i.w.; s.al.; s.et.

88 **5-Nonanol*** (*dibutylcarbinol*). $(C_4H_9)_2CHOH$, 144.16. Thick oil, *n* 1.4289^{18}. **D.** 0.823^{18}, **b.p.** 194. **Soly.** i.w.; ∞al.; ∞et.

89 —, **2, 8-dimethyl-*** (*diisoamylcarbinol*). $[(CH_3)_2CH(CH_2)_2]_2CHOH$, 172.19. Liq. **D.** $0.8305^{12.6}_{4}$, **b.p.** 105^{9}. **Soly.** i.w.; s.al.; s.et.

90 **2-Nonanone*** (*heptyl methyl ketone*). $CH_3CO(CH_2)_6CH_3$, 142.14. Liq. **D.** 0.8317, **m.p.** −8.2 (−19), **b.p.** 194–6. **Soly.** i.w.; s.al.; s.et.

91 **3-Nonanone*** (*ethyl hexyl ketone*). $C_2H_5CO(CH_2)_5CH_3$, 142.14. Pr. **D.** 0.840^{0}, **m.p.** −8, **b.p.** 190. **Soly.** s.al.; s.et.

92 **5-Nonanone*** (*dibutyl ketone*). $(CH_3CH_2CH_2CH_2)_2CO$, 142.14. Col.liq., *n* 1.421^{15}. **D.** 0.8270^{14}_{4}, **m.p.** −5.9, **b.p.** 186–7 (181–2). **Soly.** v.sl.s.w.; s.al.; s.et.; v.s.chl., CS_2.

93 —, **2, 8-dimethyl-*** (*diisoamyl ketone; isocaprone; diisopentyl ketone*). $[(CH_3)_2CH(CH_2)_2]_2CO$, 170.17. Yel. oil. **D.** 0.8208^{25}_{4}, **m.p.** 14.6, **b.p.** 226. **Soly.** i.w.; s.al.; s.et.

94 **Nonanoyl chloride***. See *Pelargonyl chloride*.

95 **1-Nonene*** (*α-nonylene*). $CH_3(CH_2)_6CH:CH_2$, 126.14. Col.liq. **D.** 0.7433 (0.7315), **b.p.** 149.9. **Soly.** i.w.; s.al.; s.et.

96 **1-Nonine.** See 1-*Nonyne**.

97 **n-Nonyl alcohol.** See 1-*Nonanol**.

98 **Nonylamine** (*n-nonylamine*). $CH_3(CH_2)_7CH_2NH_2$, 143.17. Liq. **b.p.** 195(201). **Soly.** i.w.; s.al.; s.et.

99 ***n*-Nonyl cyanide.** See *Caprinitrile*.

00 ***α*-Nonylene.** See 1-*Nonene**.

01 ***n*-Nonylic acid.** See *Pelargonic acid*.

02 **Nonylone.** See 9-*Heptadecanone**.

03 **Nonyl sulfate** (*di-n-nonyl sulfate*). $[CH_3(CH_2)_8]_2SO_4$, 350.36. **m.p.** 41.9–2.1.

04 **1-Nonyne*** (*1-nonine; n-heptylacetylene*). $CH:C(CH_2)_6CH_3$, 124.12. Col.liq. **D.** 0.7924, **m.p.** −36, **b.p.** 160^{745}. **Soly.** i.w.; s.al.; s.et.

05 **Norcamphane, 2, 2-dimethyl-3-methylene-.** See *Camphene*.

06 —. **7, 7-dimethyl-2-methylene-.** See *α-Fenchene*.

07 —, **2-keto-1, 7, 7-trimethyl-.** See *Camphor*.

08 —, **1,7,7-trimethyl-.** See *Camphane*.

09 —, **2, 2, 3-trimethyl-.** See *Isocamphane*.

10 **2-Norcamphanone, 1, 3, 3-trimethyl-.** See *Fenchone*.

11 ***dl*-Norleucine** (*dl-α-aminocaproic acid; dl-glycoleucine; dl-2-aminohexanoic acid**). $CH_3(CH_2)_3CH(NH_2)COOH$, 131.11. Shiny leaf. **m.p.** 327 d. **Soly.** 1.18^{25}, 2.88^{75}w.; 0.267^{25} 75% al.

12 ***d*-Norleucine** (*d-α-aminocaproic acid; d-2-aminohexanoic acid*; d-glycoleucine*). $CH_3(CH_2)_3CH(NH_2)COOH$, 131.11. Hex.leaf.f.w. **m.p.** 301 d. **Soly.** 1.5^{25}w.; i.al.

13 ***l*-Norleucine** (*l-α-aminocaproic acid; l-2-aminohexanoic acid*; l-glycoleucine*). $CH_3(CH_2)_3CH(NH_2)COOH$, 131.11. Leaf.f.w. **m.p.** 301 d. **Soly.** 1.6^{19}w.

14 **Normenthane.** See *Cyclohexane, isopropyl-*.

15 **3-Nortropanol, 8-methyl-.** See *Tropine*.

16 **Nosophen.** See *Phenolphthalein, 3′, 3″, 5′, 5″-tetraiodo-*.

17 **Novocain.** See *Procaine, hydrochloride*.

18 **Nucin.** See *Juglone*.

19 **Ocimene** (3, 7-*dimethyl*-1, 3, 6-*octatriene**(one form)). $(CH_3)_2C:CHCH_2CH:C(CH_3)CH:CH_2$, 136.12. Liq., *n* 1.4883^{14}. **D.** 0.801^{15}, **b.p.** 176–8.

20 **9, 12-Octadecadienoic acid*.** See *Eleostearic acid*.

21 **9, 13-Octadecadienoic acid***(?). See *Eleomargaric acid*.

22 **Octadecanal*.** See *Stearaldehyde*.

23 **Octadecanamide*.** See *Stearamide*.

For explanations and abbreviations see beginning of table.

24 **Octadecane*** (*n-octadecane*). $CH_3(CH_2)_{16}CH_3$, 254.30. Cr.f.al., *n* $1.4349^{35.2}$. **D.** 0.7768^{28}_{4}, **m.p.** 28, **b.p.** 317. **Soly.** i.w.; sl.s.al.; s.et.

25 **Octadecanenitrile***. See *Stearonitrile.*

26 **Octadecanoic acid***. See *Stearic acid.*

27 **Octadecanoic anhydride***. See *Stearic anhydride.*

28 **1-Octadecanol*** (*n-octadecyl alcohol*). $CH_3(CH_2)_{16}CH_2OH$, 270.30. Leaf.f.al. **D.** 0.8124^{59}_{4}, **m.p.** 59 (57.85), **b.p.** 210.5^{15}. **Soly.** i.w.; s.al.; s.et.

29 **Octadecanoyl chloride***. See *Stearyl chloride.*

30 **9, 12, 15-Octadecatrienoic acid***. See *α-Linolenic acid.*

31 **9-Octadecenamide***. See *Oleamide.*

32 **9-Octadecenoic acid***. See *Elaidic acid; Oleic acid.*

33 **—, 12-hydroxy-***. See *Ricinoleic acid.*

34 ***n*-Octadecyl alcohol.** See *1-Octadecanol**.

35 ***n*-Octadecylic acid.** See *Stearic acid.*

36 **Octadecyl sulfate** (*di-n-octadecyl sulfate*). $[CH_3(CH_2)_{17}]_2SO_4$, 602.64. **m.p.** 70.2–0.7.

37 **9-Octadecynoic acid***. See *Stearolic acid.*

38 **Octadiene.** See *Conylene.*

39 **2, 7-Octadiene, 2-methyl-6-methylene-.** See *Myrcene.*

40 **2, 6** (and **2, 7**)**-Octadienoic acid, 3, 7-dimethyl-***. See *Geranic acid.*

41 **1, 6-Octadien-3-ol, 3, 7-dimethyl-***. See *Linaloöl.*

42 **Octamethylene glycol.** See *1, 8-Octanediol**.

43 **Octanal***. See *Caprylaldehyde.*

44 **Octanamide***. See *Caprylamide.*

45 **Octane*** (*n-octane*). $CH_3(CH_2)_6CH_3$, 114.14. Col.liq., *n* 1.3975. **D.** 0.7036, **m.p.** −56.5, **b.p.** 125.8 (124.6). **Soly.** 0.0015^{16}w.; sl.s.al.; s.et.

46 **—, 1-amino-.** See *Octylamine**.

47 **—, 2-amino-.** See *Heptylamine, α-methyl-.*

48 **—, 1-bromo-*** (*n-octyl bromide*). $CH_3(CH_2)_6CH_2Br$, 193.05. Liq., *n* 1.4503^{25}. **D.** 1.1160^{14}_{4}; 1.118^{20}_{4}, **m.p.** −55, **b.p.** 202–3 (201.5). **Soly.** i.w.; ∞al.; ∞et.

49 **—, 2-bromo-***(*l*) (*l-sec-n-octyl bromide*). $CH_3CHBr(CH_2)_5CH_3$, 193.05. Liq. **D.** 1.099^{22}, **b.p.** 191 ($91\text{–}3^{20}$). **Soly.** i.w.; ∞al.; ∞et.

50 **—, 1-chloro-*** (*n-octyl chloride*). $CH_3(CH_2)_6CH_2Cl$, 148.59. Liq. **D.** 0.8745^{20}_{4}, **b.p.** 184.6. **Soly.** i.w.; v.s.al.; v.s.et.

51 **—, 2-chloro-*** (*sec-octyl chloride*). $CH_3(CH_2)_5CHClCH_3$, 148.59. Liq. **D.** 0.871^{16}_{4}, **b.p.** 173. **Soly.** i.w.; v.s.al.; s.et.

52 **—, 2, 7-dimethyl-*** (*biisoamyl*). $(CH_3)_2CH(CH_2)_4CH(CH_3)_2$, 142.17. Liq., *n* 1.41049^{15}. **D.** 0.72640^{16}_{4}, **m.p.** −52.5, **b.p.** 160 (156–8). **Soly.** s.w.; s.al.; s.et.; s.ac.a.

53 **—, 1-ethoxy-***. See *Ether, ethyl octyl.*

54 **—, 1-iodo-*** (*prim-n-octyl iodide*). $CH_3(CH_2)_7I$, 240.05. Liq., *n* 1.489. **D.** 1.341^{15} (1.3531^{15}), **m.p.** −45.9, **b.p.** 255.5. **Soly.** i.w.; s.al.; s.et.

55 **—, 3-methyl-***, (*d*)**-** (*d-amylethylmethylmethane*). $CH_3CH_2CH(CH_3)(CH_2)_4CH_3$, 128.16. Col.liq. **D.** 0.7206^{17}, **b.p.** 142–3. **Soly.** i.w.; i.al. s.et.

56 **—, 1-octyloxy-***. See *Octyl ether.*

57 **—, 1-phenoxy-***. See *Ether, octyl phenyl.*

58 **1, 1-Octanedicarboxylic acid.** See *Malonic acid, heptyl-.*

59 **Octanedioic acid***. See *Suberic acid.*

60 **1, 8-Octanediol*** (*octamethylene glycol*). $CH_2OH(CH_2)_6CH_2OH$, 146.14. Need. **m.p.** 63, **b.p.** 172^{20}. **Soly.** sl.s.w.; s.al.; i.et.

61 **4, 5-Octanediol*** (*octylene glycol* (one form)). $[CH_3(CH_2)_2CHOH]_2$, 146.14. (*α*) Liq. **b.p.** $112\text{–}5^{10}$. **Soly.** i.w. (*β*) **m.p.** 123–4, **b.p.** 115–8. **Soly.** i.w.; s.al.; sl.s.et.

62 **Octanenitrile***. See *Caprylonitrile.*

63 **Octanoic acid***. See *Caprylic acid.*

64 **Octanoic anhydride***. See *Caprylic anhydride.*

65 **1-Octanol*** (*heptylcarbinol; pri-n-octyl alcohol*). $CH_3(CH_2)_6CH_2OH$, 130.14. Col.liq., *n* 1.430, 1.4298^{15}. **D.** 0.827; 0.8266^{21}_{4}, **m.p.** −16.3, **b.p.** 194 (195.5). **Soly.** s.w.; ∞al.; ∞et.

66 **—, acetate** (*n-octyl acetate*). $CH_3COO(CH_2)_7CH_3$, 172.16. Col.liq. **D.** 0.885^{0}_{4}, **m.p.** −38.5, **b.p.** 210. **Soly.** i.w.; s.al.; s.et.

67 **—, esters of other organic acids.** See "octyl ester" under the corresponding acids.

68 **—, nitrate.** See *Octyl nitrate.*

69 **—, nitrite.** See *Octyl nitrite.*

* Name approved by the International Union of Chemistry.

70 **1-Octanol, 3, 7-dimethyl-***(*i*) (*tetrahydrogeraniol*). $(CH_3)_2CH(CH_2)_3CH(CH_3)CH_2CH_2OH$, 158.17. Liq. **D.** 0.8333^{15}, **b.p.** 221–3. **Soly.** i.w.; s.al.; s.et.

71 **2-Octanol*** (*methylhexylcarbinol; sec-n-octyl alcohol*). $CH_3CHOH(CH_2)_5CH_3$, 130.14. Col. oily liq., *n* 1.4260. **D.** 0.8193, **m.p.** −38.6, **b.p.** 178.5 (179). **Soly.** i.w.; s.al.; s.et.

72 —, **2-methyl-*** (*hexyldimethylcarbinol*). $(CH_3)_2COH(CH_2)_5CH_3$, 144.16. Liq. **b.p.** 178. **Soly.** i.w.; s.al.; s.et.

73 **3-Octanol, 3-ethyl-*** (*amyldiethylcarbinol; tert-decyl alcohol*). $(C_2H_5)_2COH(CH_2)_4CH_3$, 158.17. Col.oil. **D.** 0.8360^{15}_{4}, **b.p.** 199. **Soly.** i.w.; s.al.

74 **2-Octanone*** (*hexylmethyl ketone*). $CH_3COC_6H_{13}$, 128.12. Col.liq., *n* 1.41613. **D.** 0.818, **m.p.** −20.9, **b.p.** 173.5. **Soly.** i.w.; ∞al.; ∞et.

75 **3-Octanone*** (*amyl ethyl ketone*). $C_2H_5CO(CH_2)_4CH_3$, 128.12. Col.liq. **D.** 0.850^{0}_{4}, **b.p.** 168. **Soly.** i.w.; ∞al.; ∞et.

76 **Octanoyl chloride*.** See *Caprylyl chloride.*

77 **1, 3, 6-Octatriene, 3, 7-dimethyl-.** See *Ocimene.*

78 **6-Octen-1-ol, 3, 7-dimethyl-.** See *Rhodinol.*

79 **1-Octine.** See 1-*Octyne**.

80 ***n*-Octoic acid.** See *Caprylic acid.*

81 ***n*-Octoic anhydride.** See *Caprylic anhydride.*

82 ***n*-Octyl acetate.** See 1-*Octanol, acetate.*

83 ***pri-n*-Octyl alcohol.** See 1-*Octanol*.*

84 ***sec-n*-Octyl alcohol.** See 2-*Octanol*.*

85 ***n*-Octyl aldehyde.** See *Caprylaldehyde.*

86 **Octylamine** (1-*aminoöctane; pri-n-octylamine*). $CH_3(CH_2)_6CH_2NH_2$, 129.16. Col.liq., *n* 1.430. **D.** 0.777^{27}. **b.p.** 180. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

87 ***sec-n*-Octylamine.** See *Heptylamine, α-methyl-*.*

88 ***n*-Octyl bromide.** See *Octane,* 1-*bromo-*.*

89 ***sec-n*-Octyl bromide.** See *Octane,* 2-*bromo-*.*

90 ***n*-Octyl chloride.** See *Octane,* 1-*chloro-*.*

91 ***sec-n*-Octyl chloride.** See *Octane,* 2-*chloro-*.*

92 ***n*-Octyl cyanide.** See *Pelargononitrile.*

93 **Octylene** (*caprylene*). C_8H_{16}, 112.12. Col.liq., *n* 1.4087. **D.** 0.722^{17}; 0.7155^{20}_{4}, **m.p.** 104, **b.p.** 123. **Soly.** i.w.; s.al.; s.et.

94 **Octylene glycol.** See 4, 5-*Octanediol*.*

95 **Octyl ether** (1-*octyloxyoctane*; di-n-octyl ether*). $(C_8H_{17})_2O$, 242.27. Liq. **D.** 0.820^{0}_{0}, 0.805^{17}_{17}, **b.p.** 291.8. **Soly.** sl.s.w.; s.al.; s.et.

96 ***n*-Octylic acid.** See *Caprylic acid.*

97 ***pri-n*-Octyl iodide.** See *Octane,* 1-*iodo-*.*

98 **Octyl nitrate** (*n-octyl nitrate*). $CH_3(CH_2)_7NO_3$, 175.14. Liq. **D.** 0.8419^{17}_{17}, **b.p.** $110–2^{20}$.

99 **Octyl nitrite** (*n-octyl nitrite*). $CH_3(CH_2)_7ONO$, 159.14. Grn.liq. **D.** 0.862^{17}, **b.p.** 174–5.

00 **Octyl sulfate** (*di-n-octyl sulfate*). $[CH_3(CH_2)_7]_2SO_4$, 322.33, *n* 1.4408^{25}. **D.** 0.9661^{25}_{25}, **m.p.** 20.3, **b.p.** 166.1^{2}.

01 **1-Octyne*** (1-*octine; n-hexylacetylene; caprylidene*). $CH\vdots C(CH_2)_5CH_3$, 110.11. Col.liq. **D.** 0.770, **b.p.** 125. **Soly.** i.w.; v.s.al.; v.s.et.

02 **2-Octynoic acid,** methyl ester ("*methyl heptinecarbonate*"). $CH_3(CH_2)_4C\vdots CCOOCH_3$, 154.11. **D.** 0.9524^{0}, **b.p.** 107^{20}. **Soly.** i.w.

Oenanth-. See *Enanth-.*

03 **Oil of wintergreen,** artificial. See *Salicylic acid, methyl ester.*

04 **Oleamide** (9-*octadecenamide**(one form); *oleic acid amide*). $C_{17}H_{33}CONH_2$, 281.28. Cr. **m.p.** 76. **Soly.** i.w.; s.al.; s.et.

05 **Oleic acid** (9-*octadecenoic acid**(one form)). $C_8H_{17}CH{:}CH(CH_2)_7COOH$, 282.27. Col.need., *n* $1.463^{17.7}$. **D.** 0.895^{18}_{4}, **m.p.** 14, **b.p.** 286^{100}. **Soly.** i.w.; ∞al.; ∞et.; s.bz., chl.

06 —, benzyl ester. $C_{17}H_{33}COOCH_2C_6H_5$, 372.31. **D.** 0.9330^{25}_{25}, **b.p.** 237^{7}. **Soly.** i.w.; s.al.; v.s.et.

07 —, butyl ester (*butyl 9-octadecenoate** (one form)). $C_8H_{17}CH{:}CHC_7H_{14}COOC_4H_9$, 338.33. Liq. **D.** 0.868^{25}, **b.p.** $180–95^{2}$; $173–235^{75}$. **Soly.** i.w.; s.al.; s.et.

08 —, diethylene glycol ester. See under *Diethylene glycol.*

09 —, ethyl ester. $C_8H_{17}CH{:}CH(CH_2)_7COOC_2H_5$, 310.30. Liq. **D.** 0.871^{15}; 0.8671^{25}, **b.p.** $205–8^{10}$. **Soly.** i.w.; ∞al.; ∞et.

10 —, isoamyl ester. $C_{17}H_{33}COO(CH_2)_2CH(CH_3)_2$, 352.34. Col.liq. **b.p.** $223–4^{10}$. **Soly.** i.w.; s.al.; v.s.et.

11 **Oleic acid,** methyl ester (*methyl oleate*). $C_{17}H_{33}COOCH_3$, 296.28. Oil. **D.** 0.879^{18}, **b.p.** $216\text{–}7^{20}$ ($189\text{–}91^{10}$). **Soly.** i.w.; ∞al.; ∞et.

12 —, *p*-phenylphenacyl ester. $C_{17}H_{33}$-$COOCH_2COC_6H_4C_6H_5$, 476.34. **m.p.** 60.5.

13 **Olein.** See *Glycerol, trioleate.*

14 **Opianic acid** (5, 6-*dimethoxyphthalaldehydic acid*). $(CH_3O)_2C_6H_2(CHO)$-COOH, 210.08. Need.f.w. **m.p.** 150, **b.p.** 160 d. **Soly.** 0.25, 1.7^{100}w.; s.al.; s.et.

15 **Orcein.** $C_{28}H_{24}N_2O_7$, 500.20. Red-br.powd. **Soly.** s.al.; i.et.; s.acet., alk., ac.a.; i.bz., chl., CS_2.

16 **Orcinol** (5-*methyl*-1, 3-*benzenediol**; 5-*methylresorcinol;* 3, 5-*dihydroxytoluene*). $CH_3C_6H_3(OH)_2$, 124.06. Col. monocl.cr.f.chl. **D.** 1.290^4, **m.p.** $+1H_2O$, 58; anh. 107–8, **b.p.** 289–90. **Soly.** s.w.; v.s.al.; v.s.et.

17 —, **2, 4, 6-trinitro-.** $(NO_2)_3C_6(CH_3)$-$(OH)_2$, 259.06. Lng.yel.need. **m.p.** 163.5, **b.p.** exp. **Soly.** i.w.; sl.s.al.; sl.s.et.; v.s.h.bz.

18 **β-Orcinol.** See *Resorcinol,* 2, 5-*dimethyl-.*

19 **Orcinolphthalein.** $C_{22}H_{16}O_5$, 360.12. Col.pr.f.acet. **m.p.** 230 d. **Soly.** i.w.; s.al.; i.et.; s.h.ac.a., alk.; i.bz.

20 **Orexin.** See *Quinazoline,* 3, 4-*dihydro-3-phenyl-.*

21 **Ornithine** (*α, δ-diaminovaleric acid;* 2, 5-*diaminopentanoic acid**). CH_2-$(NH_2)(CH_2)_2CH(NH_2)COOH$, 132.11. Syrup. **Soly.** v.s.w.; v.s.al.; sl.s.et.

22 —, N^{δ}**-guanyl-.** See *Arginine.*

23 **Orsellinic acid,** 4-everninate. See *Evernic acid.*

24 —, 4-methyl ether. See *Everninic acid.*

25 ***o*-Orsellinic acid** (4, 6-*dihydroxy-o-toluic acid; orsellinic acid*). $(HO)_2C_6$-$H_2(CH_3)COOH$, 168.06. Need.f.acet. **m.p.** $-H_2O$, 100; 176 d. **Soly.** s.w.; s.al.; 15.7^{20}et.; s.glyc.; sl.s.bz.

26 **Orthanilic acid** (*o-aminobenzenesulfonic acid, o-anilinesulfonic acid*). $NH_2C_6H_4SO_3H \cdot \frac{1}{2}H_2O$, 182.13. Col.pr. **m.p.** d. **Soly.** 1.57^{19}w.; v.sl.s.al.; v.sl.s.et.

27 **Orthoacetic acid,** triethyl ester (1, 1, 1-*triethoxyethane**). $CH_3C(OC_2$-$H_5)_3$, 162.14. Col.liq. **D.** 0.8847^{25}_{4}, **b.p.** 142. **Soly.** ∞al.; ∞et.

28 **Orthocarbonic acid,** tetraethyl ester (*tetraethoxymethane**). $C(OC_2H_5)_4$, 192.16. Col.liq., *n* 1.393. **D.** 0.9197^{18}_{4}, **b.p.** 159. **Soly.** ∞al.; ∞et.

29 —, tetrapropyl ester (*n-propyl orthocarbonate; tetrapropoxymethane*). C-$(OC_3H_7)_4$, 248.22. Col.liq. **D.** 0.911^8, **b.p.** 224.2.

30 **Orthodiazine.** See *Pyridazine.*

31 **Orthoformic acid,** triethyl ester (*triethoxymethane**). $HC(OC_2H_5)_3$, 148.12. Col.liq. **D.** 0.8971^{18}_{4}, **m.p.** −76.1, **b.p.** 145.9 (143–5). **Soly.** s.d.w.; s.al.; s.et.

32 —, triisopropyl ester (*isopropyl orthoformate; triisopropoxymethane*). HC-$[OCH(CH_3)_2]_3$, 190.17. Liq. **D.** 0.8621, **b.p.** 166–8.

33 —, trimethyl ester (*trimethoxymethane*). $HC(OCH_3)_3$, 106.08. **D.** 0.974^{23}, **b.p.** 101–2.

34 —, triphenyl ester (*triphenoxymethane*). $CH(OC_6H_5)_3$, 292.12. Cr. **m.p.** 71, **b.p.** 265^{50}. **Soly.** s.al.; s.et.

35 —, tripropyl ester (*n-propyl orthoformate; tripropoxymethane*). HC-$(OC_3H_7)_3$, 190.17. Liq. **D.** 0.8805 **b.p.** 105^{30}. **Soly.** 2.1^{22}w.

36 **7-Oxabicyclo[2, 2, 1]heptane-2, 3-dicarboxylic anhydride, 2, 3-dimethyl-.** See *Cantharidin.*

37 **6-Oxabicyclo[3, 2, 1]oct-3-ene, 4, 7, 7-trimethyl-.** See *Pinol.*

38 **Oxalacetic acid,** diethyl ester (*diethyl oxobutanedioate**; *diethyl hydroxybutenedioate**). $C_2H_5OOCCOCH_2COOC_2H_5$ or $C_2H_5OOCC(OH){:}CHCOOC_2H_5$, 188.09. Col.liq., *n* $1.45614^{16.6}$. **D.** 1.159, **b.p.** 132^{24}. **Soly.** i.w.; ∞al. ∞et.; ∞bz.

39 **Oxalaldehyde.** See *Glyoxal.*

40 **Oxalaldehydic acid.** See *Glyoxylic acid.*

41 **Oxalamide.** See *Oxamide.*

42 **Oxalan.** See *Oxaluramide.*

43 **Oxalic acid** (*ethanedioic acid**). CO-OHCOOH$\cdot 2H_2O$, 126.05. Col.monocl. *n* 1.440, 1.475, 1.625. **D.** 1.653, **m.p.** 101; 189 anh., **b.p.** subl. 150. **Soly.** 9.5^{15}, 120^{90}w.; 23.7^{15}al.; 1.37, anh 16.9et.; i.chl., pet.eth., bz.

44 —, diallyl ester (*di-2-propenyl ethanedioate**; *allyl oxalate*). $(COOC_3H_5)_2$, 170.08. Oil. **D.** 1.055, **b.p.** 217 **Soly.** i.w.; s.al.

45 —, dianilide. See *Oxanilide.*

46 —, dibutyl ester (*dibutyl ethanedioate**; *butyl oxalate*). $(COOCH_2CH_2CH_2$-$CH_3)_2$, 202.14. Col.liq. **D.** 1.01 **b.p.** 243.4. **Soly.** i. w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

47 **Oxalic acid,** diethyl ester (*diethyl ethanedioate*; ethyl oxalate; oxalic ester*). $(COOC_2H_5)_2$, 146.08. Col.liq., *n* 1.41011. **D.** 1.08426^{15}; 1.0785^{20}_{4}, **m.p.** −40.6, **b.p.** 185.4. **Soly.** sl.s.w.; ∞al.; ∞et. ∞ord.org.solv.

48 —, diisoamyl ester (*isoamyl oxalate; bis(γ-methylbutyl) ethanedioate**). $(COOC_5H_{11})_2$, 230.17. Liq. **D.** 0.968^{11}_{11}, **b.p.** 265. **Soly.** i.w.; v.s.al.; v.s.et.

49 —, diisobutyl ester (*bis(β-methylpropyl) ethanedioate*; isobutyl oxalate*). $(COOC_4H_9)_2$, 202.14. Col.liq. **D.** 1.002^{14}, **b.p.** 229. **Soly.** i.w.; s.al.; s.et.

50 —, dimethyl ester (*dimethyl ethanedioate*; methyl oxalate*). $(COOCH_3)_2$, 118.05. Col.monocl.tab., *n* $1.379^{82.1}$. **D.** 1.120^{82}; 1.1479^{54}; 1.422^{20}_{4}, **m.p.** 54, **b.p.** 163.3. **Soly.** 6.18w.; s.al.; s.me.al.

51 —, dipropyl ester (*propyl oxalate; dipropyl oxalate*). $(COOCH_2CH_2CH_3)_2$, 174.11. Col.liq. **D.** 1.02; 1.038^{0}_{0}, **b.p.** 214–5. **Soly.** sl.s.w.; ∞al.; s.et.

52 —, ethyl methyl ester. $CH_3OOC-COOC_2H_5$, 132.06. Col.liq. **D.** 1.156^{0}, **b.p.** 173.7. **Soly.** i.w.; v.s.al.; v.s.et.

53 —, monoamide. See *Oxamic acid.*

54 —, monoanilide. See *Oxanilic acid.*

55 —, monoureide. See *Oxaluric acid.*

56 —, *p*-phenylphenacyl ester. $(COOCH_2COC_6H_4C_6H_5)_2$, 478.17. **m.p.** 165.5 d.

57 —, piperazinium salt. $C_4H_{10}N_2 \cdot C_2H_2O_4$, 176.11. Wh.cr. **m.p.** >300. **Soly.** s.h.w.; v.sl.s.al.; i.et.

58 **Oxalic ester.** See *Oxalic acid, diethyl ester.*

59 **Oxalimide.** See *Oximide.*

60 **Oxalonitrile.** See *Cyanogen.*

61 **Oxaluramide** (*oxamic acid ureide; oxalan*). $NH_2CONHCOCONH_2$, 131.06. Cr. **m.p.** d. **Soly.** i.w.; s.al.; s.H_2SO_4, KOH.

62 **Oxaluric acid** (*carbamyloxamic acid; oxalic monoureide*). $NH_2CONHCOCOOH$, 132.05. Cr.powd. **m.p.** 187. **Soly.** v.sl.s.w.

63 **Oxalyl chloride** (*ethanedioyl chloride**). COClCOCl, 126.91. Col.fum. liq., *n* $1.43395^{12.9}$. **D.** 1.488^{13}, **m.p.** −12, **b.p.** 64. **Soly.** d.w.; d.al.; s.et.

64 **Oxamethan.** See *Oxamic acid, ethyl ester.*

65 **Oxamic acid** (*oxalic acid monoamide*). $NH_2COCOOH$, 89.03. Col.cr. **m.p.** 210 d. **Soly.** 1.4^{14}w.; v.sl.s.al.; v.sl.s.et.

66 —, ethyl ester (*ethyl oxamate; oxamethan*). $NH_2COCOOC_2H_5$, 117.06. Rhomb.leaf. **D.** 0.808^{19}, **m.p.** 115. **Soly.** s.h.w.; s.al.; s.et.; v.sl.s.bz.

67 —, ureide. See *Oxaluramide.*

68 —, ***N*-acetyl-,** ethyl ester (*ethyl acetyloxamate*). $CH_3CONHCOCOOC_2H_5$, 159.08. Need. **m.p.** 54. **Soly.** i., d.h.w.; s.al.; s.et.

69 —, **carbamyl-.** See *Oxaluric acid.*

70 —, **phenyl-.** See *Oxanilic acid.*

71 **Oxamide** (*ethanediamide*; oxalamide*). $NH_2COCONH_2$, 88.05. Wh.powd., monocl. **D.** 1.667, **m.p.** 419 d. **Soly.** $0.04^{7.3}$w.; v.sl.s.al.; v.sl.s.et.

72 —, ***N, N′*-diethyl-** (*N, N′-diethylethanediamide*; sym-diethyloxamide*). $(CONHC_2H_5)_2$, 144.11. Col.need.f.al. **D.** 1.169^{4}, **m.p.** 190. **Soly.** sl.s.w.; s.al.; v.sl.s.et.

73 —, ***N, N*-dimethyl-** (*unsym-dimethyloxamide*). $(CH_3)_2NCOCONH_2$, 116.08. Col.pl.f.bz. **m.p.** 104. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.

74 —, ***N, N′*-dimethyl-** (*sym-dimethyloxamide*). $(CONHCH_3)_2$, 116.08. Col.leaf. or need.f.w. **D.** 1.3^{4}, **m.p.** 217 (209–10), **b.p.** subl. **Soly.** $2.5^{9.4}$w.; sl.s.al.; v.sl.s.et.

75 —, ***N, N′*-diphenyl-.** See *Oxanilide.*

76 **Oxanilic acid** (*phenyloxamic acid; oxalic acid monoanilide*). $C_6H_5NHCOCOOH$, 165.06. Rhomb.need.f.bz. **m.p.** 150. **Soly.** s.h.w.; v.s.al.; v.s.et.

77 **Oxanilide** (*N, N′-diphenyloxamide; oxalic acid dianilide*). $(CONHC_6H_5)_2$, 240.11. Lust.sc.f.bz. **m.p.** 250(246–7), **b.p.** 320. **Soly.** i.w.; v.sl.s.h.al.; i.(sl.s.h.)et.

78 **Oxanthranol** (9, 10-*anthradiol* or 10-*hydroxyanthrone; anthrahydroquinone*). $C_6H_4(COH)_2C_6H_4$ or $C_6H_4(CO)(CHOH)C_6H_4$, 210.08. Ylsh.need. unst. **m.p.** 180. **Soly.** i.w.; s.(grn. fluores.)al.; s.alk.

79 **1, 2-Oxathietan-4-one, 2, 2-dihydro-2, 2-dimethyl-.** See *Thetin, dimethyl-.*

80 **1, 4-Oxazine, tetrahydro-.** See *Morpholine.*

81 **Oxazole, triphenyl-** (*benzilam; azobenzil*). $OC(C_6H_5){:}NC(C_6H_5){:}C(C_6H_5)$, 297.13. Rhomb.pr.f.al.et. **m.p.** 115. **Soly.** sl.s.al.; sl.s.et.

For explanations and abbreviations see beginning of table.

82 **Oximide** (*oxalimide*). NCOHCO, 71.02. Col.pr. **Soly.** v.sl.s., d.h.w.; sl.s.NH_4OH.

83 **Oxindole** (*2(3)-indolone; o-amino-α-toluic acid lactam*). $C_6H_4NHCOCH_2$, 133.06. Col.need.f.w. **m.p.** 120, **b.p.** d. **Soly.** v.s.h.w.; s.al.; s.et.; s.alk.

84 —, **3-hydroxy-** (*dioxindole; o-aminomandelic acid lactam*). $C_6H_4NHCOCHOH$, 149.06. Rhomb.pr.f.al. **m.p.** 180, **b.p.** 195 d. **Soly.** 7.7c., 16.7h.w.; 6.6al.; s.alk.

85 —, **3-imino-**. See *Imesatin*.

86 **Oxirane.** See *Ethylene oxide*.

87 —, **(chloromethyl)-**. See *Epichlorohydrin*.

88 —, **(iodomethyl)-**. See *Epiiodohydrin*.

89 —, **methyl-**. See *Propene oxide*.

90 **Oxiraneacetonitrile.** See *Epicyanohydrin*.

91 **Oxirene, methyl-.** See *Propene, 1, 2-epoxy-**.

92 **Oxyacanthine** (*vinetine*). $C_{19}H_{21}NO_3$, 311.17. Wh.need.f.al. or et., $[\alpha]+131.6°^{15}_{D}$. **m.p.** 202–14. **Soly.** s.w.; s.al.; s.et.; s.chl., bz., pet.eth.

93 —, hydrochloride. $C_{19}H_{21}NO_3{\cdot}HCl{\cdot}2H_2O$, 383.67. Sm.need., $[\alpha]-163.6°^{15}_{D}$.

94 —, nitrate. $C_{19}H_{21}O_3N{\cdot}HNO_3{\cdot}2H_2O$, 410.22. Need. **m.p.** 195–200. **Soly.** sl.s.w.

95 **Oxynarcotine.** $C_{22}H_{23}NO_8$, 429.19. Need. **Soly.** s.al.

96 **Oxyneurine.** See *Betaine*.

97 **Oxysparteine.** $C_{15}H_{24}N_2O$, 248.20. Wh.hyg.need. **m.p.** 84. **Soly.** v.s.w.; v.s.al.; v.s.et.; s.chl.

98 —, hydrochloride. $C_{15}H_{24}N_2O{\cdot}HCl{\cdot}4H_2O$, 356.73. Wh.cr. **m.p.** 48–50. **Soly.** s.w.; s.al.

99 **Paeonol.** See *Peonol*.

00 **Palmitaldehyde,** oxime (*hexadecanal oxime**). $CH_3(CH_2)_{14}CH{:}NOH$, 255.27. Need.f.al. **m.p.** 89.5. **Soly.** i.w.; s.al.; v.s.et.

01 **Palmitamide** (*hexadecanamide*; palmitic amide*). $CH_3(CH_2)_{14}CONH_2$, 255.27. Col.leaf. **m.p.** 106, **b.p.** 236^{12}. **Soly.** i.w.; sl.s.al.; sl.s.et.

02 **Palmitic acid** (*hexadecanoic acid*; n-hexadecylic acid*). $CH_3(CH_2)_{14}COOH$, 256.25. Col.need., *n* $1.4273^{79.8}$. **D.** liq. 0.853^{62}, **m.p.** 64, **b.p.** 339–56 d. **Soly.** i.w.; 9.3^{20}al.; s.et.

03 —, benzyl ester. $C_{15}H_{31}COOCH_2C_6H_5$, 346.30. Cr. **D.** 0.9136^{38}_{8}, **m.p.** 36.0. **Soly.** i.w.; s.al.; v.s.et.

04 —, cetyl ester (*cetyl palmitate; hexadecyl hexadecanoate**). $C_{15}H_{31}COOC_{16}H_{33}$, 480.50. Pl.f.et. or ac.a., *n* 1.4398^{70}. **D.** 0.832^{50}, **m.p.** 55.5, **b.p.** d. **Soly.** i.w.; i.c., s.h.al.; s.et.; s.acet., chl., bz., CS_2.

05 —, ethyl ester (*ethyl hexadecanoate**). $CH_3(CH_2)_{14}COOC_2H_5$, 284.28. Col. need., *n* $1.4347^{34.3}$. **D.** 0.8577^{25}_{4}, **m.p.** 24.2(19–20), **b.p.** 185.5^{10}. **Soly.** i.w.; s.al.; s.et.

06 —, ethylene ester. See *Glycol, dipalmitate*.

07 —, glyceryl ester. See *Glycerol, tripalmitate*.

08 —, methyl ester (*methyl hexadecanoate*; methyl palmitate*). $C_{15}H_{31}COOCH_3$, 270.27. Col., *n* $1.4175^{80.7}$. **m.p.** 29.5, **b.p.** 196^{15}. **Soly.** i.w.; s.al.; s.et.

09 —, myricyl ester. $C_{15}H_{31}COOC_{31}H_{63}$, 690.73. Feath.cr. **m.p.** 72. **Soly.** i.w.; i.al.; s.et.

10 **Palmitic amide.** See *Palmitamide*.

11 **Palmitin.** See *Glycerol, tripalmitate*.

12 **Palmitolic acid** (*7-hexadecynoic acid**). $CH_3(CH_2)_7C{\vdots}C(CH_2)_5COOH$, 252.22. Col.need.f.w. **m.p.** 47, **b.p.** 240^{15}. **Soly.** i.w.; v.s.al.; v.s.et.

13 **Palmitone.** See *16-Hentriacontanone**.

14 **Palmitonitrile** (*hexadecanenitrile**). $CH_3(CH_2)_{14}CN$, 237.25. Col.hex.tab. **D.** liq. 0.822^{31}, **m.p.** 31, **b.p.** 251.5^{100}. **Soly.** i.w.; s.al.; s.et.

15 **Palmityl chloride** (*hexadecanoyl chloride**). $CH_3(CH_2)_{14}COCl$, 274.70. Col.liq. or cr. **m.p.** 11–2, **b.p.** 194.5^{17}. **Soly.** d.w.; d.al.; v.s.et.

16 **Papaverine.** $C_{20}H_{21}NO_4$, 339.17. Col.rhomb.need.f.al., *n* α1.625, γ1.690. **D.** 1.337, **m.p.** 147, **b.p.** d. **Soly.** v.sl.s.c., s.h.w.; v.s.al.; 0.39^{10}et; s.h.chl., h.bz.

17 —, hydrochloride. $C_{20}H_{21}NO_4{\cdot}HCl$, 375.64. Monocl.pl. **m.p.** 231. **Soly.** 2.7^{18}w.; s.al.

18 **Paraacetaldehyde.** See *Paraldehyde*.

19 **Parabanic acid** (*oxalylurea*). NHCONHCOCO, 114.03. Col.monocl.pl.f.w. **m.p.** 243 (227) d. **Soly.** 4.7^8w.; v.s.al.; sl.s.et.

20 —, **dimethyl-**. See *Cholestrophan*.

* Name approved by the International Union of Chemistry.

21 **Parabutyraldehyde.** $(C_3H_7CHO)_3$, 216.19. **D.** 0.918, **b.p.** 98–100[35].

22 **Paraconic acid** (*tetrahydro-5-oxo-3-furancarboxylic acid; itamalic acid γ-lactone*). $CH_2COOCH_2CHCOOH$, 130.05. Deliq.cr. **m.p.** 58. **Soly.** s.w.

23 **—, 2, 2-dimethyl-.** See *Terebic acid.*

25 **Paracyanogen.** $(CN)_x$, $(26.01)_x$. Br.powd. **b.p.** subl. **Soly.** i.w.; i.al.; s.KOH.

26 **Paradiazine.** See *Pyrazine.*

27 **Paraformaldehyde.** See *Polyoxymethylene.*

28 **Paralactic acid.** See *d-Lactic acid.*

29 **Paraldehyde** (2, 4, 6-*trimethyl*-1, 3, 5-*trioxane; paraacetaldehyde*). $OCH(CH_3)OCH(CH_3)OCHCH_3$, 132.09. Col.liq., *n* 1.40486. **D.** 0.9943^{20}_{4}, **m.p.** 10.5 (11–2), **b.p.** 124. **Soly.** 12[13], 5.88[100]w.; s.al.; ∞et.; ∞chlor., oils.

30 **Paraldol.** $(C_4H_8O_2)_2$, 176.12. Wh. tricl.cr. **D.** 1.345^{15}_{4-8}, **m.p.** 82, **b.p.** 90[15]. **Soly.** s.w.; 20.5[25]al.; 3.6[23]et.

31 **Paraleucaniline.** See *p₃-Leucaniline.*

32 **Param.** See *Guanidine, 1-cyano-.*

33 **Paramorphine.** See *Thebaine.*

34 **Paranitraniline red.** See 2-*Naphthol*, 1-*p-phenylazo-*.

35 **Pararosaniline** (*tris(p-aminophenyl)-carbinol; p, p′, p′′-triaminotriphenylcarbinol*). $(H_2NC_6H_4)_3COH$, 305.17. Col.-red leaf. **m.p.** 189. **Soly.** i.w.; s.al.; s.et.

36 **—, hexamethyl-.** See *Crystal violet (base).*

37 **Pararosolic acid.** See *Aurin.*

38 **Paraxylic acid.** See 3, 4-*Xylic acid.*

39 **Parsley camphor.** See *Apiole.*

40 **α-Parvoline** (2-*ethyl*-3, 5-*dimethylpyridine*). $C_9H_{13}N$, 135.11. Liq. **D.** 0.9338^0, **b.p.** 188. **Soly.** sl.s.w.; s.al.

41 **β-Parvoline** (*tetramethylpyridine; parvuline*). $C_5H(CH_3)_4N$, 135.11. Liq. **D.** 0.916, **b.p.** 220.

42 **Parvuline.** See *β-Parvoline.*

43 **Paucine.** $C_{27}H_{39}N_5O_5 \cdot 6\frac{1}{2}H_2O$, 630.45. Yel.leaf. **m.p.** d. 126. **Soly.** i.w.; i.al.; i.et.

44 **Pectinose.** See *dl-Arabinose.*

45 **Pelargonaldehyde,** oxime (*nonanal oxime**). $CH_3(CH_2)_7CH{:}NOH$, 157.16. Leaf.f.dil.al. **m.p.** 63. **Soly.** i.w.; s.al.; s.et.

46 **Pelargonamide** (*nonanamide**). $CH_3(CH_2)_7CONH_2$, 157.16. Col. **m.p.** 99–100. **Soly.** i.w.; sl.s.al.; sl.s.et.

47 **Pelargone.** See 9-*Heptadecanone**.

48 **Pelargonic acid** (*nonanoic acid*; n-nonylic acid*). $CH_3(CH_2)_7COOH$, 158.14. Col. oily liq., *n* 1.4330. **D.** 0.9055^{20}_{4}, **m.p.** 12, **b.p.** 254. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl.

49 **—,** ethyl ester (*ethyl nonanoate*; ethyl n-nonoate*). $CH_3(CH_2)_7COOC_2H_5$, 186.17. Col.liq. **D.** $0.866^{17.5}$, **m.p.** −36.7 (−44.5), **b.p.** 227(219). **Soly.** i.w.; s.al.; ∞et.

50 **—,** methyl ester (*methyl nonanoate*; methyl pelargonate*). $CH_3(CH_2)_7COOCH_3$, 172.16. Liq. **D.** 0.877^{18}, **b.p.** 214. **Soly.** i.w.; s.al.; s.et.

51 **Pelargononitrile** (*nonanenitrile*; n-octyl cyanide*). $CH_3(CH_2)_7CN$, 139.14. Col.liq. **D.** 0.8331^0; 0.786^{16}, **m.p.** −34.2, **b.p.** 224.0. **Soly.** i.w.; sl.s.al.; s.et.

52 **Pelargonyl chloride** (*nonanoyl chloride**). $CH_3(CH_2)_7COCl$, 176.59. Col. liq., *n* 1.4380^{15}. **D.** 0.9590^0_4; 0.946^{20}_{4}, **m.p.** −60.5, **b.p.** 215.35 ($108–10^{22}$). **Soly.** d.w.; d.al.; s.et.

53 **Pelletierine** (*punicine*). $C_8H_{15}NO$, 141.13. Col. oil. **D.** $0.988^{15.5}$, **b.p.** 195 d. **Soly.** 5w.; ∞al.; ∞et.; s.chl.

54 **—,** sulfate. $(C_8H_{15}NO)_2 \cdot H_2SO_4$, 380.33. Br. syrupy liq. or cr.mass, [α] −30°D. **Soly.** v.s.w.; s.al.

55 **Pellotine.** $C_{13}H_{19}NO_3$, 237.16. Pl. f.al. **m.p.** 110. **Soly.** i.w.; v.s.al.; v.s.et.

56 **Pentadecanal,** oxime*. $CH_3(CH_2)_{13}CH{:}NOH$, 241.25. Need.f.dil.al. **m.p.** 86. **Soly.** i.w.; sl.s.al.; v.s.et.; sl.s.bz.

57 **Pentadecane*** (*n-pentadecane*). $CH_3(CH_2)_{13}CH_3$, 212.25. Col.liq. **D.** 0.7689^{20}_{4}, **m.p.** 10, **b.p.** 270.5. **Soly.** i.w.; v.s.al.; v.s.et.

58 **1-Pentadecanol*** (*n-pentadecyl alcohol*). $CH_3(CH_2)_{14}OH$, 228.25. Cr. **m.p.** 43.84 (45–6).

59 **8-Pentadecanone*** (*diheptyl ketone; caprylone*). $[CH_3(CH_2)_6]_2CO$, 226.23. Cr.f.al. **m.p.** 40, **b.p.** 178. **Soly.** s.al.

60 ***n*-Pentadecyl alcohol.** See 1-*Pentadecanol**.

61 **1, 2-Pentadiene*** (*ethylallene*). $CH_2{:}C{:}CHCH_2CH_3$, 68.06. **b.p.** 45.

62 **1, 3-Pentadiene*** (*piperylene; α-methylbivinyl*). $CH_2{:}CHCH{:}CHCH_3$, 68.06. Liq., *n* $1.4402^{16.5}$. **D.** 0.696, **b.p.** 43(42–4).

For explanations and abbreviations see beginning of table.

63 **1, 4-Pentadiene***. CH_2:$CHCH_2CH$:CH_2, 68.06. *n* 1.3880. **D.** 0.6594^{20}_{4}, **b.p.** 25.8–6.2.

64 **2, 3-Pentadiene***. CH_3CH:C:CH-CH_3, 68.06. Liq. **D.** 0.702^{20}_{0}, **b.p.** 49–51.

65 **2, 4-Pentadienoic acid*** (*β-vinylacrylic acid; αγ-pentadienic acid*). CH_2:CHCH:CHCOOH, 98.05. Pr.f. et. **m.p.** 80, **b.p.** d. 110–5. **Soly.** s.h.w.; v.s.al.; v.s.et.; sl.s.pet.eth.

66 —, **5-(3, 4-methylenedioxyphenyl)-**. See *Piperic acid.*

67 **1, 4-Pentadien-3-one, 1, 5-diphenyl-***. See *Styryl ketone.*

68 **Pentaerythritol** (*pentaerythrite; 2, 2-bishydroxymethyl-1, 3-propanediol**). $C(CH_2OH)_4$, 136.09. Tetrag.cr., *n* 1.559, 1.548. **m.p.** 253 (260.5). **Soly.** 5.56^{15}w.

69 **Pentaglycerine, Pentaglycerol.** See *1, 3-Propanediol, 2-hydroxymethyl-2-methyl-**.

70 **Pentamethylene.** See *Cyclopentane**.

71 —, **keto-**. See *Cyclopentanone**.

72 **Pentamethylenediamine.** See *Cadaverine.*

73 **Pentamethylene dibromide.** See *Pentane, 1, 5-dibromo-**.

74 **Pentamethylene dichloride.** See *Pentane, 1, 5-dichloro-**.

75 **Pentamethylene glycol.** See *1, 5-Pentanediol**.

76 **Pentamethylene oxide.** See *Pyran, tetrahydro-.*

77 **Pentamethylenimine.** See *Piperidine.*

78 **Pentanal***. See *Valeraldehyde.*

79 **Pentanal, 4-oxo-***. See *Levulinaldehyde.*

80 **Pentanamide***. See *Valeramide.*

81 **Pentane*** (*n-pentane*). $CH_3(CH_2)_3$-CH_3, 72.09. Col.liq., *n* $1.3570^{16.7}$. **D.** 0.631^{20}_{4}; 0.6214^{24}_{4}, **m.p.** −131.5 (−129.9), **b.p.** 36.2(34–5.5). **Soly.** 0.036^{16}w.; ∞al.; ∞et.

82 —, **1-amino-**. See *Amylamine.*

83 —, **2-amino.** See *Butylamine, α-methyl-.*

84 —, **3-amino-**. See *Propylamine, α-ethyl-.*

85 —, **1-amino-4-methyl-**. See *Isohexylamine.*

86 —, **3, 3-bisethylsulfonyl-***. See *Tetronal.*

87 —, **1-bromo-***. See *Amyl bromide.*

88 —, **1-chloro-***. See *Amyl chloride.*

89 —, **2-chloro-***. $CH_3CHClCH_2CH_2$-CH_3, 106.54. Liq., *n* 1.4060. **D.** 0.870^{20}_{4}, **b.p.** 96–7. **Soly.** i.w.; s.al. s.et.

90 —, **3-chloro-***. $CH_3CH_2CHClCH_2$-CH_3, 106.54. *n* 1.4163^{15}. **D.** 0.8967^{15}_{4} **b.p.** 104–5.

91 —, **1, 5-dibromo-*** (*pentamethylene dibromide*). $CH_2Br(CH_2)_3CH_2Br$ 229.91. Col.arom.liq. **D.** 1.702^{15}_{8} **m.p.** −35, **b.p.** 224. **Soly.** i.w.

92 —, **1, 5-dichloro-*** (*pentamethylene dichloride*). $Cl(CH_2)_5Cl$, 140.99. **D.** 1.0940^{25}_{4}, **b.p.** 178. **Soly.** i.w.; s.al.; s.et.

93 —, **2, 2-dimethyl-*** (*trimethylpropylmethane*). $(CH_3)_3CCH_2CH_2CH_3$, 100.12. Col.liq. **D.** 0.6737, **m.p.** −125, **b.p.** 78.9. **Soly.** i.w.; s.al.; s.et.

94 —, **2, 3-dimethyl-*** (*ethylisopropylmethylmethane*). $CH_3CH(CH_3)CH$-$(CH_3)CH_2CH_3$, 100.12. Col.liq. **D.** 0.6959, **b.p.** 89.4. **Soly.** i.w.; s.al.; s.et.

95 —, **2, 4-dimethyl-*** (*diisopropylmethane*). $(CH_3)_2CHCH_2CH(CH_3)_2$ 100.12. Col.liq. **D.** 0.6745, **m.p** −123.4, **b.p.** 80.8. **Soly.** i.w.; s.al. s.et.

96 —, **3, 3-dimethyl-*** (*diethyldimethylmethane*). $CH_3CH_2C(CH_3)_2CH_2CH_3$ 100.12. Col.liq. **D.** 0.6934, **b.p.** 86.0. **Soly.** i.w.; s.al.; s.et.

97 —, **1-ethoxy-***. See *Ether, amyl ethyl.*

98 —, **3-ethyl-*** (*triethylmethane*). $(C_2H_5)_3CH$, 100.12. Col.liq. **D.** 0.6984. **m.p.** −94.5(−125.6), **b.p.** 93.3. **Soly.** i.w.; s.al.; s.et.

99 —, **3-ethyl-2-methyl-*** (*diethylisopropylmethane*). $(CH_3)_2CHCH(C_2H_5)_2$, 114.14. Col.liq., *n* 1.4016. **D.** 0.7078, **b.p.** 114.0. **Soly.** i.w.; sl.s.al.; s.et.

00 —, **3-ethyl-3-methyl-*** (*triethylmethylmethane*). $CH_3CH_2C(CH_3)(C_2H_5)CH_2CH_3$, 114.14. Liq. **D.** 0.712, **b.p.** 119.0. **Soly.** i.w.; 3et.

01 —, **1-iodo-***. See *Amyl iodide.*

02 —, **1-methoxy-*** (*amyl methyl ether*). $CH_3(CH_2)_4OCH_3$, 102.11. Liq. **D.** 0.754, **b.p.** 88.5.

03 —, **2-methyl-*** (*dimethylpropylmethane*). $(CH_3)_2CH(CH_2)_2CH_3$, 86.11. Col.liq., *n* 1.372. **D.** 0.654, **b.p.** 60. **Soly.** i.w.; s.al.; s.et.

04 —, **3-methyl-*** (*diethylmethylmethane*). $CH_3CH_2CH(CH_3)CH_2CH_3$, 86.11. Col.liq. **D.** 0.676^{20}_{4}, **b.p.** 64. **Soly.** i.w.; ∞al.; s.et.

* Name approved by the International Union of Chemistry.

05 **Pentane, 3-methylene-*.** See *1-Butene,2-ethyl-*.*

06 **—, 2-methyl-3-methylene-.** See *1-Butene, 2-ethyl-3-methyl-*.*

07 **—, 4-methyl-1-phenyl-.** See *Benzene, isohexyl-.*

08 **—, pentyloxy-*.** See *Amyl ether.*

09 **—, 1-phenyl-.** See *Benzene, amyl-.*

10 **—, 2-phenyl-.** See *Benzene, (α-methylbutyl)-.*

11 **—, 2, 2, 4-trimethyl-*** (*isobutyltrimethylmethane; "isoöctane"*). $(CH_3)_2CCH_2CH(CH_3)_2$. 114.14. Col. liq., *n* 1.3916. **D.** 0.6918, **f.p.** −107.4, **b.p.** 99.3. **Soly.** i.w.; sl.s.al.; s.et.

12 **3-Pentanecarboxylic acid.** See *Butyric acid, α-ethyl-.*

13 **1, 5-Pentanediamine*.** See *Cadaverine.*

14 **Pentanedinitrile*.** See *Glutaronitrile.*

15 **Pentanedioic acid*.** See *Glutaric acid.*

16 **—, 3-oxo-*.** See *Acetonedicarboxylic acid.*

17 **1,2-Pentanediol***(*α-n-amyleneglycol*). $CH_3CH_2CH_2CH(OH)CH_2OH$, 104.09. Col.liq. **D.** 0.980^{20}_{20}, **b.p.** 211.8. **Soly.** ∞w.; ∞al.; ∞et.

18 **1, 4-Pentanediol*** (*γ-pentylene glycol*). $CH_3CHOHCH_2CH_2CH_2OH$, 104.09. Liq. **D.** 0.9954^{18}_{8}, **b.p.** 131–3^{18}. **Soly.** ∞w.; ∞al.; v.sl.s.et.

19 **1, 5-Pentanediol*** (*pentamethylene glycol*). $CH_2OHCH_2CH_2CH_2CH_2OH$, 104.09. Thk.liq., *n* 1.4499. **D.** 0.994^{20}_{20}, **b.p.** 239.4. **Soly.** ∞w.; ∞al.; sl.s.et.

20 **2, 3-Pentanediol*** (*methylethylethylene glycol; β-n-amylene glycol*). $CH_3CH_2CH(OH)CH(OH)CH_3$, 104.09. Liq. **D.** 0.9945^0, **b.p.** 187. **Soly.** s.w.; s.al.

21 **2, 4-Pentanediol, 2-methyl-*** (*α, α, α'-trimethyltrimethylene glycol*). $(CH_3)_2COHCH_2CHOHCH_3$, 118.11. Liq. **D.** 0.9240^{17}_{4}, **b.p.** 196; 96–8^{10}. **Soly.** s.w.; s.al.; s.et.

22 **1, 4-Pentanedione, 1-phenyl-.** See *Valerophenone, γ-keto-.*

23 **1, 5-Pentanedione, 1, 2, 3, 4, 5-pentaphenyl-.** See *Benzamarone; Isobenzamarone.*

24 **2, 3-Pentanedione,** 3-oxime* (*α-isonitrosopropyl methyl ketone*). $CH_3COC(:NOH)C_2H_5$, 115.08. Leaf.f.lgr. **m.p.** 56–7, **b.p.** 183–7. **Soly.** sl.s.w.; v.s.al.; v.s.et.; v.s.chl.

25 **2, 4-Pentanedione*** (*acetylacetone*). $CH_3COCH_2COCH_3$, 100.06. Col.inflam.liq., *n* $1.45178^{18.5}$. **D.** 0.976, **m.p.** −23.2, **b.p.** 139^{746}. **Soly.** 12.5, 51.5^{80}w.; ∞al.; ∞et.; s.bz., chl., acet., glac.ac.a.

26 **Pentanenitrile*.** See *Valeronitrile.*

27 **—, 4-methyl-*.** See *Isocapronitrile.*

28 **1, 2, 3, 4, 5-Pentanepentol*.** See *Arabitol.*

29 **1-Pentanethiol*** (*amyl mercaptan*). $CH_3(CH_2)_4SH$, 104.15. Liq., *n* 1.44366. **D.** 0.857, **m.p.** −75.7, **b.p.** 126. **Soly.** i.w.; ∞al.; ∞et.

30 **Pentanoic acid*.** See *Valeric acid.*

31 **—, 4-methyl-*.** See *Isocaproic acid.*

32 **—, 4-oxo-*.** See *Levulinic acid.*

33 **Pentanoic anhydride*.** See *Valeric anhydride.*

34 **1-Pentanol*** (*butylcarbinol; pri-n-amyl alcohol*). $CH_3(CH_2)_3CH_2OH$, 88.09. Col.liq., *n* $1.40963^{14.60}$. **D.** 0.817^{20}, **m.p.** −78.5, **b.p.** 137.9. **Soly.** 2.7^{22}w.; ∞al.; ∞et.

35 **—, 2-methyl-*** (*2-methyl-2-propylethanol*). $CH_3(CH_2)_2CH(CH_3)CH_2OH$, 102.11.

36 **—, 3-methyl-*** (*active hexyl alcohol*). $(C_2H_5)(CH_3)CHCH_2CH_2OH$, 102.11. Liq. **D.** 0.8262; 0.8205^{25}_{4}, **b.p.** 153.7–54.1. **Soly.** i.w.; s.al.; s.et.

37 **—, 4-methyl-*** (*isoamylcarbinol*). $(CH_3)_2CH(CH_2)_2CH_2OH$, 102.11. Liq., *n* 1.4490. **D.** 0.8243^0; 0.8156^{20}_{4}, **b.p.** 147–8; 151.8–2.8. **Soly.** v.sl.s.(i.)w.; s.al.; s.et.

38 **2-Pentanol*** (*methylpropylcarbinol; sec-act-amyl alcohol*). $CH_3CH_2CH_2CHOHCH_3$, 88.09. Col.liq., *n* 1.4053. **D.** 0.809^{20}_{4}, **b.p.** 119.28. **Soly.** 5.3^{30} w.; ∞al.; ∞et.

39 **—, 2, 4-dimethyl-*** (*isobutyldimethylcarbinol*). $(CH_3)_2COHCH_2CH(CH_3)_2$. 116.12. Col.liq., *n* 1.4172. **D.** 0.8158, **m.p.** < −20, **b.p.** 132.8–3.4(129–30). **Soly.** i.w.; s.al.; s.et.

40 **—, 2-methyl-*** (*dimethylpropylcarbinol*). $(CH_3)_2COH(CH_2)_2CH_3$, 102.11. Liq. **m.p.** 4(< −38), **b.p.** 122.5–3.5. **Soly.** v.sl.s.w.; s.al.; ∞et.

41 **—, 4-methyl-*** (*isobutylmethylcarbinol*). $(CH_3)_2CHCH_2CHOHCH_3$, 102.11. Col.liq., *n* 1.409. **D.** 0.806 (0.813^{20}_{4}), **b.p.** 131.4. **Soly.** 1.8w.; ∞al.; ∞et.

42 **—, —,** acetate (*α, γ-dimethylbutyl acetate*). $CH_3CH(OOCCH_3)CH_2CH(CH_3)_2$, 144.12. Col.liq. **D.** 0.8580^{20}_{4}, **b.p.** 146. **Soly.** 0.082^{25}w.

For explanations and abbreviations see beginning of table.

43 2-Pentanol, 4-methyl-*, butyrate (*α-methylisoamyl butyrate*). $(CH_3)_2CHCH_2CH(OOCC_3H_7)CH_3$, 172.16. Col.liq. **D.** 0.853, **m.p.** −48, **b.p.** 183. **Soly.** 0.8^{35}w.

44 —, **2, 4, 4-trimethyl-**(?) (*isodibutol*). $(CH_3)_3CCH_2COH(CH_3)_2$, 130.14. Col. liq., *n* 1.42085. **D.** 0.8417^{0}; 0.8228^{20}_{4}, **m.p.** −20, **b.p.** 147.5(152–4). **Soly.** i.w.; sl.s.al.; s.et.

45 3-Pentanol* (*diethylcarbinol*). $CH_3CH_2CHOHCH_2CH_3$, 88.09. Col.liq., *n* 1.4077^{25}. **D.** 0.815^{25}, **b.p.** 115.6. **Soly.** sl.s.w.; s.al.; s.et.

46 —, **2, 3-dimethyl-*** (*ethylisopropylmethylcarbinol*). $(CH_3)_2CHCOH(CH_3)CH_2CH_3$, 116.12. Liq. **D.** 0.8329^{21}, **m.p.** < −30, **b.p.** $138–40^{75}$. **Soly.** i.w.; s.al.; s.et.

47 —, **2, 4-dimethyl-*** (*diisopropylcarbinol*). $(CH_3)_2CHCHOHCH(CH_3)_2$, 116.12. Col.liq., *n* 1.42259. **D.** 0.8288^{20}_{4}, **b.p.** 140. **Soly.** v.sl.s.w.; s.al.; s.et.

48 —, **2, 4,-dimethyl-3-phenyl-** (*diisopropylphenylcarbinol*). $[(CH_3)_2CH]_2COHC_6H_5$, 192.16. Yel.liq. **D.** 0.959, **m.p.** 60.5, **b.p.** 157^{60}; 229^{756}. **Soly.** sl.s.w.; i.al.; s.et.

49 —, **3-ethyl-*** (*triethylcarbinol*). $(C_2H_5)_3COH$, 116.12. Col.oil, *n* 1.4314. **D.** 0.83892, **b.p.** 140–2. **Soly.** i.w.; s.al.; s.et.

50 —, **3-ethyl-2-methyl-*** (*diethylisopropylcarbinol*). $(CH_3)_2CHCOH(C_2H_5)CH_2CH_3$, 130.14. Liq. **D.** 0.8463^{0}; 0.8295^{20}_{4}, **b.p.** $159–61^{750}$. **Soly.** i.w.; s.al.; s.et.

51 —, **2-methyl-*** (*ethylisopropylcarbinol*). $(CH_3)_2CHCHOHCH_2CH_3$, 102.11. Liq. **D.** 0.826^{18}_{4}, **b.p.** 127.5^{721}. **Soly.** v.sl.s.w.; ∞al.; ∞et.

52 —, **3-methyl-*** (*diethylmethylcarbinol*). $CH_3CH_2COH(CH_3)CH_2CH_3$, 102.11. Col.liq., *n* 1.4196. **D.** 0.824; 0.8233^{25}_{4}, **m.p.** −22(< −38), **b.p.** 122.8–3.0. **Soly.** sl.s.w.; ∞al.; ∞et.

53 2-Pentanone* (*methyl propyl ketone*). $CH_3CO(CH_2)_2CH_3$, 86.08. Col.liq., *n* $1.38946^{20.2}$. **D.** 0.812^{15}_{15}, **m.p.** −77.8, **b.p.** 101.7. **Soly.** v.sl.s.w.; ∞al.; ∞et.

54 —, oxime (*methyl propyl ketoxime*). $CH_3C(:NOH)(CH_2)_2CH_3$, 101.09. Col. liq., *n* 1.4450. **D.** 0.909., **b.p.** 168. **Soly.** s.w.; ∞al.; ∞et.

55 —, **4-hydroxy-4-methyl-*** (*diacetone alcohol*). $CH_3COCH_2C(OH)(CH_3)_2$, 116.09. Col.liq., *n* 1.4300^{9}. **D.** 0.9306^{25}_{4}; 0.938^{20}_{4}, **m.p.** −54 to −57. **b.p.** 164–6. **Soly.** ∞w.; ∞al.; ∞et.

56 —, **3-methyl-*** (*sec-butyl methyl ketone; asym-ethylmethylacetone*). $CH_3COCH(CH_3)CH_2CH_3$, 100.09. Col.liq. **D.** 0.818^{14}_{4}, **b.p.** 118. **Soly.** sl.s.w.; ∞al.; ∞et.

57 —, **4-methyl-*** (*isobutyl methyl ketone*). $CH_3COCH_2CH(CH_3)_2$, 100.09. Col.liq. **D.** 0.8017^{20}_{4}, **m.p.** −84.7, **b.p.** 119(115–8). **Soly.** 1.9w.; ∞al.; ∞et.; ∞bz.

58 3-Pentanone* (*diethyl ketone; sym-dimethylacetone; propione; ethyl ketone*). $C_2H_5COC_2H_5$, 86.08. Col. inflam.liq., *n* 1.3905^{25}. **D.** 0.8159^{19}_{4}, **m.p.** −42, **b.p.** 101.7 (100.5–2.5). **Soly.** 4.7^{20}, 3.8^{100}w.; ∞al.; ∞et.

59 —, **2, 4-dimethyl-*** (*diisopropyl ketone*). $(CH_3)_2CHCOCH(CH_3)_2$, 114.11. Col.liq. **D.** 0.8062^{20}_{4}, **b.p.** 123.7. **Soly.** i.w.; ∞al.; ∞et.; s.bz.

60 —, **2-methyl-*** (*ethyl isopropyl ketone*). $C_2H_5COCH(CH_3)_2$, 100.09. Col.liq. **D.** 0.830^{0}, **b.p.** 114.5. **Soly.** v.sl.s.w.; v.s.al.; ∞et.

61 Pentanoyl chloride*. See *Valeryl chloride*.

62 Pentatriacontane* (*n-pentatriacontane*). $CH_3(CH_2)_{33}CH_3$, 492.56. Cr. **D.** 0.782^{75}_{4}, **m.p.** 74.7, **b.p.** 331^{15}.

63 18-Pentatriacontanone* (*diheptadecyl ketone; stearone*). $(C_{17}H_{35})_2CO$, 506.55. Leaf.f.lgr. **D.** liq. 0.793^{95}, **m.p.** 88. **Soly.** i.w.; sl.s.h.al.; sl.s.h. et.

64 1-Pentene* (*propylethylene; α-n-amylene*). $CH_3CH_2CH_2CH:CH_2$, 70.08. Col.liq. **D.** 0.6454^{25}_{4}, **m.p.** −138, **b.p.** 40(32–7). **Soly.** i.w.; ∞al.; ∞et.; v.s.dil.H_2SO_4.

65 —, **2, 3-dimethyl-*** (1-*sec-butyl*-1-*methylethylene*). $CH_2:C(CH_3)CH(CH_3)CH_2CH_3$, 98.11. **D.** 0.7054, **b.p.** 84.1–4.3.

66 —, **2, 4-dimethyl-*** (1-*isobutyl*-1-*methylethylene*). $CH_2:C(CH_3)CH_2CH(CH_3)_2$, 98.11. **D.** 0.6937, **b.p.** 80.9–1.3.

67 —, **3, 3-dimethyl-*.** $CH_2:CHC(CH_3)_2CH_2CH_3$, 98.11. *n* 1.3991. **D.** 0.6961, **b.p.** 76.9.

68 —, **2-ethyl-*** (1-*ethyl*-1-*propylethylene; 3-methylenehexane**). $CH_2:C(C_2H_5)CH_2CH_2CH_3$, 98.11. **D.** 0.7079, **b.p.** 93.9–4.3.

69 —, **2-methyl-*** (1-*methyl*-1-*propyl ethylene*). $CH_2:C(CH_3)CH_2CH_2CH_3$, 84.09. **D.** 0.6817, **b.p.** 61.5–2.0.

70 —, **3-methyl-*** (*sec-butylethylene*). $CH_2:CHCH(CH_3)CH_2CH_3$, 84.09. **D.** 0.6700, **b.p.** 53.6–4.0.

* Name approved by the International Union of Chemistry.

71 1-Pentene, 4-methyl-* (*isobutylethylene*). CH_2:$CHCH_2CH(CH_3)_2$, 84.09. **D.** 0.6646, **b.p.** 53.6–3.9.

72 2-Pentene* (*sym-methylethylethylene; β-n-amylene*). CH_3CH_2CH:$CHCH_3$, 70.08. Col.inflam.liq. **D.** 0.651, **m.p.** −139, **b.p.** 36.4. **Soly.** i.w.; ∞al.; ∞et.; v.s.dil.H_2SO_4.

73 —, 2, 3-dimethyl-* (*ethyltrimethylethylene*). $(CH_3)_2C$:$C(CH_3)CH_2CH_3$, 98.11. Liq. **D.** 0.719, **b.p.** 95.1. **Soly.** i.w.; s.al.; s.et.

74 —, 2, 4-dimethyl-* (*isopropyldimethylethylene*). $(CH_3)_2C$:$CHCH$-$(CH_3)_2$, 98.11. Liq., *n* 1.4020. **D.** 0.6947^{20}_{4}, **b.p.** 82.6. **Soly.** i.w.; s.al.; s.et.

75 —, 3, 4-dimethyl-* (*1-isopropyl-1, 2-dimethylethylene*). CH_3CH:$C(CH_3)CH(CH_3)_2$, 98.11. **D.** 0.7126, **b.p.** 86.2–6.4.

76 —, 4, 4-dimethyl-*. CH_3CH:CHC-$(CH_3)_3$, 98.11, *n* 1.3986. **D.** 0.6881^{20}_{4}, **b.p.** 76.0.

77 —, 3-ethyl-* (*1, 1-diethyl-2-methylethylene*). CH_3CH:$C(C_2H_5)_2$, 98.11. **D.** 0.7172, **b.p.** 94.8–4.9.

78 —, 2-methyl-* (*2-ethyl-1, 1-dimethylethylene*). $(CH_3)_2C$:$CHCH_2$-CH_3, 84.09. **D.** 0.6904, **b.p.** 67.2–7.5.

79 —, 3-methyl-* (*1-ethyl-1, 2-dimethylethylene*). CH_3CH:$C(CH_3)$-CH_2CH_3, 84.09. **D.** (1) 0.6956; (2) 0.6940, **b.p.** (1) 67.6–8.2; (2) 65.7–6.2.

80 —, 4-methyl-* (*1-isopropyl-2-methylethylene*). CH_3CH:$CHCH$-$(CH_3)_2$, 84.09. **D.** (1) 0.6709; (2) 0.6702, **b.p.** (1) 57.7–8.5; (2) 54.2–5.2.

81 3-Pentene, 2, 3-dimethyl-*. CH_3-$CH(CH_3)C(CH_3)$:$CHCH_3$, 98.11. *n* 1.4052. **D.** 0.7126^{20}_{4}, **b.p.** 86.

82 2-Pentene-3-carboxylic acid*. See *Crotonic acid, α-ethyl-*.

83 4-Pentenenitrile* (*allylacetonitrile; allylmethyl cyanide*). CH_2:$CHCH_2$-CH_2CN, 81.06. Liq. **D.** 1.18^{13}, **b.p.** 140. **Soly.** i.w.; ∞al.; ∞et.

84 2-Pentenoic acid, 4-methyl-* (*β-isopropylacrylic acid; α-isohexenic acid*). $(CH_3)_2CHCH$:$CHCOOH$, 114.08. Liq., *n* 1.4506^{16}. **D.** 0.959, **b.p.** 108^{12}. **Soly.** s.al.

85 4-Pentenoic acid* (*allylacetic acid*). CH_2:$CHCH_2CH_2COOH$, 100.06. Col. liq., *n* $1.4341^{7.5}$. **D.** 0.984^{18}, **m.p.** <-18, **b.p.** 189. **Soly.** sl.s.w.; v.s. al.; v.s.et.

86 1-Penten-3-ol* (*ethylvinylcarbinol*). CH_2:$CHCHOHCH_2CH_3$, 86.08. **D.** 0.840^{20}_{4}, **b.p.** 114–5. **Soly.** sl.s.w.; ∞al.; ∞et.

87 3-Penten-2-ol* (*dimethylpropenylcarbinol*). $C_6H_{11}OH$, 100.09. Col. liq., *n* 1.4302. **D.** 0.8347^{20}_{4}, **b.p.** 112. **Soly.** 10^{10}w.; ∞al.; ∞et.

88 4-Penten-1-ol* (*β-allylethyl alcohol*). CH_2:$CHCH_2CH_2CH_2OH$, 86.08. Col. liq. **D.** 0.863^{0}_{4}, **b.p.** 140–2.

89 4-Penten-2-ol* (*allylmethylcarbinol*). CH_2:$CHCH_2CHOHCH_3$, 86.08. Col. liq. **D.** 0.834^{20}_{4}, **b.p.** 116.4. **Soly.** 12.5w.; ∞al.; ∞et.

90 —, 2-methyl-* (*allyldimethylcarbinol*). CH_2:$CHCH_2COH(CH_3)_2$, 100.09. Liq. **D.** 0.8430^{0}, **b.p.** 119.5. **Soly.** sl.s.w.

91 3-Penten-2-one* (*ethylideneacetone*). CH_3CH:$CHCOCH_3$, 84.06. Col.liq., *n* $1.43903^{19.6}$. **D.** 0.856, **b.p.** 122–4. **Soly.** s.w.

92 —, 4-methyl-*. See *Mesityl oxide.*

93 Pentine. See *Pentyne**.

Pentyl*. See *Amyl.*

94 1-Pentyne* (*1-pentine; n-propylacetylene*). $HC⋮CCH_2CH_2CH_3$, 68.06. Col.liq., *n* 1.4079^{18}. **D.** 0.7221^{0}; 0.6882^{25}_{4}, **m.p.** −95, **b.p.** 40. **Soly.** i.w.; v.s.al.; ∞et.

95 2-Pentyne* (*2-pentine; ethylmethylacetylene; valerylene*). $CH_3C⋮CCH_2$-CH_3, 68.06. Liq., *n* 1.40044. **D.** 0.687; $0.7127^{17.2}$, **m.p.** −101, **b.p.** 56. **Soly.** i.w.; v.s.al.; ∞et.

96 2-Pentynoic acid* (*ethylpropiolic acid; ethylacetylenecarboxylic acid*). $CH_3CH_2C⋮CCOOH$, 98.05. Cr. **m.p.** 50. **Soly.** v.s.w.

97 Peonol (*2-hydroxy-4-methoxyacetophenone; resacetophenone 4-methyl ether; paeonol*). $CH_3COC_6H_3(OCH_3)$-OH, 166.08. **m.p.** 50. **Soly.** i.w.; s.al.; s.et.

98 Perbenzoic acid (*benzoyl hydroperoxide*). $C_6H_5COO_2H$, 138.05. Leaf. **m.p.** 42, **b.p.** exp. 80–100. **Soly.** sl.s.w.; s.al.; s.et.

99 Perchloromethyl formate. See *Diphosgene.*

00 Pereirine. $C_{19}H_{24}N_2O$, 296.20. Br. amor.powd. **m.p.** 118–24. **Soly.** i.w.; v.s.al.; v.s.et.; s.chl.

01 Peroxide, dibenzoyl. See *Benzoyl peroxide.*

02 Perseitol (*d-mannoheptitol; perseite*). $C_7H_9(OH)_7$, 212.12. Col.need. **m.p.** 188. **Soly.** 5.5^{18}w.; sl.s.c.al.

03 Peucedanin (*imperatorin*). $C_{16}H_{16}O_4$, 272.12. Rhomb.pr. **m.p.** 75. **Soly.** i.w.; s.h.al.; s.et.; s.pet.eth., KOH.

For explanations and abbreviations see beginning of table.

04 Phaseomannitol. See *i-Inositol.*

05 α-Phellandrene (*1, 5-p-menthadiene; 5-isopropyl-2-methyl-1, 3-cyclohexadiene*). $C_{10}H_{16}$, 136.12. Liq. **D.** 0.843, **b.p.** 175. **Soly.** i.al.; s.et.

06 β-Phellandrene (*1(7), 2-p-menthadiene; 3-isopropyl-6-methylenecyclohexene*). $C_{10}H_{16}$, 136.12. Liq., *n* 1.4788. **D.** 0.852, **b.p.** 171.2. **Soly.** i.w.; i.al.; s.et.

07 Phenacetin. See *p-Acetophenetide.*

08 Phenacyl alcohol. See *Acetophenone, α-hydroxy-.*

09 Phenacyl bromide. See *Acetophenone, α-bromo-.*

10 Phenacyl chloride. See *Acetophenone, α-chloro-.*

11 Phenanthrahydroquinone. See *9, 10-Phenanthrenediol.*

12 Phenanthraquinone. See *Phenanthrenequinone.*

13 Phenanthrene. $C_{14}H_{10}$, 178.08. Col. monocl.leaf.f.al., *n* 1.6567^{129}. **D.** 1.025; liq. 1.063^{100}, **m.p.** 100 (97.5–8.5), **b.p.** 340.2. **Soly.** i.w.; 2^{14}, 10.0^{78}al.; $8.93^{15.5}$ et.; s.bz., chl., ac.a., CS_2.

14 —, amino-. See *Phenanthrylamine.*

15 —, ?-benzyl-. $C_6H_5CH_2C_{14}H_9$, 268.12. Need.f.bz. or leaf.f.al. **m.p.** 91–2 (155–6). **Soly.** i.w.; sl.s.al.; sl.s.bz.

16 —, 9, 10-dihydro-9, 10-dioxo-. See *Phenanthrenequinone.*

17 —, 3, 4-dimethoxy-* (*morphol dimethyl ether*). $C_{14}H_8(OCH_3)_2$, 238.11. Leaf.f.al. + w. **m.p.** 44, **b.p.** 298–303^{112}. **Soly.** i.w.; v.s.al.; v.s.et.

18 —, 9, 10-dimethyl-. $C_{14}H_8(CH_3)_2$, 206.11. Pr.f.dil.ac.a. **m.p.** 139, **b.p.** subl. **Soly.** v.sl.s.al.; v.s.bz., chl.; s.ac.a.

19 —, 9, 10-diphenyl-. $C_{14}H_8(C_6H_5)_2$, 330.14. Col.need.f.al. **m.p.** 235, **b.p.** 270 subl. **Soly.** i.w.; v.sl.s.al.; s.et.; s.bz.

20 —, hydroxy-. See *Phenanthrol.*

21 —, 7-isopropyl-1-methyl-. See *Retene.*

22 —, 1-methyl-. $CH_3C_{14}H_9$, 192.09. Leaf.f.al. **m.p.** 123. **Soly.** i.w.; s.al.

23 —, 3-methyl-. $CH_3C_{14}H_9$, 192.09. Cr.f.al. **m.p.** 65. **Soly.** i.w.; s.al.

24 —, 3, 4, 5-trihydroxy-. See *3, 4, 5-Phenanthrenetriol**.

25 3, 4-Phenanthrenediol*. See *Morphol.*

26 9, 10-Phenanthrenediol* (*phenanthrahydroquinone*). $C_{14}H_8(OH)_2$, 210.08. Col.need. **m.p.** 147–8. **Soly.** s.h.w.; v.s.al.; v.s.et.; v.s.bz.

27 Phenanthrenequinone (*9, 10-dihydro-9, 10-dioxophenanthrene; phenanthraquinone*). $C_6H_4COCOC_6H_4$, 208.06. Yel.-or. need. **D.** 1.405, **m.p.** 207 (203–5), **b.p.** 360. **Soly.** sl.s.w.; v.s.al.; v.s.et.; 0.54^{20}bz.

28 —, 2, 7-dinitro-*. $NO_2C_6H_3(CO)_2C_6H_3NO_2$, 298.06. Yel. gold need.f.ac.a. **m.p.** 301–3. **Soly.** i.w.; v.sl.s.al.; sl.s.ac.a.

29 —, 2-nitro-*. $NO_2C_6H_3(CO)_2C_6H_4$, 253.06. Yel.leaf.f.ac.a. **m.p.** 257. **Soly.** i.al.; sl.s.ac.a.

30 3, 4, 5-Phenanthrenetriol* (*3, 4, 5-trihydroxyphenanthrene*). $C_{14}H_7(OH)_3$, 226.08. Leaf.f.w. **m.p.** 148. **Soly.** i.w.; v.s.al.; v.s.et.

31 2-Phenanthrol (*2-hydroxyphenanthrene*). $C_{14}H_9OH$, 194.08. Leaf.f.dil. al. **m.p.** 168. **Soly.** sl.s.w.; v.s.al.; v.s.et.

32 3-Phenanthrol (*3-hydroxyphenanthrene*). $C_{14}H_9OH$, 194.08. Need.f. dil.al. **m.p.** 122(118–9). **Soly.** i.c., sl.s.h.w.; v.s.al.; v.s.et.

33 4-Phenanthrol (*4-hydroxyphenanthrene*). $C_{14}H_9OH$, 194.08. Cr. **m.p.** 108. **Soly.** i.w.; s.al.; s.et.

34 9-Phenanthrol. $C_{14}H_9OH$, 194.08. Col.need.f.lgr. **m.p.** 153. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.chl., bz., h.lgr.

35 2-Phenanthrylamine (*2-aminophenanthrene*). $C_{14}H_9NH_2$, 193.09. Lt. yel.cr.f.lgr. **m.p.** 85. **Soly.** i.w.; s.al.; s.et.

36 3-Phenanthrylamine (*3-aminophenanthrene*). $C_{14}H_9NH_2$, 193.09. Cr. f.lgr. **m.p.** α, 143; β, 87.5. **Soly.** sl.s.w.; v.s.(vlt.fluores.)al.; s.dil.HCl.

37 9-Phenanthrylamine (*9-aminophenanthrene*). $C_{14}H_9NH_2$, 193.09. Lt. yel.pr. **m.p.** 137–8; 104, **b.p.** subl. **Soly.** v.s.al.; v.s.et.; v.s.bz., chl.

38 Phenazine. $C_6H_4NC_6H_4N$, 180.08. Yel.need. **m.p.** 171, **b.p.** >360 subl. **Soly.** v.sl.s.w.; 2c.al.; sl.s.et.

39 —, 5, 10-dihydro- (*hydrazophenylene*). $C_6H_4NHC_6H_4NH$, 182.09. Rhomb.leaf. **m.p.** d. **Soly.** i.w.; v.sl.s.h.al.; i.bz.

40 —, 2-methyl-. $C_6H_4{:}N_2{:}C_6H_3CH_3$, 194.09. Need. **m.p.** 117, **b.p.** 350 d. **Soly.** sl.s.h.w.; sl.s.al.; sl.s.et.; s.chl., H_2SO_4.

41 2(10)-Phenazinone, 10-phenyl-. See *Aposafranone.*

42 Phenazone. See *Antipyrine.*

* Name approved by the International Union of Chemistry.

43 **Phenazothionium chloride, 3, 9-bisdimethylamino-.** See *Methylene blue.*

44 **Phene*.** See *Benzene**.

45 **Phenethyl alcohol** (*2-phenylethanol; benzylcarbinol*). $C_6H_5CH_2CH_2OH$, 122.08. Col.liq., *n* 1.5240. **D.** 1.0235^{15}, **m.p.** −27, **b.p.** 219–21. **Soly.** 1.6^{20}w.; ∞al.; ∞et.

46 **Phenethylamine** (*β-phenylethylamine; 1-amino-2-phenylethane*). $C_6H_5CH_2CH_2NH_2$, 121.09. Liq., *n* 1.575. **D.** 0.958^{24}, **b.p.** 195(198). **Soly.** s.w.; v.s.al.; v.s.et.

47 —, ***p*-hydroxy-.** See *Tyramine.*

48 —, ***p*-hydroxy-*N*, *N*-dimethyl-.** See *Hordenine.*

49 **Phenetidine, *N*-acetyl-.** See *Acetophenetide.*

50 ***o*-Phenetidine** (*o-ethoxyaniline; o-aminophenetole*). $C_2H_5OC_6H_4NH_2$, 137.09. Liq. **m.p.** < -21, **b.p.** 229.2. **Soly.** v.sl.s.w.; s.al.; s.et.

51 ***m*-Phenetidine** (*m-ethoxyaniline*). $C_2H_5OC_6H_4NH_2$, 137.09. Liq. **b.p.** 248. **Soly.** v.sl.s.w.; s.al.; s.et.

52 ***p*-Phenetidine** (*p-ethoxyaniline*). $C_2H_5OC_6H_4NH_2$, 137.09. Liq. **D.** 1.0613^{15}, **m.p.** 2.4. **b.p.** 254.2. **Soly.** v.sl.s.w.; s.al.; s.et.

53 —, ***N*, *N*-diacetyl-.** See *Diacetanilide, p-ethoxy-.*

54 —, **2-nitro-**(NH_2 = 1) (*4-ethoxy-2-nitroaniline; 4-amino-3-nitrophenetole*). $NO_2(C_2H_5O)C_6H_3NH_2$, 182.09. Red pr.f.al. **m.p.** 112–3. **Soly.** v.sl.s.c., s.h.al.; s.et.

55 **Phenetole** (*ethoxybenzene*; ethyl phenyl ether*). $C_2H_5OC_6H_5$, 122.08. Col.liq., *n* $1.51026^{13.7}$. **D.** $0.9666^{20.2}_{4}$, **m.p.** −30.2, **b.p.** 172 (168–70). **Soly.** i.w.; s.al.; ∞et.

56 —, ***o*, *m*, or *p*-amino-.** See *Phenetidine.*

57 —, **azodi-.** See *Azophenetole.*

58 —, ***β*-bromo-** (*β-bromoethyl phenyl ether*). $C_6H_5OCH_2CH_2Br$, 200.99. **m.p.** 35 (30–1), **b.p.** 240–50 d. **Soly.** v.v. sl.s.w.; s.al.; s.et.

59 —, ***o*-chloro-** (*1-chloro-2-ethoxybenzene*; o-chlorophenyl ethyl ether*). $ClC_6H_4OC_2H_5$, 156.53. Col.liq. **b.p.** 208. **Soly.** s.al.; s.et.; s.bz.

60 —, ***p*-chloro-** (*1-chloro-4-ethoxybenzene*; p-chlorophenyl ethyl ether*). $ClC_6H_4OC_2H_5$, 156.53. Cr., *n* 1.5227^{19}. **m.p.** 21, **b.p.** 212. **Soly.** s.al.; s.et.

61 —, ***o*-nitro-** (*ethyl o-nitrophenyl ether*). $NO_2C_6H_4OC_2H_5$, 167.08. Yel. liq., *n* 1.5425. **D.** 1.190^{15}, **m.p.** 2.1 (5–6), **b.p.** 268(275). **Soly.** i.w.; s.al.; s.et.

62 —, ***m*-nitro.** $NO_2C_6H_4OC_2H_5$, 167.08. Yel.need. **m.p.** 34(31–2), **b.p.** 284; 169^{70}. **Soly.** i.w.; s.al.; s.et.

63 —, ***p*-nitro-.** $NO_2C_6H_4OC_2H_5$, 167.08. Col.monocl.pr.f.et. **D.** 1.18^{15}, **m.p.** 60, **b.p.** 283. **Soly.** i.w.; s.h.al.; v.s.et.

64 **Phenmiazine.** See *Quinazoline.*

65 **Phenobarbital** (*5-ethyl-5-phenylbarbituric acid; luminal*). NHCON-HCOC$(C_2H_5)(C_6H_5)$CO, 232.11. Wh. lust. **m.p.** 174. **Soly.** s.h.w.; s.al.; s.et.

66 **Phenocoll** (*α-amino-p-acetophenetide*). $NH_2CH_2CONHC_6H_4OC_2H_5$, 194.13. Col.need. **m.p.** anh. 100.5. **Soly.** sl.s.w.; s.al.; s.et.

67 **Phenol** (*carbolic acid; hydroxybenzene*). C_6H_5OH, 94.05. Col. rhomb.need., *n* $1.54247^{40.6}$. **D.** 1.072. **m.p.** 41, **b.p.** 182. **Soly.** 6.7^{16}, ∞^{66}w.; ∞al.; v.s.et.; s.chl., glyc., CS_2.

68 —, acetate (*phenyl acetate; acetylphenol*). $CH_3COOC_6H_5$, 136.06. Col. liq., *n* 1.503. **D.** 1.077^{20}_{4}, **b.p.** 195.5. **Soly.** 0.0318w.; ∞al.; ∞et.; ∞chl., glac.ac.a.

69 —, **acetamido-.** See *Acetanilide, hydroxy-.*

70 —, **acetyl-.** See *Phenol, acetate.*

71 —, **acetylamino-.** See *Acetanilide, hydroxy-.*

72 —, ***o*-(acetylmethylamino)-.** See *Acetanilide, o-hydroxy-N-methyl-.*

73 —, ***p*-allyl-.** See *Chavicol.*

74 —, ***o*-amino-** (*o-hydroxyaniline*). $NH_2C_6H_4OH$, 109.06. Col.rhomb. pl. or need. **m.p.** 170(174), **b.p.** subl. **Soly.** 1.7^0w.; 4.4^0al.; sl.s.et.

75 —, ***m*-amino-** (*m-hydroxyaniline*). $NH_2C_6H_4OH$, 109.06. Col.pr.f.tol. **m.p.** 122–3. **Soly.** 2.6w.; v.s.al.; v.s.et.; sl.s.bz., lgr.

76 —, ***p*-amino-** (*p-hydroxyaniline; rodinal*). $NH_2C_6H_4OH$, 109.06. Wh. leaf. **m.p.** 184 d., **b.p.** subl. **Soly.** 1.1^0w.; 4.5^0al.; sl.s.et., i.bz.

77 —, **2-amino-4, 6-dinitro-*.** See *Picramic acid.*

78 —, ***p*-(*β*-aminoethyl)-.** See *Tyramine.*

For explanations and abbreviations see beginning of table.

79 **Phenol, 2-amino-3-nitro-.** $NH_2(NO_2)C_6H_3OH$, 154.06. Red need. **m.p.** 216–7, **b.p.** subl. **Soly.** s.w.

80 —, **2-amino-4-nitro-.** $NH_2(NO_2)C_6H_3OH$, 154.06. Or.pr. **m.p.** 143. **Soly.** sl.s.w.; v.s.al.; v.s.et.

81 —, **2-amino-5-nitro-.** $NH_2(NO_2)C_6H_3OH$, 154.06. Br.need.f.w. **m.p.** 202. **Soly.** s.h.al.

82 —, **2-amino-6-nitro-.** $NH_2(NO_2)C_6H_3OH$, 154.06. Red need.f.al. **m.p.** 111. **Soly.** sl.s.h.w., v.s.al.; v.s.et.; v.s.bz., chl.

83 —, **3-amino-4-nitro-.** $NH_2(NO_2)C_6H_3OH$, 154.06. Or.need. **m.p.** 185–6. **Soly.** sl.s.h.w.; s.al.; v.s.et.; v.s.bz., chl.

84 —, **3-amino-5-nitro-.** $NH_2(NO_2)C_6H_3OH$, 154.06. Yel.cr. **m.p.** 165. **Soly.** v.s.al.; v.s.et.; v.sl.s.bz., chl.

85 —, **4-amino-2-nitro-.** $NH_2(NO_2)C_6H_3OH$, 154.06. Red need.f.al. **m.p.** 131(142–3).

86 —, **4-amino-3-nitro-.** $NH_2(NO_2)C_6H_3OH$, 154.06. Red pr.f.et. **m.p.** 154. **Soly.** s.w.; s.al.; s.et.

87 —, **5-amino-2-nitro-** (*3-amino-6-nitrophenol*). $NH_2(NO_2)C_6H_3OH$, 154.06. Or.-yel.need. **m.p.** 163.

88 —, ***o*-aminothio-** (*2-aminobenzenethiol*; o-aminophenyl mercaptan; o-mercaptoaniline*). $NH_2C_6H_4SH$, 125.12. Need. **m.p.** 26, **b.p.** 234.

89 —, ***m*-aminothio-** (*3-aminobenzenethiol*; m-aminophenyl mercaptan; m-mercaptoaniline*). $NH_2C_6H_4SH$, 125.12. Oily liq. **b.p.** $180–90^{16}$. **Soly.** s.w.; s.al.; i.et.

90 —, ***p*-aminothio-** (*4-aminobenzenethiol*; p-aminophenyl mercaptan; p-mercaptoaniline*). $NH_2C_6H_4SH$, 125.12. Wh.gran.cr.mass. **m.p.** 46, **b.p.** $140–5^{16}$. **Soly.** s.w.; s.al.; s.et.

91 —, ***o*-amoxy-** (*pyrocatechol monoamyl ether*). $CH_3(CH_2)_4OC_6H_4OH$, 180.12. **b.p.** $104–6^4$.

92 —, ***m*-amoxy-** (*resorcinol monoamyl ether*). $CH_3(CH_2)_4OC_6H_4OH$, 180.12. **b.p.** 140^5.

93 —, ***p*-amoxy-** (*hydroquinone monoamyl ether*). $CH_3(CH_2)_4OC_6H_4OH$, 180.12. **m.p.** 49–50.

94 —, ***p*-amyl-.** $CH_3(CH_2)_4C_6H_4OH$, 164.12. Col.liq. **m.p.** <0, **b.p.** 262. **Soly.** v.sl.s.h.w.; s.al.; s.et.; s.NaOH.

95 —, ***p-tert*-amyl-** (*p-(α, α-dimethylpropyl)phenol*). $CH_3CH_2C(CH_3)_2C_6H_4OH$, 164.12. Col.need. **m.p.** 92–3, **b.p.** 248–50; $138–9^{16}$. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

96 —, ***o*-anilino-** (*o-hydroxydiphenylamine*). $C_6H_5NHC_6H_4OH$, 185.09. Pr.f.w. **m.p.** 69–70, **b.p.** $180–9^{20}$. **Soly.** sl.s.h.w.; s.al.; s.et.; sl.s.bz.

97 —, ***m*-anilino-** (*m-hydroxydiphenylamine*). $C_6H_5NHC_6H_4OH$, 185.09. Leaf.f.w. **m.p.** 82, **b.p.** 340. **Soly.** sl.s.h.w.; s.al.; s.et.; s.alk.; sl.s.lgr.

98 —, ***p*-anilino-** (*p-hydroxydiphenylamine*). $C_6H_5NHC_6H_4OH$, 185.09. Leaf.f.w. **m.p.** 70, **b.p.** 330. **Soly.** s.h.w.; s.al.; s.et.; s.chl., alk.

99 —, **azodi-.** See *Azophenol.*

00 —, ***p*-benzalamino-** (*N-benzal-p-hydroxyaniline*). $C_6H_5CH{:}NC_6H_5OH$, 198.10. Leaf.f.dil.al. **m.p.** 183 (185–6). **Soly.** i.w.; v.s.al.

01 —, **benzenylaminothio-.** See *Benzothiazole, 2-phenyl-.*

02 —, ***o*-benzyl-.** $C_6H_5CH_2C_6H_4OH$, 184.09. **m.p.** 21, **b.p.** 312. **Soly.** v.s.h.w.; v.s.al.; v.s.et.

03 —, ***p*-benzyl-** (*p-hydroxydiphenylmethane*). $C_6H_5CH_2C_6H_4OH$, 184.09. Col.need.f.al. **m.p.** 83–4, **b.p.** 320–2 (308). **Soly.** s.h.w.; s.al.; s.et.

04 —, ***p*-benzylamino-.** $C_6H_5CH_2NHC_6H_5OH$, 200.12. Leaf. **m.p.** 90 (84–5). **Soly.** i.w.; v.s.al.; v.s.bz.

05 —, ***o*-bromo-.** BrC_6H_4OH, 172.96. Col. oily liq. **D.** 1.5529^{20}_{4}, **m.p.** 5.6 (4–5), **b.p.** 194–5. **Soly.** v.sl.s.w.; s.al.; s.et.; s.alk.

06 —, ***m*-bromo-.** BrC_6H_4OH, 172.96. Leaf. **m.p.** 33, **b.p.** 236.5; $135–40^{12}$. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.chl., alk.

07 —, ***p*-bromo-.** BrC_6H_4OH, 172.96. Tetr. **D.** 1.840^{15}; 1.588^{80}, **m.p.** 63.5, **b.p.** 238. **Soly.** 1.42^{15}w.; v.s.al.; v.s.et.; s.chl., ac.a.

08 —, ***o*-butoxy-** (*pyrocatechol monobutyl ether*). $CH_3(CH_2)_3OC_6H_4OH$, 166.11. n 1.5113^{25}. **D.** 1.026^{25}, **b.p.** 231–4; 159^{69}.

09 —, ***m*-butoxy-** (*resorcinol monobutyl ether*). $CH_3(CH_2)_3OC_6H_4OH$, 166.11. **b.p.** 130^5.

10 —, ***p*-butoxy-** (*hydroquinone monobutyl ether*). $CH_3(CH_2)_3OC_6H_4OH$, 166.11. **m.p.** 64–5.

11 —, ***o*-butyl-.** $C_4H_9C_6H_4OH$, 150.11. Col., n 1.4961^{15}. **D.** 0.975^{20}_{4}, **b.p.** 234–7. **Soly.** v.sl.s.w.; s.al.; s.et.

12 —, ***m*-butyl-.** $C_4H_9C_6H_4OH$, 150.11. Col. **D.** 0.9742^{20}_{4}, **b.p.** $247–9^{758}$. **Soly.** v.sl.s.w.; s.al.; s.et.

13 —, ***p*-butyl-.** $C_4H_9C_6H_4OH$, 150.11. Col.liq. **D.** 0.978^{20}_{4}, **b.p.** $246–50^{751}$. **Soly.** v.sl.s.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

14 **Phenol, *p-sec*-butyl-.** $C_2H_5(CH_3)$-CHC_6H_4OH, 150.11. Col.need. **m.p.** 59, **b.p.** 240.5^{750}. **Soly.** v.sl.s.w.; s.al.; v.s.et.

15 ***p-tert*-butyl-** (*4-(α, α-dimethylethyl)-phenol*). $(CH_3)_3CC_6H_4OH$, 150.11. Need.f.w. **D.** 0.9081^{114}_{4}, **m.p.** 99, **b.p.** 236–8. **Soly.** s.w.; s.al.; s.et.

16 —, ***o*-chloro-** (*1-chloro-2-hydroxybenzene*). ClC_6H_4OH, 128.50. Col.liq., *n* 1.5473^{40}. **D.** 1.241^{18}_{15}, **m.p.** α 7; β 0; γ 4.1, **b.p.** 175.6. **Soly.** 2.85^{20}w.; s.al.; s.et.

17 —, ***m*-chloro-** (*1-chloro-3-hydroxybenzene*). ClC_6H_4OH, 128.50. Col. liq. or need., *n* 1.5565^{40}. **D.** liq. 1.245^{45}; 1.268^{25}, **m.p.** 32.8, **b.p.** 214. **Soly.** 2.60^{20}w.; s.al.; s.et.; 512^{20}bz.

18 —, ***p*-chloro-** (*1-chloro-4-hydroxybenzene*). ClC_6H_4OH, 128.50. Need.f. al., *n* 1.5579^{40}. **D.** 1.306, **m.p.** 43(39–40), **b.p.** 217. **Soly.** 2.71^{20}w.; v.s.al.; v.s.et.; 272^{20}bz.; s.alk.

19 —, **2-chloro-4-nitro-.** $Cl(NO_2)C_6H_3OH$, 173.50. Lng.col.need.f.al. or w. **m.p.** 111. **Soly.** s.h.w.; v.s.al.; v.s.et.; s.chl.

20 —, **2-chloro-5-nitro-** (*6-chloro-3-nitrophenol*). $Cl(NO_2)C_6H_3OH$, 173.50. Yel.need.f.w. **m.p.** 118–9. **Soly.** sl.s. w.; s.chl.

21 —, **4-chloro-2-nitro-.** $Cl(NO_2)C_6H_3OH$, 173.50. Yel.monocl.need.f.al. **m.p.** 87. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl.

22 —, **5-chloro-2-nitro-** (*3-chloro-6-nitrophenol*). $Cl(NO_2)C_6H_3OH$, 173.50. Yel.pr.f.w. **m.p.** 38.9, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; s.ac.a.

23 —, ***p*-cyclohexyl-.** $C_6H_{11}C_6H_4OH$, 176.12. Col.need. **m.p.** 133. **Soly.** i.w.; sl.s.al.; s.et.

24 —, **2, 4-diamino-.** $(NH_2)_2C_6H_3OH$, 124.08. Col.leaf. **m.p.** 78–80 d. **Soly.** s.al.; sl.s.et.; s.acet., alk., ac.a.; sl.s.chl.

25 —, —, dihydrochloride (*diamol; amidol* (one form)). $(NH_2)_2C_6H_3$-$OH{\cdot}2HCl$, 197.01. Gray-wh.cr. **m.p.** 168–70. **Soly.** s.w.; sl.s.al.; sl.s.et.

26 —, **2, 5-diamino-.** $(NH_2)_2C_6H_3OH$, 124.08. Need. **m.p.** 68. **Soly.** v.s.w.

27 —, **3, 4-diamino-.** $(NH_2)_2C_6H_3OH$, 124.08. Cr. **m.p.** 167–8 d.

28 —, **3, 5-diamino-.** $(NH_2)_2C_6H_3OH$, 124.08. Pr. **m.p.** 168–70. **Soly.** s.w.; sl.s.et.

29 —, **2, 4-dibromo-.** $Br_2C_6H_3OH$, 251.86. Col.need. **m.p.** 40(35–6), **b.p.** 177^{17}; 238–9. **Soly.** 0.19^{15}w.; v.s.al.; v.s.et.; s.CS_2, bz., alk.

30 —, **2, 6-dibromo-.** $Br_2C_6H_3OH$, 251.86. Col.need.f.h.w. **m.p.** 56–7, **b.p.** 162^{21}. **Soly.** s.w.; v.s.al.; v.s.et.

31 —, **2, 6-dibromo-4-nitro-.** $Br_2(NO_2)$-C_6H_2OH, 296.86. Yel.pr.f.al. **m.p.** 144, **b.p.** d. >144. **Soly.** v.sl.s.w.; s.h.al.; s.et.; s.CS_2, et.ac., chl.; sl.s.ac.a.

32 —, **2, 3-dichloro-.** $Cl_2C_6H_3OH$, 162.95. Col.cr.f.pet.eth. **m.p.** 57. **Soly.** s.al.; s.et.

33 —, **2, 4-dichloro-.** $Cl_2C_6H_3OH$, 162.95. Col.need.f.bz. **m.p.** 45, **b.p.** 210. **Soly.** 0.46^{20}w.; v.s.al.; v.s.et.; s.chl., bz.

34 —, **2, 5-dichloro-.** $Cl_2C_6H_3OH$, 162.95. Col.pr.f.pet.eth. **m.p.** 58, **b.p.** 211^{744}. **Soly.** sl.s.w.; s.al.; s.et.; s.bz.

35 —, **2, 6-dichloro-.** $Cl_2C_6H_3OH$, 162.95. Col.need. **m.p.** 67, **b.p.** 219–20. **Soly.** s.al.; s.et.

36 —, **3, 4-dichloro-.** $Cl_2C_6H_3OH$, 162.95. Col.need.f.bz. **m.p.** 68, **b.p.** 253.5^{767}.

37 —, **3, 5-dichloro-.** $Cl_2C_6H_3OH$, 162.95. **m.p.** 68, **b.p.** 233–4. **Soly.** s.al.

38 —, **2, 6-dichloro-4-nitro-.** $Cl_2(NO_2)$-C_6H_2OH, 207.95. Yel.monocl.leaf.f. al. **D.** 1.822, **m.p.** 122, **b.p.** subl. <100 exp. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.chl., bz.

39 —, ***m*-diethylamino-.** $(C_2H_5)_2NC_6H_4OH$, 165.13. Rhomb.f.CS_2 + lgr. **m.p.** 78, **b.p.** 278(276–80). **Soly.** s.w.; s.al.; s.et.; s.CS_2; i.lgr.

40 —, **2, 4-diiodo-.** $I_2C_6H_3OH$, 345.87. Col.need.f.w. **m.p.** 72, **b.p.** 100. **Soly.** sl.s.w.; s.al.; s.et.; sl.s.chl., bz.

41 —, **2, 6-diiodo-.** $I_2C_6H_3OH$, 345.87. Col.cr. **m.p.** 68. **Soly.** s.al.

42 —, **2, 3-dimethoxy-** (*pyrogallol 1, 2-dimethyl ether*). $(CH_3O)_2C_6H_3OH$, 154.08. Col.liq. **b.p.** 233–4; $124–5^{17}$.

43 —, **2, 6-dimethoxy-** (*pyrogallol 1, 3-dimethyl ether*). $(CH_3O)_2C_6H_3OH$, 154.08. Monocl.f.w. **m.p.** 55(52–3), **b.p.** 258(262.7). **Soly.** 1.75^{13}w.; v.s. al.; v.s.et.

44 —, **3, 5-dimethoxy-** (*phloroglucinol dimethyl ether*). $(CH_3O)_2C_6H_3OH$, 154.08. Cr. **m.p.** 36–8, **b.p.** $172–5^{17}$.

45 —, **dimethyl-.** See *Xylenol.*

46 —, ***m*-dimethylamino-** (*m-hydroxy-N, N-dimethylaniline*). $(CH_3)_2NC_6H_4OH$, 137.09. Need.f.lgr. **m.p.** 85–7, **b.p.** 265–8. **Soly.** v.sl.s.h.w.; v.s.al.; v.s.et.; s.bz., acet., alk., min.a.

47 —, ***p*-(α, α-dimethylpropyl)-.** See *Phenol, p-tert-amyl-.*

48 **Phenol,2,3-dinitro-*** (*1-hydroxy-2,3-dinitrobenzene*). $(NO_2)_2C_6H_3OH$, 184.05 Yel.monocl.need.f.w. **D.** 1.681^{20}, **m.p.** 144. **Soly.** sl.s.w.; v.s.h.al.; v.s.et.

49 —, **2,4-dinitro-***. $(NO_2)_2C_6H_3OH$, 184.05. Yel.rhomb.pl.f.w. **D.** 1.683^{24}, **m.p.** 111.6; 114. **Soly.** 0.56^{18}, 4.3^{100}w.; 3.9^{19}al.; 3.065^{15}et.; s.bz., chl.

50 —, —, dimethylthiolthionocarbamate. See *Carbamic acid, dimethylthiolthiono-, 2, 4-dinitrophenyl ester*.

51 —, **2,6-dinitro-***. $(NO_2)_2C_6H_3OH$, 184.05. Pa.yel.rhomb.need. or leaf. f.w. **m.p.** 63-4(61.8). **Soly.** v.sl.s.c., v.s.h.w.; v.s.h.al.; v.s.et.; s.bz., chl.

52 —, **3,4-dinitro-***. $(NO_2)_2C_6H_3OH$, 184.05. Col.tricl.need.f.w. **D.** 1.672, **m.p.** 134. **Soly.** s.al.; s.et.

53 —, **3,5-dinitro-***. $(NO_2)_2C_6H_3OH$, 184.05. Monocl.leaf.f.dil.HCl. **D.** 1.702, **m.p.** 123. **Soly.** s.al.; s.et.; s.chl., bz.; sl.s.pet.eth.

54 —, **ethenylamino-.** See *Benzoxazole, 2-methyl-.*

55 —, **ethenylaminothio-.** See *Benzothiazole, 2-methyl-.*

56 —, **o-ethoxy-** (*pyrocatechol monoethyl ether; guaethol; catechol monoethyl ether*). $C_2H_5OC_6H_4OH$, 138.08. Oily liq. **m.p.** 28, **b.p.** 214-6(241). **Soly.** sl.s.w.; ∞al.; ∞et.

57 —, **m-ethoxy-** (*resorcinol monoethyl ether*). $C_2H_5OC_6H_4OH$, 138.08. Col.-pa.yel.liq. **b.p.** 246-7. **Soly.** i.w.; s.al.; s.et.

58 —, **p-ethoxy-** (*hydroquinone monoethyl ether*). $C_2H_5OC_6H_4OH$, 138.08. Leaf.f.w. **m.p.** 66, **b.p.** 247. **Soly.** sl.s.c., s.h.w.; v.s.al.; v.s.et.

59 —, **o-ethyl-.** See *Phlorol.*

60 —, **m-ethyl-.** $C_2H_5C_6H_4OH$, 122.08. Liq. **D.** 1.025^0, **m.p.** −4, **b.p.** 214^{752}. **Soly.** sl.s.w.; v.s.al.; v.s.et.

61 —, **p-ethyl-.** $C_2H_5C_6H_4OH$, 122.08. Col.need. **m.p.** 46, **b.p.** 219. **Soly.** sl.s.w.; v.s.al.; v.s.et.

62 —, **o-ethylamino-** (*N-ethyl-2-hydroxyaniline*). $C_2H_5NHC_6H_4OH$, 137.09. Rhomb.pl. **m.p.** 107.5(108-9). **Soly.** i.w.; s.al.; sl.s.et.; s.h.bz.

63 —, **m-ethylamino-** (*N-ethyl-3-hydroxyaniline*). $C_2H_5NHC_6H_4OH$, 137.09. Cr.f.bz. **m.p.** 62, **b.p.** 176^{12}. **Soly.** s.h.w.; s.al.; s.et.; v.s.chl.; sl.s.lgr.

64 —, **p-ethylamino-** (*N-ethyl-4-hydroxyaniline*). $C_2H_5NHC_6H_4OH$, 137.09. Need.f.w. **m.p.** 100. **Soly.** s.h.w.; s.al.; s.et.

65 —, **p-heptyloxy-** (*hydroquinone mon[illegible] heptyl ether*). $CH_3(CH_2)_6OC_6H_4O[illegible]$ 208.16. **m.p.** 60.

66 —, **hexahydro-.** See *Cyclohexanol.*

67 —, **p-hexyloxy-** (*hydroquinone mon[illegible] hexyl ether*). $CH_3(CH_2)_5OC_6H_4O[illegible]$ 194.14. **m.p.** 48.

68 —, **o-iodo-.** IC_6H_4OH, 219.96. Nee[illegible] or pl. **D.** 1.8757^{80}, **m.p.** 43(40.4[illegible] **b.p.** $186\text{-}7^{160}$. **Soly.** s.h.w.; v.s.al[illegible] v.s.et.; s.CS_2.

69 —, **m-iodo-.** IC_6H_4OH, 219.9[illegible] Need.f.lgr. **m.p.** 40, **b.p.** d. **Sol[illegible]** sl.s.w.; s.al.; s.et.

70 —, **p-iodo-.** IC_6H_4OH, 219.96. Co[illegible] need.f.w. **D.** 1.857^{112}, **m.p.** 94, **b.[illegible]** d. **Soly.** sl.s.w.; v.s.al.; v.s.et.

71 —, **p-isoamyl-.** $C_5H_{11}C_6H_4O[illegible]$ 164.12. Need.f.h.w. **m.p.** 93, **b.[illegible]** 255. **Soly.** v.sl.s.h.w.; v.s.al.; v.s.et.

72 —, **o-isopropyl-** (*o-cumenol*). $(CH_3)[illegible]$ CHC_6H_4OH, 136.09. Col. **D.** 1.028[illegible] **m.p.** 16, **b.p.** 204. **Soly.** sl.s.w.; s.al[illegible] s.et.

73 —, **p-isopropyl-.** $(CH_3)_2CHC_6H[illegible]$ OH, 136.09. Need. **m.p.** 61, **b.[illegible]** 229.3^{758}. **Soly.** sl.s.w.; s.al.

74 —, **p, p′, p″-methenyltri-.** See *Leu[illegible] aurin.*

75 —, **o-methoxy-.** See *Guaiacol.*

76 —, **m-methoxy-** (*resorcinol mon[illegible] methyl ether*). $CH_3OC_6H_4OH$, 124.0[illegible] Liq. **D.** >1, **m.p.** <−17.5, **b.[illegible]** 244.3. **Soly.** sl.s.w.; ∞al.; ∞et.

77 —, **p-methoxy-** (*hydroquinone mon[illegible] methyl ether*). $CH_3OC_6H_4OH$, 124.0[illegible] Rhomb.leaf.f.w. **m.p.** 53, **b.p.** 243 **Soly.** s.w.; v.s.al.; v.s.et.; v.s.bz.

78 —, **2-methoxy-4-methyl-.** See *Cre[illegible] osol.*

79 —, **methyl-.** See *Cresol.*

80 —, **o-methylamino-.** $CH_3NHC_6H_4$ OH, 123.08. Pl.f.bz. **m.p.** 86-7 **Soly.** i.w.; s.al.; s.bz.

81 —, **p-methylamino-,** sulfate (*metol photol; pictol*). $(CH_3NHC_6H_4OH)_2$·H_2SO_4, 344.23. Wh.cr.powd. **m.p** 250-60 d. **Soly.** 5c., 16.67h.w.; s.al.

82 —, **p, p′-methylenedi-.** See *Meth[illegible] ane, 4, 4′-dihydroxydiphenyl-.*

83 —, **o-nitro-.** $NO_2C_6H_4OH$, 139.05 Lt.yel.monocl.need. or pr. **D.** 1.657^{20} **m.p.** 45, **b.p.** 214.5(217.25). **Soly** 0.21^{20}, 1.08^{100}w.; 46.0^{25}al.; v.s.et.; s.alk

84 —, **m-nitro-.** $NO_2C_6H_4OH$, 139.05 Col.-yel.monocl.f.et. **D.** 1.485, **m.p** 96, **b.p.** 194^{70}. **Soly.** 1.35^{25}, 13.3^{90}w. 195.0^{25}al.; v.s.et.; s.bz., alk.

* Name approved by the International Union of Chemistry.

85 **Phenol, *p*-nitro-.** $NO_2C_6H_4OH$, 139.05. Col.-ylsh.monocl.pr. **D.** 1.479^{20}, **m.p.** 114, **b.p.** 279 d. **Soly.** 1.6^{25}, 26.9^{90}w.; 189.5^{25}al.; v.s.et.; s.chl.

86 —, ***p*-nitroso-** (*quinone monoxime*). NOC_6H_4OH or $HON{:}C_6H_4{:}O$, 123.05 Yel.rhomb.need. **m.p.** 126 d. **Soly.** s.w.; v.s.al.; v.s.et.; s.acet., dil.alk.sol.

87 —, ***p*-octyloxy-** (*hydroquinone monooctyl ether*). $CH_3(CH_2)_7OC_6H_4OH$, 222.17. **m.p.** 60–1.

88 —, **pentabromo-.** C_6Br_5OH, 488.59. Col.monocl.need.f.al. **m.p.** 225, **b.p.** d. **subl. Soly.** i.w.; s.h.al.; sl.s.et.; s.h.bz.

89 —, **pentachloro-.** Cl_5C_6OH, 266.29. Monocl.pr. **D.** 1.978, **m.p.** 191, **b.p.** 310 d. **Soly.** i.w.; v.s.al.; v.s.et.

90 —, **pentamethyl-.** $(CH_3)_5C_6OH$, 164.12. Need.f.al. **m.p.** 125, **b.p.** 267. **Soly.** 0.15h.w.; s.al.

91 —, ***o*-phenyl-** (*o-hydroxybiphenyl*). $C_6H_5C_6H_4OH$, 170.08. Need.f.pet. eth. **m.p.** 56, **b.p.** 275. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.lgr.

92 —, ***m*-phenyl-** (*m-hydroxybiphenyl*). $C_6H_5C_6H_4OH$, 170.08. Need.f.pet. eth. or h.w. **m.p.** 78 (76–7), **b.p.** >300. **Soly.** sl.s.w.; v.s.al.; s.KOH, bz.

93 —, ***p*-phenyl-** (*p-hydroxybiphenyl*). $C_6H_5C_6H_4OH$, 170.08. Col.need. or leaf.f.dil.al. **m.p.** 165, **b.p.** 308. **Soly.** sl.s.w.; s.al.; s.et.; s.chl., NH_4OH.

94 —, **phenylazo-.** See *Azobenzene, hydroxy-*.

95 —, ***p*-propenyl-.** See *Anol*.

96 —, ***o*-propoxy-** (*pyrocatechol monopropyl ether*). $CH_3CH_2CH_2OC_6H_4OH$, 152.09. *n* 1.5176^{25}. **D.** 1.0523^{25}, **b.p.** 223-6; 140^{68}.

97 —, ***m*-propoxy-** (*resorcinol monopropyl ether*). $CH_3CH_2CH_2OC_6H_4OH$, 152.09. **b.p.** 120^{5}.

98 —, ***p*-propoxy-** (*hydroquinone monopropyl ether*). $CH_3CH_2CH_2OC_6H_4OH$, 152.09. **m.p.** 56–7.

99 —, ***o*-propyl-.** $C_3H_7C_6H_4OH$, 136.09. Liq. **D.** 1.015^{0}; 1.000^{18}_{18}, **b.p.** 220 (226.6). **Soly.** sl.s.w.; s.al.; s.et.

00 —, ***m*-propyl-.** $C_3H_7C_6H_4OH$, 136.09. Col.liq. **m.p.** 26, **b.p.** 228. **Soly.** v.sl.s.w.; s.al.; s.et.

01 —, ***p*-propyl-.** $C_3H_7C_6H_4OH$, 136.09. Cr. **D.** 1.009, **m.p.** 22(61), **b.p.** 232.6^{758}. **Soly.** sl.s.w.; s.al.

02 —, ***p*-salicylyl-.** See *Benzophenone, 2, 4′-dihydroxy-*.

03 —, **2, 3, 4, 6-tetranitro-.** $(NO_2)_4C_6HOH$, 274.05. Yel.need.f.chl. **m.p.** 140 d., **b.p.** exp. **Soly.** v.s.w.; v.sl.s. bz., lgr.

04 —, **thio-** (*benzenethiol*; phenyl mercaptan*). C_6H_5SH, 110.11. Col.liq., *n* $1.58613^{23.2}$. **D.** 1.078^{24}_{4}, **b.p.** 169.5. **Soly.** i.w.; v.s.al.; ∞et.

05 —, **2, 4, 6-triamino-.** $(NH_2)_3C_6H_2OH$, 139.09. Need.unst. **b.p.** 257. **Soly.** v.s.w.; v.s.al.; v.s.et.

06 —, **2, 4, 6-tribromo-** (*sym-tribromophenol*). $Br_3C_6H_2OH$, 330.77. Col. monocl.pr.f.dil.al. or bz. **D.** 2.55^{20}_{20}, **m.p.** 96, **b.p.** subl. **Soly.** 0.007w.; v.s.al.; s.et.; s.glyc., chl.

07 —, **2, 3, 5-trichloro-.** $Cl_3C_6H_2OH$, 197.39. Lng.col.need.f.al. **m.p.** 53–5, **b.p.** 253. **Soly.** sl.s.h.w.; s.al.; s.et.; s.lgr.

08 —, **2, 4, 6-trichloro-** (*sym-trichlorophenol*). $Cl_3C_6H_2OH$, 197.39. Rhomb. need. **D.** 1.490^{75}_{4}, **m.p.** 68, **b.p.** 244.5. **Soly.** 0.08^{25}, 0.243^{96}w.; v.s.al.; v.s.et.

09 —, **2, 4, 6-triiodo-.** $I_3C_6H_2OH$, 471.78. Col.need.f.al. **m.p.** 156–8, **b.p.** subl.d. **Soly.** i.w.; 1.58al.; s.et.; s.acet.

10 —, **2, 4, 5-trimethyl-.** See *Pseudocumenol*.

11 —, **2, 4, 6-trimethyl-.** See *Mesitol*.

12 —, **2, 3, 6-trinitro-** (*γ-trinitrophenol*). $(NO_2)_3C_6H_2OH$, 229.05. Need. **m.p.** 118. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

13 —, **2, 4, 5-trinitro-** (*β-trinitrophenol*). $(NO_2)_3C_6H_2OH$, 229.05. Need. **m.p.** 96. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

14 —, **2, 4, 6-trinitro-.** See *Picric acid*.

15 —, ***o*-vinyl-** (*o-hydroxystyrene*). $CH_2{:}CHC_6H_4OH$, 120.06. Need. **D.** $1.061^{19}_{4}{}^{.2}$, **m.p.** 29, **b.p.** 108^{15}. **Soly.** s.w.; v.s.al.; v.s.et.

16 —, ***m*-vinyl-** (*m-hydroxystyrene*). $CH_2{:}CHC_6H_4OH$, 120.06. Oil. **b.p.** $114–6^{16}$.

17 **Phenolphthalein** (2, 2-*bis(p-hydroxyphenyl)phthalide*). $C_{20}H_{14}O_4$, 318.11. Rhomb.need.f.dil.al. **D.** 1.277^{32}; 1.300^{20}_{4}, **m.p.** 261. **Soly.** 0.018^{20}w.; 20.9al.; 5.92et.

18 —, **3′, 3″, 5′, 5″-tetraiodo-** (*nosophen; iodophen*). $C_{20}H_{10}I_4O_4$, 821.76. Cr. or amor.grn.powd. **m.p.** 225 d. **Soly.** i.w.; v.sl.s.al.; s.et.; s.chl., alk.; i.a.

For explanations and abbreviations see beginning of table.

19 1-Phenol-2-sulfonic acid (*o-phenolsulfonic acid; aseptol; sozolic acid*). $HOC_6H_4SO_3H$, 174.11. Col.liq. **D.** 1.155^{15}, **m.p.** 50. **Soly.** s.w.; s.al.; s.glyc.

20 1-Phenol-4-sulfonic acid (*p-phenolsulfonic acid*). $HOC_6H_4SO_3H$, 174.11. Deliq.need. **Soly.** s.w.; s.al.

21 —, 2-amino- (*aminophenolsulfonic acid II*). $HO(NH_2)C_6H_3SO_3H$, 189.12. Rhomb. **m.p.** d. **Soly.** 0.7^{14}w.; i.al.; i.et.

22 —, 2-amino-6-nitro-. $HO(NH_2)(NO_2)C_6H_2SO_3H$, 234.12. **Soly.** s.w.

23 —, 2-nitro-. $HOC_6H_3(NO_2)SO_3H$, 219.11. Need.f.w. **m.p.** 141, **b.p.** d. **Soly.** s.w.; v.s.al.; v.s.chl.

24 Phenol-2, 4, 6-tricarboxylic acid. See *Trimesic acid, hydroxy-*.

25 Phenosuccin. See *Succinamide, N-p-phenetyl-*.

26 Phenothiazine (*phenthiazine; thiodiphenylamine*). $C_6H_4NHC_6H_4S$, 199.14. Yel.rhomb.leaf.f.al. **m.p.** 180, **b.p.** 371 d. **Soly.** sl.s.al.; sl.s.et.; s.bz.

Phenyl. For phenyl derivatives see the parent compounds (e.g., for phenylacridine see *Acridine, phenyl-*). For phenyl esters of organic acids see the acids.

27 Phenylamine. See *Aniline*.

28 Phenyl bromide. See *Benzene, bromo-**.

29 Phenyl chloride. See *Benzene, chloro-**.

30 Phenyl cyanide. See *Benzonitrile*.

31 Phenyl disulfide (*phenyldithiobenzene*; diphenyl disulfide*). $(C_6H_5)_2S_2$, 218.20. Need.f.al. **m.p.** 61, **b.p.** 310 d. **Soly.** i.w.; s.al.; s.et.; s.CS_2, bz.

32 Phenylene, diphenyl-. See *Terphenyl*.

33 *p*-Phenylene cyanide. See *Terephthalonitrile*.

34 *p*-Phenylene diacetate. See *Hydroquinone, diacetate*.

35 Phenylenediamine, *N*-acetyl-. See *Acetanilide, amino-*.

36 *o*-Phenylenediamine (*1, 2-benzenediamine*; 1, 2-diaminobenzene*). $C_6H_4(NH_2)_2$, 108.08. Brnsh.yel.monocl. cr. or tab.f.chl. **m.p.** 102, **b.p.** 252 (256–8). **Soly.** 4.15^{35}, 733^{81}w.; v.s.al.; v.s.et.; s.chl.

37 —, *N, N'*-diacetyl- (1, 4-*diacetamido*
benzene). $C_6H_4(NHCOCH_3)_2$, 192.1
Need.f.w. **m.p.** 186. **Soly.** v.s.h.w.
v.s.al.; v.sl.s.et.

38 —, *N, N*-dimethyl- (*o-amino-N, N*
dimethylaniline; 1-amino-2-dimethy
aminobenzene). $(CH_3)_2NC_6H_4NH$
136.11. Col.oil. **b.p.** 218^{751}. **Soly**
sl.s.w.; v.s.al.; v.s.et.

39 —, *N*-phenyl- (*o-aminodiphenyl*
amine). $NH_2C_6H_4NHC_6H_5$, 184.1
Need.f.w. **m.p.** 79–80. **Soly.** s.w.
s.bz., acet., chl.; sl.s.lgr.

40 *m*-Phenylenediamine (1, 3-*benzene*
diamine; 1, 3-diaminobenzene*). C_6
$H_4(NH_2)_2$, 108.08. Col.rhomb.need.
n. $1.63390^{57.7}$. **D.** 1.1389^{5}; 1.107^{58}
m.p. 62.8, **b.p.** 287 (282–4). **Soly**
35.1^{25}w.; s.al.; s.et.

41 —, 4-(3-aminophenylazo)- (2, 4, 3'
triaminoazobenzene). NH_2C_6H
$N_2C_6H_3(NH_2)_2$, 227.14. Or.red
monocl.f.w. **m.p.** 143.5. **Soly.** i.w.
v.s.al.; v.s.et.

42 —, *N, N*-dimethyl- (*m-amino-N, N*
dimethylaniline; 1-amino-3-dimethyl
aminobenzene). $(CH_3)_2NC_6H_4NH_2$
136.11. Oil. **D.** 0.995^{25}, **m.p.** < -20
b.p. 268–70 (258). **Soly.** sl.s.w.
v.s.al.; v.s.et.

43 —, *N, N'*-di-*p*-tolyl-. $C_6H_4(NHC_6$
$H_4CH_3)_2$, 288.17. Lng.need.f.al. **m.p**
138–9, **b.p.** d. **Soly.** i.w.; sl.s.al.
sl.s.et.; sl.s.bz., ac.a.

44 —, 4-phenylazo-. See *Chrysoidin*
(base).

45 *p*-Phenylenediamine (1, 4-*benzene*
diamine; 1, 4-diaminobenzene*). C_6
$H_4(NH_2)_2$, 108.08. Col.monocl.f.w. o
et. **m.p.** 139.7 (139–41), **b.p.** 267
Soly. 3.8^{24}, 669^{107}w.; s.al.; s.et.; s.chl.

46 —, *N, N*-diethyl- (*p-amino-N, N*
diethylaniline; 1-amino-4-diethylamino
benzene). $(C_2H_5)_2NC_6H_4NH_2$
164.14. Liq. **b.p.** 261–2. **Soly.** s.w.
v.s.al.; v.s.et.

47 —, *N, N*-dimethyl- (*p-amino-N, N*
dimethylaniline; 1-amino-4-dimethyl
aminobenzene). $(CH_3)_2NC_6H_4NH_2$
136.11. Col.need. **D.** 1.036[illegible]; liq
1.0168^{90}, **m.p.** 53 (41), **b.p.** 262
Soly. s.w.; v.s.al.; v.s.et.; s.chl.

48 —, *N*-methyl- (*p-methylamino*
aniline; p-amino-N-methylaniline)
$CH_3NHC_6H_4NH_2$, 122.09. Leaf. **m.p**
35.5^{0}, **b.p.** 259.5. **Soly.** v.s.w.
v.s.al.; v.s.et.

49 —, *N*-phenyl- (*p-aminodiphenyl*
amine). $C_6H_5NHC_6H_4NH_2$, 184.11
Need.f.al. **m.p.** 66–7; 75. **b.p.** 35
in H_2. **Soly.** sl.s.w.; v.s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

50 *p*-**Phenylenediamine,** *N, N, N′, N′*-**tetramethyl-.** $C_6H_4[N(CH_3)_2]_2$, 164.14. Leaf.f.dil.al. **m.p.** 51, **b.p.** 260. **Soly.** v.sl.s.h.w.; v.s.al.; v.s.et.; v.s.chl.

51 *m*-**Phenylene dimercaptan.** See *Resorcinol, dithio-.*

52 *p*-**Phenylene dimercaptan.** See *Hydroquinone, dithio-.*

53 **Phenyl ether** (*phenoxybenzene*; diphenyl ether*). $(C_6H_5)_2O$, 170.08. Col.monocl.(rhombic), n 1.5826^{24}. **D.** 1.0728^{20}, **m.p.** 28, **b.p.** 259. **Soly.** v.sl.s.w.; 4.97^{10} 87 %al.; s.et.; s.ac.a., bz.

54 **Phenyl iodide.** See *Benzene, iodo-*.*

55 **Phenyl isocyanide** (*phenylcarbylamine*). C_6H_5NC, 103.05. Col.-grnsh.liq. **D.** 0.9775^{15}, **b.p.** 166 d. **Soly.** d.w.; d.al.; s.et.

56 **Phenyl ketone.** See *Benzophenone.*

57 **Phenyl mercaptan.** See *Phenol, thio-.*

58 **Phenyl mustard oil.** See *Isothiocyanic acid, phenyl ester.*

p-**Phenylphenacyl esters.** See under the corresponding acids.

59 **Phenyl sulfide** (*diphenyl sulfide; phenylthiobenzene*; benzene sulfide*). $(C_6H_5)_2S$, 186.14. Col.liq., n 1.635^{18}. **D.** 1.1185^{15}_{15}, **m.p.** <-40, **b.p.** 296. **Soly.** i.w.; s.al.; ∞et.; ∞CS_2, bz.

60 **Phenyl sulfone** (*diphenyl sulfone; phenylsulfonylbenzene*; benzene sulfone; sulfobenzide*). $(C_6H_5)_2SO_2$, 218.14. Monocl.pr.f.bz.; pl.f.al.; need.f.w. **D.** 1.248^{20}_{4}, **m.p.** 128–9, **b.p.** 232^{18}; 377.8. **Soly.** i.c., sl.s.h.w.; s.h.al.; s.et.; s.bz.

61 **Phenzoline.** See *Quinazoline, 3, 4-dihydro-3-phenyl-.*

62 **Phloretic acid** (*p-hydroxyhydrocinnamic acid; α, β-dihydro-p-coumaric acid*). $HOC_6H_4CH_2CH_2$-COOH, 166.08. Monocl.f.et. **m.p.** 129. **Soly.** s.h.w.; s.al.; s.et.

63 —, phloroglucinol monoester. See *Phloretin.*

64 **Phloretin** (*phloroglucinol monophloretate*). $C_{15}H_{14}O_5$, 274.11. Sm. leaf. **m.p.** 255 d. **Soly.** sl.s.h.w.; ∞al.; 0.81et.; ∞ac.a.

65 **Phlorizin** (*phloridzin*). $C_{21}H_{24}O_{10}$·-$2H_2O$, 472.22. Silky need. **D.** 1.4298^{19}, **m.p.** $2H_2O$ 108–9; anh. 170 d. **Soly.** 0.1c., v.s.h.w.; 25al.; v.sl.s.et.; i.chl.

66 **Phloroglucinol** (1, 3, 5-*benzenetriol; sym-trihydroxybenzene*). $C_6H_3(OH)_3$, 126.05. Rhomb. **m.p.** anh. 219, **b.p.** subl.d. **Soly.** 1.13^{25}w.; v.s.al.; v.s.et.

67 —, dimethyl ether. See *Phenol,* 3, 5-*dimethoxy-.*

67_1 —, monomethyl ether. See *Resorcinol,* 5-*methoxy-.*

68 —, monophloretate. See *Phloretin.*

69 —, triethyl ether. See *Benzene,* 1, 3, 5-*triethoxy-*.*

70 —, trimethyl ether. See *Benzene,* 1, 3, 5-*trimethoxy-*.*

71 —, trioxime. See 1, 3, 5-*Cyclohexanetrione, trioxime.*

72 **Phloroglucinolcarboxylic acid.** See *Benzoic acid,* 2, 4, 6-*trihydroxy-.*

73 **Phlorol** (*o-ethylphenol*). $C_2H_5C_6H_4$-OH, 122.08. Col.liq. **D.** 1.0374^{12}, **m.p.** <-18, **b.p.** 207.5. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

74 **Phlorone** (*p-xyloquinone;* 2, 5-*dimethylquinone*). $(CH_3)_2C_6H_2O_2$, 136.06. Yel.tricl.f.al. **m.p.** 125, **b.p.** subl. **Soly.** sl.s.h.w.; s.al.; s.et.; s.bz., chl.

75 **Phorone** (*diisopropylideneacetone;* 2, 6-*dimethyl*-2, 5-*heptadien-4-one**). $CO[CH{:}C(CH_3)_2]_2$, 138.11. Yel.cr., n. 1.49982. **D.** 0.885, **m.p.** 28, **b.p.** 198.5. **Soly.** sl.s.(i.)w.; s.al.; s.et.

76 **Phosgene** (*carbonyl chloride; chloroformyl chloride*). $COCl_2$, 98.91. Pois.gas. **D.** 1.392^{19}_{4}, **m.p.** 118 (−104), **b.p.** 8.3. **Soly.** d.w.; d.al.; v.s.et.; s.bz., ac.a., tol.

77 —, **phenylimino-.** See *Aniline, N-(dichloromethylene)-.*

78 —, **thio-** (*thiocarbonyl chloride*). $CSCl_2$, 114.97. Red.liq., n 1.5442. **D.** 1.5085^{15}, **b.p.** 73.5. **Soly.** d.w.; d.al.; s.et.

79 **Phosphaniline.** See *Phosphine, phenyl-.*

80 **Phosphenyl chloride.** See *Phosphine, dichlorophenyl-.*

81 **Phosphine, dichlorophenyl-** (*phosphenyl chloride*). $C_6H_5PCl_2$, 178.97. Fum.liq., n 1.6053^7. **D.** 1.319, **b.p.** 224.6. **Soly.** d.w.; ∞bz., CS_2.

82 —, **diethyl-.** $(C_2H_5)_2PH$, 90.11. Col. liq. **D.** <1, **b.p.** 85. **Soly.** i.w.; s.al.; ∞et.

83 —, **dimethyl-.** $(CH_3)_2PH$, 62.07. Col.liq., ign. **D.** <1, **b.p.** 25. **Soly.** i.w.; s.al.; s.et.

84 —, **ethyl-** (*phosphinoethane*). C_2H_5-PH_2, 62.07. Col.liq. **D.** <1, **b.p.** 25. **Soly.** d.w.

For explanations and abbreviations see beginning of table.

85 **Phosphine, ethyldiphenyl-.** $(C_6H_5)_2PC_2H_5$, 214.14. Liq. **b.p.** 293. **Soly.** s.al.; s.bz.

86 —, **methyl-.** CH_3PH_2, 48.06. Col. gas. **b.p.** −14. **Soly.** sl.s.w.; sl.s.al.; v.s.et.

87 —, **phenyl-** (*phosphaniline*). $C_6H_5PH_2$, 110.07. Liq. **D.** 1.001^{15}, **b.p.** 160.

88 —, **triethyl-.** $(C_2H_5)_3P$, 118.14. Col. liq., *n* 1.446. **D.** 0.801^{20}_{4}, **b.p.** 128. **Soly.** i.w.; s.al.; s.et.

89 —, —, oxide. $(C_2H_5)_3PO$, 134.14. Col.deliq.need. **m.p.** 52.9, **b.p.** 242.9. **Soly.** s.h.w.; s.al.; s.et.; i.KOH.

90 —, —, sulfide. $(C_2H_5)_3PS$, 150.20. Hex.pr., *n* 1.590, 1.650. **m.p.** 94, **b.p.** subl.; ign. 70. **Soly.** s.h.w.; s.al.; s.et.

91 —, **trimethyl-.** $(CH_3)_3P$, 76.09. Col. liq. **D.** <1, **b.p.** 42. **Soly.** i.w.; s.et.

92 —, **triphenyl-.** $(C_6H_5)_3P$, 262.14. Monocl.pr.f.et. **D.** 1.194, **m.p.** 79, **b.p.** >360. **Soly.** i.w.; s.al.; v.s.et.; s.HCl, bz.

93 **Phosphinic acid, dimethyl-.** $(CH_3)_2POOH$, 94.07. Cr. **m.p.** 76, **b.p.** subl. **Soly.** s.w.; s.al.; s.et.

94 —, **methyl-.** See *Methanephosphonic acid.*

95 **Phosphoric acid, diethyl-.** See *Diethylphosphoric acid.*

96 **Phosphorobenzene** (*phosphobenzene*). $C_6H_5P{:}PC_6H_5$, 216.12. Pa.yel.powd. **m.p.** 149. **Soly.** i.w.; i.al.; i.et.; v.s.h.bz.

97 **Photol.** See *Phenol, p-methylamino-, sulfate.*

98 **Phthalaldehyde** (*1, 2-benzenedicarbonal*; o-phthalic aldehyde*). $C_6H_4(CHO)_2$, 134.05. Yel.need. **m.p.** 56. **Soly.** 0.62^{25}, 1.63^{60}w.; s.al.; s.et.

99 **Phthalaldehydic acid** (*o-formylbenzoic acid*). $CHOC_6H_4COOH$, 150.05. Monocl.f.w. **D.** 1.404, **m.p.** 97 (98–9), **b.p.** d. **Soly.** 9.48^{46}w.; v.s.al.; v.s.et.

00 —, **5, 6-dimethoxy-.** See *Opianic acid.*

01 **Phthalamide** (*phthalic diamide*). $C_6H_4(CONH_2)_2$, 164.08. Col.rhbdr. **m.p.** 220. **Soly.** i.w.; i.al.; i.et.

02 **Phthalandione.** See *Phthalic anhydride.*

03 **Phthalanil** (*N-phenylphthalimide*). $C_6H_4(CO)_2NC_6H_5$, 223.08. Col.need. f.al. **m.p.** 207. **b.p.** subl. **Soly.** i.w.; i.al.; ∞chl.

04 **1, 4-Phthalazinedione, 5-amino-2, 3-dihydro-.** See *Luminol.*

05 **Phthalhydrazide, 3-amino-.** See *Luminol.*

06 **Phthalic acid** (*1, 2-benzenedicarboxylic acid*; o-phthalic acid*). $C_6H_4(COOH)_2$, 166.05. Col.rhomb. or monocl.f.w. **D.** 1.593, **m.p.** 206–8 d., **b.p.** d. >191. **Soly.** 0.54^{14}, 18^{99}w.; 11.7^{18}al.; 0.69^{15}et.; i.chl.

07 —, dibenzyl ester. $C_6H_4(COOCH_2C_6H_5)_2$, 346.14. **m.p.** 42–4, **b.p.** 277^{15}. **Soly.** i.w.; v.s.al.; v.s.et.

08 —, dibutyl ester (*dibutyl 1, 2-benzenedicarboxylate*; butyl phthalate*). $C_6H_4(COOC_4H_9)_2$, 278.17. Col. oily liq. **D.** 1.0465, **b.p.** 340. **Soly.** 0.04^{25}w.; ∞al.; ∞et.; ∞acet., bz.

09 —, diethyl ester. $C_6H_4(COOC_2H_5)_2$, 222.11. Col.liq., *n* 1.5019. **D.** 1.123^{25}_{4}, **b.p.** 296.1. **Soly.** i.w.; ∞al.; ∞et.; s.bz.

10 —, dimethyl ester (*dimethyl 1, 2-benzenedicarboxylate*; methyl phthalate*). $C_6H_4(COOCH_3)_2$, 194.08. Col. liq., *n* $1.51546^{20.8}$. **D.** 1.189^{25}_{25}, **b.p.** 282. **Soly.** 0.5w.

11 —, diphenyl ester (*phenyl phthalate*). $C_6H_4(COOC_6H_5)_2$, 318.11. Col.rhomb. **m.p.** 69–70(73–5). **Soly.** i.w.; sl.s.al.; sl.s.et.

12 —, monoethyl ester (*ethyl hydrogen 1, 2-benzenedicarboxylate**). $C_6H_4(COOC_2H_5)COOH$, 194.08. Liq. **m.p.** 2, **b.p.** d. **Soly.** sl.s.w.; s.al.; s.et.

13 —, **3-benzoyl-** (*2, 3-benzophenonedicarboxylic acid*). $C_6H_5COC_6H_3(COOH)_2$, 270.08. Pl. or need. $(+1H_2O)$f.w. **m.p.** $-H_2O$, 100; 145–50→anh. **Soly.** s.h.w.; s.al.; v.sl.s.bz.

14 —, **4-benzoyl-** (*3, 4-benzophenonedicarboxylic acid*). $C_6H_5COC_6H_3(COOH)_2$, 270.08. Cr. **m.p.** 189. **Soly.** s.w.; s.al.

15 —, **3-bromo-** (*3-bromo-1, 2-benzenedicarboxylic acid**). $BrC_6H_3(COOH)_2$, 244.96. Need.f.w. **m.p.** $-H_2O$, 178.5; anh. 188. **Soly.** s.w.; s.al.; s.et.; i.chl.

16 —, **4-chloro-** (*4-chloro-1, 2-benzenedicarboxylic acid**). $ClC_6H_3(COOH)_2$, 200.50. Need.f.al. **m.p.** 150, **b.p.** $-H_2O$, >150. **Soly.** s.w.; s.al.; s.et.

17 —, **1, 6-dihydro-** (*2, 4-cyclohexadiene-1, 2-dicarboxylic acid**). $C_6H_6(COOH)_2$, 168.06. Monocl.pr.f.w. or al. **m.p.** 179–80. **Soly.** 0.2^{10}, 2^{100}w.; s.al.; sl.s.et.

18 —, **3, 6-dihydro-** (*1, 4-cyclohexadiene-1, 2-dicarboxylic acid**). $C_6H_6(COOH)_2$, 168.06. Monocl.pr.f.w. **m.p.** 153. **Soly.** 1.7^{6}w.

* Name approved by the International Union of Chemistry.

19 **Phthalic acid, 4, 5-dihydro-** (2, 6-*cyclohexadiene*-1, 2-*dicarboxylic acid**). $C_6H_6(COOH)_2$, 168.06. Tricl. **m.p.** 215. **Soly.** 0.3^{25}w.; s.al.; s.acet.

20 —, **3, 4-dimethoxy-.** See *Hemipic acid.*

21 —, **hexahydro-.** See 1, 2-*Cyclohexanedicarboxylic acid.*

22 —, **3-hydroxy-.** $HOC_6H_3(COOH)_2$, 182.05. Pr.f.w. **m.p.** 244. **Soly.** 0.14^{24}, 2.5^{100}w.; v.s.al.; v.s.et.

23 —, **4-hydroxy-.** $HOC_6H_3(COOH)_2$, 182.05. Col. rosettes f.w. **m.p.** 181 d. **Soly.** 3^{10}w.; v.s.al.; s.et.

24 —, **3-nitro-.** $NO_2C_6H_3(COOH)_2$, 211.05. Yel. monocl.f.et. **m.p.** 220 (206). **Soly.** 2.05^{25}w.; v.s.al.; v.s.et.

25 —, **4-nitro-.** $NO_2C_6H_3(COOH)_2$, 211.05. Lt.yel.need. **m.p.** 164(161). **Soly.** s.w.; s.al.; s.et.

26 —, **tetrachloro-.** $C_6Cl_4(COOH)_2$, 303.84. Leaf. or need.f.w. **m.p.** 250 d. **Soly.** 0.57^{14}, 3^{99}w.; v.s.al.; v.s.et.; v.s.acet.; v.sl.s.chl.

27 —, **Δ^1-tetrahydro-.** See 1-*Cyclohexene*-1, 2-*dicarboxylic acid.*

28 *m*-**Phthalic acid.** See *Isophthalic acid.*

29 *p*-**Phthalic acid.** See *Terephthalic acid.*

30 **Phthalic aldehyde.** See *Phthalaldehyde.*

31 *m*-**Phthalic aldehyde.** See *Isophthalaldehyde.*

32 *p*-**Phthalic aldehyde.** See *Terephthalaldehyde.*

33 **Phthalic anhydride** (*phthalandione*). $C_6H_4(CO)_2O$, 148.03. Col.rhomb.need. **D.** 1.527^4, **m.p.** 130.8, **b.p.** 284.5 subl. **Soly.** v.sl.s.w.; s.al.; sl.s.et.

34 **Phthalic diamide.** See *Phthalamide.*

35 **Phthalic imide.** See *Phthalimide.*

36 **Phthalide** (1(3)-*isobenzofuranone; α-hydroxy-o-toluic acid lactone*). $C_6H_4COOCH_2$, 134.05. Need.f.w., *n* $1.53560^{99.1}$. **m.p.** 73, **b.p.** 290. **Soly.** v.sl.s.w.; v.s.al.

37 —, **benzal-** (*benzylidenephthalide*). $C_6H_4COOC{:}CHC_6H_5$, 222.08. Col. monocl.pr.f.al. **m.p.** 108(99). **Soly.** i.w.; s.h.al.

38 —, **benzylidene-.** See *Phthalide, benzal-.*

39 —, **2, 2-bis(*p*-hydroxyphenyl)-.** See *Phenolphthalein.*

40 —, **5, 6-dimethoxy-.** See *Meconin.*

41 —, **3, 3-diphenyl-** (*triphenylcarbinol o-carboxylic anhydride; "phthalophenone"*). $C_6H_4COOC(C_6H_5)_2$, 286.11. Leaf.f.al. **m.p.** 115, **b.p.** 419–28 sl.d. **Soly.** d.h.w.; s.al.; s.H_2SO_4.

42 —, **6-nitro-.** $NO_2C_6H_3COOCH_2$, 179.05. Need.f.al. **m.p.** 141. **Soly.** i.c.w.; s.al.; s.et.; v.s.h.chl.; i.alk.carb.

43 **Phthalimide** (1, 3-*isoindoledione; o-phthalic imide*). $C_6H_4(CO)_2NH$, 147.05. Hex.pr.f.et. **m.p.** 238 (234), **b.p.** subl. **Soly.** 0.06^{25}w.; s.al.; sl.s.et.; s.caustic alk., ac.a.; v.sl.s.bz., chl.

44 —, *N*-**isobutyl-** (2-*isobutyl*-1, 3-*isoindoledione*). $C_6H_4CON(C_4H_9)CO$, 203.11. **m.p.** 93, **b.p.** 293–5.

45 —, *N*-**phenyl-.** See *Phthalanil.*

46 **Phthalimidine** (1-*isoindolinone*). $C_6H_4CONHCH_2$, 133.06. Need. **m.p.** 150, **b.p.** 337^{730}. **Soly.** s.w.; v.s.al.; v.s.et.; v.s.chl.

47 **Phthalonic acid** (*o-carboxyphenylglyoxylic acid*). $C_6H_4(COCOOH)$-$COOH$, 194.05. Pr.f.bz. or al. **m.p.** 138–40. **Soly.** 115^{15}w.; s.al.; s.et.; sl.s.chl.

48 **Phthalophenone.** See *Phthalide,* 3, 3-*diphenyl-.*

49 **Phthalyl alcohol.** See *o-Xylylene glycol.*

50 **Phthalyl chloride** (1, 2-*benzenedicarbonyl chloride*; o-phthalyl dichloride*). $C_6H_4(COCl)_2$, 202.95. Col. oily liq., *n* $1.57099^{15.6}$. **D.** 1.408, **m.p.** sym. 16; uns. 89, **b.p.** sym. 281; uns. 275. **Soly.** d.w.; d.al.; s.et.

51 *m*-**Phthalyl dichloride.** See *Isophthalyl chloride.*

52 *p*-**Phthalyl dichloride.** See *Terephthalyl chloride.*

53 **Phycitol.** See *i-Erythritol.*

54 **Physostigmine** (*eserine*). $C_{15}H_{21}N_3O_2$, 275.19. Col.hyg.trim.f.bz., *n* β 1.602. **m.p.** unst. 86–7; stab. 105–6. **Soly.** sl.s.w.; v.s.al.; s.et.; s.chl., bz.

55 —, hydrochloride. $C_{15}H_{21}N_3O_2{\cdot}HCl$, 311.65. Wh.cr. **Soly.** s.w.

56 —, salicylate. $C_{15}H_{21}N_3O_2{\cdot}C_7H_6O_3$, 413.23. Col.-yel. acicular cr. **m.p.** 178.9. **Soly.** 1.33w.; 7.71 al.; 0.57et.; s.chl.

57 —, sulfate. $(C_{15}H_{21}N_3O_2)_2{\cdot}H_2SO_4$, 648.45. Micro-cr.powd. **m.p.** 140. **Soly.** v.s.w.; v.s.al.; 0.083et.; s.chl.

For explanations and abbreviations see beginning of table.

58 **Phytol** (3, 7, 11, 15-*tetramethyl-2-hexadecen-1-ol**). $C_{20}H_{39}OH$, 296.31. Col. oil, *n* 1.46380. **D.** 0.864$^{0}_{4}$; 0.852$^{20}_{4}$, **b.p.** 145$^{.03-.04}$; 203–4$^{9-10}$. **Soly.** i.w.; ∞al.; ∞et.; ∞me.al.

59 **Piazine.** See *Pyrazine.*

60 **Picene** (*dibenzo[ai]phenanthrene*). $C_{22}H_{14}$, 278.11. Col.leaf. **m.p.** 364, **b.p.** 520. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; sl.s.chl., h.bz.

61 **2-Picoline** (2-*methylpyridine; α-picoline*). $CH_3C_5H_4N$, 93.06. Col.liq., *n* 1.50293$^{16.7}$. **D.** 0.950$^{15}_{4}$, **m.p.** −69.9, **b.p.** 128. **Soly.** v.s.w.; ∞al.; ∞et.

62 **3-Picoline** (3-*methylpyridine; β-picoline*). $CH_3C_5H_4N$, 93.06. Col.liq., *n* 1.50432$^{24.0}$. **D.** 0.9613$^{15}_{4}$, **b.p.** 143.5. **Soly.** ∞w.; ∞al.; ∞et.

63 **4-Picoline** (4-*methylpyridine; γ-picoline*). $CH_3C_5H_4N$, 93.06. Col.liq. **D.** 0.9571$^{15}_{4}$, **b.p.** 143.1. **Soly.** ∞w.; ∞al.; ∞et.

64 **2-Picoline-4, 6-dicarboxylic acid.** See *Uvitonic acid.*

65 **Picolinic acid** (2-*pyridinecarboxylic acid**). C_5H_4NCOOH, 123.05. Need. f.w. **m.p.** 137, **b.p.** subl. **Soly.** v.s. w.; 5.44^{25}al.; v.sl.s.et.; v.sl.s.bz., chl.

66 **Picraconitine.** See *Benzaconine.*

67 **Picramic acid** (2-*amino*-4, 6-*dinitrophenol**). $NH_2(NO_2)_2C_6H_2OH$, 199.06. Red monocl.f.chl., *n* 1.54, >1.95, 1.505. **m.p.** 168–9. **Soly.** 0.14^{22}w.; s.al.; sl.s.et.; s.bz., glac.ac.a., aniline.

68 **Picramide.** See *Aniline,* 2, 4, 6-*trinitro-.*

69 **Picric acid** (2, 4, 6-*trinitrophenol*). $(NO_2)_3C_6H_2OH$, 229.05. Yel.rhomb. leaf.f.w. **D.** 1.763, **m.p.** 121.8, **b.p.** exp. >300. **Soly.** 1.4^{20}, 6.8^{100}w.; 4.91^{20}al.; 1.43c.et.; s.bz.

70 —, methyl ether. See *Anisole,* 2, 4, 6-*trinitro-.*

71 **Picryl chloride** (2-*chloro*-1, 3, 5-*trinitrobenzene**). $(NO_2)_3C_6H_2Cl$, 247.50. Yel.monocl.pr.f.et. **D.** 1.797, **m.p.** 83, **b.p.** d. **Soly.** 0.018^{15}w.; 4.48^{17}al.; 7.23^{17}et.

72 **Pictol.** See *Phenol, p-methylamino-, sulfate.*

73 **Pilocarpidine**(*d*). $C_{10}H_{14}N_2O_2$, 194.13. Viscid oil, [α] + 81.3°D. **Soly.** s.w.; v.s.al.; sl.s.et.

74 —, chloroplatinate. $(C_{10}H_{14}N_2O_2 \cdot HCl)_2PtCl_4 \cdot 4H_2O$, 870.30. Or.yel.leaf. or dk. red pyr. **m.p.** 88–9; anh. 187 d. **Soly.** i.al.

75 —, nitrate. $C_{10}H_{14}N_2O_2 \cdot HNO_3$, 257.14. Wh.cr. **D.** 137. **Soly.** 50w.; s.al.

76 **Pilocarpine.** $C_{11}H_{16}N_2O_2$, 208.14. Col. oil or need., [α] + 106°$^{18}_{D}$ in w. **m.p.** 34. **Soly.** v.s.w.; v.s.al.; sl.s.et.; v.s.chl.; v.sl.s.bz.; i.pet.eth.

77 —, hydrochloride. $C_{11}H_{16}N_2O_2 \cdot HCl$, 244.61. Deliq.pr. or need., [α] +91.74°D. **m.p.** anh. 196.7. **Soly.** 333w.; 37^{25}al.; i.et.; sl.s.chl.

78 —, nitrate. $C_{11}H_{16}N_2O_2 \cdot HNO_3$, 271.16. Pr.f.al. or w., [α] + 82.9°D. **m.p.** 176–8 (173). **Soly.** 16^{20}w.; 6.2^{60}al.; i.et.; i.chl.

79 —, salicylate. $C_{11}H_{16}N_2O_2 \cdot C_7H_6O_3$, 346.19. Wh.cr., [α] + 62.5°D. **m.p.** 120. **Soly.** s.w.; s.al.

80 —, sulfate. $(C_{11}H_{16}N_2O_2)_2 \cdot H_2SO_4$, 514.36. Wh.cr.f.al. + et., [α]+84.72°D. **m.p.** 132(120). **Soly.** s.w.; s.al.

81 *d*-**Pimaric acid.** $C_{20}H_{30}O_2$, 302.23. Cr. **m.p.** 212, **b.p.** 282^{20}. **Soly.** i.w.; s.al.; s.et.

82 **Pimelic acid** (*heptanedioic acid**). $COOH(CH_2)_5COOH$, 160.09. Monocl. pr.f.w. **D.** 1.329^{15}, **m.p.** 103, **b.p.** 272^{100} subl. **Soly.** 2.52^{13}, 5^{20}w.; v.s.al.; v.s.et.

83 —, diethyl ester (*ethyl pimelate*). $CH_2(CH_2CH_2COOC_2H_5)_2$, 216.16. Col. liq. **D.** 0.999$^{15}_{18}$, **b.p.** 252–5^{748}. **Soly.** i.w.; s.al.; s.et.

84 —, γ-**keto-.** See *Acetonediacetic acid.*

85 **Pimelic ketone.** See *Cyclohexanone*.*

86 **Pinacol** (2, 3-*dimethyl*-2, 3-*butanediol*; tetramethylethylene glycol; pinacone*). $(CH_3)_2C(OH)COH(CH_3)_2$, 118.11. Col.need. **D.** 0.9672^{15}, **m.p.** 38(41–3), **b.p.** 172.8. **Soly.** s.c., v.s.h.w.; v.s.al.; v.s.et.; sl.s.CS_2.

87 **Pinacolin** (3, 3-*dimethyl-2-butanone*; tert-butyl methyl ketone*). $CH_3COC(CH_3)_3$, 100.09. Col.liq. **D.** 0.811; 0.8208$^{0}_{4}$, **m.p.** −52.5, **b.p.** 106.2. **Soly.** 2.51^{15}w.; s.al.; s.et.; v.s.acet.

88 **Pinacolyl alcohol** (3, 3-*dimethyl*-2-*butanol*; methyl-tert-butylcarbinol*). $(CH_3)_3CCHOHCH_3$, 102.11. Liq. or silky need. **D.** 0.812^{25}, **m.p.** 5.5, **b.p.** 121–3. **Soly.** v.sl.s.w.; s.al.; ∞et.

89 **Pinacone.** See *Pinacol.*

90 **Pinene,** hydrochloride. See *Bornyl chloride.*

91 *dl*-**Pinene** (*dl*-2, 6, 6-*trimethylbicyclo[3, 1, 1]hept-2-ene; dl-α-pinene*). $C_{10}H_{16}$, 136.12. Col.liq., *n* 1.4658. **D.** 0.8582$^{20}_{4}$, **m.p.** −55(−50), **b.p.** 154 (158–61). **Soly.** v.sl.s.w.; ∞al.; ∞et.; ∞chl.

* Name approved by the International Union of Chemistry.

92 **Pinole** (*dl*) (6, 8-*epoxy*-1-*p*-*menthene*; 4, 7, 7-*trimethyl*-6-*oxabicyclo*[3, 2, 1]-*oct*-3-*ene*; *dl*-*sobrerone*). $C_{10}H_{16}O$, 152.12. *n* 1.4715. **D.** 0.9420^{20}_{4}, **b.p.** 184. **Soly.** s.al.; s.et.

93 —, hydrate (*i*-1-*p*-*menthene*-6, 8-*diol*). $C_{10}H_{16}(OH)_2$, 170.14. Col. **m.p.** 150, **b.p.** 270–1. **Soly.** 3.3^{15}w.; v.s.al.; v.s.et.

94 **2-Pipecoline** (2-*methylpiperidine*; *α*-*pipecoline*). $CH_3C_5H_9NH$, 99.11. Liq., *n* $1.44627^{24.3}$. **D.** 0.844^{24}, **m.p.** 9, **b.p.** 119. **Soly.** s.w.; i.dil.KOH.

95 **3-Pipecoline** (3-*methylpiperidine*; *β*-*pipecoline*). $CH_3C_5H_9NH$, 99.11. Liq., *n* $1.43779^{21.6}$. **D.** 0.845^{24}, **b.p.** 126. **Soly.** v.s.w.

96 **4-Pipecoline** (4-*methylpiperidine*; *γ*-*pipecoline*). $CH_3C_5H_9NH$, 99.11. Liq. **D.** 0.867^{0}, **b.p.** 129. **Soly.** s.w.

97 **Piperazine** (*hexahydropyrazine*; *diethylenediamine*). $NHCH_2CH_2NHCH_2CH_2$, 86.09. Col.rhomb.f.al., *n* 1.446^{113}. **m.p.** 105.6, **b.p.** 146. **Soly.** s.w.; v.v.s.al.

98 —, dihydrobromide. $C_4H_{10}N_2{\cdot}2HBr$, 247.94. Wh.need. **m.p.** d. **Soly.** v.s.w.; i.c.al.; i.et.

99 —, dihydrochloride. $C_4H_{10}N_2{\cdot}2HCl$, 159.02. Wh.need. **m.p.** d. **Soly.** v.s.w.; i.c.al.; i.et.

00 —, hexahydrate. $C_4H_{10}N_2{\cdot}6H_2O$, 194.19. Wh.cr. **m.p.** 44. **Soly.** v.s.w.; s.al.; v.sl.s.et.

01 —, salts of organic acids. See under the acids.

02 —, **1, 4-bis(hydrocinnamyl)-.** $(C_6H_5CH_2CH_2CO)_2C_4H_8N_2$, 350.22. Wh.cr. **m.p.** 122.5–3.0. **Soly.** i.w.; s.h.al.; sl.s.et.

03 —, ***α*, *γ*-diaci-.** See *Glycine anhydride*.

04 —, **1, 4-dianisoyl-.** $(CH_3OC_6H_4CO)_2C_4H_8N_2$, 354.19. Wh.cr. **m.p.** 192.5–3.5. **Soly.** i.w.; s.h.al.; i.et.

05 —, **2, 5-dimethyl-**(*trans*). $(CH_3)_2C_4H_8N_2$, 114.13. Monocl.pr. **m.p.** *cis:* 114; *trans:* 118, **b.p.** 162. **Soly.** v.s.w.; v.s.al.; sl.s.et.

06 —, **1, 4-dinitroso-.** $(C_4H_8N_2(NO)_2$, 144.09. Wh.pl. **m.p.** 157–8. **Soly.** s.h.w.; i.c.al.; i.et.

07 —, **1, 4-di-*α*-toluyl-.** $(C_6H_5CH_2CO)_2C_4H_8N_2$, 322.19. Wh.cr. **m.p.** 150–1. **Soly.** v.sl.s.w.; s.h.al.; sl.s.et.

08 —, **1-phenyl-.** $C_4H_9N_2C_6H_5$, 162.13. Pa.yel.oil. **D.** 1.0621^{20}_{4}, **b.p.** $156–7^{10}$. **Soly.** i.w.; ∞al.; ∞et.

09 **2, 5-Piperazinedione.** See *Glycine anhydride*.

10 **Piperethylalkine.** See *Piperidine-ethanol*.

11 **Piperic acid** (5-(3, 4-*methylenedioxyphenyl*)-2, 4-*pentadienoic acid**; *β*-(3, 4-*methylenedioxystyryl*)*acrylic acid*). $(CH_2O_2)C_6H_3CH{:}CHCH{:}CHCOOH$, 218.08. Yel.need.f.al. **m.p.** 217, **b.p.** 220 d. subl. **Soly.** v.sl.s.w.; 2.84c.al.; s.et.

12 **Piperidic acid.** See *Butyric acid*, *γ*-*amino*-.

13 **Piperidine** (*hexahydropyridine*; *pentamethyleneimine*). $(CH_2)_5NH$, 85.09. Col.liq., *n* $1.45350^{18.7}$. **D.** 0.8565^{25}; 0.8606^{2}_{4}, **m.p.** −9 (−17), **b.p.** 105.8. **Soly.** ∞w.; ∞al.; ∞et.

14 —, **1-acetyl-** (*acetic acid piperidide*; *N*-*acetylpiperidine*). $CH_3CON(CH_2)_5$, 127.11. Lt.liq. **D.** 1.0111, **m.p.** 107–9, **b.p.** 227–8(224). **Soly.** ∞w.; s.al.

15 —, **2-allyl-.** See *β-Coniceine*.

16 —, **4-benzoxy-2, 2, 6-trimethyl-,** lactate. See *β-Eucaine, lactate*.

17 —, **1-benzoyl-.** $C_6H_5CONC_5H_{10}$, 189.13. Col.need. **m.p.** 48(29–33), **b.p.** 184^{17}. **Soly.** i.w.; s.al.; s.et.

18 —, **1, 2-dimethyl-** (*N*, *α*-*dimethylpiperidine*). $C_5H_9N(CH_3)_2$, 113.13. Liq. **b.p.** 127.9.

19 —, **ethoxyl-.** See *Piperidine-ethanol*.

20 —, **1-ethyl-** (*N*-*ethylpiperidine*). $C_2H_5NC_5H_{10}$, 113.13. Liq. **b.p.** 128.

21 —, **2-ethyl-**(*dl*) (*dl*-*α*-*ethylpiperidine*). $NHCH(C_2H_5)(CH_2)_4$, 113.13. **D.** 0.867^{0}, **b.p.** 143. **Soly.** 5w.

22 —, **3-ethyl-**(*dl*) (*dl*-*β*-*ethylpiperidine*). $NHCH_2CH(C_2H_5)(CH_2)_3$, 113.13. Liq. **D.** 0.8658^{0}, **b.p.** 152.6(155). **Soly.** v.sl.s.w.

23 —, **1-formyl-** (*N*-*formylpiperidine*). $HCONC_5H_{10}$, 113.09. Wh.-yel.liq. **D.** 1.0205^{25}_{4}, **b.p.** 218–22. **Soly.** ∞w.; ∞al.; ∞et.

24 —, ***β*-hydroxyethyl-.** See *Piperidineëthanol*.

25 —, **1-methyl-.** $C_5H_{10}NCH_3$, 99.11. Liq., *n* $1.44639^{23.6}$. **D.** 0.818, **b.p.** 107. **Soly.** 14.8^{49}, 5.5^{77}w.; ∞al.; ∞et.

26 —, **2-methyl-.** See 2-*Pipecoline*.

27 —, **3-methyl-.** See 3-*Pipecoline*.

28 —, **4-methyl-.** See 4-*Pipecoline*.

29 —, **1-piperyl-.** See *Piperine*.

For explanations and abbreviations see beginning of table.

30 Piperidine, 1-propyl- (*N-n-propylpiperidine*). $CH_3CH_2CH_2NC_5H_{10}$, 127.14. Col.liq., *n* 1.444. **D.**0.8220$^{2}_{4}$, **b.p.** 149–50. **Soly.** 2.774$^{0.5}$, 0.606^{32} w.; v.s. al.; v.s.et.

31 —, 2-propyl-. See *Coniine*.

32 —, 2-(3-pyridyl)-. See *Anabasine*.

33 1-Piperidinecarbodithioic acid, piperidinium salt (*piperidinium cyclopentamethylenedithiocarbamate*). $C_5H_{10}NCSSNH_2C_5H_{10}$, 246.31. Pa.yel. pl. **m.p.** 171–2. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.

34 —, zinc salt. $(C_5H_{10}NCSS)_2Zn$, 385.79. Wh.powd. **m.p.** 223–5. **Soly.** i.w.; i.al.; i.et.; sl.s.chl.

35 Piperidineëthanol (*β-hydroxyethylpiperidine; ethoxylpiperidine; piperethylalkine*). $C_5H_{10}NCH_2CH_2OH$, 129.13. Liq. **b.p.** 199. **Soly.** s.w.; s.al.

36 4-Piperidone, 2, 2, 6, 6-tetramethyl-. See *Triacetonamine*.

37 Piperine (*1-piperylpiperidine*). $C_{17}H_{19}NO_3$, 285.16. Col.monocl.need.f. al. **D.** 1.193, **m.p.** 128–9.5. **Soly.** v.sl.s.c.w.; 6.7, 23^{60}al.; 2.8et.; s.chl.

38 —, hydriodide diiodide. $(C_{17}H_{19}NO_3)_2 \cdot HI \cdot I_2$, 952.08. Steel bl.need. **m.p.** 145. **Soly.** s.w.; v.s.chl.

39 Piperolidine (*octahydropyrrocoline; δ-coniceine*). $C_8H_{15}N$, 125.13. Liq. **D.** 0.904$^{1}_{4}{}^{5}$, **b.p.** *dl.* 161; *l.* 158.

40 Piperonal (3, 4-*methylenedioxybenzaldehyde; protocatechualdehyde methylene ether; heliotropin*). $CH_2(O_2)C_6H_3CHO$, 150.05. Wh.-yel.cr.f.w. **m.p.** 37, **b.p.** 263. **Soly.** 0.2c., ∞^{78}w.; s.c., ∞h.al.; ∞et.

41 Piperonyl alcohol (3, 4-*methylenedioxybenzyl alcohol*). $CH_2(O_2)C_6H_3CH_2OH$, 152.06. Cr. **m.p.** 51, **b.p.** d. **Soly.** sl.s.w.; ∞al.; ∞et.

42 Piperonylic acid (3, 4-*methylenedioxybenzoic acid; protocatechuic acid methylene ether*). $CH_2(O_2)C_6H_3COOH$, 165.04. Need.f.w. or al. **m.p.** 228, **b.p.** subl. **Soly.** sl.s.h.w.; s.h.al.; sl.s.et.; s.alk.

43 Piperylene. See 1, 3-*Pentadiene**.

44 Pivalaldehyde (2, 2-*dimethylpropanal**; *trimethylacetaldehyde*). $(CH_3)_3CCHO$, 86.08. Liq. **D.** 0.793^{17}, **m.p.** 3, **b.p.** 75. **Soly.** s.al.; s.et.

45 —, oxime (*trimethylacetaldoxime*). $(CH_3)_3CCH{:}NOH$, 101.09. Cr. **m.p.** 41, **b.p.** 65^{20}. **Soly.** s.al.

46 Pivalic acid (2, 2-*dimethylpropanoic acid**; *α, α-dimethylpropionic acid; trimethylacetic acid*). $(CH_3)_3CCOOH$, 102.08. Col.need., *n* 1.3931$^{36.5}$. **D.** 0.905^{50}, **m.p.** 35.5, **b.p.** 163.8. **Soly.** 2.2w.; v.s.al.; v.s.et.

47 —, methyl ester (*methyl pivalate*). $(CH_3)_3CCOOCH_3$, 116.09. Col.liq. **D.** 1.044^{0}, **b.p.** 102. **Soly.** sl.s.w.; ∞al., ∞et.

48 Plumbane, tetramethyl-. See *Lead, tetramethyl-**.

49 —, tetraphenyl-. See *Lead, tetraphenyl-**.

50 Polyoxymethylene (*trioxymethylene; paraformaldehyde; metaformaldehyde*). $(CH_2O)_x$, $(30.02)_x$. Wh.need. **m.p.** 64(60), **b.p.** subl. **Soly.** 17.2^{18}, 21.1^{25}w.; s.al.; s.et. (See also *sym-Trioxane*).

51 Populin (*benzoylsalicin*). $C_{20}H_{22}O_8 \cdot 2H_2O$, 426.20. Col.need. **m.p.** anh. 180. **Soly.** 0.04^{15}, 2.4^{100}w.; s.al.; s.et.; s.dil.a., alk.

52 — (anhydrous synthetic) (*benzoylsalicin*). $C_{20}H_{22}O_8$, 390.17. Pr. **m.p.** 178–9.

53 Prehnitene (1, 2, 3, 4-*tetramethylbenzene; prehnitole*). $(CH_3)_4C_6H_2$, 134.11. Col., *n* 1.52031$^{16.0}$. **D.** 0.901$^{2}_{4}{}^{0}$, 1.801$^{2}_{4}{}^{0}$, **m.p.** −4, **b.p.** 204. **Soly.** i.w.; ∞al.; ∞et.

54 Prehnitic acid (1, 2, 3, 5-*benzenetetracarboxylic acid**). $C_6H_2(COOH)_4$, 254.05. Pr. (+2H$_2$O)f.w. **m.p.** 237 d., **b.p.** d. **Soly.** s.w.; s.et.

55 Prehnitylic acid (2, 3, 4-*trimethylbenzoic acid*). $(CH_3)_3C_6H_2COOH$, 164.09. Pr.f.al. **m.p.** 167.5. **Soly.** s.w.; s.al.; s.et.

56 Procaine, hydrochloride (*β-diethylaminoethyl p-aminobenzoate hydrochloride; novocain; ethocain*). $NH_2C_6H_4COOC_2H_4N(C_2H_5)_2 \cdot HCl$, 272.64. Col.need.f.al. **D.** 0.707^{17}, **m.p.** 156. **Soly.** 0.6^{25}w.; 30^{25}al.; v.sl.s.et.; sl.s. chl.

57 Proline, hydroxy-(*l*). $C_4H_7N(OH)COOH$, 131.08. Rhomb.pl. or fine need. **m.p.** 274; (238–41) d. **Soly.** 25^{0}w.; v.sl.s.al.; i.et.

58 —, 4-hydroxy-(*d*) (*4-hydroxy-2-pyrrolidinecarboxylic acid*). $C_4H_7N(OH)COOH$, 131.08. **m.p.** (a) 274; (b) 238–41 d.

59 *dl*-Proline (*dl-2-pyrrolidinecarboxylic acid*). $C_4H_8N \cdot COOH$, 115.08. **m.p.** 205 d. **Soly.** s.w.; s.al.; i.et.; sl.s.chl., acet., bz.

* Name approved by the International Union of Chemistry.

60 ***d*-Proline** (*d-2-pyrrolidinecarboxylic acid*). C_4H_8NCOOH, 115.08. Pr. **m.p.** 215–20 d.

61 ***l*-Proline** (*l-2-pyrrolidinecarboxylic acid*). $C_4H_8N{\cdot}COOH$, 115.08. Flat need.f.al.; pr.f.w. **m.p.** 220–2 d. **Soly.** v.s.w.; 1.55^{19}al.; i.et.; i.butyl al., propyl al.

62 **Propadiene*** (*allene, dimethylenemethane*). $CH_2{:}C{:}CH_2$, 40.03. Gas. **D.** 1.787g/l, **m.p.** −146, **b.p.** −32.

63 —, **dioxo-.** See *Carbon suboxide.*

64 —, **tetraphenyl-** (*tetraphenylallene*). $(C_6H_5)_2C{:}C{:}C(C_6H_5)_2$, 344.16. Need. or pr.f.dil.al. or acet. **m.p.** 166. **Soly.** i.w.; sl.s.c.al.; s.et.

65 **Propanal*.** See *Propionaldehyde.*

66 —, **2, 2-dimethyl-*.** See *Pivalaldehyde.*

67 —, **2-methyl-*.** See *Isobutyraldehyde.*

68 —, **2-oxo-*,** 1-oxime. See *Pyruvaldehyde, aldoxime.*

69 —, **3-phenyl-.** See *Hydrocinnamaldehyde.*

70 **Propanamide*.** See *Propionamide.*

71 —, **2-hydroxy-*.** See *Lactamide.*

72 —, **2-methyl-*.** See *Isobutyramide.*

73 **Propane*** (*dimethylmethane*). CH_3-CH_2CH_3, 44.06. Col.gas. **D.** liq. $0.5853^{-44.5}_{4}$; 2.014^{0}g/l, **m.p.** −189.9, **b.p.** −44.5. **Soly.** 6.5^{18}cm³w.; 790^{17} cm³al.; 926^{17}cm³et.

74 —, **1-amino-2, 2-dimethyl-.** See *Propylamine, β, β-dimethyl-*.*

75 —, **1-amino-2-methyl-.** See *Isobutylamine.*

76 —, **2, 2-bis(ethylsulfonyl)-*** (*acetone diethylsulfone; sulfonmethane; sulfonal*). $(CH_3)_2C(SO_2C_2H_5)_2$, 228.24. Col. monocl.pr.f.al. **D.** 1.260^{25}_{4}, **m.p.** 128, **b.p.** 300 d. **Soly.** 2^{15}, 6.7^{100}w.; 1.2c., 39h.al.; 0.54c.et.

77 —, **1-bromo-*.** See *Propyl bromide.*

78 —, **2-bromo-*.** See *Isopropyl bromide.*

79 —, **1-bromo-2-chloro-*.** CH_3CH-$ClCH_2Br$, 157.42. Liq., *n* 1.47449. **D.** 1.531^{20}_{4}, **b.p.** 118.0.

80 —, **2-bromo-1-chloro-*.** CH_3CH-$BrCH_2Cl$, 157.42. Liq., *n* 1.47763. **D.** 1.537^{20}_{4}, **b.p.** 117.0^{756}.

81 —, **1-bromo-2, 2-dimethyl-*** (*tert-butylmethyl bromide*). $(CH_3)_3CCH_2Br$, 151.00. Col.liq. **D.** 1.2604^{20}_{0}, **b.p.** $89–91^{749}$. **Soly.** i.w.; s.al.; s.et.

82 —, **1-bromo-2-methyl-*.** See *Isobutyl bromide.*

83 —, **2-bromo-2-methyl-*.** See *tert-Butyl bromide.*

84 —, **1-chloro-*.** See *Propyl chloride.*

85 —, **2-chloro-*.** See *Isopropyl chloride.*

86 —, **1-chloro-2-(β-chloroisopropoxy)-*.** See *Ether, bis-β-chloroisopropyl.*

87 —, **1-chloro-2, 2-dimethyl-*.** $(CH_3)_3CCH_2Cl$, 106.54. **b.p.** 84.4.

88 —, **1-chloro-2, 3-epoxy-*.** See *Epichlorohydrin.*

89 —, **1-chloro-2-methyl-*.** See *Isobutyl chloride.*

90 —, **2-chloro-2-methyl-*.** See *tert-Butyl chloride.*

91 —, **1, 1-dibromo-*** (*propylidene bromide*). $CH_3CH_2CHBr_2$, 201.88. Liq. **b.p.** *ca.* 130.

92 —, **1, 2-dibromo-*** (*propylene bromide; propylene dibromide*). CH_2-$BrCHBrCH_3$, 201.88. Col.liq., *n* 1.5203. **D.** 1.9333^{20}_{4}, **m.p.** −55.5, **b.p.** 141.6(140). **Soly.** 0.25^{20}w.; s.al.; v.s.et.

93 —, **1, 3-dibromo*** (*trimethylene bromide; trimethylene dibromide*). $BrCH_2$-CH_2CH_2Br, 201.88. Col.liq., *n* 1.523. **D.** 1.979^{20}_{4}; 1.987^{17}_{4}, **m.p.** −34.4, **b.p.** 167. **Soly.** 0.168^{30}w.; s.al.; s.et.

94 —, **2, 2-dibromo-*** (*bromacetol*). $CH_3CBr_2CH_3$ 201.88. **D.** 1.7825^{20}, **b.p.** $114–5^{740}$.

95 —, **1, 1-dibromo-2-methyl-*** (*isobutylidene bromide*). $(CH_3)_2CHCHBr_2$, 215.89. Liq., *n* 1.509. **D.** 1.759, **m.p.** −70.3, **b.p.** 149.0.

96 —, **1, 1-dichloro-*** (*propylidene chloride*). $CH_3CH_2CHCl_2$, 112.96. Liq. **D.** 1.143^{10}, **b.p.** 87.

97 —, **1, 2-dichloro-*** (*propylene chloride; propylene dichloride*). CH_2-$ClCHClCH_3$, 112.96. Col.liq., *n* 1.4388. **D.** 1.1593^{20}_{20}; 1.1656^{14}, **b.p.** 96.8. **Soly.** 0.27^{20}w.; v.s.al.; v.s.et.

98 —, **1, 3-dichloro-*** (*trimethylene chloride; trimethylene dichloride*). $ClCH_2$-CH_2CH_2Cl, 112.96. Col.liq. **D.** 1.1896^{18}_{4}; 1.1770^{25}_{4}, **b.p.** 120.4 (125). **Soly.** 0.287^{30}w.; v.s.al.; v.s.et.

99 —, **2, 2-dichloro-*** (*isopropylidene chloride; acetone dichloride; chloroacetol; dichlorodimethylmethane*). CH_3CCl_2-CH_3, 112.96. Liq., *n* 1.4093. **D.** 1.093^{20}_{20}, **m.p.** −34.6, **b.p.** 69–70. **Soly.** i.w.; s.al.; ∞et.; ∞CS_2.

00 —, **1, 2-diiodo-*** (*propylene diiodide; propylene iodide*). CH_3CHICH_2I, 295.89. Liq. **D.** 2.490, **b.p.** d.

For explanations and abbreviations see beginning of table.

91 **Propane, 2, 2-dimethyl-*** (*tetramethylmethane; neopentane*). $(CH_3)_4C$, 72.09. Gas. **D.** 0.613^{0}_{0}, **m.p.** −20, **b.p.** 9.5. **Soly.** i.w.; s.al.; s.et.

02 —, **1, 3-diphenoxy-*** (*trimethylene glycol diphenyl ether*). $C_6H_5OCH_2$-$CH_2CH_2OC_6H_5$, 228.12. Shiny leaf. f.al. **m.p.** 61, **b.p.** 338–40. **Soly.** i.w.; s.al.; s.et.

03 —, **1, 2-epoxy-.** See *Propene oxide.*

04 —, **1, 2-epoxy-3-iodo-.** See *Epiiodohydrin.*

05 —, **1, 2-epoxy-2-methyl-.** See *Ethylene oxide, α, α-dimethyl-.*

06 —, **1-ethoxy-*.** See *Ether, ethyl propyl.*

07 —, **2-ethoxy-*.** See *Ether, ethyl isopropyl.*

08 —, **1-ethoxy-2-methyl-*.** See *Ether, ethyl isobutyl.*

09 —, **2-ethoxy-2-methyl-*.** See *Ether, tert-butyl ethyl.*

10 —, **1-fluoro-*.** See *Propyl fluoride.*

11 —, **2-fluoro-*.** See *Isopropyl fluoride.*

12 —, **1-fluoro-2-methyl-*.** See *Isobutyl fluoride.*

13 —, **1-iodo-*.** See *Propyl iodide.*

14 —, **2-iodo-*.** See *Isopropyl iodide.*

15 —, **1-iodo-2, 2-dimethyl-*** (*tert-butylmethyl iodide*). $(CH_3)_3CCH_2I$, 198.01. Col.oil. **D.** 1.5317^{13}, **b.p.** 127–9 d. **Soly.** i.w.; s.al.; s.et.

16 —, **1-iodo-2-methyl-*.** See *Isobutyl iodide.*

17 —, **2-iodo-2-methyl-*.** See *tert-Butyl iodide.*

18 —, **2-(isopropylthio)-*.** See *Isopropyl sulfide.*

19 —, **2-isopropoxy-*.** See *Isopropyl ether.*

20 —, **1-methoxy-*.** See *Ether, methyl propyl.*

21 —, **2-methoxy-*.** See *Ether, isopropyl methyl.*

22 —, **1-methoxy-2-methyl-*.** See *Ether, isobutyl methyl.*

23 —, **2-methyl-*.** See *Isobutane.*

24 —, **1-methyl-1-(methylpropylthio)-*.** See *sec-Butyl sulfide.*

25 —, **2-methyl-1-(β-methylpropoxy)-*.** See *Isobutyl ether.*

26 —, **2-methyl-1-(β-methylpropylthio)-*.** See *Isobutyl sulfide.*

27 —, **2-methyl-1-nitro-*** (*nitroisobutane*). $(CH_3)_2CHCH_2NO_2$, 103.08. Col.liq. **D.** 0.9625^{25}_{25}, **b.p.** 140.8 (158–9). **Soly.** v.sl.s.w.; ∞al.; ∞et.

28 —, **2-methyl-1-phenoxy-.** See *Ether, isobutyl phenyl.*

29 —, **2-methyl-1-phenyl-.** See *Benzene, isobutyl-.*

30 —, **2-methyl-2-phenyl-.** See *Benzene, tert-butyl-.*

31 —, **1-nitro-*.** $CH_3CH_2CH_2NO_2$, 89.06. Col.liq., n $1.40027^{24.3}$. **D.** 1.011^{15}, **b.p.** 131.5. **Soly.** v.sl.s.w.; ∞al.; ∞et.

32 —, **2-phenoxy-.** See *Ether, isopropyl phenyl.*

33 —, **1-phenyl-.** See *Benzene, propyl-.*

34 —, **2-phenyl-.** See *Cumene.*

35 —, **1-propoxy-*.** See *Propyl ether.*

36 —, **1-propylsulfonyl-*.** See *Propyl sulfone.*

37 —, **1-propylthio-*.** See *Propylsulfide.*

38 —, **1, 2, 3-tribromo-*** (*glycerol tribromohydrin; tribromohydrin; allyl tribromide*). $CH_2BrCHBrCH_2Br$, 280.79. Pr., n 1.584. **D.** 2.436^{23}, **m.p.** 16, **b.p.** 220. **Soly.** i.w.; v.s.al.; v.s.et.

39 —, **1, 2, 3-trichloro-*** (*glycerol trichlorohydrin; allyl trichloride; trichlorohydrin*). $CH_2ClCHClCH_2Cl$, 147.41. Col.liq. **D.** 1.417^{15}_{4}, **m.p.** −14.7, **b.p.** 156–8. **Soly.** i.w.; s.al.; s.et.

40 —, **1, 1, 1-triphenyl-** (*α-ethyltritan*). $(C_6H_5)_3CCH_2CH_3$, 272.16. Col.cr.f. me.al. **m.p.** 51–1.5. **Soly.** i.w.; s.al.; v.s.et.

41 **Propanediamide*.** See *Malonamide.*

42 ***dl*-1, 2-Propanediamine*** (*dl-propylenediamine*). $CH_3CH(NH_2)CH_2NH_2$, 74.09. Col.liq. **D.** 0.878^{15}, **b.p.** 119.

43 **1, 3-Propanediamine*** (*trimethylenediamine*). $NH_2(CH_2)_3NH_2$, 74.09. Col.liq. **D.** 0.884^{25}_{4}, **b.p.** 135.5. **Soly.** s.w.; ∞al.; ∞et.

44 **Propanedinitrile*.** See *Malononitrile.*

45 **Propanedioic acid*.** See *Malonic acid.*

46 —, **2-propenyl-*.** See *Malonic acid, allyl-.*

47 **1, 2-Propanediol*** (*propylene glycol*). $CH_2OHCHOHCH_3$, 76.06. Col.liq. **D.** 1.040, **b.p.** 189. **Soly.** ∞w.; ∞al.; s.et.

48 —, **3-chloro-*** (*α-chlorohydrin; glycerol α-chlorohydrin*). $CH_2ClCHOH$-CH_2OH, 110.51. Ylsh.liq. **D.** 1.326^{18}_{18}, **b.p.** 213 d. ($115–20^{18}$). **Soly.** s.w.; s.al.; s.et.

49 —, **3-mercapto-*.** See *Glycerol, 1-thio-.*

* Name approved by the International Union of Chemistry.

50 1, 2-Propanediol, 2-methyl-* (*isobutylene glycol; as-dimethylethylene glycol*). $(CH_3)_2C(OH)CH_2OH$, 90.08. Liq. **D.** 1.003, **b.p.** 177. **Soly.** s.w.

51 —, 3-octadecyloxy-* (*glycerol 1-octadecyl ether*). $CH_3(CH_2)_{17}OCH_2CHOHCH_2OH$, 344.34. Col.cr. **m.p.** 70–1. **Soly.** i.w.; s.h.al.; s.et.

52 1, 3-Propanediol* (*trimethylene glycol*). $HOCH_2CH_2CH_2OH$, 76.06. Visc.liq., n 1.4274. **D.** 1.0526^{19}_{4}, **b.p.** 214 d. **Soly.** ∞w.; ∞al.; v.s.et.

53 —, 2, 3-bishydroxymeth yl-. See *Pentaerythritol*.

54 —, 2, 2-dimethyl-* (*dimethyltrimethylene glycol*). $(CH_3)_2C(CH_2OH)_2$, 104.09. Need.f.bz. **m.p.** 127, **b.p.** 203^{738}. **Soly.** i.w.; v.s.al.; v.s.et.

55 —, 2-hydroxymethyl-2-methyl-* (*pentaglycerol; pentaglycerin*). $CH_3C(CH_2OH)_3$, 120.09. Need.f.al. **m.p.** 199, **b.p.** subl. **Soly.** s.w.; v.s.al.; i.et.

56 1, 3-Propanedione, 1, 3-diphenyl-. See *Methane, dibenzoyl-*.

57 Propanenitrile*. See *Propionitrile*.

58 —, 2-hydroxy-*. See *Lactonitrile*.

59 —, 2-methyl-*. See *Isobutyronitrile*.

60 —, 2-oxo-*. See *Pyruvonitrile*.

61 —, 3-oxo-3-phenyl-. See *Acetonitrile, benzoyl-*.

62 1-Propanethiol* (*n-propyl mercaptan*). $CH_3CH_2CH_2SH$, 76.12. Liq. **D.** 0.8357^{24}_{4}, **m.p.** −111.5, **b.p.** 68. **Soly.** v.sl.s.w.; s.al.; s.et.

63 —, 2-methyl-* (*isobutyl mercaptan*). $(CH_3)_2CHCH_2SH$, 90.14. Liq., n 1.43859. **D.** 0.8357^{20}_{4}, **m.p.** < −79, **b.p.** 88. **Soly.** sl.s.w.; v.s.al.; v.s.et.

64 2-Propanethiol* (*isopropyl mercaptan*). $CH_3CHSHCH_3$, 76.12. Col.liq. **D.** 0.8055^{25}_{4}, **m.p.** −130.7, **b.p.** 60. **Soly.** sl.s.w.; ∞al.; ∞et.

65 1, 2, 3-Propanetricarboxylic acid*. See *Tricarballylic acid*.

66 1, 2, 3-Propanetriol*. See *Glycerol*.

67 Propanetrione, diphenyl-* (*diphenyl triketone*). $C_6H_5(CO)_3C_6H_5$, 238.08. Yel.need. **m.p.** 68–70. **Soly.** i.w.; sl.s.al.; s.et.

68 Propanoic acid*. See *Propionic acid*.

69 —, 2-amino-3-mercapto-*. See *Cysteine*.

70 —, 3, 3′-dithiobis(2-amino-*. See *Cystine*.

71 —, 2-hydroxy-. See *Lactic acid*.

72 —, 2-methyl-*. See *Isobutyric acid*.

73 1-Propanol*. See *Propyl alcohol*.

74 —, 3-bromo-* (*trimethylene bromohydrin*). $BrCH_2CH_2CH_2OH$, 138.97. Liq. **D.** 1.5710^{20}_{4}, **b.p.** $98–112^{185}$. **Soly.** 16.6c.w.; ∞al.; ∞et.

75 —, 2-chloro-*, acetate (*β-chloropropyl acetate; 2-chloropropyl ethanoate**). $CH_3COOCH_2CHClCH_3$, 136.53. Col. liq. **D.** 1.098, **b.p.** $152–3^{750}$. **Soly.** i.w.; s.al.; s.et.

76 —, 3-chloro-* (*trimethylene chlorohydrin*). $ClCH_2CH_2CH_2OH$, 94.51. Liq. **D.** 1.1309^{20}_{4}, **b.p.** 160–2. **Soly.** 50c.w.; s.al.; s.et.

77 —, 2, 3-dibromo-* (*β, γ-dibromopropyl alcohol; β-dibromohydrin; allyl alcohol dibromide*). $CH_2BrCHBrCH_2OH$, 217.88. Col.liq. **D.** 2.1682^{0}; 2.1259^{25}, **b.p.** 219sl.d.; 118^{17}. **Soly.** sl.s.w.; s.al.; s.et.; s.acet., bz.

78 —, 2, 3-dichloro-* (*β-dichlorohydrin; asym-glycerol dichlorohydrin; β, γ-dichloropropyl alcohol; allyl alcohol dichloride*). $CH_2ClCHClCH_2OH$, 128.96. Col.liq. **D.** 1.3681^{11}, **b.p.** 183. **Soly.** sl.s.w.; s.al.; s.et.

79 —, 2, 2-dimethyl-* (*tert-butylcarbinol; neopentyl alcohol*). $(CH_3)_3CCH_2OH$, 88.09. Col.cr. **D.** 0.812, **m.p.** 53, **b.p.** 114; 111.5^{738}. **Soly.** sl.s.w.; v.s.al.; v.s.et.

80 —, 2, 2-dimethyl-1-phenyl- (*tert-butylphenylcarbinol*). $C_6H_5CHOHC(CH_3)_3$, 164.12. Need. **m.p.** 45, **b.p.** $114–6^{16}$. **Soly.** i.w.; s.al.

81 —, 2, 3-epoxy-*. See *Glycidol*.

82 —, 2-methyl-*. See *Isobutyl alcohol*.

83 —, 2-methylamino-1-phenyl-. See *Pseudoephedrine*.

84 —, 1-phenyl- (*ethylphenylcarbinol*). $C_2H_5CHOHC_6H_5$, 136.09. Liq. **D.** 0.9962^{17}_{4}, **b.p.** 219 (212). **Soly.** i.w.; s.al.; s.et.

85 —, 3-phenyl- (*hydrocinnamyl alcohol*). $C_6H_5CH_2CH_2CH_2OH$, 136.09. Liq., n 1.53565. **D.** 1.008, **m.p.** < −18, **b.p.** 235.6 (237.4). **Soly.** s.w.; ∞al.; ∞et.

86 2-Propanol*. See *Isopropyl alcohol*.

87 —, nitrate. See *Isopropyl nitrate*.

88 —, nitrite. See *Isopropyl nitrite*.

89 —, 1-chloro-* (*propylene chlorohydrin*). $CH_2ClCHOHCH_3$, 94.51. Col.liq. **D.** 1.103^{20}, **b.p.** 127.0. **Soly.** ∞w.; ∞al.; ∞et.

90 —, —, acetate (*β-chloroisopropyl ethanoate**). $CH_3COOCH(CH_3)CH_2Cl$, 136.53. Liq. **b.p.** 149–50.

91 **2-Propanol, 1, 3-dichloro-*** (*α-dichlorohydrin; sym-glycerol dichlorohydrin; sym-dichloroisopropyl alcohol*). $CH_2ClCHOHCH_2Cl$, 128.96. Col.liq., *n* 1.480245^{17}. **D.** 1.3506^{17}_{4} (1.367^{20}_{4}), **b.p.** 174–5. **Soly.** 11^{19}w.; ∞ al.; ∞ et.

92 —, —, nitrate (*β, β′-dichloroisopropyl nitrate; dichloronitrohydrin*). CH_2Cl-$CH(NO_3)CH_2Cl$, 173.96. Col.liq. **D.** 1.459, **b.p.** 180. **Soly.** i.w.; s.al.; s.et.

93 —, **2-methyl-***. See *tert-Butyl alcohol.*

94 —, **2-phenyl-** (*α, α-dimethylbenzyl alcohol; dimethylphenylcarbinol*). $C_6H_5(CH_3)_2COH$, 136.09. Pr., *n* 1.5314^{19}. **D.** 0.9724^{18}_{4}, **m.p.** 35–7, **b.p.** 202 (215–20 d.). **Soly.** i.w.; s.al.; s.et.

95 —, **1, 1, 1-trichloro-2-methyl-***. See *Chloretone.*

96 **1-Propanone, 1-phenyl-.** See *Propiophenone.*

97 **2-Propanone***. See *Acetone.*

98 —, **1-amino-*** (*aminoacetone; acetonylamine*). $CH_3COCH_2NH_2$, 73.06. Need.f.al. **m.p.** 189 d. **Soly.** v.s.w.; s.al.; s.et.

99 —, **1-bromo-*** (*bromoacetone*). $CH_2BrCOCH_3$, 136.96. Pois.liq. **D.** 1.634^{23}, **m.p.** −54, **b.p.** 136.5^{725}. **Soly.** sl.s.w.; sl.s.al.; s.acet.

00 —, **1-chloro-*** (*chloroacetone*). CH_3COCH_2Cl, 92.50. Col.liq. **D.** 1.51^{20}, **m.p.** −44.5, **b.p.** 119. **Soly.** s.w.; s.al.; s.et.; s.chl.

01 —, **1, 1-dichloro-*** (*uns-dichloroacetone; dichloromethyl methyl ketone*). $CH_3COCHCl_2$, 126.95. Col.liq. **D.** 1.234^{15}, **b.p.** 120. **Soly.** sl.s.w.; s.al.; ∞ et.

02 —, **1, 3-dichloro-*** (*sym-dichloroacetone; bischloromethyl ketone*). $CH_2ClCOCH_2Cl$, 126.95. Pl. or need., *n* 1.47144^{46}. **D.** 1.383^{46}, **m.p.** 45, **b.p.** 173.4. **Soly.** s.w.; v.s.al.; v.s.et.

03 —, **1, 3-diphenyl-*** (*dibenzyl ketone; diphenylacetone*). $(C_6H_5CH_2)_2CO$, 210.11. Cr.f.dil.al. **m.p.** 34–5, **b.p.** 330.5. **Soly.** i.w.; v.s.al.; v.s.et.

04 —, **1-hydroxy-***. See *Acetol.*

05 —, **1-phenyl-** (*benzyl methyl ketone*). $CH_3COCH_2C_6H_5$, 134.08. Col.cr. **D.** 1.019^{0}; 1.003^{20}, **m.p.** −15.4, **b.p.** 216.7. **Soly.** i.w.; v.s.al.; v.s.et.

06 —, **1, 1, 3, 3-tetrachloro-*** (*sym-tetrachloroacetone*). $CHCl_2COCHCl_2 \cdot 2H_2O$, 231.87. Tricl. **m.p.** 48.

07 —, **1-ureido-.** See *Urea, acetonyl-.*

Propanoyl*. See *Propionyl.*

08 **Propargyl acetate.** See *2-Propyn-1-ol, acetate.*

09 **Propargyl alcohol.** See *2-Propyn-1-ol**.*

10 **Propargylaldehyde.** See *Propiolaldehyde.*

11 **Propargyl bromide.** See *Propyne, 3-bromo-**.*

12 **Propargyl chloride.** See *Propyne, 3-chloro-**.*

13 **Propargylic acid.** See *Propiolic acid.*

14 **Propargyl iodide.** See *Propyne, 3-iodo-**.*

15 **Propenal***. See *Acrolein.*

16 —, **3-phenyl-.** See *Cinnamaldehyde.*

17 **Propene*** (*methylethylene; propylene*). $CH_2{:}CHCH_3$, 42.05. Col.gas. **D.** liq. 0.6095^{-47}_{4}; 1.937^{0}g/l, **m.p.** −185.2, **b.p.** −47.0. **Soly.** 44.6cm³w.; 1250 cm³al.; 524.5cm³ac.a.

18 —, **1-bromo-*** (*propenyl bromide*). $CH_3CH{:}CHBr$, 120.96. Liq., *n* 1.4554. **D.** $1.428^{19.5}$, **m.p.** −116.6, **b.p.** 60.2.

19 —, **2-bromo-*** (*isopropenyl bromide*). $CH_3CBr{:}CH_2$, 120.96. Liq. **D.** 1.362, **m.p.** −124.8, **b.p.** 48.4.

20 —, **3-bromo-***. See *Allyl bromide.*

21 —, **1-chloro-*** (*propenyl chloride; α-chloropropylene*). $CH_3CH{:}CHCl$, 76.50. Liq. **b.p.** 35–6.

22 —, **2-chloro-*** (*isopropenyl chloride; β-chloropropylene*). $CH_3CCl{:}CH_2$, 76.50. Liq. **D.** 0.918^{9}, **b.p.** 23^{738}.

23 —, **3-chloro-***. See *Allyl chloride.*

24 —, **3-chloro-1-phenyl-*** (*(γ-chloropropenyl)benzene; cinnamyl chloride*). $C_6H_5CH{:}CHCH_2Cl$, 152.53. Col.liq., **b.p.** 213–5. **Soly.** i.w.; ∞ al.; ∞ et.

25 —, **2, 3-dibromo-*** (*α-bromoallyl bromide; α-epidibromohydrin*). CH_2Br-$CBr{:}CH_2$, 199.86. Liq. **D.** 1.934^{20}_{4}, **b.p.** 140.

26 —, **1, 2-dichloro-*** (*allylene dichloride*). $CHCl{:}CClCH_3$, 110.95. Liq. **b.p.** 75 (84–6).

27 —, **2, 3-dichloro-*** (*α-epidichlorohydrin; α-chloroallyl chloride*). $CH_2{:}$-$CClCH_2Cl$, 110.95. Col.liq. **D.** 1.205^{25}_{4}; 1.236^{0}_{0}, **b.p.** 94. **Soly.** i.w.; ∞ al.; ∞ et.

28 —, **1, 1-diphenyl-.** $(C_6H_5)_2C{:}CHCH_3$, 194.11. Leaf.f.al. **D.** 0.984^{60}, **m.p.** 51.5–52, **b.p.** 284.5. **Soly.** i.w.; v.s.al.; v.s.et.; s.bz.

29 —, **1, 2-epoxy-*** (*allylene oxide, methyloxirene*). $CH_3C{:}CH{\cdot}O$, 56.03 Liq. **b.p.** 63. **Soly.** sl.s.w.; ∞ al. ∞ et.

* Name approved by the International Union of Chemistry.

30 **Propene, 3-ethoxy-*.** See *Ether, allyl ethyl.*

31 —, **3-fluoro-*.** See *Allyl fluoride.*

32 —, **3-iodo-*.** See *Allyl iodide.*

33 —, **3-methoxy-*.** See *Ether, allyl methyl.*

34 —, **2-methyl-*** (*uns-dimethylethylene; isobutylene; γ-butylene*). CH_2:C-$(CH_3)CH_3$, 56.06. Col.gas. **b.p.** −6. **Soly.** i.w.; v.s.al.; v.s.et.; s.H_2SO_4.

35 —, **1-phenyl-.** See *Benzene, propenyl-.*

36 —, **2-phenyl-.** See *Benzene, isopropenyl-.*

37 —, **3-(2-propenoxy)-*.** See *Allyl ether.*

38 —, **3-(2-propenylthio)-*.** See *Allyl sulfide.*

39 **Propenenitrile*.** See *Acrylonitrile.*

40 **Propene oxide** (*1, 2-epoxypropane; propylene oxide; methyloxirane*). $\underbrace{OCH_2}CHCH_3$, 58.05. Col.liq. **D.** 0.859^{0}_{4}; 0.8313^{20}_{20}, **b.p.** 35. **Soly.** 65^{30}w.; ∞al.; ∞et.

41 **2-Propene-1-thiol*** (*allyl mercaptan*). CH_2:$CHCH_2SH$, 74.11. Liq. **b.p.** 90. **Soly.** i.w.; ∞al.; ∞et.

42 **1, 2, 3-Propenetricarboxylic acid*.** See *Aconitic acid.*

43 **Propenoic acid*.** See *Acrylic acid.*

44 **2-Propen-1-ol*.** See *Allyl alcohol.*

45 —, **2-bromo-*** (*β-bromoallyl alcohol*). CH_2:$CBrCH_2OH$, 136.96. Liq. **D.** 1.6^{15}, **b.p.** 153–4^{755}.

46 —, **2-chloro-*** (*β-chloroallyl alcohol*). CH_2:$CClCH_2OH$, 92.50. **b.p.** 153.

48 —, **3-(4-hydroxy-3-methoxyphenyl)-.** See *Coniferyl alcohol.*

49 —, **3-phenyl-.** See *Cinnamic alcohol.*

51 **2-Propen-1-one, 1, 3-diphenyl-.** See *Chalcone.*

52 **2-Propenylamine*.** See *Allylamine.*

53 **Propenyl bromide.** See *Propene, 1-bromo-*.*

54 **Propenyl chloride.** See *Propene, 1-chloro-*.*

55 **2-Propenyl sulfide*.** See *Allyl sulfide.*

56 **Propine.** See *Propyne*.*

57 **Propiolaldehyde** (*propynal*; propargylaldehyde*). $CH\vdots CCHO$, 54.02. Oil. **b.p.** 61. **Soly.** v.s.w.

58 **Propiolic acid** (*propynoic acid*; propargylic acid*). $CH\vdots CCOOH$, 70.02. Col.liq. **D.** 1.139^{15}_{15}, **m.p.** 9, **b.p.** 144 d. **Soly.** s.w.; s.al.; s.et.

59 —, ethyl ester. $CH\vdots CCOOC_2H_5$, 98.05. Col.liq. **D.** 0.968^{15}_{15}, **b.p.** 119.5. **Soly.** i.w.; v.s.al.; v..;s.et v.s.chl.

60 —, **ethyl-.** See *2-Pentynoic acid*.*

61 —, **methyl-.** See *Tetrolic acid.*

62 —, ***o*-nitrophenyl-.** $NO_2C_6H_4C\vdots C$-COOH, 191.05. Need.f.h.w. **m.p.** 155.5 d., **b.p.** exp. 155–6. **Soly.** v.s. h.w.; s.al.; s.et.; s.alk.; sl.s.chl.; i.CS_2.

63 —, ***p*-nitrophenyl-.** $NO_2C_6H_4C\vdots C$-COOH, 191.05. Need.f.al. **m.p.** 181 d., **b.p.** d. **Soly.** sl.s.w.; s.h.al.; s.et.; i.pet.eth.

64 —, **phenyl-** (*phenylpropynoic acid*). $C_6H_5C\vdots CCOOH$, 146.05. Col.trim. need.f.w. **m.p.** 137, **b.p.** subl. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; 3.32CCl_4.

65 **Propiolic alcohol.** See *2-Propyn-1-ol*.*

66 **Propionaldehyde** (*propanal*; methylacetaldehyde*). CH_3CH_2CHO, 58.05. Col.liq., *n* 1.36356. **D.** 0.807^{20}_{4}, **m.p.** −81, **b.p.** 48.8. **Soly.** 20^{20}w.; ∞al.; ∞et.

67 —, oxime (*propanal oxime*; propionaldoxime*). CH_3CH_2CH:NOH, 73.06. Liq. **D.** 0.926^{20}_{4}, **m.p.** 21.5, **b.p.** 131–5.

69 —, **α, β-dihydroxy-.** See *Glyceraldehyde.*

70 **Propionaldoxime.** See *Propionaldehyde, oxime.*

71 **Propionamide** (*propanamide*; propionic acid amide*). $CH_3CH_2CONH_2$, 73.06. Col.rhomb.leaf.f.chl., *n* $1.4161^{107.8}$. **D.** 1.042, **m.p.** 79, **b.p.** 213. **Soly.** s.w.; s.al.; s.et.

72 —, ***n*-phenyl-.** See *Propionanilide.*

73 **Propionanilide** (*N-phenylpropionamide*). $CH_3CH_2CONHC_6H_5$, 149.09. Col.leaf.f.al. **D.** 1.175, **m.p.** 104, **b.p.** 222.2. **Soly.** 0.42^{24}w.; v.s.al.; v.s.et.

74 **2-Propionaphthone, 4-bromo-1-hydroxy-** (*4-bromo-2-propionyl-1-naphthol*). $CH_3CH_2COC_{10}H_5BrOH$, 255.00. Yel.need. **m.p.** 98. **Soly.** i.w.; s.al.; s.et.

75 —, **1-hydroxy-** (*ethyl 1-hydroxy-2-naphthyl ketone*). $CH_3CH_2COC_{10}H_6$-OH, 176.09. Yel.-grn.leaf. **m.p.** 81. **Soly.** i.w.; s.al.; s.et.

76 **Propione.** See *3-Pentanone*.*

77 **Propionic acid** (*propanoic acid*; methylacetic acid*). CH_3CH_2COOH, 74.05. Col.liq., *n* $1.38736^{19.9}$. **D.** 0.992, **m.p.** −22, **b.p.** 141.1. **Soly.** ∞w.; ∞al.; ∞et.; ∞chl.

For explanations and abbreviations see beginning of table.

78 Propionic acid, amide. See *Propionamide.*

79 —, amyl ester (*amyl propionate; pentyl propanoate**). $CH_3CH_2COO(CH_2)_4CH_3$, 144.12. **D.** 0.8761^{15}_{4}, **m.p.** −73.1, **b.p.** 164–6. **Soly.** i.w.; ∞al.; ∞et.

80 —, butyl ester (*butyl propionate; butyl propanoate**). $CH_3CH_2COOC_4H_9$, 130.11. Col.liq. **D.** 0.8828^{15}, **m.p.** −89.55, **b.p.** 145.4. **Soly.** v.sl.s.w.; ∞al.; ∞et.

81 —, ethylene ester. See *Glycol, dipropionate.*

82 —, ethyl ester. $CH_3CH_2COOC_2H_5$, 102.08. Col.liq., *n* $1.38385^{20.2}$. **D.** 0.89574^{15}; 0.8846^{20}_{4}, **m.p.** −73.9 (−72.6), **b.p.** 99.10. **Soly.** 2.4^{20}w.; ∞al.; ∞et.

83 —, furfuryl ester. See *Furfuryl alcohol, propionate.*

84 —, isoamyl ester (*isoamyl propionate; γ-methylbutyl propanoate**). $CH_3CH_2COOC_5H_{11}$, 144.12. Col.liq., *n* 1.4065. **D.** 0.870, **b.p.** 160.2. **Soly.** 0.09^{25}w.; s.al.; s.et.

85 —, isobutyl ester (*β-methylpropyl propanoate**). $CH_3CH_2COOCH_2CH(CH_3)_2$, 130.11. Col.liq. **D.** 0.8876^{0}, **m.p.** −71.4, **b.p.** 136.8. **Soly.** v.sl.s.w; s.al.; s.et.

86 —, isopropyl ester. $CH_3CH_2COOCH(CH_3)_2$, 116.09. Col.liq. **D.** 0.893^{0}, **b.p.** 111.3. **Soly.** 0.6^{25}w.; ∞al.; ∞et.

87 —, methyl ester (*methyl propanoate*; methyl propionate*). $CH_3CH_2COOCH_3$, 88.06. Col.liq., *n* $1.37767^{18.5}$. **D.** 0.9148^{20}_{4}, **m.p.** −87.5, **b.p.** 79.9. **Soly.** 6.5^{20}w.; ∞al.; ∞et.

88 —, *p*-phenylphenacyl ester. $CH_3CH_2COOCH_2COC_6H_4C_6H_5$, 268.12. **m.p.** 102.

89 —, piperazinium salt. $C_4H_{10}N_2 \cdot 2C_2H_5COOH$, 234.19. Wh.cr. **m.p.** 124 5. **Soly.** s.w.; s.al.; i.et.; s.h.dioxane.

90 —, propyl ester (*propyl propanoate*; n-propyl propionate*). $CH_3CH_2COOC_3H_7$, 116.09. Col.liq., *n* 1.3935. **D.** 0.883, **m.p.** −75.9, **b.p.** 123.4; 122–5. **Soly.** 0.5w.; ∞al.; ∞et.

90₁ —, **α-amino-.** See *Alanine.*

91 —, **β-amino-.** See *β-Alanine.*

92 —, **α-amino-β-hydroxy-.** See *Serine.*

93 —, **α-benzal-.** See *Cinnamic acid, α-methyl-.*

94 —, **β-benzal-.** See *3-Butenoic acid, 4-phenyl-.*

95 —, **α-benzamido-.** See *Alanine, N-benzoyl-.*

96 —, **β-benzoyl-** (*γ-keto-γ-phenylbutyric acid; 4-oxo-4-phenylbutanoic acid*). $C_6H_5COCH_2CH_2COOH$, 178.08. Leaf.f. al. **m.p.** 116, **b.p.** d. **Soly.** s.h.w.; s.al.; s.et.; s.chl., CS_2, bz.; i.lgr.

97 —, **α-bromo-**(*dl*) (*dl-2-bromopropanoic acid**). $CH_3CHBrCOOH$, 152.96. Col.pr., *n* 1.4753. **D.** 1.700, **m.p.** 25.7, **b.p.** 203.5. **Soly.** v.s.w.; v.s.al.; s.et.

98 —, **α-bromo-,** ethyl ester (*ethyl 2-bromopropanoate**). $CH_3CHBrCOOC_2H_5$, 180.99. Col.liq. **D.** 1.394^{20}_{4}, **b.p.** 159–61 d. (160–5). **Soly.** i.w.; ∞al.; ∞et.

99 —, **β-bromo-** (*3-bromopropanoic acid**). CH_2BrCH_2COOH, 152.96. Col.leaf. **D.** 1.48, **m.p.** 62.5. **Soly.** s.w.; s.al.; s.et.

00 —, **β-carbamyl-.** See *Succinamic acid.*

01 —, **α-chloro-** (*2-chloropropanoic acid**). $CH_3CHClCOOH$, 108.50. Col.liq., $[\alpha]-2.36^{\circ 17}_{D}$. **D.** 1.28^{0}, **b.p.** 186. **Soly.** ∞w.; ∞al.; ∞et.

02 —, —, ethyl ester (*ethyl 2-chloropropanoate**). $CH_3CHClCOOC_2H_5$, 136.53. Col.liq., *n* 1.41850. **D.** 1.087, **b.p.** 146. **Soly.** v.sl.s.w.; ∞al.; ∞et.

03 —, **β-chloro-** (*3-chloropropanoic acid**). CH_2ClCH_2COOH, 108.50. Col.leaf.f.w. **D.** hyg., **m.p.** 41(61), **b.p.** 204. **Soly.** s.w.; s.al.; ∞et.

04 —, —, ethyl ester (*ethyl 3-chloropropanoate**). $CH_2ClCH_2COOC_2H_5$, 136.53. Col.liq. **D.** 1.1086^{20}_{4}, **b.p.** $162–3^{765}$. **Soly.** v.sl.s.w.; ∞al.; ∞et.

05 —, **α-cyano-** (*2-cyanopropanoic acid*; methylmalonic mononitrile; methylcyanoacetic acid*). $CH_3CH(CN)COOH$, 99.05. Oil. **D.** 1.14^{20}_{4}, **b.p.** $142–5^{11}$. **Soly.** s.w.; s.al.

06 —, **α, β-dibromo-** (*2, 3-dibromopropanoic acid**). $CH_2BrCHBrCOOH$, 231.86. Monocl.need. or pl. **m.p.** 51; 64, **b.p.** 220–40 d.; 160^{20}. **Soly.** 1940^{11}w.; 160^{20}al.; 217et.; s.bz., CS_2.

07 —, **β, β-diethyl-.** See *Valeric acid, β-ethyl-.*

08 —, **α, β-dihydroxy-.** See *Glyceric acid.*

09 —, **α, α-dimethyl-.** See *Pivalic acid.*

10 —, **α-hydroxy-.** See *Lactic acid.*

11 —, **β-hydroxy-.** See *Hydracrylic acid.*

12 —, **α-iodo-** (*2-iodopropanoic acid**). $CH_3CHICOOH$, 199.96. Pr. or need. **m.p.** 45.5, **b.p.** $105^{0.3}$. **Soly.** sl.s.w.; v.s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

13 **Propionic acid, β-iodo-** (*3-iodopropanoic acid**). CH_2ICH_2COOH, 199.96. Leaf. **m.p.** 82. **Soly.** 8^{25}w.; v.s.al.; v.s.et.

14 —, **α-keto-.** See *Pyruvic acid.*

15 —, **α-methyl-.** See *Isobutyric acid.*

16 —, **α-phenyl-.** See *Hydratropic acid.*

17 —, **β-phenyl-.** See *Hydrocinnamic acid.*

18 **Propionic anhydride** (*propanoic anhydride**). $(CH_3CH_2CO)_2O$, 130.08. Col. liq., *n* 1.4038. **D.** 1.0336^{0}_{0}; 1.010^{20}_{4}, **m.p.** −45, **b.p.** 169.3(166). **Soly.** d.w.; d.al.; ∞et.

19 **Propionitrile** (*propanenitrile*; ethyl cyanide*). CH_3CH_2CN, 55.05. Col. liq., *n* $1.36888^{14.6}$. **D.** 0.783^{21}_{4}, **m.p.** −91.9(−104), **b.p.** 97.1(96–7). **Soly.** 11.9^{40}, 28^{100}w.; ∞al.; s.et.

20 —, **α, α-dimethyl-** (*2, 2-dimethylpropanenitrile*; tert-butyl cyanide; trimethylacetonitrile*). $(CH_3)_3CCN$, 83.08. Cr. **m.p.** 15–6, **b.p.** 105–6.

21 —, **β-hydroxy-.** See *Hydracrylonitrile.*

22 **Propionyl bromide** (*propanoyl bromide**). CH_3CH_2COBr, 136.96. Liq. **D.** 1.521^{16}, **b.p.** 103.5. **Soly.** d.w.; d.al.; s.et.

23 —, **α-methyl-.** See *Isobutyryl bromide.*

24 **Propionyl chloride** (*propanoyl chloride**). CH_3CH_2COCl, 92.50. Col. liq., *n* 1.40507. **D.** 1.065, **m.p.** −94, **b.p.** 80. **Soly.** d.w.; d.al.; s.et.

25 —, **α-methyl-.** See *Isobutyryl chloride.*

26 **Propionyl iodide** (*propanoyl iodide**). CH_3CH_2COI, 183.96. Liq. **b.p.** 127. **Soly.** d.w.; d.al.

27 **Propiophenone** (*ethyl phenyl ketone; 1-phenyl-1-propanone*). $C_2H_5COC_6H_5$, 134.08. Col.leaf. or liq., *n* $1.52900^{15.9}$. **D.** 1.012^{20}_{4}, **m.p.** 21, **b.p.** 218. **Soly.** i.w.; s.al.; s.et.

28 —, **β-acetyl-.** See *Valerophenone, γ-keto-.*

29 —, **2, 4-dihydroxy-** (*4-propionylresorcinol*). $CH_3CH_2COC_6H_3(OH)_2$, 166.08. **D.** 97.5. **Soly.** sl.s.w.; s.al.; s.et.

30 **Proponal.** See *Barbituric acid, 5, 5-dipropyl-.*

Propyl. For propyl derivatives see the parent compounds (e.g., for propylbenzene see *Benzene, propyl-*). For propyl esters of organic acids see the acids.

31 **Propyl alcohol** (*n*) (*1-propanol*; ethylcarbinol*). $CH_3CH_2CH_2OH$, 60.06. Col.liq., *n* 1.38543. **D.** 0.8044^{20}_{4}; 0.7998^{25}_{4}. **m.p.** −127, **b.p.** 97.19 (97.8). **Soly.** ∞w.; ∞al.; ∞et.

32 —, derivatives. See under *1-Propanol**.

33 **Propylamine***(*n*). $CH_3(CH_2)_2NH_2$, 59.08. Col.liq., *n* $1.39006^{16.6}$. **D.** 0.719, **m.p.** −83, **b.p.** 48.7. **Soly.** s.w.; ∞al.; ∞et.

34 —, **α, α-dimethyl-.** See *tert-Amylamine.*

35 —, **α, β-dimethyl-** (*methylisopropylcarbinylamine*). $(CH_3)_2CHCH(CH_3)$-NH_2, 87.11. Liq., *n* $1.40959^{17.9}$. **D.** 0.7574^{19}, **b.p.** 83–4. **Soly.** v.s.w.; s.al.

36 —, **β, β-dimethyl-** (*tert-butylmethylamine; 1-amino-2, 2-dimethylpropane*). $(CH_3)_3CCH_2NH_2$, 87.11. Liq. **b.p.** 82–3.

37 —, **α-ethyl-** (*diethylcarbinylamine; sec-n-amylamine; 3-aminopentane*). $CH_3CH_2CH(C_2H_5)NH_2$, 87.11. Oil. **D.** 0.7487^{20}_{4}, **b.p.** 91. **Soly.** s.al.

38 —, **α-methyl-.** See *sec-Butylamine.*

39 —, **β-methyl-.** See *Isobutylamine.*

40 —, ***N*-methyl-.** $CH_3NHC_3H_7$, 73.09. Col.liq. **D.** 0.720^{17}, **b.p.** 62–4. **Soly.** s.w.; s.al.

41 —, ***N*-nitro-** (*n-propylnitramine*). $C_3H_7NHNO_2$, 104.08. Col.liq. **D.** 1.103^{15}, **m.p.** −21, **b.p.** 128^{40}. **Soly.** sl.s.w.; v.s.al.; v.s.et.

42 **Propyl borate** (*tripropyl borate; tripropoxyboron*). $B(OC_3H_7)_3$, 187.98. Col.liq. **D.** 0.867^{16}, **b.p.** 175. **Soly.** d.w.; ∞al.; ∞et.

43 **Propyl bromide** (*n*) (*1-bromopropane**). $CH_3CH_2CH_2Br$, 122.97. Liq., *n* 1.43414. **D.** 1.353^{20}_{4}, **m.p.** −110, **b.p.** 70.9. **Soly.** 0.25^{20}w.; ∞al.; ∞et.

44 **Propyl chloride** (*n*) (*1-chloropropane**). $CH_3CH_2CH_2Cl$, 78.51. Col.liq., *n* 1.38856. **D.** 0.890^{20}_{4}, **m.p.** −122.8, **b.p.** 47.2(45–7). **Soly.** 0.27^{20}w.; ∞al.; ∞et.

45 ***n*-Propyl cyanide.** See *Butyronitrile.*

46 **Propylene.** See *Propene**.

47 **Propylene aldehyde.** See *Crotonaldehyde.*

48 **Propylene bromide.** See *Propane, 1, 2-dibromo-**.

49 **Propylene chloride.** See *Propane, 1, 2-dichloro-**.

50 **Propylene chlorohydrin.** See *2-Propanol, 1-chloro-**.

For explanations and abbreviations see beginning of table.

51 **Propylenediamine.** See 1, 2-*Propanediamine**.

52 **Propylene glycol.** See 1, 2-*Propanediol**.

53 **Propylene iodide.** See *Propane*, 1,2-*diiodo-**.

54 **Propylene oxide.** See *Propene oxide.*

55 —, γ-**chloro-.** See *Epichlorohydrin.*

56 —, γ-**cyano-.** See *Epicyanohydrin.*

57 —, γ-**iodo-.** See *Epiiodohydrin.*

58 **Propyl ether** (*di-n-propyl ether; 1-propoxypropane**). $(CH_3CH_2CH_2)_2O$, 102.11. Col.liq., *n* 1.3807. **D.** 0.7360^{20}_{4}, **m.p.** −122, **b.p.** 91. **Soly.** 0.25^{25}w.; ∞al.; ∞et.

59 **Propyl fluoride** (*n*) (*1-fluoropropane**). $CH_3CH_2CH_2F$, 62.05. Gas. **b.p.** −3(2). **Soly.** sl.s.w.; v.s.al.; ∞et.

60 **Propylidene bromide.** See *Propane*, 1, 1-*dibromo-**.

61 **Propylidene chloride.** See *Propane*, 1, 1-*dichloro-**.

62 **Propyl iodide** (*n*) (1-*iodopropane**). $CH_3CH_2CH_2I$, 169.97. Col.liq., *n* 1.50508. **D.** 1.747, **m.p.** −101.4, **b.p.** 102.4. **Soly.** $.0867^{20}$w.; ∞al.; ∞et.

63 **Propyl isocyanide** (*n*) (*propylcarbylamine*). $CH_3(CH_2)_2NC$, 69.06. Liq. **b.p.** 99.5. **Soly.** i.w.; ∞al.; ∞et.

64 *n*-**Propyl mercaptan.** See 1-*Propanethiol**.

65 *n*-**Propyl mustard oil.** See *Isothiocyanic acid, propyl ester.*

66 **Propyl nitrate** (*n*). $CH_3CH_2CH_2$-NO_3, 105.06. Liq., *n* 1.3972. **D.** 1.058^{20}_{4}, **b.p.** 100.5. **Soly.** v.sl.s.w.; s.al.; s.et.

67 **Propyl nitrite** (*n*). $CH_3CH_2CH_2$-ONO, 89.06. Liq., *n* 1.3613. **D.** 0.935, **b.p.** 57. **Soly.** s.al.; s.et.

68 **Propyl sulfate** (*di-n-propyl sulfate*). $(CH_3CH_2CH_2)_2SO_4$, 182.17. Col. oil, *n* 1.4139. **D.** $1.11^{22.5}$, **m.p.** d. 140–70, **b.p.** 120^{20}. **Soly.** i., sl.d.w.

69 **Propyl sulfide** (1-*propylthiopropane**; *di-n-propyl sulfide*). $(C_3H_7)_2S$, 118.17. Liq. **D.** 0.814^{17}, **m.p.** frz. −101.9, **b.p.** 141–2. **Soly.** i.w.; s.al.; s.et.

70 **Propyl sulfone** (1-*propylsulfonylpropane**; *dipropyl sulfone*). $(CH_3CH_2CH_2)_2SO_2$, 150.17. Sc. **m.p.** 29–30. **Soly.** sl.s.w.; s.al.; s.et.

71 **Propynal***. See *Propiolaldehyde.*

72 **Propyne*** (*propine; methylacetylene; allylene*). CH₃C⋮CH, 40.03. Gas. **D.** liq. 0.6785^{-27}_{4}; 1.787^{0}g/l, **m.p.** −104.7; frz. −110, **b.p.** −23(−27.5). **Soly.** v.sl.s.w.; v.s.al.; 2142^{16}cm³et.

73 —, **3-bromo-*** (*propargyl bromide; γ-bromoallylene*). CH⋮CCH₂Br, 118.94. Liq. **D.** 1.520, **b.p.** 88–90.

74 —, **3-chloro-*** (*propargyl chloride*) CH⋮CCH₂Cl, 74.48. Liq. **D.** 1.0454^{5}, **b.p.** 65. **Soly.** i.w.; ∞al.; ∞et.

75 —, **3-ethoxy-*** (*ethyl propargyl ether*) CH⋮CCH₂OC₂H₅, 84.06. Liq., *n* 1.40390. **D.** 0.8326, **b.p.** 80. **Soly.** i.w.; s.al.; s.et.

76 —, **3-iodo-*** (*propargyl iodide*). CH⋮-CCH₂I, 165.94. Liq. **D.** 2.018^{0}, **b.p.** 115. **Soly.** s.et.

77 —, **3-methoxy-*** (*methyl propargyl ether*). CH⋮CCH₂OCH₃, 70.05. Col. liq. **D.** 0.83^{13}, **b.p.** 62. **Soly.** sl.s.w.; ∞al.; ∞et.

78 —, **1-phenyl-** (*methylphenylacetylene; 1-propynylbenzene; phenylallylene*). C₆-H₅C⋮CCH₃, 116.06. Arom. oil. **b.p.** 185. **Soly.** i.w.; s.et.

79 **Propynoic acid***. See *Propiolic acid.*

80 **2-Propyn-1-ol*** (*propargyl alcohol. ethynylcarbinol; acetylenylcarbinol; propiolic alcohol*). CH⋮CCH₂OH, 56.03. Col.liq., *n* 1.43064. **D.** 0.9715^{20}_{4}, **m.p.** −17, **b.p.** 115. **Soly.** s.w.; ∞al.; ∞et.

81 —, acetate (*propargyl acetate*). CH₃-COOCH₂C⋮CH, 98.05. Col.liq., *n* 1.42047. **D.** 1.005, **b.p.** 125. **Soly** sl.s.w.; s.al.; s.et.

82 **Propytal.** See *Barbituric acid*, 5, 5 *dipropyl-.*

83 **Protocatechualdehyde** (3, 4-*dihydroxybenzaldehyde;* 3, 4-*dihydroxybenzenecarbonal**). $(HO)_2C_6H_3CHO$, 138.05. Col.tab.f.w. **m.p.** 154, **b.p.** d. **Soly.** 5w.; 78.9h.al.; v.s.et.

84 —, dimethyl ether. See *Veratraldehyde.*

85 —, 4-ethyl 3-methyl ether. See *Benzaldehyde, 4-ethoxy-3-methoxy-.*

86 —, methylene ether. See *Piperonal.*

87 —, 3-methyl ether. See *Vanillin.*

88 —, 4-methyl ether. See *Isovanillin.*

89 **Protocatechuic acid** (3, 4-*dihydroxybenzoic acid;* 3, 4-*dihydroxybenzenecarboxylic acid**). $(OH)_2C_6H_3COOH$, 154.05. Monocl.need. **D.** 1.542^{4}, **m.p.** 199 d. **Soly.** 1.82^{14}, 27^{80}w.; v.s.al.; s.et.

90 —, dimethyl ether. See *Veratric acid.*

91 —, methylene ether. See *Piperonylic acid.*

* Name approved by the International Union of Chemistry.

92 **Protopine.** $C_{20}H_{19}NO_5$, 353.16. Monocl.cr. **m.p.** 207. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; s.acet.; sl.s.NH_4OH, bz.

93 **Proteveratrine.** $C_{32}H_{51}NO_{11}$, 625.41; Rect.tab. **m.p.** 245–50. **Soly.** sl.s.al., sl.s.et.; sl.s.chl.

94 **Prussic acid.** See *Hydrocyanic acid.*

95 **Prussite.** See *Cyanogen.*

96 **Pseudaconine, acetylbenzoyl-.** See *Indaconitine.*

97 **—, acetylveratryl-.** See *Pseudaconitine.*

98 **Pseudaconitine** (*acetylveratrylpseudaconine*). $C_{36}H_{49}NO_{12}$, 687.39. Rhomb.f.chl. + et. **m.p.** 211–2 d. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl.

99 **Pseudobutylene.** See *2-Butene**.

00 **Pseudobutylene glycol.** See *2, 3-Butanediol**.

01 **Pseudocinchonine.** See *Cinchotine.*

02 **Pseudocodeine.** $C_{18}H_{21}NO_3$, 299.17. Col.need., n 1.574, 1.602, 1.647. **D.** 1.315; 1.290^{180}, **m.p.** 181. **Soly.** sl.s. w.; s.al.

03 **Pseudoconhydrine** (*ψ-conhydrine*). $C_8H_{17}NO$, 143.14. Slend.col.need., $[\alpha] + 11°^{15}_{D}$. **m.p.** 105–6, **b.p.** 236.5. **Soly.** s.w.; s.al.; s.et.; s.bz.

04 **Pseudoconiceine.** $C_8H_{15}N$, 125.13. Oily liq. **D.** 0.8776^{15}, **b.p.** 171–2.

05 **Pseudocumene** (1, 2, 4-*trimethylbenzene; as-trimethylbenzene*). $(CH_3)_3C_6H_3$, 120.09. Col.liq., n $1.50672^{15.3}$. **D.** 0.876, **m.p.** −57.4(−61), **b.p.** 169.8(162–5). **Soly.** i.w.; s.al.; s.et.

06 **—, 5-nitro-.** $NO_2C_6H_2(CH_3)_3$, 165.09. Lng.col. or grn.-yel.need. **m.p.** 65; 45–6(71), **b.p.** 265. **Soly.** s.al.; s.pet.eth.

07 **—, 6-nitro-** (1, 2, 4-*trimethyl*-6-*nitrobenzene*). $NO_2C_6H_2(CH_3)_3$, 165.09. Grn.pr. **m.p.** 20. **Soly.** s.al.

08 **—, 3, 5, 6-trinitro-.** $(NO_2)_3C_6(CH_3)_3$, 255.09. Pr. **m.p.** 185. **Soly.** i.w.; v.sl.s.h.al.; s.h.bz.

09 **Pseudocumenol** (2, 4, 5-*trimethylphenol*). $(CH_3)_3C_6H_2OH$, 136.09. Need.f.w. **m.p.** 72, **b.p.** 235. **Soly.** v.v.sl.s.w.; v.s.al.; v.s.et.

10 **Pseudocumidine** (2, 4, 5-*trimethylaniline*). $(CH_3)_3C_6H_2NH_2$, 135.11. Col.need.f.al. **D.** 0.957, **m.p.** 66–8. **b.p.** 234–5. **Soly.** 0.12^{19}w.; s.al.; s.et.; s.chl.

11 **Pseudoephedrine** (*d*) (2-*methylamino*-1-*phenyl*-1-*propanol*(one form); *d-isoephedrine*). $C_6H_5CHOHCH(NHCH_3)CH_3$, 165.13. Col.rhomb. tab.f.et. **m.p.** 116–7. **Soly.** sl.s.c.w.; s.al.; s.et.; s.chl.

12 **—, hydrochloride.** $C_{10}H_{15}NO{\cdot}HCl$, 201.59. Ylsh.need. **m.p.** 176. **Soly.** s.w.; s.al.

13 **Pseudohexyl alcohol.** See *1-Butanol, 2-ethyl-**.

14 **Pseudohyoscyamine.** $C_{17}H_{23}NO_3$, 289.19. Ylsh.need. **m.p.** 133–4. **Soly.** sl.s.w.; v.s.al.; s.et.; s.chl.

15 **3-Pseudoindolone, 2-chloro-.** See *Isatin chloride.*

16 **Pseudoisatin, 1-acetyl-** (*acetylisatin*). $C_6H_4N(COCH_3)COCO$, 189.06. Yel.need.f.bz. **m.p.** 141. **Soly.** sl.s.w.; s.al.; s.bz.; d.h.HCl.

17 **Pseudoleucaniline.** See *mp₂-Leucaniline.*

18 **Pseudomorphine.** $C_{34}H_{36}N_2O_6$, 568.30. Crusts or need. **m.p.** 327 d. **Soly.** i.w.; i.al.; i.et.; s.alk., NH_4OH; i.chl.

19 **—, hydrochloride** (*l*). $C_{34}H_{36}N_2O_6{\cdot}2HCl{\cdot}2H_2O$, 677.26. Cr.powd. **Soly.** 70^{10}w.

20 **Pseudopelletierine** (*methylgranatonine; ψ-pelletierine*). $C_9H_{15}NO$, 153.13. Pl.f.pet.eth., n $1.47596^{99.5}$. **D.** 1.001^{100}, **m.p.** 48–9, **b.p.** 246. **Soly.** s.w.; v.s.al.; v.s.et.; s.chl., bz.; sl.s.pet.eth.

21 **Pseudotropeine, benzoyl-.** See *Tropacocaine.*

22 **Pseudotropine.** $C_8H_{15}NO$, 141.13. Rhbdr.tab or pr.f.et. **m.p.** 108, **b.p.** 243. **Soly.** v.s.w.; v.s.al.; sl.s.et.; s.chl.

23 **Pukateine**(*l*). $C_{17}H_{17}NO_3$, 283.14. Cr.f.al. **Soly.** s.al.; 0.6et.; s.chl., pyr., alk.

24 **Pulegone** (4(8)-*p-methen*-3-*one*). $C_{10}H_{16}O$, 152.12. Col.liq., n $1.48705^{18.3}$. **D.** 0.9323^{20}, **b.p.** 224. **Soly.** i.w.; ∞al.; ∞et.

25 **Punicine.** See *Pelletierine.*

26 **Purine** (*imidazo*[4, 5-*d*]*pyrimidine*). $C_5H_4N_4$, 120.06. Need.f.al. **m.p.** 217. **b.p.** d. **Soly.** v.s.w.; s.al.; v.sl.s.et.; s.tol.

27 **—, 6-amino-.** See *Adenine.*

28 **—, 2, 6-dioxy-.** See *Xanthine.*

29 **—, 2, 6, 8-trioxy-.** See *Uric acid.*

30 **2, 6(1, 3)Purinedione.** See *Xanthine.*

31 **2, 6, 8(1, 3, 9)-Purinetrione.** See *Uric acid.*

32 **6(1)-Purinone.** See *Hypoxanthine.*

33 **Purpuric acid,** ammonium salt. See *Murexide.*

For explanations and abbreviations see beginning of table.

34 **Purpurin** (1, 2, 4-*trihydroxyanthraquinone*). $C_6H_4(CO)_2C_6H(OH)_3$, 256.06. Red.need.f.al. **m.p.** 256, **b.p.** d. subl. **Soly.** s.w.; s.al.; s.et.

35 **Purpuroxanthin** (1, 3-*dihydroxyanthraquinone*). $C_6H_4(CO)_2C_6H_2(OH)_2$, 240.06. Yel.need.f.ac.a. **m.p.** 262–3, **b.p.** subl. **Soly.** i.w.; sl.s.al.; s.h.ac.a., acet.

36 **Putrescine** (1, 4-*butanediamine**; *tetramethylenediamine*). $NH_2(CH_2)_4NH_2$, 88.11. Leaf. **m.p.** 27, **b.p.** 158. **Soly.** v.s.w.; v.s.al.; v.s.et.

37 **Pyraconitine.** $C_{32}H_{43}NO_9$, 585.34. Need. **m.p.** 167–8. **Soly.** sl.s.w.; v.s.al.; v.s.et.

38 **Pyran, tetrahydro-** (*pentamethylene oxide*). $O(CH_2)_4CH_2$, 86.08. **D.** 0.8540, **b.p.** 81–2. **Soly.** s.w.; ∞al.; ∞et.

39 **1, 4-Pyran, 4-keto-.** See 1, 4-*Pyrone.*

40 **1, 2-Pyran-5-carboxylic acid, 2-oxo-.** See *Coumalic acid.*

41 **1, 4-Pyran-2, 5-dicarboxylic acid, tetrahydro-2, 6, 6-trimethyl-*.** See *Cineolic acid.*

42 **1, 4-Pyran-2, 6-dicarboxylic acid, 3-hydroxy-4-keto-.** See *Meconic acid.*

43 **2, 4-Pyrandione, 3-acetyl-6-methyl-.** See *Dehydroacetic acid.*

14 **Pyrantin.** See *Succinamide, N-p-phenetyl-.*

45 **Pyrazine.** (1, 4-*diazine*; *paradiazine*; *piazine*). N:CHCH:NCH:CH, 80.05. Col.pr.f.w., *n* $1.49526^{60.9}$. **D.** 1.031^{84}_{4}, **m.p.** 53, **b.p.** 118. **Soly.** ∞w.; v.s.al.; v.s.et.; s.chl., HCl, H_2SO_4.

46 **—, 2, 5-dimethyl-.** See *Ketine.*

47 **—, hexahydro-.** See *Piperazine.*

48 **—, tetraphenyl-.** See *Amaron.*

49 **Pyrazole** (1, 2-*diazole*; *α-pyrromonazole*). NHN:CHCH:CH, 68.05. Need.f.al., *n* $1.47027^{99.8}_{He}$. **m.p.** 70, **b.p.** 188. **Soly.** v.s.w.; v.s.al.; v.s.et.; s.bz.

50 **—, 4, 5-dihydro-.** See 2-*Pyrazoline.*

51 **—, 4, 5-dihydro-5-oxo-.** See 5-*Pyrazolone.*

52 **2-Pyrazoline** (*Δ²-pyrazoline*; 4, 5-*dihydropyrazole*; *pyrazoline*). $NHN:CHCH_2CH_2$, 70.06. Col.liq. **b.p.** 144. **Soly.** ∞w.; ∞al.; sl.s.et.

53 **—, 1-phenyl-.** $C_6H_5NN:CHCH_2CH_2$, 146.09. Cr. **m.p.** 52, **b.p.** 273. **Soly.** i.w.; s.al.

54 **3-Pyrazolone, 1, 5-dimethyl-2-phenyl-.** See *Antipyrine.*

55 **—, 1, 5-dimethyl-2-phenyl-3-thio-.** See *Thiopyrine.*

56 **5-Pyrazolone** (4, 5-*dihydro-5-oxopyrazole*). $NHN:CHCH_2CO$, 84.05. Need.f.tol. **m.p.** 165, **b.p.** subl. d. **Soly.** s.w.; s.al.; sl.s.et.

57 **—, 3-methyl-3-phenyl-.** $N(C_6H_5)N:C(CH_3)CH_2CO$, 174.09. Pr., *n* β 1.637. **m.p.** 127, **b.p.** 287^{205}. **Soly.** s.h.w.; s.h.al.; v.sl.s.et.; sl.s.bz.

58 **Pyrene** (*benzo[def]phenanthrene*). $C_{16}H_{10}$, 202.08. Lt.yel.monocl.tab. **m.p.** 150, **b.p.** >360. **Soly.** i.w.; 1.4al.; v.s.et.

59 **Pyridazine** (1, 2-*diazine*; *orthodiazine*). N:NCH:CHCH:CH, 80.05. Col.liq., *n* $1.52311^{23.5}$. **D.** 1.107, **m.p.** −8, **b.p.** 208. **Soly.** ∞w.; v.s.al.; v.s.et.; s.HCl, bz., H_2SO_4; i.lgr.

60 **Pyridine.** N:CHCH:CHCH:CH, 79.05. Col.liq., *n* 1.50910^{21}. **D.** 0.982, **m.p.** −42, **b.p.** 115.3. **Soly.** ∞w.; ∞al.; ∞et.; s.bz.

61 **—, 2-allyl-.** $C_3H_5C_5H_4N$, 119.08. Liq. **D.** 0.959^{0}, **b.p.** 190. **Soly.** sl.s.w.; ∞al.; ∞et.

62 **—, 2-amino-** (*α-pyridylamine*). $NH_2C_5H_4N$, 94.06. Leaf.f.lgr. **m.p.** 56, **b.p.** 204. **Soly.** s.w.; v.s.al.; s.et.; sl.s.lgr.

63 **—, 3-amino-.** (*β-pyridylamine*). $NH_2C_5H_4N$, 94.06. Leaf.f.bz. **m.p.** 64, **b.p.** 252. **Soly.** v.s.w.; v.s.al.; v.s.et.; i.lgr.

64 **—, 4-amino-** (*γ-pyridylamine*). $NH_2C_5H_4N$, 94.06. Col.need.f.bz. **m.p.** 158. **Soly.** s.w.; s.al.; s.et.; s.alk., bz.; sl.s.lgr.

65 **—, 2-benzyl-.** $C_6H_5CH_2C_5H_4N$, 169.09. Need. **D.** 1.067^{0}_{0}, **m.p.** 139, **b.p.** 276^{742}. **Soly.** i.w.; s.al.; s.et.

36 **—, 3-benzyl-.** $C_6H_5CH_2C_5H_4N$, 169.09. Need. **D.** 1.061^{20}_{0}, **m.p.** 34, **b.p.** 286^{740}. **Soly.** i.w.; s.al.; s.et.

67 **—, 3-bromo-*.** BrC_5H_4N, 157.96. Oil. **D.** 1.632^{10}; 1.645^{0}_{4}, **b.p.** 169–70 (173). **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

68 **—, 2-chloro-*** (*α-chloropyridine*). ClC_5H_4N, 113.50. Oily liq. **D.** 1.205^{15}, **b.p.** 170 (166^{714}). **Soly.** v.sl.s.w.; s.et.

* Name approved by the International Union of Chemistry.

69 Pyridine, 3-chloro-* (*β-chloropyridine*). ClC_5H_4N, 113.50. Liq. **b.p.** 148^{744}. **Soly.** s.w.

70 —, **4-chloro-*** (*γ-chloropyridine*). ClC_5H_4N, 113.50. Liq. **b.p.** 147–8. **Soly.** s.w.

71 —, **3, 5-dibromo-***. $C_5H_3Br_2N$, 236.86. Col.need.f.al. **m.p.** 112 (110–1), **b.p.** 222. **Soly.** s.w.; s.h.al.; v.s.et.; s.H_2SO_4.

72 —, **dihydroxy-.** See *Pyridinediol.*

73 —, **dimethyl-.** See *Lutidine.*

74 —, **2-ethyl-** (*α-ethylpyridine*). $C_2H_5{\cdot}C_5H_4N$, 107.08. Liq., *n* $1.50214^{22.5}$. **D.** 0.950^0, **b.p.** 148.8. **Soly.** sl.s.w.; ∞al.; v.s.et.

75 —, **3-ethyl-** (*β-ethylpyridine*). $C_2H_5{\cdot}C_5H_4N$, 107.08. Col.liq. **D.** 0.945^{15}, **b.p.** 165.3. **Soly.** v.sl.s.w.; s.al.; s.et.

76 —, **4-ethyl-** (*γ-ethylpyridine*). $C_2H_5{\cdot}C_5H_4N$, 107.08. Col.liq. **D.** 0.936, **b.p.** 166. **Soly.** s.dil.a.

77 —, **2-ethyl-3, 5-dimethyl-.** See *α-Parvoline.*

78 —, **3-ethyl-4-methyl-.** See *β-Collidine.*

79 —, **4-ethyl-2-methyl-.** See *α-Collidine.*

80 —, **5-ethyl-2-methyl-.** See *Aldehydine.*

81 —, **hexahydro-*.** See *Piperidine.*

82 —, **hydroxy-.** See *Pyridol.*

83 —, **2-isopropyl-.** $(CH_3)_2CHC_5H_4N$, 121.09. Liq. **D.** 0.934^0, **b.p.** 159. **Soly.** sl.s.w.; ∞al.; ∞et.

84 —, **4-isopropyl-.** $(CH_3)_2CHC_5H_4N$, 121.09. Liq. **D.** 0.944^0, **b.p.** 178. **Soly.** sl.s.w.; ∞al.; ∞et.

85 —, **4-methoxy-*.** N:CHCH:C(OCH$_3$)CH:CH, 109.06. Liq. **b.p.** 191. **Soly.** s.w.

86 —, **methyl-.** See *Picoline.*

87 —, **3-(1-methyl-2-pyrryl)-.** See *Nicotyrine.*

88 —, **2-phenyl-.** $C_6H_5C_5H_4N$, 155.08. Liq. **D.** >1, **b.p.** 270. **Soly.** i.w.; v.s.al.; v.s.et.

89 —, **3-phenyl-.** $C_6H_5C_5H_4N$, 155.08. Oil. **D.** >1, **b.p.** 270.4. **Soly.** i.w.; v.s.al.; v.s.et.

90 —, **4-phenyl-.** $C_6H_5C_5H_4N$, 155.08. Leaf.f.w.; **m.p.** 78, **b.p.** 275. **Soly.** v.sl.s.h.w.; s.al.; s.et.

91 —, **2-propyl-.** See *Conyrine.*

92 —, **1, 2, 3, 4-tetrahydro-6-propyl-.** See *γ-Coniceine.*

93 —, **tetramethyl-.** See *β-Parvoline.*

94 —, **2, 4, 6-trihydroxy-.** See *2, 4, 6-Pyridinetriol.*

95 —, **2, 4, 6-trimethyl-.** See *γ-Collidine.*

96 2-Pyridinecarboxylic acid*. See *Picolinic acid.*

97 3-Pyridinecarboxylic acid*. See *Nicotinic acid.*

98 4-Pyridinecarboxylic acid*. See *Isonicotinic acid.*

99 2, 3-Pyridinedicarboxylic acid*. See *Quinolinic acid.*

00 2, 4-Pyridinedicarboxylic acid*. See *Lutidinic acid.*

01 2, 5-Pyridinedicarboxylic acid*. See *Isocinchomeronic acid.*

02 2, 6-Pyridinedicarboxylic acid*. See *Dipicolinic acid.*

03 3, 4-Pyridinedicarboxylic acid*. See *Cinchomeronic acid.*

04 3, 5-Pyridinedicarboxylic acid*. See *Dinicotinic acid.*

05 2, 4-Pyridinediol (*2, 4-dihydroxypyridine*). $C_5H_3N(OH)_2$, 111.05. Yel. rhomb.cr.f.w. or al. **m.p.** 265. **Soly.** sl.s.w.; sl.s.al.; v.sl.s.et.

06 2, 6-Pyridinediol (*2, 6-dihydroxypyridine*). $C_5H_3N(OH)_2{\cdot}H_2O$, 129.06. Yel.need.f.w. **m.p.** 195. **Soly.** sl.s.w.; sl.s.al.; v.sl.s.et.

07 Pyridinepentacarboxylic acid* $C_5N(COOH)_5{\cdot}2H_2O$, 335.08. Cr. et., $2H_2O$; f.w. $3H_2O$. **m.p.** 220 d. $-H_2O$, 100, **b.p.** d. **Soly.** v.s.w.; v.sl.s.et.

08 3-Pyridinesulfonic acid*. $C_5H_4NSO_3H$, 159.11. Need. or leaf **m.p.** d. **Soly.** v.s.w.; v.sl.s.al.; i.et.

09 2, 3, 4-Pyridinetricarboxylic acid*. See *Carbocinchomeronic acid.*

10 2, 4, 5-Pyridinetricarboxylic acid*. See *Berberonic acid.*

11 2, 4, 6-Pyridinetricarboxylic acid*. See *Trimesitic acid.*

12 3, 4, 5-Pyridinetricarboxylic acid* (*β-carbocinchomeronic acid*). $C_5H_2N(COOH)_3$, 211.05. Leaf. or pl. **m.p.** $-H_2O$, 115; anh. 261. **Soly.** s.h.w.

13 2, 4, 6-Pyridinetriol (*2, 4, 6-trihydroxypyridine*). $C_5H_2N(OH)_3$, 127.05. Need. or powd. **m.p.** 230 d. **Soly.** sl.s.w.; s.al.; s.et.

14 2-Pyridol (*2(1)-pyridone; α-pyridone*). HOC_5H_4N, 95.05. Col.need. f.bz. **m.p.** 107, **b.p.** 281. **Soly.** v.s.w.; v.s.al.; s.et.; sl.s.lgr.

15 **3-Pyridol** (3-*hydroxypyridine*). HOC_5H_4N, 95.05. Need. **m.p.** 129. **Soly.** v.s.w.; v.s.al.; sl.s.et.

16 **4-Pyridol** (4(1)-*pyridone; γ-pyridone*). HOC_5H_4N, 95.05. Col. monocl. **m.p.** $+H_2O$, 92; anh. 148.5, **b.p.** >350. **Soly.** 100^{15}w.; v.s.al.; v.sl.s.et.; v.sl.s.chl.; i.bz.

17 **α-Pyridone.** See 2-*Pyridol.*

18 **γ-Pyridone.** See 4-*Pyridol.*

19 **2(1)-Pyridone.** See 2-*Pyridol.*

20 **4(1)-Pyridone.** See 4-*Pyridol.*

21 **α-Pyridylamine.** See *Pyridine, 2-amino-.*

22 **β-Pyridylamine.** See *Pyridine, 3-amino-.*

23 **γ-Pyridylamine.** See *Pyridine, 4-amino-.*

24 **Pyrimidine.** (1, 3-*diazine; meta-diazine; miazine*). N:CHN:CHCH:-CH, 80.05. Cr. **m.p.** 22, **b.p.** 124. **Soly.** s.w.; s.al.

25 **2, 4(1, 3)-Pyrimidinedione.** See *Uracil.*

26 **Pyrimidinetetrone.** See *Alloxan.*

27 **Pyrimidinetrione.** See *Barbituric acid.*

28 **Pyrocatechol** (1, 2-*benzenediol*; catechol; pyrocatechin*). $C_6H_4(OH)_2$, 110.05. Col.monocl.leaf.f.bz., *n* 1.604, 1.615, 1.650. **D.** 1.371^{15}, **m.p.** 105, **b.p.** 240(240–5). **Soly.** 45.1^{20}w.; v.s.al.; s.et.; s.bz., chl., alk.

29 —, dibutyl ether. See *Benzene, 1, 2-dibutoxy-*.*

30 —, diethyl ether. See *Benzene, 1, 2-diethoxy-*.*

31 —, dimethyl ether. See *Veratrole.*

32 —, dipropyl ether. See *Benzene, 1, 2-dipropoxy-*.*

33 —, monoamyl ether. See *Phenol, o-amoxy-.*

34 —, monobutyl ether. See *Phenol, o-butoxy-.*

35 —, monoethyl ether. See *Phenol, o-ethoxy-.*

36 —, monomethyl ether. See *Guaiacol.*

37 —, monopropyl ether. See *Phenol, o-propoxy-.*

38 —, **3-methoxy-** (*pyrogallol 1-methyl ether*). $CH_3OC_6H_3(OH)_2$, 140.06. Need. **m.p.** 38–41, **b.p.** $146\text{–}7^{15-16}$.

39 —, **3-methyl-** (3-*methyl*-1, 2-*benzenediol*; isohomopyrocatechol;* 2, 3-*dihydroxytoluene*). $CH_3C_6H_3(OH)_2$, 124.06. Leaf.f.bz. **m.p.** 68(47), **b.p.** 241. **Soly.** s.w.; s.al.; s.et.; s.chl., bz.

40 —, **4-methyl-.** See 4-*Homopyrocatechol.*

41 **Pyrocatechol-o-acid.** See *Benzoic acid, 2, 3-dihydroxy-.*

42 **o-Pyrocatechuic acid.** See *Benzoic acid, 2, 3-dihydroxy-.*

43 **Pyrocoll** (5, 10-*dipyrrolo*[1, 2-*a*, 1, 2-*d*]-*pyrazinedione*). $C_4H_3N(CO)_2$-NC_4H_3, 186.06. Yel.monocl.leaf. **m.p.** 269, **b.p.** subl. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.; s.ac.a.

44 **Pyrodin.** See *Hydrazine, 1-acetyl-2-phenyl-.*

45 **Pyrogallol** (1, 2, 3-*benzenetriol*; v-trihydroxybenzene*). $C_6H_3(OH)_3$, 126.05. Need. or leaf. **D.** $1.453\frac{4}{4}$, **m.p.** 133–4, **b.p.** 309(293 d.). **Soly.** 62.5^{25}w.; 100^{25}al.; 83.3^{25}et.; sl.s.bz., chl., CS_2.

46 —, 1, 2-dimethyl ether. See *Phenol, 2, 3-dimethoxy-.*

47 —, 1, 3-dimethyl ether. See *Phenol, 2, 6-dimethoxy-.*

48 —, 1-methyl ether. See *Pyrocatechol, 3-methoxy-.*

49 —, 2-methyl ether. See *Resorcinol, 2-methoxy-.*

50 —, triacetate. $C_6H_3(OOCCH_3)_3$, 252.09. Wh.cr.powd. **m.p.** 165. **Soly.** v.v.sl.s.w.; s.dil.alk.

51 —, trimethyl ether. See *Benzene, 1, 2, 3-trimethoxy-*.*

52 —, **4-acetyl-.** See *Gallacetophenone.*

53 —, **4-benzoyl-.** See *Benzophenone, 2, 3, 4-trihydroxy-.*

54 —, **5-methyl-** (3, 4, 5-*trihydroxytoluene*). $CH_3C_6H_2(OH)_3$, 140.06. Need.f.bz. **m.p.** 129.

55 **4-Pyrogallolcarboxylic acid.** See *Benzoic acid, 2, 3, 4-trihydroxy-.*

56 **Pyrogallolphthalein.** See *Gallein.*

57 **Pyromellitic acid** (1, 2, 4, 5-*benzenetetracarboxylic acid**). $C_6H_2(COOH)_4$, 254.05. Tricl.tab.($+2H_2O$)f.w. **m.p.** 264(269–71). **Soly.** 1.42^{16}w.; v.s.al.; sl.s.et.

58 **Pyromucic acid** (2-*furancarboxylic acid; furoic acid; 2-furoic acid*). C_4H_3OCOOH, 112.03. Wh.monocl. need. **m.p.** 131–2, **b.p.** 230–2; subl. 100. **Soly.** 3.57^{15}w.; s.al.; v.s.et.

59 —, amyl ester (*n-amyl furoate; pentyl 2-furancarboxylate*). $C_4H_3O \cdot COOC_5H_{11}$, 182.11. Col.liq. **D.** 1.0335, **b.p.** 95–7. **Soly.** i.w.; ∞al.

* Name approved by the International Union of Chemistry.

60 Pyromucic acid, butyl ester (*n-butyl furoate*). $C_4H_3O{\cdot}COOC_4H_9$, 168.09. Col.liq. **D.** 1.0555, **b.p.** 118–20^{25}; 83–4^{1}. **Soly.** i.w.; ∞al.; ∞et.

61 —, *sec*-butyl ester (*sec-butyl furoate*). $C_4H_3OCOOC_4H_9$, 168.09. Col.liq. **D.** 1.0465, **b.p.** 67–9^{1}. **Soly.** i.w.; ∞al.; ∞et.

62 —, ethyl ester (*ethyl pyromucate; ethyl furoate*). $C_4H_3O{\cdot}COOC_2H_5$, 140.06. Wh.cr.leaf., *n* 1.4699^{40}. **D.** 1.0974$^{40}_{4}$; 1.1774$^{21}_{4}$, **m.p.** 34(30–3), **b.p.** 195^{706}. **Soly.** i.w.; ∞al.; s.et.

63 —, furfuryl ester. See *Furfuryl alcohol, pyromucate.*

64 —, heptyl ester (*n-heptyl furoate*) $C_4H_3OCOOC_7H_{15}$, 210.14. Col.liq. **D.** 1.0005$^{20}_{4}$, **b.p.** 116–7^{1}. **Soly.** i.w.; s.al.

65 —, hexyl ester (*n-hexyl furoate*). $C_4H_3OCOOC_6H_{13}$, 196.12. Col.liq. **D.** 1.0170$^{20}_{4}$, **b.p.** 105–7^{1}. **Soly.** i.w.; s.al.

66 —, isoamyl ester (*isoamyl furoate*). $C_4H_3O{\cdot}COOC_5H_{11}$, 182.11. Col.liq. **b.p.** 135–7^{25}. **Soly.** i.w.; ∞al.

67 —, methyl ester (*methyl furoate*). $C_4H_3OCO_2CH_3$, 126.05. Liq. **D.** 1.178, **b.p.** 181.3. **Soly.** i.(sl.s.)w.; ∞al.; ∞et.

68 —, octyl ester. $C_4H_3OCOOC_8H_{17}$, 224.16. Col.liq. **D.** 0.9885, **b.p.** 126–7^{1}. **Soly.** i.w.; s.al.

69 —, propyl ester (*n-propyl furoate*). $C_4H_3OCOOC_3H_7$, 154.08. Col.liq. **D.** 1.075, **b.p.** 211. **Soly.** i.(sl.s.)w.; s.al.; ∞et.

70 —, **3-bromo-** (*3-bromofuroic acid*). $C_4H_2BrO{\cdot}COOH$, 190.94. Wh.need. f.w. **m.p.** 127–9. **Soly.** 1.3^{20}w.; s.al.; s.et.; v.sl.s.lgr., CS_2.

71 —, **5-bromo-.** $BrC_4H_2O{\cdot}COOH$, 190.94. Wh.leaf.f.w. **m.p.** 186. **Soly.** v.sl.s.c.w.; s.al.; v.s.et.

72 —, —, ethyl ester. $BrC_4H_2O{\cdot}COOC_2H_5$, 218.97. Pr. **D.** 1.528^{20}, **m.p.** 17, **b.p.** 235^{767}. **Soly.** i.w.; s.al.; s.et.

73 —, **3-chloro-** (*3-chloro-2-furancarboxylic acid*; 3-chlorofuroic acid*). $C_4H_2ClO{\cdot}COOH$, 146.48. Wh.cr. **m.p.** 148.5–9.5. **Soly.** i.w.; s.al.

74 —, **5-chloro-** (*5-chloro-2-furancarboxylic acid*; 5-chlorofuroic acid*). $C_4H_2ClO{\cdot}COOH$, 146.48. Wh.leaf. **m.p.** 179–80. **Soly.** 0.3^{20}w.; s.al.

75 —, **5-methyl-.** $CH_3C_4H_2O{\cdot}COOH$, 126.05. Pl. or need.f.w. **m.p.** 108–9. **Soly.** v.s.h.w.; v.s.al.; v.s.et.

76 —, —, methyl ester. $CH_3C_4H_2O{\cdot}COOCH_3$, 140.06. Col.liq. **b.p.** 98^{15}. **Soly.** s.et.

77 —, **5-nitro-.** $NO_2C_4H_2O{\cdot}COOH$, 157.03. Wh.cr.f.w. **m.p.** 185.0–5.5, **b.p.** subl. **Soly.** s.h.w.; s.al.; s.et.

78 —, **tetrahydro-** (*tetrahydrofuroic acid*). $C_4H_7O{\cdot}COOH$, 116.06. Wh.cr. **D.** 1.1933, **m.p.** 21, **b.p.** 131–2^{14}.

79 Pyromucyl chloride (*2-furancarbonyl chloride; furoyl chloride*). C_4H_3OCOCl, 130.48. Col.liq. **m.p.** 0, **b.p.** 59.5–61.5^{7}; 176. **Soly.** d.w.; s.et.

80 1, 4-Pyrone (*4-keto-1, 4-pyran; α-pyrone*). $OCH{:}CHCOCH{:}CH$, 96.03. Pr., *n* 1.5238$^{40.3}$. **D.** 1.190$^{40.3}$, **m.p.** 32.5, **b.p.** 217.7. **Soly.** v.sl.s.w.; s.al.; v.s.et.

81 —, **5-hydroxy-2-hydroxymethyl-.** See *Kojic acid.*

82 Pyroracemic acid. See *Pyruvic acid.*

83 Pyrotartaric acid (*methylbutanedioic acid*; methylsuccinic acid*). $COOH{-}CH_2CH(CH_3)COOH$, 132.06. Tricl., *n* 1.43025$^{15.3}$. **D.** 1.410, **m.p.** 111, **b.p.** d. **Soly.** 66.7^{20}w.; 71al.; s.et.; 110^{19}me.al.

84 —, *α*-**hydroxy-.** See *Citramalic acid.*

85 Pyrotritaric acid (*2, 5-dimethyl-3-furancarboxylic acid; uvic acid; uvinic acid*). $(CH_3)_2C_4HO{\cdot}COOH$, 140.06. Col.need.f.w. **m.p.** 135(136–7), **b.p.** subl. **Soly.** 0.25^{100}w.; v.s.al.; v.s.et.

87 Pyrrocoline, octahydro-. See *Piperolidine.*

88 Pyrro(ab₁)diazole. See *1, 2, 4-Triazole.*

89 Pyrrole (*azole*). $NHCH{:}CHCH{:}CH$, 67.05. Col.liq., *n* 1.5035. **D.** 0.948$^{20}_{4}$ (0.9669$^{21}_{4}$), **b.p.** 131. **Soly.** i.w.; v.s.al.; v.s.et.; s.bz., dil.a.; i.dil.alk.

90 —, **1-acetyl-** (*N-acetylpyrrole*). $CH_3CONC_4H_4$, 109.06. Liq. **b.p.** 181–2. **Soly.** sl.s.w.; d.HCl.

91 —, **dihydro-*.** See *Pyrroline*.*

92 —, **2, 4-dimethyl-.** $NHC(CH_3){:}CHC(CH_3){:}CH$, 95.08. Pa.bl.fluores. liq. **D.** 0.927$^{14}_{4}$, **b.p.** 165^{743}(171). **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz.

93 —, **2, 5-dimethyl-.** $NHC(CH_3){:}CHCH{:}C(CH_3)$, 95.08. Oil., *n* 1.50357. **D.** 0.935, **b.p.** 165(169). **Soly.** v.sl.s.w.; s.al.; s.et.

For explanations and abbreviations see beginning of table.

94 **Pyrrole, 1-ethyl-** (*N-ethylpyrrole*). $C_2H_5NC_4H_4$, 95.08. **D.** 0.888[16], **b.p.** 130–1. **Soly.** i.w.; ∞al.; ∞et.

95 —, **1-methyl-** (*N-methylpyrrole*). $\overline{N(CH_3)CH:CHCH:CH}$, 81.06. Col. liq., *n* 1.4888[16]. **D.** 0.9203[10], **b.p.** 114–5[748]. **Soly.** i.w.; ∞al.; ∞et.

96 —, **2-methyl-** (*α-methylpyrrole*). $\overline{NCH(CH_3):CHCH:CH}$, 81.06. Liq. **D.** 0.945, **b.p.** 148. **Soly.** i.w.; ∞al.; ∞et.

97 —, **3-methyl-** (*β-methylpyrrole*). $\overline{NCH:CH(CH_3)CH:CH}$, 81.06. Liq. **b.p.** 143. **Soly.** sl.s.dil.a.

98 —, **1-propyl-** (*N-n-propylpyrrole*). $CH_3CH_2CH_2NC_4H_4$, 109.09. Liq. **b.p.** 145.5–6.5.

99 —, **tetrahydro-***. See *Pyrrolidine**.

00 —, **tetrahydro-2-oxo-.** See *2-Pyrrolidone*.

01 —, **2, 3, 4, 5-tetraiodo-*** (*iodol*). C_4I_4NH, 570.70. Yel.need.f.dil.al. **m.p.** d. 150. **Soly.** 0.02w.; 5.8[15] 90%al.; 50et.; s.bz., chl.

02 **2-Pyrrolecarboxylic acid*.** $C_4H_4N{\cdot}COOH$, 111.05. Monocl.pr. **m.p.** 191.5 d., **b.p.** d. 208.5. **Soly.** s.w.; s.al.; s.et.

03 **Pyrrolidine*** (*tetrahydropyrrole; tetramethylenimine*). $\overline{NHCH_2CH_2CH_2CH_2}$, 71.08. Col.liq. **D.** 0.871[10]; 0.8520[22], **b.p.** 88.5. **Soly.** ∞w.; ∞al.; ∞et.

04 —, **2-keto-.** See *2-Pyrrolidone*.

05 —, **1-methyl-** (*N-methylpyrrolidine*). $CH_3NC_4H_8$, 85.09. Liq. **b.p.** 81–3. **Soly.** s.w.

06 **2-Pyrrolidinecarboxylic acid*.** See *Proline*.

07 **2, 5-Pyrrolidinedione.** See *Succinimide*.

08 **2-Pyrrolidone** (*2-ketopyrrolidine; α-pyrrolidone*). $\overline{NHCOCH_2CH_2CH_2}$, 85.06. Cr. **D.** 1.116[25], **m.p.** 24.6, **b.p.** 245(250.8). **Soly.** v.s.w.; v.s.al.; v.s.et.

09 **Pyrroline*** (*dihydropyrrole**). C_4H_5N, 67.05. Liq. **D.** 0.910^{22}_{4}, **b.p.** 90. **Soly.** v.s.w.; ∞al.; ∞et.

10 **Pyrrolylene.** See *1, 3-Butadiene**.

11 *α*-**Pyrromonazole.** See *Pyrazole*.

12 **Pyruvaldehyde,** aldoxime (*2-oxopropanal 1-oxime*; isonitrosoacetone*). $CH_3COCH{:}NOH$, 87.05. Leaf.f.et. **D.** 1.074[67.5], **m.p.** 69, **b.p.** subl. **Soly.** v.s.w.; v.s.et.; v.sl.s.pet.eth.

13 **Pyruvic acid** (*2-oxopropanoic acid*; α-ketopropionic acid; pyroracemic acid; acetylformic acid*). $CH_3COCOOH$, 88.03. Col.liq. **D.** 1.267, **m.p.** 13.6, **b.p.** 165sl.d. **Soly.** ∞w.; ∞al.; ∞et.

14 —, ethyl ester (*ethyl pyruvate*). $CH_3COCOOC_2H_5$, 116.06. Col.liq. **D.** 1.060^{14}_{4}, **b.p.** 144; 55[17]. **Soly.** sl.s.w.; ∞al.; ∞et.

15 —, methyl ester (*methyl 2-oxopropanoate*; methyl pyruvate*). $CH_3COCOOCH_3$, 102.05. Col.liq. **D.** 1.154[0], **b.p.** 137. **Soly.** sl.s.w.; ∞al.; ∞et.

16 **Pyruvonitrile** (*2-oxopropanenitrile*; acetyl cyanide*). CH_3COCN, 69.03. Rhomb. **b.p.** 93. **Soly.** d.w.; s.et.

17 **Quercetin** (*3, 3′, 4′, 5, 7-pentahydroxyflavone; meletin; sophoretin*). $C_{15}H_{10}O_7$, 302.08. Yel.need. **m.p.** anh. 310 d., **b.p.** subl. **Soly.** 0.35w.; 0.48al.; v.sl.s.et.; s.alk.

18 *d*-**Quercitol** (*cyclohexanepentol** (one form); *d-quercite*). $C_6H_7(OH)_5$, 164.09. Col.monocl. **D.** 1.585[13], **m.p.** 234, **b.p.** d. **Soly.** 10c.w.; sl.s.al.; i.et.

19 **Quercitrin.** $C_{21}H_{20}O_{11}$, 448.16. Yel. need. or leaf. **m.p.** 250–2; 185; (168d.). **Soly.** 0.04[20], 0.69[100]w.; 25.6[78] al.; 0.8et.; s.alk.sol., amyl.al., ac.a.

20 **Quinacetophenone.** See *Acetophenone, 2, 5-dihydroxy-*.

21 **Quinaldic acid, 4-hydroxy-.** See *Kynurenic acid*.

22 **Quinaldine,** (*2-methylquinoline*). $CH_3C_9H_6N$, 143.08. Col.liq. **D.** 1.1013, **b.p.** 246–7. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl.

23 —, **hydroxy-.** See *Quinolinol, 2-methyl-*.

24 —, **methyl-.** See *Quinoline, dimethyl-*.

25 **Quinalgen.** See *Analgen*.

26 **Quinalizarin** (*1, 2, 5, 8-tetrahydroxyanthraquinone; alizarin bordeaux*). $(HO)_2C_6H_2(CO)_2C_6H_2(OH)_2$, 272.06. Red rhomb.need. **m.p.** >275, **b.p.** subl. **Soly.** i.w.; v.sl.s.al.; v.sl.s.et.

27 **Quinamine.** $C_{19}H_{24}N_2O_2$, 312.20. Need. **m.p.** 172. **Soly.** i.w.; v.s.h.al.; s.h.et.

28 *p*-**Quinanisole.** See *Quinoline, 6-methoxy-*.

29 **Quinazine.** See *Quinoxaline*.

* Name approved by the International Union of Chemistry.

30 **Quinazoline** (*benzo[a]pyrimidine; 1,3-benzodiazine; phenmiazine*). $C_6H_4N{:}CHN{:}CH$, 130.06. Pl.f.pet.eth. **m.p.** 48, **b.p.** 243. **Soly.** v.s.w.; s.al.; s.et.

31 —, **3,4-dihydro-3-phenyl-** (*orexin; phenzoline; cedrarine*). $C_6H_4N{:}CHN(C_6H_5)CH_2$, 208.11. Hex.pl. **D.** 1.290^4, **m.p.** 95. **Soly.** s.al.; s.et.

32 **Quinhydrone** (*benzoquinhydrone*). $C_6H_4O_2{\cdot}C_6H_4(OH)_2$, 218.08. Dk.grn. rhomb.pr. **D.** 1.401^{20}_{4}, **m.p.** 171, **b.p.** subl. **Soly.** s.h.w.; v.s.al.; v.s.et.; s.NH_4OH; d.chl.

33 **Quinic acid** (*1,2,4,5-tetrahydroxycyclohexanecarboxylic acid**). $(HO)_4{\cdot}C_6H_7COOH$, 192.09. Col.monocl.f.w. **D.** 1.637, **m.p.** 163, **b.p.** d. **Soly.** 40^9w.; s.al.; v.sl.s.et.; s.ac.a.

34 **Quinicine.** $C_{20}H_{24}N_2O_2$, 324.20. Yel. oil. **m.p.** 60. **Soly.** sl.s.w.; s.al.; s.et.; s.chl.

35 —, oxalate (*d*). $(C_{20}H_{24}N_2O_2)_2{\cdot}H_2C_2O_4{\cdot}9H_2O$, 900.56. Pr.f.chl. or need.f. al. **m.p.** 149. **Soly.** s.h.w.; s.al.; s.chl.

36 **Quinidine** (*conquinine*). $C_{20}H_{24}N_2O_2{\cdot}2\frac{1}{2}H_2O$, 369.24. Pr.f.al., $[\alpha]$ $-274.7^{\circ 17}_{D}$ in al. + chl. **m.p.** 171.5 d. **Soly.** 0.05^{15}w.; 4^{20}80% al.; 4.5^{20}et.; s.chl.

37 —, bisulfate. $C_{20}H_{24}N_2O_2{\cdot}H_2SO_4{\cdot}4H_2O$, 494.34. Hair-like need.; bl.fluores. in sol., $[\alpha]$ 184.17°$_D$ 3% sol. in chl. **Soly.** 1^{15}w.; 12al.; v.sl.s.et.

38 —, hydrochloride(*d*). $C_{20}H_{24}N_2O_2{\cdot}HCl{\cdot}H_2O$, 378.68. Asbestoslike pr., $[\alpha]$ 2.212–2.562°$_D$ 97% al. **m.p.** anb. 258–9 d. **Soly.** 1.6^{10}w.; v.s.al.; v.sl.s. et.; v.s.chl.

39 —, sulfate (*d*). $(C_{20}H_{24}N_2O_2)_2{\cdot}H_2SO_4{\cdot}2H_2O$, 782.51. Pr. or need.; sol.fluores. bl., $[\alpha]$ + 184.17°$_D$ 3% sol. in chl. **Soly.** 1^{15}w.; 12al.; v.sl.s.et.; s.chl.

40 **Quinine**(anhydrous). $C_{20}H_{24}N_2O_2$, 324.20. Amor.powd. **m.p.** 174.9. **Soly.** 0.0571w.; 166al.; 22.2et.

41 **Quinine** (hydrate). $C_{20}H_{24}N_2O_2{\cdot}3H_2O$, 378.25. Flaky or micro.cr. powd., effior., *n* 1.620, 1.625, 1.630; $[\alpha]$ − $145.2^{\circ 15}_{D}$. **m.p.** 57. **Soly.** 0.064 w.; 154al.; 73.8et.; s.chl., bz., CS_2, oils, glyc.

42 —, arsenate. $(C_{20}H_{24}N_2O_2)_2{\cdot}H_3AsO_4{\cdot}8H_2O$, 934.48. Wh.cr. **Soly.** s.h.w.

43 —, bisulfate. $C_{20}H_{24}N_2O_2{\cdot}H_2SO_4{\cdot}7H_2O$, 548.39. Sm.orthorhomb.need. efflor. **m.p.** 160 d. **Soly.** 11.1w.; 5.36al.; 0.056et.; s.chl.

44 —, dihydrochloride. $C_{20}H_{24}N_2O_2{\cdot}2HCl$, 397.13. Wh.powd. or need. **Soly.** 166.6w.; 10.3al.; v.sl.s.et.; sl.s.chl.

45 —, formate. $C_{20}H_{24}N_2O_2{\cdot}HCOOH$, 370.22. Cr.powd. **m.p.** 109. **Soly.** 3w.; s.al.; v.sl.s.et.; s.chl.

46 —, hydrobromide. $C_{20}H_{24}N_2O_2{\cdot}HBr{\cdot}H_2O$, 423.14. Silky efflor.need. **m.p.** 152–200. **Soly.** 2.5w.; 149.2al.; 6.25 et.; s.chl.

47 —, (mono)hydrochloride. $C_{20}H_{24}O_2N_2{\cdot}HCl$, 360.67. Silky efflor.need., $[\alpha]$ $-144.98^{\circ 15}_{D}$ in w. **m.p.** 158–60, **b.p.** 259 d. **Soly.** 5.6^{25}w.; 166^{25}al.; 0.42^{25} et.; s.CS_2, bz., oils, glyc., NH_4OH, KOHsol., ac.

48 —, (mono)hydrochloride(hydrate). $C_{20}H_{24}O_2N_2{\cdot}HCl{\cdot}2H_2O$, 396.70. Silky efflor.need., $[\alpha]$ − $144.98^{\circ 15}_{D}$ **m.p.** 156–90. **Soly.** 5.55w.; 166al.; 0.415 et.; s.chl., glyc.

49 —, iodosulfate (*herapathite*). $4C_{20}H_{24}N_2O_2{\cdot}3H_2SO_4{\cdot}2HI{\cdot}I_4{\cdot}6H_2O$, 2462.69. Red-grn.dichroic cr. or olive grn.powd. **Soly.** d.w.; 0.12c., s.h.al.

50 —, salicylate. $C_{20}H_{24}N_2O_2{\cdot}C_7H_6O_3{\cdot}H_2O$, 480.27. Col.need. **m.p.** 185 d. **Soly.** 1.3w.; 8.8al.; 0.88et.; s.chl., glyc.

51 —, sulfate. $(C_{20}H_{24}N_2O_2)_2{\cdot}H_2SO_4$, 746.48. Silky efflor.need. **m.p.** anh. 235. **Soly.** 0.14^{25}w.; 1.16^{25}al.; sl.s.et.; s.CS_2, bz., oils, glyc., KOHsol., NH_4OH, a.; sl.s.chl.

52 —, sulfate(hydrate). $(C_{20}H_{24}N_2O_2)_2{\cdot}H_2SO_4{\cdot}2H_2O$, 782.51. Silky cr. or need., efflor. **m.p.** 205. **Soly.** 0.139w.; 1.16al.; sl.s.et.; s.glyc.; sl.s.chl.

53 —, urea-hydrochloride. $C_{20}H_{24}O_2N_2{\cdot}HCl{\cdot}CO(NH_2)_2{\cdot}HCl{\cdot}5H_2O$, 547.26. Wh.pr. or powd. **m.p.** 70–5. **Soly.** 111.1w.; 51.4al.

54 —, valerate. $C_{20}H_{24}N_2O_2{\cdot}C_5H_{10}O_2{\cdot}H_2O$, 444.30. Cr.powd. **m.p.** 90. **Soly.** 0.8w.; 50al.; 7et.

55 **Quinizarin** (*1,4-dihydroxyanthraquinone*). $C_6H_4(CO)_2C_6H_2(OH)_2$, 240.06. Red need.f.al. **m.p.** 194–5, **b.p.** subl. sl.d. **Soly.** s.al.; s.et.; s.bz., KOH., H_2SO_4.

56 **Quinol.** See *Hydroquinone.*

57 **Quinoline** (*benzo[b]pyridine; 1-benzazine*). $C_6H_4N{:}CHCH{:}CH$, 129.06. Col.liq., *n* $1.62450^{24.9}$. **D.** 1.095^{20}_{4}, **m.p.** −19.5, **b.p.** 237.7. **Soly.** 6w.; ∞al.; ∞et.; ∞CS_2.

For explanations and abbreviations see beginning of table.

58 **Quinoline, 2-amino-** (*α-quinolylamine*). $NH_2C_9H_6N$, 144.08. Leaf.f.w. **m.p.** 129. **Soly.** v.sl.s.c., s.h.w.; v.s.al.; v.s.et.; s.chl.; sl.s.bz., lgr.

59 —, **4-amino-** (*γ-quinolylamine*). NH_2-C_9H_6N, 144.08. Need. (+1H_2O) f.w. **m.p.** anh. 154; +1H_2O, 69–70, **b.p.** −H_2O, 100. **Soly.** s.w.; s.al.; v.s.chl.; sl.s.lgr., CS_2.

60 —, **5-benzamido-8-ethoxy-.** See *Analgen.*

61 —, **2-chloro-*** (*α-chloroquinoline*). ClC_9H_6N, 163.51. Need.f.dil.al. **D.** 1.275^{17}, **m.p.** 37–8, **b.p.** 266–7(276). **Soly.** i.w.; s.al.; s.et.; s.bz., lgr.

62 —, **3-chloro-*** (*β-chloroquinoline*). ClC_9H_6N, 163.51. Hyg. **b.p.** 255^{743}.

63 —, **4-chloro-*** (*γ-chloroquinoline*). ClC_9H_6N, 163.51. Cr. **D.** 1.251, **m.p.** 34, **b.p.** 261^{744}. **Soly.** v.s.al.; v.s.et.; s.dil.HCl.

64 —, **decahydro-*.** $C_9H_{17}N$, 139.14. *cis:* Col.liq. **D.** 0.9426^{20}_{4}, **m.p.** −40, **b.p.** 205–6(83–3.5^{16}). **Soly.** sl.s.w.; s.al.; s.et.
trans: Wh.cr. **D.** $0.9021^{55.5}_{4}$, **m.p.** 48, **b.p.** 203^{735}. **Soly.** s.h.w.; v.s.al.; v.s.et.

65 —, **2, 3-dichloro-*.** $C_9H_5Cl_2N$, 197.96. Cr.f.dil.al. **m.p.** 104–5. **Soly.** i.w.; s.al.; s.et.; s.bz.; sl.s.lgr.

66 —, **5, 8-dichloro-*.** $C_9H_5Cl_2N$, 197.96. Sh.need.f.al. **m.p.** 93. **Soly.** s.al.; s.et.

67 —, **6, 8-dichloro-*.** $C_9H_5Cl_2N$, 197.96. Lng.need.f.al. **m.p.** 104–5. **Soly.** s.al.; s.et.

68 —, **7, 8-dichloro-*.** $C_9H_5Cl_2N$, 197.96. Need. **m.p.** 85.5. **Soly.** s.al.; s.et.

70 —, **2, 3-dimethyl-** (*3-methylquinaldine*). $(CH_3)_2C_9H_5N$, 157.09. Yel. need.or leaf. **D.** 1.1013^{10}, **m.p.** 68–9, **b.p.** 261 (247). **Soly.** sl.s.w.; s.al.; s.et.; s.lgr.

71 —, **2, 4-dimethyl-** (*4-methylquinaldine*). $(CH_3)_2C_9H_5N$, 157.09. Liq. **D.** 1.061^{15}_{4}, **b.p.** 264. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

72 —, **2, 6-dimethyl-** (*p-toluquinaldine; 6-methylquinaldine*). $(CH_3)_2C_9$-H_5N, 157.09. Trim.f.et. **m.p.** 60, **b.p.** 266–7 (259–61). **Soly.** sl.s.h.w.; s.al.; s.et.

73 —, **3, 4-dimethyl-.** $(CH_3)_2C_9H_5N$, 157.09. Cr. **m.p.** 73–4 (65), **b.p.** 290^{737}. **Soly.** i.w.; s.al.; s.et.

74 —, **5, 8-dimethyl-.** $(CH_3)_2C_9H_5N$, 157.09. Liq. **D.** 1.070^{21}_{4}, **m.p.** 4–5, **b.p.** 265^{736}. **Soly.** sl.s.w.; s.al.; s.et.

75 —, **6, 8-dimethyl-** (*β-cytisolidine*). $(CH_3)_2C_9H_5N$, 157.09. Liq. **D.** 1.0665^4, **b.p.** 269. **Soly.** sl.s.w.; s.al.; s.et.

76 —, **2-homopiperonyl-4-methoxy-.** See *Cusparine.*

77 —, **6-methoxy-** (*p-quinanisole; methyl 6-quinolyl ether*). C_9H_6N-OCH_3, 159.08. Liq. **D.** 1.665^0; 1.154^{20}, **m.p.** < −18, **b.p.** 186^{35}. **Soly.** s.al.

78 —, **2-methyl-.** See *Quinaldine.*

79 —, **3-methyl-** (*β-methylquinoline*). $CH_3C_9H_6N$, 143.08. Col.liq. or cr., *n* $1.60695^{23.3}$. **D.** 1.074, **m.p.** 14, **b.p.** 250. **Soly.** i.w.; s.al.; s.et.

80 —, **4-methyl-.** See *Lepidine.*

81 —, **6-methyl-.** $CH_3C_9H_6N$, 143.08. *n* 1.6141^{23}. **D.** 1.066, **m.p.** 10–4, **b.p.** 255. **Soly.** v.sl.s.(i.)w.; s.al.; s.et.

82 —, **7-methyl-.** $CH_3C_9H_6N$, 143.08. Yel.oil. **D.** 1.072, **m.p.** < −20, **b.p.** 252.5. **Soly.** v.sl.s.(i.)w.; s.al.; s.et.

83 —, **8-methyl-.** $CH_3C_9H_6N$, 143.08. Liq. **D.** 1.073, **b.p.** 247.3–8.3^{751}. **Soly.** v.sl.s.(i.)w.; s.al.; s.et.

84 —, **1-methyl-1, 2, 3-4-tetrahydro-.** See *Kairoline.*

85 —, **5-nitro-*.** $NO_2C_9H_6N$, 174.06. Need.f.w. **m.p.** 72, **b.p.** subl. **Soly.** sl.s.h.w.; s.bz.

86 —, **6-nitro-*.** $NO_2C_9H_6N$, 174.06. Need. **m.p.** 150, **b.p.** subl. **Soly.** v.sl.s.c., s.h.w.; v.sl.s.al.; v.sl.s.et.; v.s.bz.; sl.s.lgr.

87 —, **7-nitro-*.** $NO_2C_9H_6N$, 174.06. Need.f.al. **m.p.** 133. **Soly.** v.sl.s.al.; v.s.et.

88 —, **8-nitro-*.** $NO_2C_9H_6N$, 174.06. Monocl.need.f.al. **m.p.** 89. **Soly.** v.sl.s.c.w.; s.al.; s.et.; s.bz.

89 —, **2-phenyl-.** $C_6H_5C_9H_6N$, 205.09. Need.f.al. **m.p.** 86; **b.p.** 363. **Soly.** sl.s.w.; v.s.h.al.; v.s.et.

90 —, **6-phenyl-.** $C_6H_5C_9H_6N$, 205.09. Trim.f.et. or al. **D.** 1.195, **m.p.** 111, **b.p.** 260^{77}. **Soly.** v.sl.s.w.; s.al.; s.et.

91 —, **8-phenyl-.** $C_6H_5C_9H_6N$, 205.09. Thk.fluores.oil. **b.p.** 283^{157}. **Soly.** s.al.; s.et.; s.bz.

92 —, **1, 2, 3, 4-tetrahydro-*.** $C_9H_{11}N$, 133.09. Col.-yel.cr., *n* $1.59331^{23.9}$. **D.** 1.055, **m.p.** 20, **b.p.** 251. **Soly.** v.sl.s.w.; ∞al.; ∞et.

93 —, **1, 2, 3, 4-tetrahydro-6-methoxy-.** See *Thalline.*

94 —, **2, 3, 4-trimethyl-.** C_9H_4N-$(CH_3)_3$, 171.11. Cr. **m.p.** *ca.* 65, **b.p.** 285.

* Name approved by the International Union of Chemistry.

95 **Quinoline, 2, 4, 5-trimethyl-.** $C_9H_4N(CH_3)_3$, 171.11. Need.f.w. **m.p.** 63–4. **Soly.** s.w.

96 —, **2, 5, 7-trimethyl-** (*tetracoline*). $C_9H_4N(CH_3)_3$, 171.11. Pr. **m.p.** 43, **b.p.** 285–7. **Soly.** v.s.w.; v.s.al.; v.s.et.

97 —, **2, 6, 7-trimethyl-.** $C_9H_4N(CH_3)_3$, 171.11. Monocl.

98 —, **2, 6, 8-trimethyl-.** $C_9H_4N(CH_3)_3$, 171.11. Monocl.pr.f.lgr. **m.p.** 46, **b.p.** 260^{719}. **Soly.** i.w.; v.s.al.; v.s.lgr.

99 **Quinolinic acid** (2, 3-*pyridinedicarboxylic acid**). $C_5H_3N(COOH)_2$, 167.05. Monocl.pr. **m.p.** 190 d. (195). **Soly.** $0.55^{6.5}$w.; sl.s.al.; v.sl.s.et.

00 **2-Quinolinol.** See *Carbostyril.*

01 **4-Quinolinol** (*kynurine*). $HOC_9H_6N{\cdot}3H_2O$, 199.11. Col.monocl.need. f.w. **m.p.** $3H_2O$, 52; $-H_2O$, 110; anh. 201, **b.p.** >300 d. **Soly.** 0.47^{15}w.; s.al.; sl.s.et.

02 —, **2-methyl-** (*4-hydroxyquinaldine*). $C_{10}H_9NO$, 159.08. Pr.f.w. **m.p.** 231, **b.p.** d. **Soly.** 1c., 10h.w.; s.al.; v.sl.s.et.; v.sl.s.bz.

03 **5-Quinolinol.** HOC_9H_6N, 145.06. Pr. or leaf.f.al. **m.p.** 224, **b.p.** subl. **Soly.** sl.s.w.; s.al.; sl.s.et.; v.s.h.Na_2CO_3; i.lgr.

04 **6-Quinolinol.** HOC_9H_6N, 145.06. Sm.pr.f.al. **m.p.** 193, **b.p.** 360. **Soly.** v.sl.s.w.; sl.s.al.; v.sl.s.et.; s.alk.

05 —, **2-methyl-** (*6-hydroxyquinaldine*). $C_{10}H_9NO$, 159.08. Cr. **m.p.** 213, **b.p.** sl.d. **Soly.** v.sl.s.w.; s.al.; s.et.

06 **7-Quinolinol.** HOC_9H_6N, 145.06. Pr.f.al. **m.p.** 235–8 d., **b.p.** subl. **Soly.** sl.s.w.; v.s.al.; s.alk.

07 —, **2-methyl-** (*7-hydroxyquinaldine*). $C_{10}H_9NO$, 159.08. Leaf.f.al. **m.p.** 232–4, **b.p.** sl.d. **Soly.** i.w.; s.h.al.; s.et.

08 **8-Quinolinol.** HOC_9H_6N, 145.06. Pr.f.dil.al. **m.p.** 76 (73–4), **b.p.** 266.9. **Soly.** v.sl.s.w.; v.s.al.; sl.s.et.; s.dil.alk.

09 —, **2-methyl-** (*8-hydroxyquinaldine*). $C_{10}H_9NO$, 159.08. Tricl.pr.f.al. **m.p.** 74, **b.p.** 267.

10 **2(1)-Quinolone.** See *Carbostyril.*

11 —, **3, 4-dihydro-.** See *Hydrocarbostyril.*

12 **α-Quinolylamine.** See *Quinoline, 2-amino-.*

13 **γ-Quinolylamine.** See *Quinoline, 4-amino-.*

14 **Quinone**(para or ordinary) (*p-benzoquinone; 1, 4-cyclohexadienedione**). $O{:}C_6H_4{:}O$, 108.03. Yel.monocl.pr.f.w. **D.** 1.318^{20}_{4}, **m.p.** 115.7, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.; s.h.lgr., alk.

15 —, bischloroimide (*p-benzoquinone bischloroimide*). $C_6H_4({:}NCl)_2$, 174.96. Need.f.w. **m.p.** 124 d. **Soly.** sl.s.h.w.; s.h.al.; s.et.; v.s.bz.

16 —, chloroimide (*p-benzoquinone monochloroimide*). $O{:}C_6H_4{:}NCl$, 141.50. Yel.cr.f.lgr. **m.p.** 84.7–5.0, **b.p.** exp. **Soly.** s.h.w.; v.s.h.al.; v.s.et.; v.s.chl.; s.a.

17 —, dioxime (*p-benzoquinone dioxime*). $C_6H_4({:}NOH)_2$, 138.06. Col. or yel. need. **m.p.** 240 d. **Soly.** s.h.w.; s. NH_4OH.

18 —, monoxime. See *Phenol, p-nitroso-.*

19 —, **2, 6-dichloro-** (*2, 6-dichloro-p-benzoquinone*). $C_6H_2Cl_2O_2$, 176.93. Yel.rhomb.pr.f.lgr. or bz. **m.p.** 121, **b.p.** subl. <120. **Soly.** sl.s.w.; s.h. al.; s.chl.

20 —, **2, 5-dichloro-3, 6-dihydroxy-.** See *Chloranilic acid.*

21 —, **2, 5-dihydroxy-** (*2, 5-dihydroxy-p-benzoquinone*). $C_6H_2O_2(OH)_2$, 140.03. Dk.yel.need.f.et.ac. **m.p.** 215–20 sl.d., **b.p.** subl. **Soly.** v.sl.s. w.; s.al.; v.sl.s.et.; s.ac.a.

22 —, **2, 5-dihydroxy-3, 6-dinitro-.** See *Nitranilic acid.*

23 —, **2, 3-dimethyl-.** See *o-Xyloquinone.*

24 —, **2, 5-dimethyl-.** See *Phlorone.*

25 —, **2, 6-dimethyl-.** See *m-Xyloquinone.*

26 —, **2-methyl-.** See *Toluquinone.*

27 —, **nitro-.** $NO_2C_6H_3O_2$, 153.03. Yel. **m.p.** d.*ca.*206. **Soly.** v.s.h.w.; s.al.; sl.s.et.

28 —, **tetrachloro-.** See *Chloranil.*

29 —, **tetrahydro-.** See *1, 4-Cyclohexanedione**.

30 —, **tetrahydroxy-.** $(HO)_4C_6O_2$, 172.03. Bl.cr. **m.p.** d. **Soly.** s.h.w.; v.s.al.; sl.s.et.

31 —, **trichloro-.** $Cl_3C_6HO_2$, 211.38. Yel.leaf.f.w. **m.p.** 168–9, **b.p.** subl. **Soly.** i.w.; sl.s.al.; v.s.et.

32 **Quinovic acid.** $C_{32}H_{48}O_6$, 528.37. Wh.cr.powd. **Soly.** i.w.; sl.s.h.al.; i.et.; s.chl., NH_4OH.

33 **Quinoxaline** (*benzopyrazine; 1, 4-benzodiazine; quinazine*). $C_6H_4N{:}CH{-}CH{:}N$, 130.06. Wh.cr., *n* $1.62311^{48.0}$ **D.** 1.133^{48}, **m.p.** 30.5, **b.p.** 226. **Soly.** s.w.; s.al.; s.et.; ∞bz.

For explanations and abbreviations see beginning of table.

34 Racemic acid. See *dl-Tartaric acid.*

35 R acid. See *2-Naphthol-3, 6-disulfonic acid.*

36 Raffinose. $C_{18}H_{32}O_{16}·5H_2O$, 594.33. Need.f.w. **D.** 1.465[0], **m.p.** anh. 118–9, **b.p.** 130 d. **Soly.** 14[20], ∞h.w.; v.sl.s.al.; i.et.; s.me.al.

37 Resacetophenone (*2, 4-dihydroxyacetophenone*). $CH_3COC_6H_3(OH)_2$, 152.06. Need. **m.p.** 147. **Soly.** i.w.; s.al.; s.et.

38 —, 4-methyl ether. See *Peonol.*

39 Resodiacetophenone (*4, 6-diacetylresorcinol*). $(CH_3CO)_2C_6H_2(OH)_2$, 194.08. Wh.need. **m.p.** 180. **Soly.** i.w.; sl.s.al.; s.et.

40 Resorcinol (*1, 3-benzenediol*; resorcin*). $C_6H_4(OH)_2$, 110.05. Col.rhomb. tab.f.w. or bz. **D.** 1.285[15], **m.p.** 110, **b.p.** 276.5 (281.4). **Soly.** 229[30] w.; 243[25]al.; v.s.et.; s.glyc., bz., amyl al.

41 —, diethyl ether. See *Benzene, 1, 3-diethoxy-*.*

42 —, diisoamyl ether. See *Benzene, 1, 3-diisoamoxy-.*

43 —, dimethyl ether. See *Benzene, 1, 3-dimethoxy-*.*

44 —, dipropyl ether. See *Benzene, 1, 3-dipropoxy-*.*

45 —, monoamyl ether. See *Phenol, m-amoxy-.*

46 —, monobutyl ether. See *Phenol, m-butoxy-.*

47 —, monoethyl ether. See *Phenol, m-ethoxy-.*

48 —, monomethyl ether. See *Phenol, m-methoxy-.*

49 —, monopropyl ether. See *Phenol, m-propoxy-.*

50 —, **4-amyl-** (*1-n-amyl-2, 4-dihydroxybenzene*). $CH_3(CH_2)_4C_6H_3(OH)_2$, 180.12. Col. **m.p.** 71.5–3.0, **b.p.** 168–70[6]. **Soly.** v.sl.s.w.; s.al.; s.et.

51 —, **4-benzoyl-.** See *Benzophenone, 2, 4-dihydroxy-.*

52 —, **4-butyl-** (*1-n-butyl-2, 4-dihydroxybenzene*). $CH_3(CH_2)_3C_6H_3(OH)_2$, 166.11. Col. **m.p.** 47–8, **b.p.** 196–200[24]. **Soly.** v.sl.s.w.; s.al.; s.et.

53 —, **4-caproyl-.** See *Caprophenone, 2, 4-dihydroxy-.*

54 —, **4, 6-diacetyl-.** See *Resodiacetophenone.*

55 —, **dihydro-.** See *1, 3-Cyclohexanedione*.*

56 —, **2, 4-dimethyl-** (*2, 4-dimethyl-1, 3-benzenediol*; 2, 4-dihydroxy-m-xylene*). $(CH_3)_2C_6H_2(OH)_2$, 138.08. Need. by subl. **m.p.** 149–50. **Soly.** s.w.; v.s.al.; v.s.et.

57 —, **2, 5-dimethyl-** (*2, 5-dimethyl-1, 3-benzenediol*; p-xylorcinol; β-orcinol; 2, 6-dihydroxy-p-xylene; betorcinol*). $(CH_3)_2C_6H_2(OH)_2$, 138.08. Tetrag.f. w. or bz. **m.p.** 163, **b.p.** 277–80. **Soly.** s.w.; s.al.; s.et.

58 —, **4, 5-dimethyl-** (*4, 5-dimethyl-1, 3-benzenediol*; 3, 5-dihydroxy-o-xylene*). $(CH_3)_2C_6H_2(OH)_2$, 138.08. Need.f.bz.; pr. (+1H_2O) f.w. **m.p.** +1H_2O, 115–7; anh. 136–7, **b.p.** subl. **Soly.** s.w.; v.s.al.; v.s.et.; s.ac.a.; sl.s.chl., bz.; v.sl.s.CS_2.

59 —, **4, 6-dimethyl-** (*4, 6-dimethyl-1, 3-benzenediol*; m-xylorcinol; 4, 6-dihydroxy-m-xylene*). $(CH_3)_2C_6H_2(OH)_2$, 138.08. Monocl.cr.f.w., chl. or bz. **m.p.** 124.5–5, **b.p.** 276–9 subl. **Soly.** s.w.; s.al.; s.et.

60 —, **2, 4-dinitro-** (*2, 4-dinitro-1, 3-benzenediol*; v-dinitroresorcin*). $(NO_2)_2C_6H_2(OH)_2$, 200.05. Yel.leaf. **m.p.** 147–8, **b.p.** subl; exp. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.chl.

61 —, **dithio-** (*1, 3-benzenedithiol*; m-phenylene dimercaptan*). $C_6H_4(SH)_2$, 142.17. Col.shiny cr. **m.p.** 27(25), **b.p.** 243–5. **Soly.** i.w.; s.al.; s.et.; s.alk.

62 —, **4-ethyl-** (*1, 3-dihydroxy-4-ethylbenzene*). $C_2H_5C_6H_3(OH)_2$, 138.08. Col.pr. **m.p.** 98–9, **b.p.** 131[15]. **Soly.** s.w.; s.al.; s.et.

63 —, **4-hexyl-** (*1-n-hexyl-2, 4-dihydroxybenzene; caprokol*). $CH_3(CH_2)_5C_6H_3(OH)_2$, 194.14. Col.need. **m.p.** 68–70, **b.p.** 178–80[7]. **Soly.** 0.05w.; v.s.al.; v.s.et.; v.s.acet.; s.bz.; sl.s.pet.eth.

64 —, **4-isoamyl-** (*2, 4-dihydroxy-1-isoamylbenzene*). $(CH_3)_2CH(CH_2)_2C_6H_3(OH)_2$, 180.12. Col. **m.p.** 61–2.5, **b.p.** 177–8[6]. **Soly.** v.sl.s.w.; s.al. s.et.

65 —, **4-isobutyl-** (*2, 4-dihydroxy-1-isobutylbenzene*). $(CH_3)_2CHCH_2C_6H_3(OH)_2$, 166.11. Col. **m.p.** 63.5, **b.p.** 166–8[6]. **Soly.** sl.s.w.; s.al.; s.et.

66 —, **4-isohexyl-** (*2, 4-dihydroxy-1-isohexylbenzene*). $(CH_3)_2CH(CH_2)_3C_6H_3(OH)_2$, 194.14. Col. **m.p.** 70–1.5, **b.p.** 182–3[6]. **Soly.** v.sl.s.w.; s.al. s.et.

67 —, **4-isopropyl-** (*2, 4-dihydroxy-1-isopropylbenzene*). $(CH_3)_2CHC_6H_3(OH)_2$, 152.09. Col. **m.p.** 105, **b.p.** 265–81. **Soly.** sl.s.w.; s.al.; s.et.

68 —, **2-methoxy-** (*pyrogallol 2-methyl ether*). $CH_3OC_6H_3(OH)_2$, 140.06. Cr. f.bz. **m.p.** 85–7, **b.p.** 154–5[24].

69 —, **5-methoxy-** (*phloroglucinol monomethyl ether*). $CH_3OC_6H_3(OH)_2$, 140.06. Tab.f.bz. **m.p.** 78.81, **b.p.** 213[1]. **Soly.** sl.s.w.; v.s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

70 **Resorcinol, 2-methyl-** (*2-methyl-1, 3-benzenediol**; *2, 6-dihydroxytoluene*). $CH_3C_6H_3(OH)_2$, 124.06. Col.need. **m.p.** 116–21, **b.p.** 264. **Soly.** s.w.; s.al.; s.et.; s.bz.

71 —, **4-methyl-.** See *Cresorcinol.*

72 —, **5-methyl-.** See *Orcinol.*

73 —, **4-propionyl-.** See *Propiophenone, 2, 4-dihydroxy-.*

74 —, **4-propyl-** (*2, 4-dihydroxy-1-propylbenzene*). $CH_3(CH_2)_2C_6H_3(OH)_2$, 152.09. Col.pr.f.bz. **m.p.** 107–8(82–3), **b.p.** $172–4^{14-5}$. **Soly.** s.w.; s.al.; s.et.

75 —, **2-salicylyl-.** See *Benzophenone, 2, 2′, 6-trihydroxy-.*

76 —, **2, 4, 6-tribromo-.** $Br_3C_6H(OH)_2$, 346.77. Col.need.f.w. **m.p.** 111. **Soly.** sl.s.w.; v.s.al.; s.et.

77 —, **2, 4, 6-trimethyl-.** See *Mesorcinol.*

78 —, **2, 4, 6-trinitro-.** See *Styphnic acid.*

79 **Resorcinolphthalein.** See *Fluoresceïn.*

80 β-**Resorcylaldehyde** (*2, 4-dihydroxybenzaldehyde; 2, 4-dihydroxybenzenecarbonal**). $(HO)_2C_6H_3CHO$, 138.05. Yel. need.f.w. **m.p.** 135, **b.p.** $220–8^{22}$. **Soly.** v.s.w.; v.s.al.; v.s.et.; sl.s.c.bz.

81 —, dimethyl ether. See *Benzaldehyde, 2, 4-dimethoxy-.*

82 α-**Resorcylic acid** (*3, 5-dihydroxybenzoic acid; 3, 5-dihydroxybenzenecarboxylic acid**). $(HO)_2C_6H_3COOH \cdot 1\frac{1}{2}H_2O$, 181.07. Col.pr. **m.p.** 232–3; anh. 237. **Soly.** s.w.; v.s.al.; v.s.et.

83 β-**Resorcylic acid** (*2, 4-dihydroxybenzoic acid; 2, 4-dihydroxybenzenecarboxylic acid**). $(HO)_2C_6H_3COOH \cdot 3H_2O$, 208.09. Col.need.f.et. **m.p.** *ca.* 213 (226-7 d.), **b.p.** d. **Soly.** 0.26^{17}w.; v.s.al.; v.s.et.

84 γ-**Resorcylic acid** (*2, 6-dihydroxybenzoic acid; 2, 6-dihydroxybenzenecarboxylic acid**). $(HO)_2C_6H_3COOH \cdot 1\frac{1}{2}H_2O$, 181.07. Col.need.f.w. **m.p.** anh. 167 d. **Soly.** v.s.h.w.; s.alk.

85 **Retene** (*7-isopropyl-1-methylphenanthrene*). $C_{18}H_{18}$, 234.14. Leaf.f.al. **D.** 1.13^{16}, **m.p.** 98.5, **b.p.** 394. **Soly.** i.w.; 2.13c., 69^{78}al.; s.et.; s.bz., CS_2.

86 **Rhamnitol** (*1, 2, 3, 4, 5-hexanepentol** (one form); *rhamnite*). $CH_3(CHOH)_4CH_2OH$, 166.11. Tricl.pr. **m.p.** 121. **Soly.** v.s.w.; v.s.al.; v.sl.s.et.; sl.s. acet., chl.

87 β-**Rhamnose.** $C_6H_{12}O_5 \cdot H_2O$, 182.11. Col.monocl.f.w., *n* 1.523, 1.531, 1.534. **D.** 1.471, **m.p.** 126. **Soly.** 57^{18}, 109^{40}w.; sl.s.al.; i.et.

88 **Rheadine** (*rhoeadine*). $C_{21}H_{21}NO_6$, 383.17. Sm.pr. **m.p.** 245–7 d. **Soly.** sl.s.w.; sl.s.al.; sl.s.et.; sl.s.chl.; i.bz.

89 **Rheum emodin.** See *Emodin.*

89₁ **Rhodanates.** See under *Thiocyanic acid.*

90 **Rhodinal.** See *Citronellal.*

91 **Rhodinol** (*3, 7-dimethyl-6-octen-1-ol(?)*). $C_{10}H_{19}OH$, 156.16. Col. oily liq. **b.p.** $113–4^{15}$.

92 **Rhoeadine.** See *Rheadine.*

93 **Ricinine.** $C_8H_8N_2O_2$, 164.08. Pr. or tab.f.al. or w. **m.p.** 201 subl. **Soly.** s.h.w.; s.h.al.; sl.s.et.; sl.s.bz.

94 **Ricinoleïc acid** (*12-hydroxy-9-octadecenoic acid** (one form); *ricinolic acid*). $CH_3(CH_2)_5CHOHCH_2CH{:}CH(CH_2)_7COOH$, 298.27. Col.liq., or cr.mass. **D.** 0.945^{15}, **m.p.** 17, **b.p.** 250^{15}. **Soly.** i.w.; ∞al.; ∞et.; s.chl.

95 —, butyl ester (*butyl ricinoleate; butyl 12-hydroxy-9-octadecenoate**(one form)). $C_{18}H_{33}O_3C_4H_9$, 354.33. Liq. **D.** 0.906^{22}, **b.p.** 275^{13}. **Soly.** i.w.; s.et.

96 —, glycerol esters. See under *Glycerol.*

97 —, isobutyl ester (*isobutyl ricinoleate; β-methylpropyl 12-hydroxy-9-octadecenoate**(one form)). $C_{22}H_{42}O_3$, 354.33. Liq., *n* 1.4538^{22}. **D.** 0.903^{22}, **b.p.** 262^{9}. **Soly.** i.w.; s.et.

98 **Rodinal.** See *Phenol, p-amino-.*

99 **Rosaniline** (*bis-p-aminophenyl-4-amino-m-tolylcarbinol*). $H_2NC_7H_6(H_2NC_6H_4)_2COH$, 319.19. Col.need. f.w. **m.p.** 186 d., **b.p.** d. **Soly.** sl.s.w.; s.al.; i.et.; s.a., aniline.

00 **Rosinduline** (*5, 8-dihydro-8-imino-5-phenylbenzo[b]phenazine*). $HN{:}C_{10}H_5{:}NC_6H_4NC_6H_5$, 321.14. Br.leaf.f.al. or need.f.et. **m.p.** 199. **Soly.** i.w.; v.s. al.; v.s.et.; s.bz.

01 **Rosolic acid.** See *Aurin.*

02 **Rotenone.** $C_{23}H_{22}O_6$, 394.17. Hex. pl.f.al. or et.; need.f.bz., chl., or CCl_4. **m.p.** 163. **Soly.** i.w.; 0.2^{20}al.; 0.4et.; 8.5bz.; $0.6CCl_4$; 7.34chl.

03 **Rufigallic acid** (*1, 2, 3, 5, 6, 7-hexahydroxyanthraquinone; rufigallol*). $C_{14}H_2O_2(OH)_6$, 304.06. Or.red cr. **m.p.** subl.sl.d. **Soly.** i.w.; s.et.; s.alk., conc.H_2SO_4.

04 **Rufigallol.** See *Rufigallic acid.*

05 **Rufiopin** (*1, 2, 5, 6-tetrahydroxyanthraquinone*). $C_{14}H_4(OH)_4O_2$, 272.06. Yel.-red need. **m.p.** subl. **b.p.** d. **Soly.** sl.s.h.w.; s.al.; sl.s.et.; s.ac.a., H_2SO_4.

06 Rufol (1, 5-*anthracenediol**; 1, 5-*anthradiol*). $HOC_6H_3(CH)_2C_6H_3OH$, 210.08. Cr.f.bz. **m.p.** 280–5 d. (265). **Soly.** v.s.w.; s. (vlt.fluores.)al.; s.alk.

07 Rutaecarpine. $C_{18}H_{13}N_3O$, 287.13. Yel.pl.; need.f.et.ac. **m.p.** 257–8. **Soly.** sl.s.al.

08 Sabadine. $C_{29}H_{51}NO_8$, 541.41. Need. f.et. **m.p.** 238–40 d. **Soly.** sl.s.w.; v.s.al.; sl.s.et.

09 Sabinane, 6-keto-. See *α-Thujone.*

10 Sabinene (1-*isopropyl*-4-*methylenebicyclo*[3, 1, 0]*hexane*). $C_{10}H_{16}$, 136.12. Col.liq., n $1.46738^{17.0}$. **D.** 0.842, **b.p.** 165. **Soly.** i.w.; ∞al.; ∞et.

11 *d*-Saccharic acid (2, 3, 4, 5-*tetrahydroxyhexanedioic acid**(one form)). $COOH(CHOH)_4COOH$, 210.08. Syrup. **m.p.** 125–6 d. **Soly.** v.s.w.; v.s.al.; i.et.

12 Saccharin (*o-sulfobenzoic imide; benzoic sulfinide; glucide*). $C_6H_4SO_2$–NHCO, 183.11. Col.monocl.f.acet. **m.p.** 228 d. (224–6), **b.p.** subl. **Soly.** 0.43^{25}w.; 3.1al.; sl.s.et.; s.alk., bz., amyl ac., et.ac., xylol.; sl.s.chl., acet., glyc.

13 Saccharose. See *Sucrose.*

14 S acid. See 1-*Naphthol*-5-*sulfonic acid, 8-amino-.*

15 Safrole (1-*allyl*-3, 4-*methylenedioxybenzene; shikimole*). $CH_2(O_2)C_6H_3CH_2$-$CH{:}CH_2$, 162.08. Col.liq. or monocl., n 1.5420^{12}. **D.** 1.096, **m.p.** 11, **b.p.** 234.5. **Soly.** i.w.; v.s.al.; v.s.et.; ∞chl.

16 —, 2, 5-dimethoxy-. See *Apiole.*

17 —, 5-methoxy-. See *Myristicin.*

18 Salazolon. See *Salipyrine.*

19 Salicin. $C_6H_{11}O_5OC_6H_4CH_2OH$, 286.14. Col.rhomb.need. or leaf. **D.** 1.434^{26}, **m.p.** 198–202, **b.p.** 240 d. **Soly.** 3.6^{15}w.; 1.13^{26}, 3.33^{60}al.; i.et.; i.chl.

20 —, benzoyl-. See *Populin.*

21 Salicyl alcohol. See *Saligenin.*

22 Salicylaldehyde (*o-hydroxybenzaldehyde; salicylic aldehyde*). HOC_6H_4-CHO, 122.05. Col.liq., n $1.57358^{19.7}$. **D.** 1.1669^{20}_{4}, **m.p.** −7(1.6), **b.p.** 196.5. **Soly.** 1.72^{86}w.; ∞al.; ∞et.; 64.6^{12}bz.

23 —, glucoside. See *l-Helicin.*

24 —, methyl ether. See *Benzaldehyde, o-methoxy-*

25 Salicylamide (*o-hydroxybenzamide; salicylic amide*). $HOC_6H_4CONH_2$, 137.06. Leaf.f.w. **m.p.** 140 (137–8), **b.p.** 270 d. **Soly.** sl.s.w.; s.al.; sl.s.et.; s.Na_2CO_3 sol.

26 —, *N*-phenyl-. See *Salicylanilide.*

27 Salicylanilide (*N-phenylsalicylamide*). $HOC_6H_4CONHC_6H_5$, 213.09. Pr.f.al. **m.p.** 135, **b.p.** d. **Soly.** sl.s.h.w.; s.al.; s.et.; sl.s.CS_2.

28 Salicylic-*O*-acetic acid. See *Benzoic acid, o-(carboxymethoxy)-.*

29 Salicylic acid (*o-hydroxybenzoic acid*). HOC_6H_4COOH, 138.05. Monocl.col. need.f.w., n 1.565. **D.** 1.443^{20}_{4}, **m.p.** 159 (155–7), **b.p.** subl. 76. **Soly.** 0.18^{20}; 1.76^{75}w.; 39.2^{15}al.; 50.5^{15}et.; s. chl.

30 —, acetate. See *Aspirin.*

31 —, amyl ester (*amyl salicylate; pentyl o-hydroxybenzoate*). $HOC_6H_4CO_2C_5$-H_{11}, 208.12. Col.-yelsh.liq. **D.** 1.065^{15}, **b.p.** 265. **Soly.** i.w.; ∞al.; ∞et.; s.chl.

32 —, ethyl ester. $HOC_6H_4COOC_2H_5$, 166.08. Col.liq., n $1.52511^{14.4}$. **D.** 1.1362^{15}_{4}, **m.p.** 1.3, **b.p.** 234.0(231.5). **Soly.** i.w.; ∞al.; ∞et.

33 —, ethyl ether. See *Benzoic acid, o-ethoxy-.*

34 —, isoamyl ester (*isoamyl salicylate; isoamyl o-hydroxybenzoate*). HOC_6-$H_4COOC_5H_{11}$, 208.12. Col.-ylsh. liq. **D.** 1.042^{15}_{4}, **b.p.** 273 (128–30^{12}). **Soly.** 0.004^{22}w.; 33 90%al.; ∞et.; s.chl.

35 —, isobutyl ester. $HOC_6H_4COOC_4$-H_9, 194.11. **D.** 1.075, **b.p.** 259. **Soly.** i.w.; s.al.; s.et.

36 —, methyl ester (*methyl salicylate; artificial oil of wintergreen*). HOC_6-H_4COOCH_3, 152.06. Col.liq., n 1.5369. **D.** $1.1840^{20}_{4}{}^{.2}$, **m.p.** −8.6, **b.p.** 223.3. **Soly.** 0.074^{30}w.; ∞al.; ∞et.; s.glac.ac.a., CS_2.

37 —, methyl ether. See *Benzoic acid, o-methoxy-.*

38 —, 1-naphthyl ester (*α-naphthyl salicylate*). $HOC_6H_4COOC_{10}H_7$, 264.09. Wh.cr.powd. **m.p.** 83. **Soly.** i.w.; s.al.; s.et.; s.fixed oils.

39 —, 2-naphthyl ester. See *Betol.*

40 —, nicotine salt. See *Nicotine, salicylate.*

41 —, phenyl ester (*salol*) HOC_6H_4COO-C_6H_5, 214.08. Col.rhomb.f.al. **D** 1.250, **m.p.** 43, **b.p.** 173^{12}. **Soly** 0.015^{25}w.; 21.5^{25}al.; v.s.et.; v.s.bz; chl.; v.sl.s.glyc.

42 —, phenyl ether. See *Benzoic acid o-phenoxy-.*

43 —, propyl ester (*n-propyl salicylate*) $HOC_6H_4COOC_3H_7$, 180.09. Col.liq **D.** 1.099^{15}, **b.p.** 240. **Soly.** v.sl.s.w. ∞al.; ∞et.

* Name approved by the International Union of Chemistry.

44 **Salicylic acid, acetyl-.** See *Aspirin.*

45 —, **5-allyl-3-methoxy-.** See *Eugetic acid.*

46 —, **3-amino-** (*3-amino-2-hydroxybenzoic acid*). $NH_2C_6H_3(OH)COOH$, 153.06. Cr. **m.p.** 235 d. **Soly.** v.sl.s.al.

47 —, **4-amino-** (*4-amino-2-hydroxybenzoic acid*). $NH_2C_6H_3(OH)COOH$, 153.06. Redsh.br.cr.powd. **m.p.** 220 d. **Soly.** s.w.; s.al.; s.et.

48 —, **5-amino-** (*5-amino-2-hydroxybenzoic acid*). $NH_2C_6H_3(OH)COOH$, 153.06. Wh.need. **m.p.** 283 (280 d.). **Soly.** sl.s.h.w.; i.al.; s.CS_2.

49 —, **3, 5-dinitro-** (*3, 5-dinitro-2-hydroxybenzoic acid*). $(NO_2)_2(HO)C_6H_2COOH$, 228.05. Need or pl. $(+1H_2O)$f.w. **m.p.** anh. 174(170–2), **b.p.** subl. d. **Soly.** v.s.h.w.; v.s.al.; v.s.et.

50 —, **hexahydro-.** See *Cyclohexanecarboxylic acid, 2-hydroxy-.*

51 —, **3-nitro-** (*2-hydroxy-3-nitrobenzoic acid*). $NO_2C_6H_3(OH)COOH \cdot H_2O$, 201.06. Rhomb.need.f.w. **m.p.** hyd. 125; anh. 144. **Soly.** 0.13^{15}w.; v.s.al.; v.s.et.

52 —, **5-nitro-** (*2-hydroxy-5-nitrobenzoic acid*). $NO_2C_6H_3(OH)COOH$, 183.05. Need.f.w. **D.** 1.650^{20}, **m.p.** 228. **Soly.** 0.18^{22}w.; v.s.al.; v.s.et.

53 —, **6-nitro-** (*2-hydroxy-6-nitrobenzoic acid*). $NO_2C_6H_3(OH)COOH$, 183.05. Yel.need. **m.p.** 130. **Soly.** sl.s.al.; v.s.et.; s.acet.

54 —, **O-phenyl-.** See *Benzoic acid, o-phenoxy-.*

55 —, **thio-.** See *Benzoic acid, o-mercapto-.*

56 **Salicylic anhydride** (*o, o'-dihydroxybenzoic anhydride*). $(HOC_6H_4CO)_2O$, 258.08. Yel.amor. **m.p.** 200–20, **b.p.** d. **Soly.** i.w.; v.s.al.; v.s.et.

57 **Saligenin** (*o-hydroxybenzyl alcohol; salicyl alcohol; α, 2-toluenediol*). $HOC_6H_4CH_2OH$, 124.06. Rhomb.f.w. **D.** 1.161^{25}, **m.p.** 86, **b.p.** subl. **Soly.** 6.7^{22}w.; v.s.al.; v.s.et.

58 —, 2-methyl ether. See *Benzyl alcohol, o-methoxy-.*

59 **Salipyrazolon.** See *Salipyrine.*

60 **Salipyrine** (*antipyrine salicylate; salazolon; salipyrazolon; etc.*). $C_{11}H_{12}N_2O \cdot C_7H_6O_3$, 326.16. Cr.powd. **m.p.** 92. **Soly.** 0.5^{15}, 4.0^{100}w.; s.et.; s.bz.; v.s.chl.

61 **Salol.** See *Salicylic acid, phenyl ester.*

62 **Salvarsan.** See *Arsphenamine.*

63 **Sanguinarine.** $C_{20}H_{15}NO_4 \cdot H_2O$, 351.14. Bl.fluores.need. **m.p.** 213. **Soly.** i.w.; s.al.; s.et.

64 **Santalic acid.** $C_{15}H_{14}O_5$, 274.11. Red micr.pr. **m.p.** 226 (104), **b.p.** 195^9. **Soly.** i.w.; s.al.; s.et.; s.alk.

65 **Santonic lactone.** See *Santonin.*

66 **Santonin** (*santonic lactone*). $C_{15}H_{18}O_3$, 246.14. Col.rhomb.pr., n 1.590, 1.630, 1.640. **D.** 1.187, **m.p.** 170, **b.p.** subl. **Soly.** 0.02^{17}, 0.4^{100}w.; 2.0^{22}, 37^{80}al.; sl.s.et.; s.chl., alk.

67 **Sarcine.** See *Hypoxanthine.*

68 **Sarcolactic acid.** See *d-Lactic acid.*

69 **Sarcosine** (*N-methylglycine*). CH_3NHCH_2COOH, 89.06. Deliq.col. rhomb.f.dil.al. **m.p.** 210 d., **b.p.** d. **Soly.** v.s.w.; sl.s.al.; i.et.

70 —, hydrochloride. $HCl \cdot NH(CH_3)CH_2COOH$, 125.53. Need.f.al. **m.p.** 170–2, **b.p. d.** **Soly.** v.s.w.; v.sl.s.al.; v.sl.s.et.

71 **Schäffer's acid.** See *2-Naphthol-6-sulfonic acid.*

72 **Schöllkopf's acid.** See *Naphthionic acid.*

73 ***i*-Scopolamine** (*atroscine*). $C_{17}H_{21}NO_4$, 303.17. Cr., $[\alpha] - 33.1°$D. **m.p.** 82–3(50–9). **Soly.** 10.52^{15}w.; v.s.al.; v.s.et.; s.chl.; sl.s.bz .

74 ***l*-Scopolamine.** See *Hyoscine.*

75 **Sebacic acid** (*decanedioic acid**). $COOH(CH_2)_8COOH$, 202.14. Thin col.leaf., n $1.422^{133.3}$. **m.p.** 133, **b.p.** 295^{100}. **Soly.** 0.1^{17}, 2.0^{100}w.; v.s.al.; v.s.et.

76 —, diethyl ester (*ethyl sebacate*). $[(CH_2)_4COOC_2H_5]_2$, 258.20. Col.liq. **D.** 0.9646^{20}_{4}, **m.p.** 1, **b.p.** 308. **Soly.** 0.008^{20}w.; s.al.; s.et.

77 —, piperazinium salt. $C_4H_{10}N_2 \cdot C_{10}H_{18}O_4$, 288.23. Wh.cr. **m.p.** 166–8. **Soly.** s.h.w.; s.h.al.; i.et.

78 **Selenide, diethyl.** See *Ethyl selenide.*

79 —, **dimethyl.** See *Methyl selenide.*

80 **Semicarbazide** (*aminourea; carbamylhydrazine*). $NH_2NHCONH_2$, 75.06. Pr.f.al. **m.p.** 96. **Soly.** v.s.w.; s.al.; i.et.; i.bz., chl.

81 —, hydrochloride. $NH_2NHCONH_2 \cdot HCl$, 111.53. Pr.f.dil.al. **m.p.** 173 d. **Soly.** v.s.w.; i.al.; i.et.

82 —, **1-phenyl-** (*1-carbamyl-2-phenylhydrazine*). $C_6H_5NHNHCONH_2$, 151.09. Leaf.f.dil.al. **m.p.** 172. **Soly.** s.h., sl.s.c.w.; s.al.; sl.s.et.; s.chl., acet.

84 —, **thio-.** $NH_2NHCSNH_2$, 91.12. Need.f.w. **m.p.** 183. **Soly.** s.w.; s.al

For explanations and abbreviations see beginning of table.

85 **Seminose.** See *d-Mannose.*

86 **Septentrionaline.** $C_{31}H_{46}N_2O_9$ (?), 590.37. Wh.powd. **m.p.** 129. **Soly.** 1.7w.; 58 al.; 50 et.

87 ***dl*-Serine.** $CH_2OHCH(NH_2)COOH$, 105.06. Monocl.pr.f.w. **m.p.** 246 d. **Soly.** 5.02^{25}, 19.21^{75}w.; 0.187 75 %, i.abs. al.; i.et.

88 ***d*-Serine** (*d-β-hydroxyalanine*). $CH_2OHCH(NH_2)COOH$, 105.06. Hex. tab., *n* 1.515, 1.575, 1.586. **m.p.** 228 d. **Soly.** *ca.* 25^{20}w.; i.al.; i.et.

89 ***l*-Serine** (*l-α-amino-β-hydroxypropionic acid; l-β-hydroxyalanine*). $HOCH_2CH(NH_2)COOH$, 105.06. Hex. pl. or pr. **m.p.** 228 d. **Soly.** 25^{20}w.

90 **Shikimole.** See *Safrole.*

91 **Silanol**(mono). See *Silicol.*

92 **Silicane, dimethyl-** (*dimethylmonosilane*). $(CH_3)_2SiH_2$, 60.12. **D.** 0.68^{-80}, **m.p.** −150, **b.p.** −20.1.

93 —, **ethoxytriethyl-** (*triethylsilicol ethyl ether*). $(C_2H_5)_3SiOC_2H_5$, 160.22. Liq. **D.** 0.8403^0, **b.p.** 153. **Soly.** i.w.; ∞al.; ∞et.; s.H_2SO_4.

94 —, **hydroxy-.** See *Silicol.*

95 —, **methyl-** (*methylmonosilane*). CH_3SiH_3, 46.11. **D.** 0.62^{-57}, **m.p.** −156.5, **b.p.** −56.8.

96 —, **tetraethyl-** (*silicon tetraethyl*). $(C_2H_5)_4Si$, 144.22. Col.liq. **D.** 0.7682, **b.p.** 153. **Soly.** i.w

97 —, **tetramethyl-** (*silicon tetramethyl; tetramethylsilicon*). $(CH_3)_4Si$, 88.15. Liq.ign. in air. **D.** 0.645^{20}_{4}, **b.p.** $26–7^{761}$. **Soly.** i.w.; v.s.al.; v.s.et. i.H_2SO_4.

98 —, **trichlorophenyl-** (*phenylsilicon trichloride*). $C_6H_5SiCl_3$, 211.47. Liq. **b.p.** 197. **Soly.** d.w.; d.al.; s.et.

99 —, **triethyl-** (*triethylsilicon hydride*). $(C_2H_5)_3SiH$, 116.18. Liq. **D.** 0.751^{0}_{4}, **b.p.** 107(95–6). **Soly.** i.w.; i.H_2SO_4.

00 **Silicoheptyl alcohol.** See *Silicol, triethyl-.*

01 **Silicol, triethyl-** (*silicoheptyl alcohol*). $(C_2H_5)_3SiOH$, 132.18. Liq. **D.** 0.8709^0, **b.p.** 154. **Soly.** i.w.; ∞al.; ∞et.

02 —, —, ethyl ether. See *Silicane, ethoxytriethyl-.*

03 **Silicon, tetramethyl-.** See *Silicane, tetramethyl-.*

04 **Silicon hydride, triethyl-.** See *Silicane, triethyl-.*

05 **Silicon oxide, triethyl-.** See *Silicyl oxide, hexaethyl-.*

06 **Silicon tetraethyl.** See *Silicane, tetraethyl-.*

07 **Silicon trichloride, phenyl-.** See *Silicane, trichlorophenyl-.*

08 **Silicyl oxide, hexaethyl-** (*triethylsilicon oxide*). $[(C_2H_5)_3Si]_2O$, 246.35. Liq. **D.** 0.859^0, **b.p.** 231. **Soly.** i.w.; s.al.; s.et.; s.H_2SO_4.

09 **Silvan** (*2-methylfuran; sylvan*). $C_4H_3OCH_3$, 82.05. Col.liq. **D.** 0.916, **b.p.** $62.5–3.0^{737}$. **Soly.** i.w.; s.al.; s.et.

11 **Sinapine,** bisulfate. $C_{16}H_{24}NO_6HSO_4 \cdot 3H_2O$, 473.31. Leaf.f.al. **m.p.** 127; 186 dry. **Soly.** s.w.; s.h.al.; i.et.

12 —, thiocyanate. $C_{16}H_{24}NO_5SCN \cdot H_2O$, 386.28. Pa.yel.need.f.w. **m.p.** 178 **Soly.** sl.s.w.; sl.s.al.

13 **Sincaline.** See *Choline.*

14 **Skatole** (*3-methylindole*). C_9H_9N, 131.08. Leaf.f.lgr. **m.p.** 95, **b.p.** 266.2. **Soly.** 0.05c. w.; v.s.al.; s.et.; s.bz., chl., lgr.

15 **Sneezing gas.** See *Arsine, chlorodiphenyl-.*

16 ***dl*-Sobrerone.** See *Pinole* (*dl*).

17 **Sodium glycerolate.** See *Glycerol, 1-sodium derivative.*

18 **Sodium mercaptide.** See *Ethanethiol, sodium derivative.*

19 **Sodium thioethylate.** See *Ethanethiol, sodium derivative.*

20 **Solanidine.** Mixt. Need.f.et. **m.p.** 191. **Soly.** v.sl.s.w.; s.h.al.; sl.s.et.; s.chl.

21 **Solanine.** Mixt. (?). Slend.need.f.al. **m.p.** 244–50(262), **b.p.** d. **Soly.** v.sl.s.w.; s.h.al.; i.et.; i.chl., bz.

22 **Sophoretin.** See *Quercetin.*

23 **Sophorine.** See *Cytisine.*

24 **Sorbic acid** (2, 4-*hexadienoic acid**). $CH_3CH{:}CHCH{:}CHCOOH$, 112.06. Col.need.f.w. **m.p.** 134.5, **b.p.** 228 d. **Soly.** sl.s.w.; v.s.al.; v.s.et.

25 D-**Sorbitol** (1, 2, 3, 4, 5, 6-*hexanehexol** (one form); D-*sorbite;* D-*sorbol*). $C_6H_{14}O_6 \cdot \frac{1}{2}H_2O$, 191.12. Col.need. **m.p.** anh. 110(89–93). **Soly.** s.w.; v.sl.s.al.; i.et.

26 D-**Sorbose** (1, 3, 4, 5, 6-*pentahydroxy-2-hexanone** (one form); D-*sorbinose*). $C_6H_{12}O_6$, 180.09. Col.rhomb. **D.** *d* 1.612;(*dl* 1.64), **m.p.** 165. **Soly.** 55^{17}w.; v.sl.s.h., 0.26^{17}al.; i.et.; sl.s. me.al.

27 **Sozolic acid.** See 1-*Phenol-2-sulfonic acid.*

* Name approved by the International Union of Chemistry.

28 Sparteine (*lupinidine*). $C_{15}H_{26}N_2$, 234.22. Col. oil, $[\alpha]$ −14.6°D in al. **D.** 1.023^{20}_{4}, **b.p.** 325^{754} in H_2; $180–1^{20}$. **Soly.** 0.304^{22}w.; v.s.al.; v.s.et.; s.chl.; i.bz.

29 —, bisulfate. $C_{15}H_{26}N_2 \cdot H_2SO_4 \cdot 5H_2O$, 422.37. Col.hyg.rhbdr.cr. or powd., n 1.5289^{19}. **m.p.** 136; anh. 150–2. **Soly.** 91^{25}w.; 32^{25}al.; i.et.; i.chl.

30 Spirit of wine. See *Ethyl alcohol.*

31 Stachydrine. $C_7H_{13}NO_2 \cdot H_2O$, 161.13. Deliq.cr. **m.p.** 210 dry. **Soly.** s.w.; s.al.; i.et.; i.chl.

32 —, oxalate. $C_7H_{13}NO_2 \cdot H_2C_2O_4$, 233.13. Need. **m.p.** 105–7. **Soly.** i.c.al.

33 Stannane, diethyldimethyl-. See *Tin, diethyldimethyl-.*

34 —, **tetraethyl-.** See *Tin, tetraethyl-*.*

35 —, **tetramethyl-.** See *Tin, tetramethyl-*.*

36 Stannone, diethyl-. See *Tin oxide, diethyl-*.*

37 Stannonic acid, methyl-. See *Methanestannonic acid.*

38 Starch. $(C_6H_{10}O_5)_x$, $(162.08)_x$. Wh. amor., n 1.53. **D.** 1.50^{21}, **m.p.** d. **Soly.** i.w.; i.al.; i.et.

39 —, **animal.** See *Glycogen.*

40 Starch gum. See *Dextrin.*

41 Stearaldehyde (*octadecanal**). $C_{17}H_{35}CHO$, 268.28. Sc.f.et. **m.p.** 63.5, **b.p.** 261^{100}. **Soly.** i.w.; s.al.; s.et.

42 Stearamide (*octadecanamide**). $CH_3(CH_2)_{16}CONH_2$, 283.30. Col.leaf. **m.p.** 109, **b.p.** 251^{12}. **Soly.** i.w.; sl.s.al.; sl.s.et.

43 Stearic acid (*octadecanoic acid*; n-octadecylic acid*). $CH_3(CH_2)_{16}COOH$, 284.28. Col.monocl.leaf., n $1.4299^{80.2}$. **D.** 0.847^{69}, **m.p.** 69.4, **b.p.** 383. **Soly.** 0.034^{25}, 0.1^{37}w.; 2.5c.al.; v.s.et.; s.chl., CCl_4, CS_2.

44 —, amyl ester. $C_{17}H_{35}COO(CH_2)_4CH_3$, 354.36. Pl. **D.** 0.860, **m.p.** 30, **b.p.** 360. **Soly.** i.w.; s.al.; v.s.et.

45 —, benzyl ester. $C_{17}H_{35}COOCH_2C_6H_5$, 374.33. Cr. **D.** 0.9075^{50}_{50}, **m.p.** 45.8. **Soly.** i.w.; s.al.; v.s.et.

46 —, butyl ester (*butyl stearate; butyl octadecanoate**). $C_{17}H_{35}COOC_4H_9$, 340.34. Col.liq. **D.** $0.855–75^{26}$, **m.p.** 19.5(27.5), **b.p.** $220–5^{25}$. **Soly.** 0.29^{25} w.; s.al.; s.et.

47 —, diethylene glycol ester. See *Diethylene glycol, distearate.*

48 —, ethylene ester. See *Glycol, distearate.*

49 —, ethyl ester (*ethyl octadecanoate**). $CH_3(CH_2)_{16}COOC_2H_5$, 312.31. Col.cr. **m.p.** 33.7, **b.p.** 224. **Soly.** i.w.; s.al.; s.et.

50 —, glyceryl ester. See *Glycerol, tristearate.*

51 —, isoamyl ester (*isoamyl stearate; γ-methylbutyl octadecanoate**). $CH_3(CH_2)_{16}COOC_5H_{11}$, 354.36. Cr. **D.** 0.855^{20}_{4}, **m.p.** 23, **b.p.** $185–90^1$. **Soly.** i.w.; sl.s.al.; s.et.

52 —, methyl ester (*methyl octadecanoate*; methyl stearate*). $C_{17}H_{35}COOCH_3$, 298.30. Col.cr.f.et. **m.p.** 38(35–7), **b.p.** 215^{15}. **Soly.** i.w.; s.al.; s.et.

53 —, *p*-phenylphenacyl ester. $C_{17}H_{35}COOCH_2COC_6H_4C_6H_5$, 478.36. **m.p.** 91.

54 —, θ, ι-**dibromo-.** See *Elaidic acid, dibromide.*

55 —, α, β-**dihydroxy-** (*2, 3-dihydroxyoctadecanoic acid**). $C_{17}H_{33}(OH)_2COOH$, 316.28.

(**a**) Leaf. f.al. **m.p.** 132(136.5). **Soly.** 0.47 c.al.; sl.s.et.

(**b**) Leaf. or pl.f.w. **m.p.** 99. **Soly.** s.w.; 2.8^{18} al.; s.et.

56 —, θ, ι-**dihydroxy-** (*9, 10-dihydroxyoctadecanoic acid**). $CH_3(CH_2)_7CH(OH)CH(OH)(CH_2)_7COOH$, 316.28. Leaf. **m.p.** 131.5(136.5). **Soly.** v.sl. s.c.w.; 2.84^{18}al.; sl.s.et.

57 —, θ, ι-**diketo-.** See *Stearoxylic acid.*

58 —, θ, ι, λ, μ, ξ, ο-**hexabromo-** (*9, 10, 12, 13, 15, 16-hexabromo-octadecanoic acid*; α-linolenic acid hexabromide*). $C_{17}H_{29}Br_6COOH$, 757.73. Need. **m.p.** 180–1. **Soly.** i.w.; i.et.; s.h.xylene; i.chl., bz.

59 —, —, ethyl ester. $C_{17}H_{29}Br_6COOC_2H_5$, 785.76. Fine need. **m.p.** 151.5–2.5. **Soly.** i.w.; i.al.; i.et.; sl.s.glac. ac.a.

60 —, α-**hydroxy-** (*2-hydroxyoctadecanoic acid**). $CH_3(CH_2)_{15}CHOHCOOH$, 300.28. Need.f.chl. **m.p.** 93; 85. **Soly.** 6.94c.al.; 1.64c.et.; v.s.h.bz.

61 —, β-**hydroxy-**(*dl*) (*dl-3-hydroxyoctadecanoic acid**). $CH_3(CH_2)_{14}CHOHCH_2COOH$, 300.28. Pl.f.chl. **m.p.** 89. **Soly.** s.h.al.; s.et.; s.chl.

62 —, ι-**hydroxy-** (*10-hydroxyoctadecanoic acid**). $CH_3(CH_2)_7CHOH(CH_2)_8COOH$, 300.28. Hex.pl. **m.p.** 81–1.5. **Soly.** i.w.; 8.78al.; 2.3et.

63 —, κ-**hydroxy-** (*11-hydroxyoctadecanoic acid*). $CH_3(CH_2)_6CHOH(CH_2)_9COOH$, 300.28. Tab.f.al. **m.p.** 84(77–9). **Soly.** i.w.; 0.58al.; 1.71^{20}et.

For explanations and abbreviations see beginning of table.

64 Stearic acid, λ-hydroxy- (12-*hydroxyoctadecanoic acid**). $CH_3(CH_2)_5CH$-$OH(CH_2)_{10}COOH$, 300.28. Cr.f.al. **m.p.** 81–2. **Soly.** i.w.; s.al.; s.et.; s.chl.

65 —, δ, ι, λ, μ-**tetrabromo-** (9, 10, 12, 13-*tetrabromooctadecanoic acid**; *linoleic acid tetrabromide*). $C_{17}H_{31}Br_4COOH$, 599.91. Wh.pl. **m.p.** 114–5. **Soly.** i.w.; v.s.al.; v.s.chl.; sl.s.pet.eth.

66 —, —, ethyl ester. $C_{17}H_{31}Br_4COOC_2H_5$, 627.94. Need. **m.p.** 58–8.5. **Soly.** i.w.; s.al.; s.pet.eth., glac.ac.a.

67 —, —, methyl ester. $C_{17}H_{31}Br_4COOCH_3$, 613.93. Leaf. **m.p.** 50–6. **Soly.** i.w.; s.al.; s.pet.eth., glac.ac.a.

68 Stearic anhydride (*octadecanoic anhydride**). $(C_{17}H_{35}CO)_2O$, 550.55. Col. cr. **D.** 0.8368^{82}_{4}, **m.p.** 71.5. **Soly.** i., d.w.; d.al.; s.et.

69 Stearin. See *Glycerol, tristearate.*

70 Stearolic acid (9-*octadecynoic acid**). $CH_3(CH_2)_7C:C(CH_2)_7COOH$, 280.25. Col.pr.f.al. **m.p.** 48, **b.p.** 260. **Soly.** i.w.; sl.s.c.al.; v.s.et.

71 Stearone. See 18-*Pentatriacontanone**.

72 Stearonitrile (*octadecanenitrile**). $C_{17}H_{35}CN$, 265.28. Col.cr. **D.** 0.817^{41}_{4}, **m.p.** 41, **b.p.** 214^{13}. **Soly.** i.w.; sl.s.al.; s.et.

73 Stearoxylic acid (9, 10-*dioxooctadecanoic acid**; *θ, ι-diketostearic acid*). $CH_3(CH_2)_7COCO(CH_2)_7COOH$, 312.25. Yel.leaf. **m.p.** 86. **Soly.** i.w.; v.s.h.al.; v.s.h.et.; sl.s.lgr.

74 Stearyl chloride (*octadecanoyl chloride**). $C_{17}H_{35}COCl$, 302.73. Col.cr. **m.p.** 23, **b.p.** 215^{15}. **Soly.** d.w.; d.al.; v.s.et.

75 Stibine, triethyl- (*antimony triethyl*). $Sb(C_2H_5)_3$, 208.88. Col.liq. **D.** 1.324^{16}, **m.p.** < −29, **b.p.** 159.5. **Soly.** i.w.; s.al.; s.et.

76 —, **trimethyl-** (*antimony trimethyl*). $Sb(CH_3)_3$, 166.83. Col.monocl.liq.f.w. **D.** 1.523^{15}, **b.p.** 80.6. **Soly.** sl.s.w.; i.al.; s.et.

77 Stilbene (*trans*-1, 2-*diphenylethylene*; *trans-sym-diphenylethylene; toluylene*). $C_6H_5CH:CHC_6H_5$, 180.09. Col.monocl. tab.f.al. **D.** liq. 0.970^{130}_{4}; $1.164^{0}_{}$, **m.p.** 124, **b.p.** 307. **Soly.** i.w.; 0.88^{17}al.; 5.59^{13}et.; s.bz.

78 —, **diamino-.** See *Stilbenediamine.*

79 —, **2, 2′-diamino-**(*cis*). $NH_2C_6H_4$-$CH:CHC_6H_4NH_2$, 210.13. Red need f.w. **m.p.** 123.

80 —, α-**phenyl-.** See *Ethylene, triphenyl-.*

81 2, 2′-Stilbenediamine (*o, o′-diaminostilbene*). $NH_2C_6H_4CH:CHC_6H_4NH_2$, 210.13.
cis: Red need.f.w. **m.p.** 123.
trans: Gold-yel.pr.f.al. **m.p.** 176(168). **Soly.** s.al.; s.et.; s.bz.

82 4, 4′-Stilbenediamine (*p, p′-diaminostilbene*). $NH_2C_6H_4CH:CHC_6H_4$-NH_2, 210.13. Yel.need. or leaf.f.al. **m.p.** 227–8, **b.p.** subl. **Soly.** s.h.w.; s.al.; s.et.; s.me.al.; sl.s.bz., chl., CS_2.

83 Strychnine. $C_{21}H_{22}N_2O_2$, 334.19. Col. rhomb.f.al. **D.** 1.359^{18}, **m.p.** 268, **b.p.** 270^5. **Soly.** 0.016^{25}w.; 0.9al.; 0.018et.; s.chl.; sl.s.bz.

84 —, hydrochloride. $C_{21}H_{22}N_2O_2 \cdot HCl \cdot 2H_2O$, 406.68. Col.trim.efflor. **Soly.** 2.9c.w.; 1.7al.; i.et.; i.HCl.

85 —, nitrate. $C_{21}H_{22}N_2O_2 \cdot HNO_3$, 397.20. Col.need., $[\alpha] - 46°$D. **m.p.** d. **Soly.** 2.4^{25}w.; 0.83^{25}al.; i.et.; 0.64^{25}chl.; s.glyc.

86 —, sulfate. $(C_{21}H_{22}N_2O_2)_2 \cdot H_2SO_4 \cdot 5H_2O$, 856.53. Col.monocl.pr., *n* 1.6137, 1.5988. **m.p.** anh. 200. **Soly.** 3.2^{25}w.; 1.5^{25}al.; i.et.; s.chl., glyc.

87 Styphnic acid (2, 4, 6-*trinitroresorcinol*). $(NO_2)_3C_6H(OH)_2$, 245.05. Yel. hex.pr.f.acet. **D.** 1.829, **m.p.** 180 (176–7), **b.p.** subl. **Soly.** 0.6^{14}w.; s.al.; sl.s.et.

88 Stypticin. See *Cotarnine, hydrochloride.*

89 Styptol. See *Cotarnine, phthalate.*

90 Styracin (*γ-phenylallyl cinnamate; cinnamyl cinnamate*). $C_{18}H_{16}O_2$, 264.12. Need.or pr. **D.** $1.085^{10.5}$, **m.p.** 44. **Soly.** i.w.; 3.95c.al.; v.s.et.; s.bz.

91 Styrene (*vinylbenzene; phenylethylene; cinnamene*). $C_6H_5CH:CH_2$, 104.06. Col.liq., *n* 1.54344^{17}. **D.** 0.9074^{20}_{4}, **b.p.** 146. **Soly.** v.sl.s.w.; ∞al.; ∞et.

92 —, α-**bromo-** (1-*bromo-1-phenylethylene; α-bromostyrol; (α-bromovinyl)benzene*). $C_6H_5CBr:CH_2$, 182.97. Oil, *n* $1.5881^{19.5}$. **D.** 1.4057, **m.p.** −43.5, **b.p.** 160^{75}(86-7^{14}).

93 —, β-**bromo** (1-*bromo-2-phenylethylene; (β-bromovinyl)benzene; ω-bromostyrene*). $C_6H_5CH:CHBr$, 182.97.
(1) *n* $1.6094^{20.5}$. **D.** 1.4269^{16}, **m.p.** +7, **b.p.** 219 sl.d. **Soly.** i.w.; ∞al.; ∞et.
(2) *n* 1.5990^{22}. **D.** 1.4322^{16}, **m.p.** −8 to −7, **b.p.** 71^6.

94 —, α-**chloro-** (1-*chloro-1-phenylethylene*). $C_6H_5CCl:CH_2$, 138.51. Liq., *n* 1.5623^{17}. **D.** $1.1016^{15}_{}$, **m.p.** −23, **b.p.** 199. **Soly.** i.w.; s.al.; s.et.

95 —, β-**chloro-** (1-*chloro-2-phenylethylene; ω-chlorostyrene*). $C_6H_5CH:CHCl$ 138.51. Liq. **D.** $1.112^{15}_{}$, **b.p.** 199 **Soly.** i.w.; s.al.; s.et.

* Name approved by the International Union of Chemistry.

96 Styrene, *o*, *m* or *p*-hydroxy-. See *Phenol, vinyl-*.

97 —, **3-hydroxy-4-methoxy-.** See *Hesperetol*.

98 —, ***o***, ***m*** or ***p*-methoxy-.** See *Anisole, vinyl-*.

99 —, ***o*-nitro** (1-*nitro-2-vinylbenzene*). $NO_2C_6H_4CH:CH_2$, 149.06. Col.liq. **m.p.** 13.5. **Soly.** s.conc.H_2SO_4.

00 —, ***m*-nitro-** (1-*nitro-3-vinylbenzene*). $NO_2C_6H_4CH:CH_2$, 149.06. Yel. oil. **m.p.** −5. **Soly.** v.s.al.; s.et.; s.lgr., chl.

01 —, ***p*-nitro-** (1-*nitro-4-vinylbenzene*). $NO_2C_6H_4CH:CH_2$, 149.06. Pr.f.lgr. **m.p.** 29, **b.p.** d. **Soly.** v.s.h.al.; v.s.et.; v.s.bz.; s.lgr.

02 *o*, *β*-Styrenedicarboxylic acid. See *Cinnamic acid, o-carboxy-*.

03 *p*, *β*-Styrenedicarboxylic acid. See *Cinnamic acid, p-carboxy-*.

04 Styrone. See *Cinnamic alcohol*.

05 Styryl ketone (1, 5-*diphenyl*-1, 4-*pentadien-3-one*; dibenzalacetone; cinnamone; dicinnamyl ketone; distyryl ketone*). $(C_6H_5CH:CH)_2CO$, 234.11. Yel.monocl.leaf.f.acet. or et. **m.p.** 112, **b.p.** d. **Soly.** v.sl.s.c.w.; sl.s.al.; sl.s.et.; s.acet.

06 Suberane. See *Cycloheptane**.

07 Suberene. See *Cycloheptene**.

08 Suberic acid (*octanedioic acid**). $COOH(CH_2)_6COOH$, 174.11. Col. need.f.w. **m.p.** 140, **b.p.** 279^{100}. **Soly.** 0.14^{16}w.; s.al.; v.sl.s.et.

09 —, diethyl ester (*ethyl suberate*). $(CH_2CH_2CH_2COOC_2H_5)_2$, 230.17. Col. liq. **D.** 0.982^{20}_{4}, **b.p.** 282–6. **Soly.** i.w.; s.al.; s.et.

10 Suberol. See *Cycloheptanol**.

11 Suberone. See *Cycloheptanone**.

12 Suberyl alcohol. See *Cycloheptanol**.

13 Suberylene. See *Cycloheptene**.

14 Succinaldehyde (*butanedial**). $CHO(CH_2)_2CHO$, 86.05. Liq., *n* 1.4254. **D.** 1.064^{20}_{4}, **b.p.** 169–70sl.d. (201–3). **Soly.** s.w.; s.al.; s.et.

15 Succinamic acid (*β-carbamylpropionic acid; succinic acid monoamide*). $NH_2COCH_2CH_2COOH$, 117.06. Col. need. or tab. **m.p.** 157. **Soly.** s.w.; v.sl.s.al.; i.bz.

16 —, ***α*-amino-.** See *Asparagine*.

17 Succinamide (*butanediamide**). $NH_2COCH_2CH_2CONH_2$, 116.08. Col.need. f.w. **m.p.** 243. **Soly.** 0.45^{15}, 11^{100}w.; i.al.; i.et.

18 —, ***α*-hydroxy-.** See *Malamide*.

19 —, ***N*-*p*-phenetyl-** (*pyrantin; phenosuccin*). $(CH_2CO)_2NC_6H_4OC_2H_5$, 219.11. Pr.f.al. **m.p.** 155. **Soly.** 0.075^{17}, 1.2^{100}w.; v.s.h.al.; i.et.

20 Succinic acid (*butanedioic acid**). $COOH(CH_2)_2COOH$, 118.05. Col. monocl., *n* 1.450, 1.534, 1.610. **D.** 1.564^{15}_{4}, **m.p.** 185(189–90), **b.p.** 235 d. **Soly.** 6.8^{20}, 121^{100}w.; $7.5^{21.5}$al.; 0.3et., i.bz., chl.

21 —, dibenzyl ester. $(CH_2COOCH_2C_6H_5)_2$, 298.14. Leaf.f.al. **m.p.** 44–6, **b.p.** 238^{14}. **Soly.** i.w.; v.s.al.; v.s.et.

22 —, diethyl ester (*ethyl succinate*). $(CH_2COOC_2H_5)_2$, 174.11. Col.liq., *n* 1.42007. **D.** 1.0402^{20}_{4}, **m.p.** −21, **b.p.** 217.7. **Soly.** i.w.; ∞al.; ∞et.

23 —, dimethyl ester (*dimethyl butanedioate*; methyl succinate*). $CH_3OOC(CH_2)_2COOCH_3$, 146.08. Col., *n* $1.41976^{18.3}$. **D.** 1.1202^{18}_{4}, **m.p.** 19.5, **b.p.** 192.8. **Soly.** 2.8w.; s.al.

24 —, monoamide. See *Succinamic acid*.

25 —, *p*-phenylphenacyl ester. $(CH_2COOCH_2COC_6H_4C_6H_5)_2$, 506.20. **m.p.** 208.

26 —, piperazinium salt. $C_4H_{10}N_2 \cdot C_4H_6O_4$, 204.14. Wh.cr. **m.p.** 205–6, d. **Soly.** s.w.; s.h.al.; i.et.

27 —, **acetoxy-.** See *Malic acid, acetate*.

28 —, **acetyl-,** diethyl ester (*ethyl acetylsuccinate; diethyl acetylbutanedioate**). $CH_3COCH(COOC_2H_5)CH_2COOC_2H_5$, 216.12. Col.liq., *n* 1.438^{16}. **D.** 1.081^{20}_{4}, **b.p.** 256 d. **Soly.** i.w.; s.al.; s.et.; s.bz., CS_2.

29 —, ***α*-amino-.** See *Aspartic acid*.

30 —, **bromo-**(*dl*) (*dl-2-bromobutanedioic acid**). $CH_2CHBr(COOH)_2$, 196.96. Col.cr. **D.** 2.073, **m.p.** 159. **Soly.** 19^{15}w.; v.s.al.; i.et.

31 —, ***α*, *β*-dibromo-** (2, 3-*dibromobutanedioic acid**). $C_2H_2Br_2(COOH)_2$, 275.86. (*d*) $[\alpha] + 126.3°^{24}_{D}$ in et. ac. **m.p.** 151–3.
(*l*) Need.f.bz., $[\alpha] - 148°^{13}_{D}$ in et. ac. **m.p.** 157–8 d. (152–4). **Soly.** s.w.; s.al.; s.me.al., acet., et.ac.; sl.s.chl., CCl_4, pet.eth.
(*dl*) **m.p.** 166–7; 255–6 d. **Soly.** s.h.w.; s.al.; s.et.

32 —, ***α*, *β*-dihydroxy-.** See *Tartaric acid*.

33 —, **ethyl-** (2-*ethylbutanedioic acid*; 1, 2-butanedicarboxylic acid*). $(COOH)CH(C_2H_5)CH_2COOH$, 146.08. Col.pr. **m.p.** 98. **Soly.** v.s.w.; v.s.al.; v.s. et.; 1.06 chl.

34 Succinic acid, ethyl-, methyl ester. $C_2H_5OOC(CH_2)_2COOCH_3$, 160.09. Col.liq. **D.** 1.093^0, **m.p.** < -20, **b.p.** 208.2. **Soly.** i.w.; v.s.al.; v.s.et.

35 —, ethylene-. See 1, 2-*Cyclobutanedicarboxylic acid**.

36 —, formyl-, lactone. See *Aconic acid.*

37 —, hydroxy-. See *Malic acid.*

38 —, α-hydroxy-α-methyl-. See *Citramalic acid.*

39 —, isopropylidene-. See *Teraconic acid.*

40 —, methyl-. See *Pyrotartaric acid.*

41 —, methylene-. See *Itaconic acid.*

42 —, tetrahydroxy- (*tetrahydroxybutanedioic acid*; dihydroxytartaric acid*). $(COOH)C(OH)_2C(OH)_2COOH$, 182.05. Wh.cr. **m.p.** 114–5. **Soly.** v.s., d.h.w.

43 —, tetramethyl- (*tetramethylbutanedioic acid*; 2, 3-dimethyl-2, 3-butanedicarboxylic acid*). $HOOCC(CH_3)_2C(CH_3)_2COOH$, 174.11. Cr. **m.p.** 190.2, **b.p.** subl. **Soly.** $0.48^{13.5}$w.; v.s.al.; s.et.; i.lgr.

44 Succinic anhydride (*butanedioic anhydride**). $(CH_2CO)_2O$, 100.03. Col. need.f.al. **D.** 1.104, **m.p.** 119.6, **b.p.** 261. **Soly.** v.sl.s.w.; s.al.; v.sl.s.et.

45 Succinimide (*butanimide*; 2, 5-pyrrolidinedione*). $(CH_2CO)_2NH$, 99.05. Octahdr.col.need.f.acet. **D.** 1.412^{16}, **m.p.** 124–6, **b.p.** 288. **Soly.** 23^{20}, 152^{70}w.; 4.1^{20}, 16^{50}al.; v.sl.s.et.

46 Succinonitrile (*butanedinitrile*; ethylene cyanide*). $CNCH_2CH_2CN$, 80.05. Col., n $1.41645^{63.1}$. **D.** 0.985^{60}_{4}; 1.023^{45}, **m.p.** 54.5, **b.p.** 267. **Soly.** v.s.w.; v.s.al.; s.et.

47 Succinyl chloride (*butanedioyl chloride**). $(CH_2COCl)_2$, 154.95. Col. fum.liq. or cr., n $1.47348^{16.2}$, **D.** 1.395^{20}_{4}, **m.p.** 17, **b.p.** 192. **Soly.** d.w.; d.al.; v.s.et.; s.bz., i.pet.eth.

48 Sucrose (*cane sugar; saccharose*). $C_{12}H_{22}O_{11}$, 342.17. Col.monocl., n 1.5376, 1.5651, 1.5705. **D.** 1.588^{15}, **m.p.** 186 d., **b.p.** d. **Soly.** 179^0, 487^{100}w.; 0.9al.; i.et.; sl.s.me.al.; i.chl.

50 Sulfanilic acid (*p-aminobenzenesulfonic acid; p-anilinesulfonic acid*). $NH_2C_6H_4SO_3H\cdot H_2O$, 191.14. Col. rhomb.pl. or monocl.cr.($+2H_2O$). **m.p.** 288 d. **Soly.** 1.08^{20}, 6.67^{100}w.; v.sl.s.al.; v.sl.s.et.

51 Sulfide, 2-benzothiazyl 2, 4-dinitrophenyl. See *Benzothiazole, 2-(2, 4-dinitrophenylthio)-.*

52 —, bis-β-chloroethyl. See *Sulfide, β, β′-dichloroethyl.*

53 —, bis(dimethylthiocarbamyl) (*tetramethylthiuram (mono)sulfide*). $[(CH_3)_2NCS]_2S$, 208.09. Yel.cr. **D.** 1.40, **m.p.** 107. **Soly.** i.w.; s.h.al.; sl.s.et.; s.chl.

54 —, bis-β-hydroxyethyl. See *Ethanol, 2, 2′-thiodi-.*

55 —, bis(β-methylbutyl) (*di-act-amyl sulfide; 2-methyl-1-(β-methylbutylthio)-butane**). $[CH_3CH_2CH(CH_3)CH_2]_2S$, 174.23. $[\alpha] + 24.5°^{20}_{D}$. **D.** 0.8362^{20}_{0}, **m.p.** $95–8^{13}$.

56 —, bis(1-piperidylthiocarbonyl) (*dicyclopentamethylenethiuram monosulfide*). $(C_5H_{10}NCS)_2S$, 288.35. Yel. cr. **m.p.** 121. **Soly.** i.w.; sl.s.c., s.h. al.; sl.s.et.; s.chl.

57 —, 4, 4′-diaminodiphenyl. See *Aniline, p, p′-thiodi-.*

58 —, di-act-amyl. See *Sulfide, bis(β-methylbutyl).*

59 —, dibenzyl. See *Benzyl sulfide.*

60 —, dibutyl. See *Butyl sulfide.*

61 —, β, β′-dichloroethyl (*1-chloro-2-(β-chloroethylthio)ethane*; bis-β-chloroethyl sulfide; 2, 2′-dichlorodiethyl sulfide; mustard gas; yperite; yellow cross liquid*). $(ClCH_2CH_2)_2S$, 159.04. Col. oily liq. or pr. **D.** 1.199^{15}_{4}; solid 1.338^{13}, **m.p.** 13–4, **b.p.** 215–7. **Soly.** 0.048w.; s. al.; s.et.

62 —, diethyl. See *Ethyl sulfide.*

63 —, diisoamyl. See *Isoamyl sulfide.*

64 —, diisobutyl. See *Isobutyl sulfide.*

65 —, diisopropyl. See *Isopropyl sulfide.*

66 —, dimethyl. See *Methyl sulfide.*

67 —, diphenyl. See *Phenyl sulfide.*

68 —, dipropyl. See *Propyl sulfide.*

69 —, divinyl. See *Vinyl sulfide.*

70 —, ethyl methyl (*methylthioethane**). $CH_3SC_2H_5$, 76.12. Liq. **D.** 0.837 **m.p.** -104.8, **b.p.** 66. **Soly.** i.w. ∞al.; ∞et.

71 Sulfobenzide. See *Phenyl sulfone.*

72 Sulfocyanic acid. See *Thiocyanic acid.*

73 Sulfonal. See *Propane, 2, 2-bis(ethylsulfonyl)-**.

74 Sulfone, dibenzyl. See *Benzyl sulfone.*

75 —, diethyl. See *Ethyl sulfone.*

76 —, diphenyl. See *Phenyl sulfone.*

77 —, dipropyl. See *Propyl sulfone.*

* Name approved by the International Union of Chemistry.

78 **Sulfone, ethylenebisphenyl.** See *Ethane, 1, 2-bisphenylsulfonyl-**.

79 —, **ethyl phenyl** (*ethylsulfonylbenzene**). $C_2H_5SO_2C_6H_5$, 170.14. Monocl.pl.f.et. **D.** 1.010^{22}, **m.p.** 42, **b.p.** >300. **Soly.** sl.s.c.w.; s.al.; s.et.

80 —, **pentane-γ, γ-diethyl.** See *Tetronal*.

81 **Sulfonmethane.** See *Propane, 2, 2-bis(ethylsulfonyl)-**.

82 **Sulfoxide, dibenzyl.** See *Benzyl sulfoxide*.

83 —, **diethyl.** See *Ethyl sulfoxide*.

84 **Sulfur chloride, trichloromethyl-.** See *Methyl mercaptan, perchloro-*.

85 **Sulfuric ether.** See *Ethyl ether*.

86 **Sumatra camphor.** See *d-Borneol*.

87 **Superpalite.** See *Diphosgene*.

88 **Suprarenine.** See *Adrenaline*.

89 **Sylvan.** See *Silvan*.

90 ***d*-Sylvestrene** (*d-1, 8(9)-m-menthadiene*). $C_{10}H_{16}$, 136.12. Liq., n $1.47717^{17.2}$. **D.** 0.863^{20}_{4}, **b.p.** 177. **Soly.** i.w.; ∞al.; ∞et.

91 **Sylvic acid.** See *Abietic acid*.

92 **Tannin.** See *m-Digallic acid*.

93 **Tartaric acid, dihydroxy-.** See *Succinic acid, tetrahydroxy-*.

94 ***dl*-Tartaric acid** (*racemic acid*). $HOOC(CHOH)_2COOH \cdot H_2O$, 168.06. Col.tricl. **D.** 1.697, **m.p.** $-H_2O$, 100; anh. 204–6. **Soly.** 20.6^{20}, 9.2^{30}, 185^{100}w.; 1.66c.al.; 0.87c.et.

94₁ —, diethyl ester (*diethyl tartrate (dl-racemic); diethyl racemate*). $C_8H_{14}O_6$, 206.11. n 1.4454^{25}, $[\alpha]$ $+7.45°^{20}_{D}$. **D.** 1.2036^{20}_{4}, **m.p.** 17, **b.p.** 280. **Soly.** sl.s.w.; ∞al.; ∞ et.; s. ord.org.solv.

95 —, dimethyl ester (*dimethyl dl-2, 3-dihydroxy butanedioate*; methyl racemate*). $(COOCH_3)(CHOH)_2COOCH_3$, 178.08. Monocl.f.al. **m.p.** stable 90; metastable 84; meso 111, **b.p.** 282. **Soly.** s.al.

96 ***d*-Tartaric acid** (*d-2, 3-dihydroxybutanedioic acid*; d-α, β-dihydroxysuccinic acid*). $HOOC(CHOH)_2COOH$, 150.05. Col.monocl., n 1.4955, 1.5352, 1.6045. **D.** 1.7598^{20}_{4}, **m.p.** 170. **Soly.** 139^{20}, 343^{100}w.; 19.85^{15}al.; 0.44c.et.; s.acet.; i.bz., chl.

97 —, dibutyl ester (*dibutyl d-2, 3-dihydroxybutanedioate**). $(CHOHCOOC_4H_9)_2$, 262.17. Pr. **D.** 1.087^{21}, **m.p.** 22.5, **b.p.** 203^{18}.

98 —, diethyl ester (*diethyl d-2, 3-dihydroxybutanedioate*; ethyl d-tartrate*). $[CH(OH)COOC_2H_5]_2$, 206.11. Col. hyg.liq. n 1.4454^{25}, $[\alpha]+7.45°^{20}_{D}$. **D.** 1.2036^{20}_{4}, **m.p.** 17, **b.p.** 280. **Soly.** sl.s.w.; ∞al.; ∞et.; s.ord.org.solv.

99 —, diethyl ester diacetate (*ethyl diacetyl-d-tartrate; ethyl d-diacetoxysuccinate*). $[CH(OOCCH_3)COOC_2H_5]_2$, 290.14. Monocl.cr. **D.** 1.109^{71}, **m.p.** 67, **b.p.** $291\text{–}2^{727}$. **Soly.** sl.s.w.; s.al.; v.s.et.

00 —, dimethyl ester (*methyl d-tartrate*). $(COOCH_3)(CHOH)_2COOCH_3$, 178.08. Col., $[\alpha]+9.32°^{0}_{D}$ in me.al. **D.** 1.3046^{65}_{4}, **m.p.** (1)48; (2)50; (3)61, **b.p.** 280. **Soly.** s.w.; v.s.al.; s.chl., bz.

01 —, dinitrate (*dinitrotartaric acid*). $COOH(CHNO_3)_2COOH$, 240.05. Need. **m.p.** d. **Soly.** d.w.; s.al.; s.et.; i.bz.

02 —, dipropyl ester (*dipropyl d-2, 3-dihydroxybutanedioate*; propyl tartrate*). $(CHOHCOOC_3H_7)_2$, 234.14. Liq., **D.** 1.139, **b.p.** 303. **Soly.** i.w.; v.s.al.; v.s.et.

03 —, monoethyl ester (*ethyl hydrogen d-tartrate*). $COOH(CHOH)_2COOC_2H_5$, 178.08. Col.rhomb. **m.p.** 90. **Soly.** s.w.; s.al.; s.et.

04 —, nicotine salt. See *Nicotine, tartrate*.

05 —, **dinitro-.** See *d-Tartaric acid, dinitrate*.

05₁ ***l*-Tartaric acid,** diethyl ester (*ethyl l-tartrate*). $C_8H_{14}O_6$, 206.11. $[\alpha]$ $-7.55°^{19.7}_{D}$. **D.** $1.2054^{19.7}_{4}$, **b.p.** 162^{19}.

06 ***i*-Tartaric acid** (*mesotartaric acid*). $HOOC(CHOH)_2COOH$, 150.05. Col. tab., n 1.495, 1.536, 1.605. **D.** 1.666, **m.p.** anh. 140. **Soly.** 125^{15}w.; s.al.; sl.s.et.

06₁ —, diethyl ester (*diethyl tartrate (dl-meso)*). $C_8H_{14}O_6$, 206.11. **m.p.** 55.

07 **Tartronic acid** (*2-hydroxypropanedioic acid*; hydroxymalonic acid*). $HOCH(COOH)_2$, 120.03. Col.pr.f.et. **m.p.** 158 d., **b.p.** d.; subl. 110–20. **Soly.** v.s.w.; v.s.al.; sl.s.et.

08 —, **benzyl-** (*1-hydroxy-2-phenyl-1, 1-ethanedicarboxylic acid*). $C_6H_5CH_2C(OH)(COOH)_2$, 210.08. Pr. **m.p.** 153(147 d.). **Soly.** s.w.; s.al.; s.et.

09 **Taurine** (*2-aminoethanesulfonic acid*). $H_2NCH_2CH_2SO_3H$, 125.12. Tetr. need. **m.p.** >240 d., **b.p.** d. **Soly.** 6.5^{12}w.; 0.0032^{17}al.; i.et.

For explanations and abbreviations see beginning of table.

10 **Taurocholic acid.** $C_{26}H_{45}NO_7S \cdot H_2O$, 533.43. Deliq.need. **m.p.** 180 d. **Soly.** v.s.w.; v.s.al.; sl.s.et.

11 **Telluride, diethyl.** See *Ethyl telluride.*

12 **—, dimethyl.** See *Methyl telluride.*

13 **Tellurium ethyl.** See *Ethyl telluride.*

14 **Teraconic acid** (*2-isopropylidenebutanedioic acid*; isopropylidenesuccinic acid; γ, γ-dimethylitaconic acid*). $(CH_3)_2C{:}C(COOH)CH_2COOH$, 158.08. Tricl.f.et. **m.p.** 161 d. **Soly.** v.s.w.; v.s.al.; v.s.et.; v.sl.s.bz.

16 **Terebic acid** (2, *2-dimethylparaconic acid*). $C_7H_{10}O_4$, 158.08. Monocl.f.al. **D.** 0.8155^{24}_{4}, **m.p.** 174, **b.p.** d. **Soly.** sl.s.w.; s.al.; 1.21c.et.

17 **Terephthalaldehyde** (1, *4-benzenedicarbonal**). $C_6H_4(CHO)_2$, 134.05. Need.f.w. **m.p.** 116, **b.p.** 248. **Soly.** 1.5^{100}w.; v.s.al.; v.sl.s.et.

18 **Terephthalaldehydic acid** (*p-formylbenzoic acid*). $CHOC_6H_4COOH$, 150.05. Need.f.w. **m.p.** 256(248–50), **b.p.** subl. **Soly.** s.h.w.; v.s.al.; sl.s.et.; sl.s.chl.

19 **—, 3-hydroxy-** (*4-formyl-3-hydroxybenzoic acid*). $CHOC_6H_3(OH)COOH$, 166.05. Need. **m.p.** 234. **Soly.** sl.s. h.w.; s.al.; s.et.

20 **Terephthalic acid** (1, *4-benzenedicarboxylic acid*; p-phthalic acid*). $C_6H_4(COOH)_2$, 166.05. Need. or amor. **D.** 1.510, **m.p.** subl., **b.p.** subl. *ca.* 300. **Soly.** 0.0016w.; v.sl.s.al.; v.sl. s.et.; s.alk., v.sl.s.chl.

21 —, diethyl ester (*ethyl p-phthalate*). $C_6H_4(COOC_2H_5)_2$, 222.11. Col. **m.p.** 44.

22 —, dimethyl ester (*dimethyl 1, 4-benzenedicarboxylate**). $C_6H_4(COOCH_3)_2$, 194.08. Rhomb.f.al. **m.p.** 140, **b.p.** subl. >300. **Soly.** 0.33h.w.; s.h.al.; s.et.

23 —, mononitrile. See *Benzoic acid, p-cyano-.*

24 **—, benzoyl-** (2, *5-benzophenonedicarboxylic acid*). $C_6H_5COC_6H_3(COOH)_2$, 270.08. Need. **m.p.** 285. **Soly.** i.w.; s.al.; s.et.; i.tol.

25 **—, 2, 3-dihydro-.** See 1, *3-Cyclohexadiene-1, 4-dicarboxylic acid.*

26 **—, 2, 5-dihydroxy-** (2, *5-dihydroxy-1, 4-benzenedicarboxylic acid*; 2, 5-hydroquinone dicarboxylic acid*). $(HO)_2C_6H_2(COOH)_2$, 198.05. Yel.cr. f.al. or et. **m.p.** d. **Soly.** s. (grn.fluores.)w.; s.(bl.fluores.)al.; s.et.

27 **—, hexahydro-.** See 1, *4-Cyclohexanedicarboxylic acid*.*

28 **—, 2-nitro-.** $NO_2C_6H_3(COOH)_2$, 211.05. **m.p.** 270(263). **Soly.** v.s. h.w.; s.h.al.

29 **Terephthalonitrile** (1, *4-benzenedicarbonitrile*; p-phenylene cyanide*). $C_6H_4(CN)_2$, 128.05. Col.need.f.bz. **m.p.** 222. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.h.ac.a.

30 **Terephthalyl chloride** (1, *4-benzenedicarbonyl chloride*; p-phthalyl dichloride*). $C_6H_4(COCl)_2$, 202.95. Need. **m.p.** 78, **b.p.** 259. **Soly.** d.w.; d.al.; s.et.

31 **Terpane.** See *p-Menthane.*

32 **Terphenyl** (1, *4-diphenylbenzene; p-phenylbiphenyl; triphenyl; diphenylphenylene*). $(C_6H_5)_2C_6H_4$, 230.11. Col.leaf.f.al. **D.** 1.234^{0}_{4}, **m.p.** 213, **b.p.** subl. 427. **Soly.** v.sl.s.al.; sl.s. et.; s.h.bz.(bl.fluores.); sl.s.ac.a., CS_2.

33 ***m*-Terphenyl.** See *Benzene, 1, 3-diphenyl-.*

34 **α-Terpinene** (1, *3-p-menthadiene*). $C_{10}H_{16}$, 136.12. Col.liq., *n* 1.4846. α: **D.** 0.846, **b.p.** 180. β: **D.** 0.838, **b.p.** 173. **Soly.** i.w.; ∞al.; ∞et.

35 ***dl*-α-Terpineol** (*dl-1-p-menthen-8-ol*). $C_{10}H_{17}OH$, 154.14. Col.liq., *n* 1.4827. **D.** 0.9357^{20}_{4}, **m.p.** 35; d. 40, **b.p.** 219.8. **Soly.** i.w.; v.s.al.; v.s.et.; s.chl.

36 **Terpin hydrate.** See *Terpinol, hydrate.*

38 ***cis*-Terpinol,** hydrate (*cis-1, 8-p-menthanediol hydrate; cis-terpin hydrate*). $C_{10}H_{18}(OH)_2 \cdot H_2O$, 190.17. Col.rhomb., *n* 1.505, 1.512, 1.524. **m.p.** anh. 117.1, **b.p.** subl. 100. **Soly.** 0.36^{20}w.; 7.94^{15}al.; 0.714^{15}et.; 0.745^{15}chl.

39 **Terpinolene** (1, *4(8)-p-menthadiene*). $C_{10}H_{16}$, 136.12. Col.liq., *n* 1.4823. **D.** 0.855, **b.p.** 185. **Soly.** i.w.; ∞al.; ∞et.

40 **Tetracoline.** See *Quinoline, 2, 5, 7-trimethyl-.*

41 **Tetracosane*(*n*).** $CH_3(CH_2)_{22}CH_3$, 338.39. Cr. **D.** 0.7786^{51}_{4}, **m.p.** 51.1, **b.p.** 324.1; 243^{15}. **Soly.** i.w.; v.s.al.; v.s.et.

42 **Tetradecanal*,** oxime. See *Myristaldehyde, oxime.*

43 **Tetradecanamide*.** See *Myristamide.*

44 **Tetradecane*** (*n-tetradecane*). $CH_3(CH_2)_{12}CH_3$, 198.23. Col.liq., *n* 1.4459. **D.** 0.765, **m.p.** 5.5, **b.p.** 252.5. **Soly.** i.w.; v.s.al.; v.s.et.

45 **—, 1-amino-.** See *Tetradecylamine**

46 **Tetradecanenitrile*.** See *Myristonitrile.*

* Name approved by the International Union of Chemistry.

47 **Tetradecanoic acid*.** See *Myristic acid.*

48 **Tetradecanoic anhydride*.** See *Myristic anhydride.*

49 **1-Tetradecanol*** (*n-tetradecyl alcohol; myristic alcohol*). $CH_3(CH_2)_{12}CH_2OH$, 214.23. Opaque leaf.f.al. **D.** liq. 0.8236^{38}_{4}, **m.p.** 37.62, **b.p.** 167^{15}. **Soly.** i.w.; sl.s.al.; s.et.

50 **Tetradecanoyl chloride*.** See *Myristyl chloride.*

51 **1-Tetradecene*** (*α-tetradecylene*). $CH_2{:}CH(CH_2)_{11}CH_3$, 196.22. Col.liq. **D.** 0.775, **m.p.** −12, **b.p.** 246. **Soly.** i.w.; v.s.al.; v.s.et.

52 ***n*-Tetradecyl alcohol.** See 1-*Tetradecanol**.

53 **Tetradecylamine*** (*prim-n-tetradecylamine; 1-aminotetradecane*). $CH_3(CH_2)_{13}NH_2$, 213.25. **m.p.** 37, **b.p.** 162^{15}.

54 **Tetradecyl sulfate** (*di-n-tetradecyl sulfate*). $[CH_3(CH_2)_{13}]_2SO_4$, 490.51. **m.p.** 57.8–8.0.

Tetrahydro-. See the parent compounds (e.g., for tetrahydronaphthalene see *Naphthalene, tetrahydro-*).

55 **Tetralin.** See *Naphthalene*, 1, 2, 3, 4-*tetrahydro-**.

56 **Tetramethylene.** See *Cyclobutane**.

57 **Tetramethylenediamine.** See *Putrescine.*

58 **Tetramethylene glycol.** See 1, 4-*Butanediol**.

59 **Tetramethylene oxide.** See *Furan, tetrahydro-*.

60 **Tetramethylenimine.** See *Pyrrolidine.*

61 ***s*-Tetrazine** (1, 2, 4, 5-*tetrazine*). N:NCH:NN:CH, 82.05. Red. **m.p.** 99, **b.p.** subl. **Soly.** s.w.

62 ***s*-Tetrazinedione, tetrahydro-.** See *p-Urazine.*

63 **2, 1, 3, 5-Tetrazole** (1, 2, 3, 5-*tetrazole*). NHN:NCH:N, 70.05. Leaf.f.al. **m.p.** 155, **b.p.** subl. **Soly.** s.w.; s.al.; i.et.; s.ac.a.; sl.s.bz.

64 **Tetrolic acid** (*2-butynoic acid*; methylpropiolic acid*). $CH_3C{:}CCOOH$, 84.03. Col.tab.f.et. or CS_2. **m.p.** 76.5, **b.p.** 203. **Soly.** v.s.w.; v.s.al.; v.s.et.; 8.33CS_2.

65 **Tetronal** (3, 3-*bisethylsulfonylpentane*; pentane γ, γ-diethyl sulfone*). $(C_2H_5)_2C(SO_2C_2H_5)_2$, 256.28. Glit. leaf.f.w. **m.p.** 85. **Soly.** 0.22c.w.; 4.3^{16}al.; 7.1^{15}et.

66 **Tetryl** (*N-methyl-N, 2, 4, 6-tetranitroaniline; methylpicrylnitramine*). $(NO_2)_3C_6H_2N(NO_2)CH_3$, 287.08. Yel. monocl.f.al. **D.** 1.57^{19}, **m.p.** 130, **b.p.** exp. 187. **Soly.** v.s.w.; 0.422^{18}al.; v.s.et.; s.bz., ac.a.

67 **Thalline** (1, 2, 3, 4-*tetrahydro-6-methoxyquinoline*). $C_{10}H_{13}NO$, 163.11. Rhomb. **m.p.** 43, **b.p.** 283.8. **Soly.** s.h.w.; v.s.al.; v.s.et.; v.s.bz.

68 **Thebaine** (*paramorphine*). $C_{19}H_{21}NO_3$, 311.17. Glit.pr.f.al., $[\alpha]$ $-218.64°^{15}_{D}$ in al. **D.** 1.305, **m.p.** 193. **Soly.** v.sl.s.w.; 10c.al.; 0.71^{10}et.; v.s.chl.; s.bz.

69 —, hydrochloride. $C_{19}H_{21}NO_3{\cdot}HCl{\cdot}H_2O$, 365.65. Rhomb., $[\alpha]-168.32°_D$. **Soly.** s.h.w.; 6.3^{10}al.; s.et.

70 **Theine.** See *Caffeine.*

71 **α-Thenyl alcohol.** See 2-*Thiophenecarbinol.*

72 **Theobromine** (3, 7-*dimethylxanthine*). $C_7H_8N_4O_2$, 180.09. Wh. rhomb.f.w. **m.p.** 337, **b.p.** subl. 290–5. **Soly.** 0.03^{18}, 0.67^{100}w.; 0.023^{17}al.; sl.s.et.; sl.s.amyl al.; v.sl.s.bz.

73 **Theophylline** (1, 3-*dimethylxanthine*). $C_7H_8N_4O_2$, 180.09. Monocl.need.f.w. **m.p.** 269–72. **Soly.** 0.44^{15}, 1.3^{37}w.; 1.25al.; sl.s.et.; s.alk., NH_4OH.

74 **Thetin, dimethyl-** (2, 2-*dihydro-2, 2-dimethyl-1, 2-oxathietan-4-one*). $OS(CH_3)_2CH_2CO$, 120.12. Deliq.cr. **m.p.** d., $-H_2O$. **Soly.** s.w.; s.al.

75 **Thialdine** (5, 6-*dihydro-2, 4-6-trimethyl-1, 3-5-dithiazine*). $SCH(CH_3)SCH(CH_3)NHCHCH_3$, 163.23. Monocl. **D.** 1.191, **m.p.** 43, **b.p.** d. **Soly.** sl.s.w.; s.al.; v.s.et.

76 **Thianthrene** (*dibenzo-p-dithiin; diphenylene disulfide*). $C_6H_4SC_6H_4S$, 216.18. Monocl.pr.f.al. **m.p.** 158–60, **b.p.** 353–4 d.; 204^{11}. **Soly.** i.w.; 0.25c.al.; s.h.et.; s.CS_2, H_2SO_4, bz.

77 **Thiazole** (*thio[b]monazole; metathiazole*). SCH:NCH:CH, 85.09. Col. liq. **D.** 1.198, **b.p.** 116.8. **Soly.** s.al.; s.et.

78 —, **2-amino-** (*2-thiazolylamine*). $C_3H_2NS{\cdot}NH_2$, 100.11. Yel.cr.f.al. **m.p.** 90, **b.p.** d. **Soly.** sl.s.w.; sl.s.al.; sl.s.et.

79 **2-Thiazolylamine.** See *Thiazole*, 2-*amino-*.

80 2-Thienyl ketone (*2, 2′-dithienyl ketone; thienone*). $(C_4H_3S)_2CO$, 194.17. Col.need.f.al. **m.p.** 87–8, **b.p.** 326. **Soly.** i.w.; s.h.al.; s.ord.org.solv.

81 Thioacetic acid. See *Acetic acid, thiol-*.

82 Thioaniline. See *Aniline, p, p′-thiodi-*.

83 Thiocarbonyl chloride. See *Phosgene, thio-*.

84 Thiocarbonyl tetrachloride. See *Methyl mercaptan, perchloro-*.

85 Thiocyanic acid (*sulfocyanic acid*), CNSH, 59.08. Col.liq. **m.p.** 5, **b.p.** d. **Soly.** ∞, d.w.; v.s.al.; v.s.et.

86 —, allyl ester (*2-propenyl thiocyanate*; allyl sulfocyanide*). $CH_2{:}CHCH_2CNS$, 99.11. Oil. **D.** 1.056^{15}; (1.071^{0}), **b.p.** 161. **Soly.** v.sl.s.w.; ∞al.; ∞et.

88 —, butyl ester (*n-butyl sulfocyanate; n-butyl rhodanate*). $CH_3(CH_2)_3SCN$, 115.14. Col.liq., *n* $1.4636^{21.6}$. **D.** 0.9563^{25}, **b.p.** $184.5–5.5^{743}$. **Soly.** i.w.; s.al.; s.et.

90 —, *tert*-butyl ester (*tert-butyl sulfocyanate; tert butyl rhodanate*). $(CH_3)_3CSCN$, 115.14. Oil. **b.p.** d.

91 —, cyanogen ester (*cyanogen sulfide; cyanogen thiocyanate*). N⋮CSC⋮N, 84.08. Rhomb.pl. or leaf. **m.p.** 65 (60), **b.p.** d.; subl. 30–40. **Soly.** s.w.; s.al.; s.et.

92 —, ethylene ester. See *Glycol, dithiocyanate*.

93 —, ethyl ester. C_2H_5SCN, 87.11. Col.liq., *n* 1.4666. **D.** $0.996^{2}_{4}{}^{5}$, **m.p.** −85.5, **b.p.** 144.4. **Soly.** i.w.; ∞al.; ∞et.

94 —, isoamyl ester (*isoamyl sulfocyanate; isoamyl rhodanate*). $(CH_3)_2CH(CH_2)_2SCN$, 129.15. Col.liq. **b.p.** 197; $193.5–5^{740}$. **Soly.** v.sl.s.w.; s.al.; s.et.

95 —, isobutyl ester (*isobutyl sulfocyanate; isobutyl rhodanate*). $(CH_3)_2CHCH_2SCN$, 115.14. Col.liq **b.p.** 174–6. **Soly.** ∞w.

96 —, isopropyl ester (*isopropyl sulfocyanate; isopropyl rhodanate*). $(CH_3)_2CHSCN$, 101.12. **D** 0.963^{20}, **b.p.** 149–51(152–3) **Soly.** i.w.; ∞al.; ∞et.

97 —, methyl ester (*methyl thiocyanate; methyl sulfocyanate*). CH_3SCN, 73.09. Col.liq., *n* $1.46801^{23.8}$. **D.** 1.068, **m.p.** −51, **b.p.** 133. **Soly.** i.(v.sl.s.)w.; ∞al.; ∞et.

98 —, phenyl ester (*phenyl sulfocyanate; phenyl rhodanate*). C_6H_5SCN, 135.11. Liq. **D.** $1.1228^{23.6}$, **b.p.** 232. **Soly.** i.w.; s.al.; s.et.

99 —, propyl ester (*n-propyl sulfocyanate; n-propyl rhodanate*). $CH_3CH_2CH_2SCN$, 101.12. Col.liq. **b.p.** 163.

00 Thiocyanuric acid (*trithiocyanuric acid*). $C_3H_3N_3S_3$, 177.23. Yel.need **m.p.** d. 200. **Soly.** v.s.h.w.; v.sl.s.al. v.sl.s.et.

01 Thiodiglycol. See *Ethanol, 2, 2′ thiodi-*.

02 Thiodiphenylamine. See *Phenothiazine*.

03 Thiofuran. See *Thiophene*.

04 Thioglycolic acid. See *Acetic acid mercapto-*.

05 Thiohydantoin. See *Hydantoin, 2 thio-*.

06 Thioisatin. See *Thionaphthenequinone*.

07 Thio[*b*]monazole. See *Thiazole*.

08 Thionaphthene (*benzothiophene; benzothiofuran*). $C_6H_4SCH{:}CH$, 134.1 Leaf., *n* $1.63324^{36.2}$. **D.** $1.165^{3}_{4}{}^{2}$, **m.p.** 32, **b.p.** 221 volat. **Soly.** i.w.; v.s.al v.s.et.

09 Thionaphthenequinone (*1, 2-thionaphthenedione; thioisatin*). C_6H_4SCOCO, 164.09. Yel.pr. **m.p.** 121, **b.p.** 247. **Soly.** i.w.; s.al.

10 Thionine (*Lauth's violet*). $C_{12}H_9N_3S$, 227.15. Grn.powd. or br.blk.lea **Soly.** v.v.sl.s.c.w.; sl.s.al.; s.et.

11 Thiophene (*thiofuran*). $SCH{:}CHCH{:}CH$, 84.09. Liq., *n* 1.5285. **D** 1.0884^{2}_{4}, **m.p.** −40, **b.p.** 84. **Soly** i.w.; s.al.; s.bz., H_2SO_4.

12 —, **2-acetyl-.** See *Ketone, methyl 2-thienyl*.

13 —, **2-acetyl-5-bromo-.** See *Ketone 5-bromo-2-thienyl methyl*.

14 —, **2-acetyl-5-chloro-.** See *Ketone 5-chloro-2-thienyl methyl*.

15 —, **2-amino-.** See *Thiophenine*.

16 —, **2-bromo-.** $SCBr{:}CHCH{:}CH$, 163.00. Col. **D.** $1.652^{2}_{4}{}^{3}$, **b.p.** 149.5–50.5. **Soly.** i.w.; v.s.al.; v.s.et.

17 —, **2-chloro-.** $SCCl{:}CHCH{:}CH$ 118.54. Col. **b.p.** 130.

18 —, **2, 5-dibromo-.** $SCBr{:}CHCH{:}CBr$, 241.91. Col. **D.** $2.147^{2}_{4}{}^{3}$, **b.p.** 210.5–1.0. **Soly.** i.w.; v.s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

19 **Thiophene, 2, 5-dibromo-3, 4-dinitro-.** $(NO_2)_2C_4Br_2S$, 331.91. Pa. yel. **m.p.** 139–40. **Soly.** v.s.h.al.

20 —, **2, 5-dichloro-.** SCCl:CHCH:C-Cl, 152.99. Col. **b.p.** 170.

21 —, **2, 3-dihydro-2-imino-.** See *Thiophenine.*

22 —, **2, 5-diiodo-.** SCI:CHCH:CI, 335.92. Col.fluores. **m.p.** 40.5. **Soly.** i.w.; v.s.al.

23 —, **2, 3-dimethyl-** (*2, 3-thioxene*). $(CH_3)_2C_4H_2S$, 112.12. Col.liq. **D.** 0.9938$^{22}_{4}$, **b.p.** 136–7. **Soly.** i.w.; v.s.al.; v.s.et.

24 —, **2, 4-dimethyl-** (*2, 4-thioxene*). $(CH_3)_2C_4H_2S$, 112.12. Liq. **D.** 0.9956^{20}, **b.p.** 138. **Soly.** i.w.; s.al.; s.et.

25 —, **2, 5-dimethyl-** (*2, 5-thioxene*). $(CH_3)_2C_4H_2S$, 112.12. Liq., n 1.51418. **D.** 0.9859$^{24.8}_{4}$, **b.p.** 137.5. **Soly.** i.w.; s.al.; s.et.

26 —, **2, 5-dinitro-.** $(NO_2)_2C_4H_2S$, 174.09. Yel.pl. **m.p.** 52., **b.p.** 290. **Soly.** sl.s.w.; s.al.; v.s.et.

27 —, **2-ethyl-.** $C_2H_5C_4H_3S$, 112.12. Col. **D.** 0.990$^{24}_{4}$, **b.p.** 132–4. **Soly.** i.w.; v.s.al.; v.s.et.

28 —, **3-ethyl-.** $C_2H_5C_4H_3S$, 112.12. Col. **D.** 1.0012$^{24}_{4}$, **b.p.** 135–6. **Soly.** i.w.; v.s.al.; v.s.et.

29 —, **2-formyl-.** See *2-Thiophenecarbonal.*

30 —, **2-iodo-.** C_4H_3IS, 210.00. Col. **b.p.** 182; 73^{15}. **Soly.** v.s.et.

31 —, **2-iodo-5-nitro-.** $NO_2C_4H_2IS$, 255.00. Lam.yel., shiny. **m.p.** 74. **Soly.** s.al.

32 —, **2-methyl-.** (*α-thiotolene*). CH_3-C_4H_3S, 98.11. Col. **b.p.** 113. **Soly.** i.w.; v.s.al.; v.s.et.

33 —, **3-methyl-** (*β-thiotolene*). CH_3-C_4H_3S, 98.11. Col.oil. **D.** 1.0247$^{15}_{4}$, **b.p.** 114^{738}. **Soly.** i.w.; v.s.al.; v.s.et.

34 —, **2-methyl-5-phenyl-.** CH_3-C_4-$H_2S{\cdot}C_6H_5$, 174.14. Col.need. **m.p.** 49–51. **Soly.** v.s.al.; v.s.et.

35 —, **2-nitro-.** $NO_2C_4H_3S$, 129.09. Monocl.f.al. **m.p.** 46.5, **b.p.** 225. **Soly.** i.w.; v.s.al.; v.s.et.; i.alk.

36 —, **tetrabromo-.** C_4Br_4S, 399.72. Wh.need. **m.p.** 116, **b.p.** 326. **Soly.** i.w.; s.h.al.; v.s.et.

37 —, **tetrachloro-.** C_4Cl_4S, 221.89. Spears. **m.p.** 36. **Soly.** v.s.al.

38 —, **2, 3, 5-tribromo-.** C_4HBr_3S, 320.82. Shiny spears. **m.p.** 29, **b.p.** 259–60. **Soly.** i.w.; sl.s.h.al.; v.s.et.

39 —, **2, 3, 5-tribromo-4-nitro-.** NO_2-C_4Br_3S, 365.82. Red-yel.need. **m.p.** 106. **Soly.** v.s.et.

40 —, **2, 3, 5-trichloro-.** C_4HCl_3S, 187.44. Col.oil. **b.p.** 206–7.

41 —, **2, 3, 5-trichloro-4-nitro-.** NO_2-C_4Cl_3S, 232.44. Red-yel.need. **m.p.** 86. **Soly.** s.al.; v.s.et.; v.s.bz.

42 —, **2, 3, 5-trimethyl-.** $(CH_3)_3C_4HS$, 126.14. Col. **b.p.** 160–3.

43 **2-Thiopheneacetic acid** (*2-thienylacetic acid*). $C_4H_3S{\cdot}CH_2COOH$, 142.11. Col. **m.p.** 76. **Soly.** s.h.w.; s.al.; s.et.

44 —, **α-keto-** (*2-thienylglyoxylic acid; 2-thenoylformic acid*). C_4H_3SCOCO-OH, 156.09. Cr.+1H_2O. **m.p.** +1 H_2O 58–9; anh. 91.5. **Soly.** v.s.w.; v.s.et.

45 **Thiophene aldehyde.** See *Thiophenecarbonal*.*

46 **2-Thiophenecarbinol** (*α-thienylcarbinol; α-thenyl alcohol*). $C_4H_3S{\cdot}CH_2$-OH, 114.11. Col.liq. **b.p.** 207. **Soly.** i.w.; v.s.al.; v.s.et.

47 **2-Thiophenecarbonal*** (*2-thiophenealdehyde; α-thienylformaldehyde; 2-formylthiophene*). $C_4H_3S{\cdot}CHO$, 112.09. Yel.oil. **D.** 1.215$^{21}_{4}$, **b.p.** 198. **Soly.** i.w.; v.s.al.; s.et.

48 —, oxime (*2-thiophenealdoxime*). C_4-$H_3S{\cdot}CH{:}NOH$, 127.11. Wh.need **m.p.** 128. **Soly.** v.s.et.

49 —, phenylhydrazone (*2-thienylformaldehyde phenylhydrazone*). $C_4H_3S{\cdot}CH$ $NNHC_6H_5$, 202.15. Yel.need. **m.p.** 134.5. **Soly.** i.w.; s.al.

50 **2-Thiophenecarboxylic acid*** (*α-thiophenic acid*). $C_4H_3S{\cdot}COOH$, 128.09. Need.f.w. **m.p.** 126.5, **b.p.** 260 d. **Soly.** 0.75^{25}, v.s.h.w.; v.s.al.; v.s.et.; sl.s.lgr.

51 —, **3-methyl-.** $CH_3C_4H_2S{\cdot}COOH$, 142.11. Col.need. **m.p.** 140; 144. **Soly.** sl.s.c., v.s.h.w.; v.s.al.; v.s.et.

52 —, **5-methyl-** (*o, o-thiotolenic acid*) $CH_3C_4H_2S{\cdot}COOH$, 142.11. Col.need. **m.p.** 137 subl. **Soly.** sl.s.c., v.s.h.w.; v.s.al.; v.s.et.

53 **3-Thiophenecarboxylic acid*** (*β-thiophenic acid*). $C_4H_3S{\cdot}COOH$ 128.09. Need.f.w. **m.p.** 136, **b.p.** subl. **Soly.** 0.43^{25}w.

54 **2, 3-Thiophenedicarboxylic acid** $C_4H_2S(COOH)_2$, 172.09. Need.f.w **m.p.** 270 d. **Soly.** sl.s.h.w.; v.s.et.

55 **2, 4-Thiophenedicarboxylic acid** $C_4H_2S(COOH)_2$, 172.09. Cr. **m.p.** 280 subl. d. **Soly.** sl.s.h.w.

For explanations and abbreviations see beginning of table.

56 **2, 5-Thiophenedicarboxylic acid.** $C_4H_2S(COOH)_2$, 172.09. Wh.cr. **m.p.** subl. >350. **Soly.** sl.s.h.w.; s.al.; s.et.

57 —, diethyl ester. $C_4H_2S(COOC_2H_5)_2$, 228.15. Need. or pr. **m.p.** 50. **Soly.** v.s.al.

58 **2-Thiophene-ol, 5-methyl-** (*2, 5-thiotenol*). $CH_3C_4H_2S{\cdot}OH$, 114.11. Col.oil. **b.p.** 85^{40}unst. **Soly.** sl.s.w.; v.s.al.; v.s.et.

59 **2-Thiophenesulfonamide.** $C_4H_3S{\cdot}SO_2NH_2$, 163.17. Wh. **m.p.** 141–2. **Soly.** sl.s.w.

60 **3-Thiophenesulfonamide.** $C_4H_3S{\cdot}SO_2NH_2$, 163.17. Shiny pl. **m.p.** 152–3. **Soly.** sl.s.w.

61 **α-Thiophenic acid.** See *2-Thiophenecarboxylic acid**.

62 **β-Thiophenic acid.** See *3-Thiophenecarboxylic acid**.

63 **Thiophenine** (*2-aminothiophene* or *2, 3-dihydro-2-iminothiophene*). $C_4H_3S \cdot NH_2$ or $C_4H_4S(:NH)$, 99.11. Yel. resin.oil. **b.p.** $61–2^{1}$ d. **Soly.** v.s.w.; v.s.al.; i.et.

64 —, ***N*-acetyl-.** See *Acetamide, N-2-thienyl-*.

65 —, ***N*-methyl-.** $CH_3NHC_4H_3S$, 113.12. Col. **b.p.** $88–92^{15}$.

66 **Thiophenol.** See *Phenol, thio-*.

67 **Thiopyrine** (*1, 5-dimethyl-2-phenyl-3-thio-3-pyrazolone*). $CH_3NN(C_6H_5)CS\text{-}CH{:}CCH_3$, 204.17. Col.cr. **m.p.** 166 **Soly.** sl.s.c., s.h.w.; s.al.; s.et.

68 **Thiosalicylic acid.** See *Benzoic acid, o-mercapto-*.

69 **Thiosinamine.** See *Urea, allylthio-*.

70 **2, 5-Thiotenol.** See *2-Thiophene-ol, 5-methyl-*.

71 **α-Thiotolene.** See *Thiophene, 2-methyl-*.

72 **β-Thiotolene.** See *Thiophene, 3-methyl-*.

73 ***o, o*-Thiotolenic acid.** See *2-Thiophenecarboxylic acid, 5-methyl-*.

74 **Thiourea.** See *Urea, thio-*.

75 **Thioxene.** See *Thiophene, dimethyl-*.

76 **Thiuram disulfide, dicyclopentamethylene-.** See *Disulfide, bis(1-piperidylthiocarbonyl)*.

77 —, **diethyldimethyl-.** See *Disulfide, bis(ethylmethylthiocarbamyl)*.

78 —, **tetrabenzyl-.** See *Disulfide, bis-(tetrabenzylthiocarbamyl)*.

79 —, **tetrabutyl-.** See *Disulfide, bis-(dibutylthiocarbamyl)*.

80 —, **tetraethyl-.** See *Disulfide, bis-(diethylthiocarbamyl)*.

81 —, **tetramethyl-.** See *Disulfide, bis(dimethylthiocarbamyl)*.

82 —, **dicyclopentamethylene-.** See *Sulfide, bis(1-piperidylthiocarbonyl)*.

83 **Thiuram sulfide, tetramethyl-.** See *Sulfide, bis(dimethylthiocarbamyl)*.

84 **α-Thujone** (*6-ketosabinane*(one form)). $C_{10}H_{16}O$, 152.12. Col.liq., *n* $1.4540^{13.6}$, **D.** 0.913^{20}, **b.p.** 200. **Soly.** v.sl.s.w.; ∞al.; ∞et.

86 **Thymine** (*5-methyluracil*). $NHCO\text{-}NHCOC(CH_3){:}CH$, 126.06. Need.f. al. **m.p.** d. 270. **Soly.** 0.74^{22}w.; sl.s. al.; v.sl.s.et.; s.alk., H_2SO_4.

87 **Thymohydroquinone** (*2, 5-p-cymenediol*). $CH_3(C_3H_7)C_6H_2(OH)_2$, 166.11. Pr. **m.p.** 143(139), **b.p.** 290. **Soly.** s.h.w.; s.al.; s.et.

88 **Thymol** (*3-p-cymenol*). $CH_3(C_3H_7)\text{-}C_6H_3OH$, 150.11. Col.hex.pl., *n* $1.51893^{24.4}$; *n* 1.525, 1.609. **D.** 0.969^{20}_{4}; 0.978^{15}_{4}, **m.p.** 51.5, **b.p.** 233.5. **Soly.** 0.085^{20}, 0.132^{37}w.; 357^{20} 91 %al.; 360^{20} et.; s.chl., CS_2, glac.ac.ac.; sl.s.glyc.

89 —, **-hexahydro-.** See *Menthol*.

90 —, **6-nitroso-** (*thymoquinone 2-oxime*). $C_{10}H_{13}O(.NOH)$, 180.12. Need. **m.p.** 160. **Soly.** i.w.; v.s.al.; v.s.et.

91 **Thymolphthalein.** $OCOC_6H_4C(C_{10}H_{13}O)_2$, 430.23. Col.need. **m.p.** 245–6. **Soly.** s.al.; s.et.; s.acet., caustic alk., chl.

92 **Thymoquinone** (*3, 6-p-menthadiene-2, 5-dione; 2-isopropyl-5-methylhydroquinone*). $(CH_3)_2CHC_6H_2(CH_3)O_2$, 164.09. Yel.tricl.tab. **m.p.** 45.5, **b.p.** 232. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.chl.

93 —, 2-oxime. See *Thymol, 6-nitroso-*.

94 ***o*-Thymotic acid** (*3-hydroxy-2-p-cymenecarboxylic acid*). $CH_3(C_3H_7)\text{-}C_6H_2(OH)COOH$, 194.11. Monocl.f. w. or bz. **m.p.** 127, **b.p.** subl. **Soly.** 0.01c.w.; s.al.; s.et.; s.bz.

95 **Thymylamine** (*3-p-cymylamine; 2-isopropyl-5-methylaniline*). $C_3H_7(CH_3)\text{-}C_6H_3NH_2$, 149.13. Oil. **b.p.** 230. **Soly.** v.sl.s.w.; s.al.; s.et.

96 **Thyronine, tetraiodo-.** See *Thyroxine*.

97 ***d*-Thyroxine** (*β-[(3, 5-diiodo-4-hydroxyphenoxy)-3, 5-diiodophenyl]-d-alanine*). $HOC_6H_2I_2OC_6H_2I_2CH_2CH(NH_2)COOH$, 776.77. Need. **m.p.** 237 d.

* Name approved by the International Union of Chemistry.

98 **l-Thyroxine** (*l-tetraiodothyronine*). $C_{15}H_{11}I_4NO_4$, 776.77. Wh. or sl.yel. need. **m.p.** 235–6 d. **Soly.** 0.001w.; i.al., i.et.

99 **Tiglaldehyde** (*2-methyl-2-butenal*; α, β-dimethylacrolein; guaiole*). $CH_3CH{:}C(CH_3)CHO$, 84.06. Liq., *n* 1.4495. **D.** 0.865, **b.p.** 116.5. **Soly.** 40–50w.; ∞al.; ∞et.

00 **Tiglic acid** (*2-methyl-2-butenoic acid* (one form); α, β-dimethylacrylic acid*). $CH_3CH{:}C(CH_3)COOH$, 100.06. Col. tricl.pr., *n* 1.4342^{81}. **D.** 0.872^{20}_{0}; $0.964^{7.8}_{4}$, **m.p.** 64, **b.p.** 198.5. **Soly.** sl.s.c., v.s.h.w.; s.al.; s.et.

01 **Tin, diethyl-*** (*tin diethyl*). $Sn(C_2H_5)_2$, 176.78. Oil. **D.** 1.654, **b.p.** d. **Soly.** i.w.; s.al.; s.et.

02 —, **diethyldimethyl-*** (*diethyldimethylstannane*). $(C_2H_5)_2Sn(CH_3)_2$, 206.82. Col.liq. **D.** 1.2319^{19}, **m.p.** < −13, **b.p.** 144–6. **Soly.** i.w.; i.al.; s.org. solv.

03 —, **hexaethyldi-** (*triethyltin*). $(C_2H_5)_3SnSn(C_2H_5)_3$, 411.63. Liq. **D.** 1.4115^{0}_{4}, **b.p.** 270 d. **Soly.** i.w.; i.al.; s.et.; s.bz

04 —, **tetraethyl-*** (*tetraethylstannane; tin tetraethyl*). $Sn(C_2H_5)_4$, 234.86. Col.liq., *n* 1.5143. **D.** 1.187^{23}, **m.p.** −112, **b.p.** 181. **Soly.** i.w.; s.al.; s.et.

05 —, **tetraisoamyl-** (*tetraisoamylstannane*). $[(CH_3)_2CHCH_2CH_2]_4Sn$, 403.04. Liq. **D.** $1.035^{19.8}$, **b.p.** 188^{34}.

06 —, **tetramethyl-*** (*tin tetramethyl; tetramethylstannane*). $Sn(CH_3)_4$, 178.79. Col.liq., *n* 1.5201. **D.** 1.314^{0}_{4}, **b.p.** 78. **Soly.** i.w.; s.al.; s.et.

07 —, **tetraphenyl-*** (*tetraphenylstannane*). $(C_6H_5)_4Sn$, 426.86. Col.tetr. f.xylene. **D.** 1.490^{0}_{4}, **m.p.** 226, **b.p.** >420. **Soly.** i.w.; sl.s.al.; s.h.bz., pyr., CCl_4, chl., ac.a.

08 —, **tetrapropyl-*** (*tetrapropylstannane*). $(CH_3CH_2CH_2)_4Sn$, 290.92. Col. liq. **D.** $1.1065^{20.2}$, **b.p.** 222–5. **Soly.** i.w.; s.org.solv.

09 —, **tetra-o-tolyl-** (*tetra-o-tolyl stannane*). $(CH_3C_6H_4)_4Sn$, 482.92. Col. liq. **m.p.** 158–9(215). **Soly.** i.w.; i.al.; s.et.; s.bz.

10 —, **tetra-p-tolyl** (*tetra-p-tolylstannane*). $(CH_3C_6H_4)_4Sn$, 482.92. Col. need. **m.p.** 230–3. **Soly.** i.w.; sl.s.al.; sl.s.et.; s.bz., chl., CS_2, pyr.

11 —, **triethyl-**. See *Tin, hexaethyldi-*.

12 **Tin chloride, tribenzyl-***. $(C_6H_5CH_2)_3SnCl$, 427.32. Wh.need. **m.p.** 142–4, **b.p.** d. **Soly.** i.w.; i.al.; s.et.; s.ac.a., acet., bz., chl., pyr.

13 —, **triethyl-***. $(C_2H_5)_3SnCl$, 241.27. Col.liq. **D.** 1.428^{8}, **m.p.** 10(15.5), **b.p.** 208–10. **Soly.** i.c.w.; s.org.solv.

14 —, **triisoamyl-**. $[(CH_3)_2CHCH_2CH_2]_3SnCl$, 367.41. **D.** $1.1290^{34.2}$, **m.p.** −30.2, **b.p.** 114^{13}.

15 —, **triphenyl-***. $(C_6H_5)_3SnCl$, 385.27. Col.cr. **m.p.** 106, **b.p.** $240^{13.5}$. **Soly.** i.w.; s.org.solv.

16 **Tin dichloride, diethyl-***. $(C_2H_5)_2SnCl_2$, 247.69. Wh.need. **m.p.** 84–5, **b.p.** 220. **Soly.** s.w.; s.HCl, org.solv.

17 **Tin difluoride, diethyl-***. $(C_2H_5)_2SnF_2$, 214.78. Sq.pl. or lng.rhomb. tab.f.me.al. **m.p.** 229. **Soly.** 0.45^{31} al.; 2.64^{31}me.al.; 0.047^{31}bz.

18 **Tin oxide, diethyl-*** (*diethylstannone*). $(C_2H_5)_2SnO$, 192.78. Wh.powd. **m.p.** infus. **Soly.** i.w.; s.HCl, dil.a., conc.alk.; i.org.solv.

19 **Tin trichloride, methyl-***. CH_3SnCl_3, 240.09. Col.cr. **m.p.** 43. **Soly.** s.c.w.; s.org.solv.; hyd. by alk.

20 **T.N.A.** See *Aniline, 2, 4, 6-trinitro-*.

21 **T.N.T.** See *Toluene, 2, 4, 6-trinitro-**.

22 **Tobias' acid.** See *2-Naphthylamine-1-sulfonic acid*.

23 **Tolan.** See *Acetylene, diphenyl-*.

24 **o-Tolidine** (*4, 4′-bi-o-toluidine* (NH_2 = 1); *4, 4′-diamino-3, 3′-dimethylbiphenyl*). $[NH_2(CH_3)C_6H_3]_2$, 212.14. Col.sc.f.h.w. **m.p.** 126.5–9. **Soly.** sl.s.w.; v.s.al.; v.s.et.

25 **m-Tolidine** (*4, 4′-bi-m-toluidine* (NH_2 = 1); *4, 4′-diamino-2, 2′-dimethylbiphenyl*). $[NH_2(CH_3)C_6H_3]_2$, 212.14. Pr.f.h.w. **m.p.** 107–8. **Soly.** s.h.w.; v.s.al.; v.s.et.

26 **p-Tolidine.** $[NH_2(CH_3)C_6H_3]_2$, 212.14. Leaf. **m.p.** 103. **Soly.** s.h.w.; v.s.al.; v.s.et.

27 **o-Tolualdehyde** (*2-methylbenzenecarbonal*; o-methylbenzaldehyde*). $CH_3C_6H_4CHO$, 120.06. Liq., *n* $1.54852^{19.0}$. **D.** 1.039, **b.p.** 195.5. **Soly.** sl.s.w.; s.al.; s.et.

28 **m-Tolualdehyde** (*m-methylbenzaldehyde*). $CH_3C_6H_4CHO$, 120.06. Liq., *n* $1.54068^{21.4}$. **D.** 1.019, **b.p.** 199 (195.5). **Soly.** sl.s.w.; ∞al.; ∞et.

29 **p-Tolualdehyde** (*p-methylbenzaldehyde*). $CH_3C_6H_4CHO$, 120.06. Liq., *n* $1.54693^{16.6}$. **D.** 1.020, **b.p.** 204. **Soly.** sl.s.w.; ∞al.; ∞et.

30 **α-Tolualdehyde** (*phenylacetaldehyde*). $C_6H_5CH_2CHO$, 120.06. Col.liq., *n* $1.52546^{19.6}$. **D.** 1.027, **m.p.** < −10, **b.p.** 194. **Soly.** v.sl.s.w.; ∞al.; ∞et.

For explanations and abbreviations see beginning of table.

31 ***o*-Toluamide** (*o-methylbenzamide*). $CH_3C_6H_4CONH_2$, 135.08. Col.need.f.w. **m.p.** 147(139–40). **Soly.** sl.s.c., v.s.h.w.; v.s.al.; v.s.et.

32 ***m*-Toluamide** (*m-methylbenzamide*). $CH_3C_6H_4CONH_2$, 135.08. Need.f.et. **m.p.** 97(94). **Soly.** sl.s.w.; s.al.; sl.s.et.; v.sl.s.bz.

33 ***p*-Toluamide** (*p-methylbenzamide*). $CH_3C_6H_4CONH_2$, 135.08. Col.need.f.w. **m.p.** 165(159–60). **Soly.** sl.s.c., v.s.h.w.; v.s.al.; v.s.et.

34 ***α*-Toluanilide** (*α-phenylacetanilide*). $C_6H_5CH_2CONHC_6H_5$, 211.11. Wh.pr.f.al. **m.p.** 117. **Soly.** i.w.; 3.3al.; i.let.; i.H_2SO_4, dil.KOH.

35 **Tolubenzyl alcohol.** See *Carbinol, tolyl-.*

36 **Toluene** (*methylbenzene; phenylmethane*). $C_6H_5CH_3$ 92.06. Col.liq., *n* 1.49782$^{16.35}$. **D.** 0.866$^{20}_{4}$; 0.86234$^{30}_{4}$, **m.p.** −95, **b.p.** 110.8. **Soly.** 0.047^{16} w.; ∞al.; ∞et.; s.chl., glac.ac.a., acet., CS_2, bz.

37 —, ***α*-amino-.** See *Benzylamine.*

38 —, ***ω*-azido-.** See *Toluene, α-triazo-.*

39 —, **benzyl-.** See *Methane, phenyltolyl-.*

40 —, ***α*-(benzyldithio)-.** See *Benzyl disulfide.*

41 —, ***o*-bromo-** (*o-tolyl bromide*). $CH_3C_6H_4Br$, 170.97. Col.liq. **D.** 1.422, **m.p.** −27(−26 to −9), **b.p.** 181.75. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.bz.

42 —, ***m*-bromo-** (*m-tolyl bromide*). $BrC_6H_4CH_3$, 170.97. Col.liq., *n* 1.551. **D.** 1.4099$^{20}_{4}$, **m.p.** −39.8, **b.p.** 183.7. **Soly.** i.w.; s.al.; ∞et.

43 —, ***p*-bromo-** (*p-tolyl bromide*). $BrC_6H_4CH_3$, 170.97. Rhomb.cr.f.al., *n* 1.5490. **D.** 1.3808$^{30}_{4}$, **m.p.** 28, **b.p.** 184.5. **Soly.** i.w.; s.al.; s.et.; s.bz.

44 —, ***α*-bromo-.** See *Benzyl bromide.*

45 —, ***α*-bromo-*o*-nitro-** (*o-nitrobenzyl bromide*). $NO_2C_6H_4CH_2Br$, 215.97. Cr.f.dil.al. **m.p.** 46–7. **Soly.** i.w.; v.s.al.; s.bz.

46 —, ***α*-bromo-*m*-nitro-** (*m-nitrobenzyl bromide*). $NO_2C_6H_4CH_2Br$, 215.97. Need. **m.p.** 58. **Soly.** v.sl.s.w.; s.al.

47 —, ***α*-bromo-*p*-nitro-** (*p-nitrobenzyl bromide*). $NO_2C_6H_4CH_2Br$, 215.97. Need.f.al. **m.p.** 100(97–8). **Soly.** sl.s.(i.)w.; 2^{19}, 37^{75}al.; v.s.et.

48 —, **butoxy-.** See *Ether, butyl tolyl.*

49 —, ***o*-butyl-** (*1-butyl-2-methylbenzene*). $CH_3C_6H_4(CH_2)_3CH_3$, 148.12. Oil. **D.** 0.8702$^{20}_{4}$. **b.p.** 200–1. **Soly.** i.w.; sl.s.al.; s.et.

50 —, ***m*-butyl-** (*1-butyl-3-methylbenzene*). $CH_3C_6H_4C_4H_9$, 148.12. Oil. **D.** 0.8624$^{15}_{4}$, **b.p.** 197–8. **Soly.** i.w.; sl.s.al.; s.et.

51 —, ***p*-butyl-** (*1-butyl-4-methylbenzene*). $CH_3C_6H_4C_4H_9$, 148.12. Oil. **D.** 0.86132$^{15}_{4}$, **b.p.** 198–9. **Soly.** i.w.; sl.s.al.; s.et.

52 —, **3-*tert*-butyl-2, 4, 6-trinitro-** (*artificial musk*). $[(CH_3)_3C](CH_3)C_6H(NO_2)_3$, 283.13. Wh.need.f.al. **m.p.** 85(97). **Soly.** i.w.; s.al.; s.et.; s.bz.

53 —, ***o*-chloro-** (*2-chloro-1-methylbenzene*). $ClC_6H_4CH_3$, 126.51. Col.liq. *n* 1.5238. **D.** 1.0817$^{20}_{4}$, **m.p.** −34(−36), **b.p.** 159. **Soly.** i.w.; s.al. ∞et.; s.bz., chl.

54 —, ***m*-chloro-** (*3-chloro-1-methylbenzene*). $ClC_6H_4CH_3$, 126.51. Col.liq. *n* 1.5214^{19}. **D.** 1.0722$^{20}_{4}$, **m.p.** −47.8 **b.p.** 162. **Soly.** i.w.; s.al.; ∞et.; s.bz. chl.

55 —, ***p*-chloro-** (*4-chloro-1-methylbenzene*). $ClC_6H_4CH_3$, 126.51. Col.liq. *n* 1.5199^{19}. **D.** 1.0697$^{20}_{4}$, **m.p.** 7.5 **b.p.** 162. **Soly.** i.w.; s.al.; ∞et. s.bz., chl.

56 —, ***α*-chloro-.** See *Benzyl chloride.*

57 —, ***α*-chloro-*α*, *α*-difluoro-** (*benzodifluorochloride*). $C_6H_5CF_2Cl$, 162.50 Col.liq. **D.** 1.254^{13}, **b.p.** 142.6^{775} **Soly.** i.w.; s.al.; s.et.

58 —, **chloromercuri-.** See *Mercur chloride, tolyl-.*

59 —, ***α*-chloro-*o*-nitro-** (*o-nitrobenzy chloride*). $NO_2C_6H_4CH_2Cl$, 171.51. C f.lgr., *n* 1.5557$^{61.5}$. **m.p.** 49. **Soly** i.w.; s.al.; v.s.h.et.

60 —, ***α*-chloro-*m*-nitro-** (*m-nitrobenzy chloride*). $NO_2C_6H_4CH_2Cl$, 171.5 Yel.need.f.lgr., *n* 1.5577$^{61.5}$. **m.p.** 44. **b.p.** 183^{35}. **Soly.** i.w.; s.al.; s.et.

61 —, ***α*-chloro-*p*-nitro-** (*p-nitrobenz chloride*). $NO_2C_6H_4CH_2Cl$, 171.5 Leaf. or need.f.w., *n* 1.5647$^{61.5}$. **m.** 71. **Soly.** i.w.; 7.10^{25}al.; s.et.; 8.8 me.al.; 69.7^{25}bz.

62 —, **diamino-.** See *Tolylenediamin*

63 —, ***α*, *α*-dibromo-** See *Benzal b mide.*

64 —, ***α*, *α*-dibromo-*p*-nitro-** (*p-nit benzal bromide*). $NO_2C_6H_4CHB$ 294.88. Need.f.al. **m.p.** 82.0–2 **Soly.** i.w.; v.s.al.; v.s.et.

65 —, ***α*, *α*-dichloro-.** See *Benzal c ride.*

66 —, ***α*, 4-dichloro-.** See *Benzyl c ride, p-chloro-.*

* Name approved by the International Union of Chemistry.

87 **Toluene, α, α-dichloro-m-nitro-** (*m-nitrobenzal chloride*). $NO_2C_6H_4CHCl_2$, 205.96. Monocl.cr.f.al. **m.p.** 65. **Soly.** i.w.; v.s.h.al.; v.s.h.et.

88 **—, α, α-dichloro-p-nitro-** (*p-nitrobenzal chloride*). $NO_2C_6H_4CHCl_2$, 205.96. Pr.f.al. **m.p.** 46. **Soly.** i.w.; s.al.; s.et.

89 **—, 3, 5-diethyl-** (1, 3-*diethyl-5-methylbenzene**). $(C_2H_5)_2C_6H_3CH_3$, 148.12. Col.liq. **D.** 0.879, **b.p.** 200. **Soly.** i.w.; ∞al.; ∞et.

70 **—, o-diethylamino-.** See *o-Toluidine, N, N-diethyl-.*

71 **—, p-diethylamino-.** See *p-Toluidine, N, N-diethyl-.*

72 **—, 1, 2-dihydro-.** $C_6H_7CH_3$, 94.08 Liq., *n* 1.4763. **D.** 0.8354^{20}_{4}, **b.p.** 110.1. **Soly.** i.w.; v.s.al.; s.et.

73 **—, 2, 3-dihydroxy-.** See *Pyrocatechol, 3-methyl-.*

74 **—, 2, 4-dihydroxy-.** See *Cresorcinol.*

75 **—, 2, 5-dihydroxy-.** See *Toluhydroquinone.*

76 **—, 2, 6-dihydroxy-.** See *Resorcinol, 2-methyl-.*

77 **—, 3, 5-dihydroxy-.** See *Orcinol.*

78 **—, 2, 4-dinitro-** (1-*methyl*-2, 4-*dinitrobenzene*). $(NO_2)_2C_6H_3CH_3$, 182.06. Yel.need.f.al. or CS_2, *n* 1.442, 1.662, 1.756. **D.** 1.521^{15}; 1.321^{71}, **m.p.** 69.5–70.5, **b.p.** 300 sl.d. **Soly.** 0.027^{22}w.; 3.04^{15}al.; 9.4^{22}et.; s.bz., CS_2.

79 **—, 2, 5-dinitro-** (2-*methyl*-1, 4-*dinitrobenzene*). $(NO_2)_2C_6H_3CH_3$, 182.06. Need.f.al. **D.** 1.282^{111}, **m.p.** 52.5(50.5). **Soly.** v.s.al.; v.s.bz., CS_2.

80 **—, 2, 6-dinitro-** (2-*methyl*-1, 3-*dinitrobenzene*). $(NO_2)_2C_6H_3CH_3$, 182.06. Rhomb.need., *n* 1.479, 1.669, 1.734. **D.** 1.283^{111}, **m.p.** 66 (61). **Soly.** s.al.

81 **—, 3, 4-dinitro-** (4-*methyl*-1, 2-*dinitrobenzene*). $(NO_2)_2C_6H_3CH_3$, 182.06. Yel.need.f.CS_2. **D.** 1.259^{111}, **m.p.** 59.8(59–61). **Soly.** i.w.; s.al. s.et; $2.2^{17}CS_2$.

82 **—, 3, 5-dinitro-** (1-*methyl*-3, 5-*dinitrobenzene*). $(NO_2)_2C_6H_3CH_3$, 182.06. Yel.monocl.need.f.w. **D.** 1.277^{111}, **m.p.** 93, **b.p.** subl. **Soly.** sl.s.w.; s.al.; v.s.et.; s.CS_2, chl., bz.; sl.s.lgr.

83 **—, o, m or p-ethoxy-.** See *Ether, ethyl tolyl.*

84 **—, α-ethoxy-.** See *Ether, benzyl ethyl.*

85 **—, o-ethyl-** (1-*ethyl-2-methylbenzene*). $CH_3C_6H_4C_2H_5$, 120.09. Col. liq., *n* $1.50569^{16.05}$. **D.** 0.873, **m.p.** < −17, **b.p.** 162. **Soly.** i.w.; ∞al.; ∞et.

86 **—, m-ethyl-** (1-*ethyl-3-methylbenzene*). $CH_3C_6H_4C_2H_5$, 120.09. Col. liq., *n* $1.49966^{19.9}$. **D.** 0.869^{20}, **b.p.** 162.5(158–9). **Soly.** i.w.; s.al.; s.et.

87 **—, p-ethyl-** (1-*ethyl-4-methylbenzene*). $CH_3C_6H_4C_2H_5$, 120.09. Col. liq., *n* $1.49303^{22.8}$. **D.** 0.862, **m.p.** < −20, **b.p.** 162. **Soly.** i.w.; s.al.; s.et.

88 **—, o-fluoro-.** $CH_3C_6H_4F$, 110.05. Col.liq., *n* 1.4704. **D.** 1.0041^{13}, **m.p.** < −80, **b.p.** 114. **Soly.** i.w.; v.s.al.; v.s.et.

89 **—, m-fluoro-.** $CH_3C_6H_4F$, 110.05. Col.liq., *n* 1.4691. **D.** 0.9972^{13}, **m.p.** −110.8, **b.p.** 116. **Soly.** i.w.; v.s.al.; v.s.et.

90 **—, p-fluoro-.** $CH_3C_6H_4F$, 110.05. Col.liq., *n* 1.470. **D.** 1.001^{15}, **b.p.** 117. **Soly.** i.w.; v.s.al.; v.s.et.

91 **—, hexahydro-.** See *Cyclohexane, methyl-.*

92 **—, o, m or p-hydroxy-.** See *Cresol.*

93 **—, α-hydroxy-.** See *Benzyl alcohol.*

94 **—, o-iodo-.** $CH_3C_6H_4I$, 217.97. Liq., *n* $1.61066^{15.9}$. **D.** 1.697, **b.p.** 211. **Soly.** i.w.; ∞al.; ∞et.

95 **—, m-iodo-.** $CH_3C_6H_4I$, 217.97. Liq. **D.** 1.698, **b.p.** 204. **Soly.** i.w.; ∞al.; ∞et.

96 **—, p-iodo-.** $CH_3C_6H_4I$, 217.97. Leaf. **m.p.** 35, **b.p.** 211.5. **Soly.** i.w.; v.s.al.; v.s.et.

97 **—, α-iodo-.** See *Benzyl iodide.*

98 **—, isopropyl-.** See *Cymene.*

99 **—, o, m or p-methoxy-.** See *Ether, methyl tolyl.*

00 **—, α-methoxy-.** See *Ether, benzyl methyl.*

02 **—, o-nitro-.** $NO_2C_6H_4CH_3$, 137.06. Yel.liq., *n* $1.54739^{20.4}$. **D.** 1.163^{20}_{4}, **m.p.** α, −10.6; β, −4.1, **b.p.** 222.3. **Soly.** 0.0652^{30}w.; ∞al.; ∞et.; s.bz., chl., pet.eth.

03 **—, m-nitro-.** $NO_2C_6H_4CH_3$, 137.06. Cr. or liq. *n* 1.5475. **D.** 1.164^{15}; 1.157^{20}_{4}, **m.p.** 15.5, **b.p.** 231. **Soly.** 0.0498^{30}w.; ∞al.; ∞et.; s.bz.

04 **—, p-nitro-.** $NO_2C_6H_4CH_3$, 137.06. Col.rhomb.need., *n* $1.5346^{62.5}$. **D.** 1.286^{20}; 1.139^{55}_{55}, **m.p.** 51.3, **b.p.** 238. **Soly.** 0.0442^{30}w.; s.al.; v.s.et.; s.bz.

05 **—, o-nitroso-.** $NOC_6H_4CH_3$, 121.06. Need. **m.p.** 72–2.5. **Soly.** v.s.al., v.s.et.; v.s.chl.

For explanations and abbreviations see beginning of table.

06 Toluene, *m*-nitroso-. $NOC_6H_4CH_3$, 121.06. Need. **m.p.** 53. **Soly.** i.w.; sl.s.al.; s.et.

07 —, ***p*-nitroso-.** $NOC_6H_4CH_3$, 121.06. Col.need.f.lgr.**m.p.** 48. **Soly.** v.sl.s.(i.)w.; v.s.bz., h.me.al.

08 —, ***o*, *m* or *p*-phenyl-.** See *Biphenyl, methyl-*.

08₁ —, **α-phenyl-.** See *Methane, diphenyl-*.

09 —, **(2-propenoxy-).** See *Ether, allyl tolyl*.

10 —, **propoxy-.** See *Ether, propyl tolyl*.

11 —, ***o*-propyl-** (*1-methyl-2-propylbenzene*). $CH_3C_6H_4(CH_2)_2CH_3$, 134.11. Liq., *n* $1.50139^{15.75}$. **b.p.** 181–2. **Soly.** i.w.; s.al.

12 —, ***m*-propyl-** (*1-methyl-3-propylbenzene*). $CH_3C_6H_4(CH_2)_2CH_3$, 134.11. Liq., *n* $1.49640^{17.0}$. **D.** 0.863^{16}, **b.p.** 176–7. **Soly.** i.w.; s.al.; ∞et.

13 —, ***p*-propyl-** (*1-methyl-4-propylbenzene*). $CH_3C_6H_4(CH_2)_2CH_3$, 134.11. Liq., *n* $1.49655^{18.8}$. **D.** 0.8682^{15}, **b.p.** 183–4. **Soly.** i.w.; s.al.; s.et.

14 —, **1, 2, 3, 6-tetrahydro-.** See *Cyclohexene, 4-methyl-*.

15 —, **α-triazo-** (*benzyl azide; ω-azidotoluene*). $C_6H_5CH_2N_3$, 133.08. Oil, *n* 1.53414^{25}. **D.** 1.0655^{25}, **m.p.** exp., **b.p.** 108^{23}. **Soly.** i.w.; ∞al.; ∞et.

16 —, **α-trichloro-** (*benzotrichloride; phenylchloroform*). $C_6H_5CCl_3$, 195.41. Col.oil. **D.** 1.38. **m.p.** −22, **b.p.** 214. **Soly.** i.w.; s.al.; s.et.; s.bz.

17 —, **α-trifluoro-** (*benzotrifluoride*). $C_6H_5CF_3$, 146.04. **D.** 1.196^{14}, **b.p.** 102.4. **Soly.** i.w.; s.al.; s.et.

18 —, **3, 4, 5-trihydroxy-.** See *Pyrogallol, 5-methyl-*.

19 —, **2, 3, 4-trinitro-*.** $(NO_2)_3C_6H_2CH_3$, 227.06. Tricl.leaf.f.al. **D.** 1.620, **m.p.** 112, **b.p.** 302 d. exp. **Soly.** i.w.; sl.s.c.al.; v.s.et.

20 —, **2, 4, 5-trinitro-*** (*γ-trinitrotoluene*). $(NO_2)_3C_6H_2CH_3$, 227.06. Yel.rhomb.pl.f.acet. **D.** 1.620, **m.p.** 104, **b.p.** 291 d. **Soly.** i.w.; sl.s.c.al.; v.s.et.

21 —, **2, 4, 6-trinitro-*** (*sym-trinitrotoluene; α-trinitrotoluene; "T.N.T."*). $(NO_2)_3C_6H_2CH_3$, 227.06. Col.monocl.(rhomb.)f.al. **D.** 1.654, **m.p.** 80.7 (81–2), **b.p.** 240 exp. **Soly.** 0.02^{15}w.; 1.99^{32}, 18.6^{74}al.; $3.33^{20.3}$et.

22 Toluenediamine. See *Tolylenediamine*.

23 α, **α-Toluenediamine,** ***N, N'*-dibenzal-.** See *Hydrobenzamide*.

24 α, **2,-Toluenedicarboxylic acid.** See *Homophthalic acid*.

25 α, **2-Toluenediol.** See *Saligenin*.

26 α, **3-Toluenediol.** See *Benzyl alcohol, m-hydroxy-*.

27 α, **4-Toluenediol.** See *Benzyl alcohol, p-hydroxy-*.

28 *o*-Toluenesulfonamide. $CH_3C_6H_4SO_2NH_2$, 171.14. Octahdr. **m.p.** 153–6. **Soly.** 0.1^9w.; 3.6^5al.; sl.s.et.

29 *p*-Toluenesulfonamide. $CH_3C_6H_4SO_2NH_2$, 171.14. Monocl. **m.p.** 137.5. **Soly.** 1.94^9w.; 7.42^5al.; sl.s.et.

30 —, ***N, N*-dichloro-.** See *Dichloramine(T)*

31 *o*-Toluenesulfonic acid (*2-methylbenzenesulfonic acid*). $CH_3C_6H_4SO_3H$. 172.12. Deliq.cr. **m.p.** 67.5, **b.p.** 128.8^{25}. **Soly.** 0.16w.; s.al.; i.et.

32 —, **5-amino-** (SO_3H = 1) (*p-toluidine-3-sulfonic acid: NH_2 = 1*). $NH_2C_6H_3(CH_3)(SO_3H)$. 187.14. Cr. + H_2O. **m.p.** d. **Soly.** 0.45w.; i.al.

33 *m*-Toluenesulfonic acid. $CH_3C_6H_4SO_3H$, 172.12. Need. **Soly.** 0.78 w.; s.al.; i.et.

34 *p*-Toluenesulfonic acid (*4-methylbenzenesulfonic acid*). $CH_3C_6H_4SO_3H$ 172.12. Monocl.leaf. or pr. **m.p.** 106–7, **b.p.** 140^{20}. **Soly.** 0.32w. s.al.; s.et.

35 —, **3-amino-** (SO_3H = 1) (*o-toluidine-5-sulfonic acid: NH_2 = 1*). $NH_2C_6H_3(CH_3)(SO_3H)$, 187.14. Need. **Soly.** 0.974w.; i.al.

36 *p*-Toluenesulfonyl chloride (*p-toluenesulfone chloride*). $CH_3C_6H_4SO_2Cl$ 190.57. Col.tricl. or rhomb. **m.p.** 69, **b.p.** 146^{15}. **Soly.** i.w.; s.al. s.et.; v.s.bz.

37 *o*, *m* or *p*-Toluenethiol. See *Cresol thio-*.

38 α-Toluenethiol (*benzyl mercaptan thiobenzyl alcohol; benzyl hydrosulfide*) $C_6H_5CH_2SH$, 124.12. Liq. **D.** 1.058^{20} **b.p.** 194–5. **Soly.** i.w.; v.s.al.; v.s.et. s.CS_2.

39 Toluhydroquinone (*2-methyl-1, 4-benzenediol*; 2-methylhydroquinone homohydroquinone, 2, 5-dihydroxytoluene; hydrotoluquinone*). $CH_3C_6H_3(OH)_2$, 124.06. Col.rhomb.leaf.f.bz **m.p.** 124–5, **b.p.** subl. **Soly.** v.s.w. v.s.al.; v.s.et.; sl.s.bz.

40 *o*-Toluic acid (*o-methylbenzoic acid*) $CH_3C_6H_4COOH$, 136.06. Col.need *n* $1.512^{114.6}$. **D.** 1.062^{115}_{4}, **m.p.** 103 (104–5), **b.p.** 259.2. **Soly.** 0.118c 2.17[100]w.; v.s.al.; s.chl.

* Name approved by the International Union of Chemistry.

41 ***o*-Toluic acid,** ethyl ester. $CH_3C_6H_4COOC_2H_5$, 164.09. Col.liq., *n* $1.50699^{21.6}$. **D.** 1.033; 1.038^{15}_{4}, **m.p.** < −10, **b.p.** 221.3. **Soly.** i.w.; ∞al.; ∞et.

42 —, methyl ester. $CH_3C_6H_4COOCH_3$, 150.08. Liq. **D.** 1.073^{15}, **m.p.** < −50, **b.p.** 213. **Soly.** i.w.; ∞al.; ∞et.

43 —, *p*-phenylphenacyl ester. $CH_3C_6H_4COOCH_2COC_6H_4C_6H_5$, 330.14. **m.p.** 94.5.

44 —, **4, 6-dihydroxy-.** See *o-Orsellinic acid.*

45 —, **α-hydroxy-** (*o-(hydroxymethyl)-benzoic acid*). $HOCH_2C_6H_4COOH$, 152.06. Need. **m.p.** 120 (128) d. **Soly.** 0.4^{20}w.; v.s.al.; v.s.et.

46 —, —, lactone. See *Phthalide.*

47 —, **3-hydroxy-.** See 3, 2-*Cresotic acid.*

48 —, **4-hydroxy-.** See 4, 2-*Cresotic acid.*

49 —, **5-hydroxy-.** See 3, 6-*Cresotic acid.*

50 —, **6-hydroxy-.** See 2, 6-*Cresotic acid.*

51 ***m*-Toluic acid** (*m-methylbenzoic acid*). $CH_3C_6H_4COOH$, 136.06. Col.pr.f.w., *n* 1.509. **D.** 1.054^{112}, **m.p.** 108.75 (109–12), **b.p.** 263. **Soly.** 0.085^{15}, 1.7^{100}w.; v.s.al.; v.s.et.

52 —, ethyl ester. $CH_3C_6H_4COOC_2H_5$, 164.09. Col.liq., *n* $1.50502^{21.6}$. **D.** 1.028, **b.p.** 226.4. **Soly.** i.w.; ∞al.; ∞et.

53 —, *p*-phenylphenacyl ester. $CH_3C_6H_4COOCH_2COC_6H_4C_6H_5$, 330.14. **m.p.** 136.5.

54 —, **2-hydroxy-.** See 2, 3-*Cresotic acid.*

55 —, **4-hydroxy-.** See 4, 3-*Cresotic acid.*

56 —, **5-hydroxy-.** See 3, 5-*Cresotic acid.*

57 —, **6-hydroxy-.** See 2, 5-*Cresotic acid.*

58 ***p*-Toluic acid** (*p-methylbenzoic acid*). $CH_3C_6H_4COOH$, 136.06. Col.need.f.w. **m.p.** 179.6, **b.p.** 275. **Soly.** 0.034c., 1.26^{100}w.; v.s.al.; v.s.et.

59 —, ethyl ester. $CH_3C_6H_4COOC_2H_5$, 164.09. Col.liq., *n* $1.50888^{18.2}$. **D.** 1.026, **b.p.** 228(235.5). **Soly.** i.w.; ∞al.; ∞et.

60 —, methyl ester. $CH_3C_6H_4COOCH_3$, 150.08. Cr.f.pet.eth. **m.p.** 33, **b.p.** 217. **Soly.** i.w.; v.s.al.; v.s.et.

61 —, *p*-phenylphenacyl ester. $CH_3C_6H_4COOCH_2COC_6H_4C_6H_5$, 330.14. **m.p.** 165.

62 —, **2-hydroxy-.** See 2, 4-*Cresotic acid.*

63 —, **3-hydroxy-.** See 3, 4-*Cresotic acid.*

64 **α-Toluic acid** (*phenylacetic acid*). $C_6H_5CH_2COOH$, 136.06. Col.leaf. **D.** 1.228^{20}_{4}; liq. 1.0778^{83}, **m.p.** 76.7, **b.p.** 265.5. **Soly.** b.f. 1.66^{20}w.; 186al.; v.s.et.; 151chl.

65 —, ethyl ester (*ethyl phenylacetate*). $C_6H_5CH_2COOC_2H_5$, 164.09. Col.liq., *n* $1.49921^{18.5}$. **D.** 1.031, **b.p.** 226 $(120\text{–}1^{20})$. **Soly.** i.w.; ∞al.; ∞et.

66 —, isobutyl ester (*eglantine*). $C_6H_5CH_2COOC_4H_9$, 192.12. **D.** 0.990, **b.p.** 254; $128\text{–}31^{20}$. **Soly.** i.w.; s.al.; s.et.

67 —, methyl ester (*methyl phenylacetate*). $C_6H_5CH_2COOCH_3$, 150.08. Col.liq. **D.** 1.044^{16}, **m.p.** d. 360 **b.p.** 220. **Soly.** i.w.; ∞al.; ∞et.

68 —, piperazinium salt. $C_4H_{10}N_2{\cdot}2C_8H_8O_2$, 258.22. Wh.need. **m.p.** 146.5–7.5. **Soly.** s.h.w.; s.h.al.; i.et.

69 —, ***o*-amino-,** lactam. See *Oxindole.*

70 —, ***p*-amino-** (*p-aminophenylacetic acid*). $NH_2C_6H_4CH_2COOH$, 151.08. Leaf. **m.p.** 199–200 d. **Soly.** i.c., s.h.w.; s.al.

71 —, **α-amino-(*dl*)** (*dl-α-amino-α-phenylacetic acid*). $C_6H_5CH(NH)_2COOH$, 151.08. Pr.f.w. + al. **m.p.** 237–8 d., **b.p.** subl. 256. **Soly.** i.w.; sl.s.al.; sl.s.most org.solv.

72 —, **2, 4-dinitro-** (*2, 4-dinitrophenylacetic acid; 2, 4-dinitrobenzeneethanoic acid*). $(NO_2)_2C_6H_3CH_2COOH$, 226.06. Col.need.f.w. **m.p.** 179 d. (188–9), **b.p.** d. **Soly.** sl.s.w.; s.al.; s.et.

73 —, ***o*-hydroxy-** (*o-hydroxyphenylacetic acid*). $HOC_6H_4CH_2COOH$, 152.06. Need.f.et. **m.p.** 137 (145–7), **b.p.** 240–3 d. **Soly.** s.w.; v.s.et.; sl.s.c.chl.

74 —, ***m*-hydroxy-.** $HOC_6H_4CH_2COOH$, 152.06. Need.f.bz. + lgr. **m.p.** 129, **b.p.** 190^{11}. **Soly.** v.s.w.; v.s.al.; v.s.et.

75 —, ***p*-hydroxy-.** $HOC_6H_4CH_2COOH$, 152.06. Pr. or need.f.w. **m.p.** 148, **b.p.** subl. **Soly.** v.s.h.w.; v.s.al.; v.s.et.

76 —, **α-hydroxy-.** See *Mandelic acid.*

77 —, ***o*-methyl-** (*o-tolylacetic acid*). $CH_3C_6H_4CH_2COOH$, 150.08. Col. need.f.w. **m.p.** 88–9. **Soly.** v.s.h.w.

78 —, ***m*-methyl-** (*m-tolylacetic acid*). $CH_3C_6H_4CH_2COOH$, 150.08. Need. **m.p.** 61. **Soly.** v.s.h.w.

79 —, ***p*-methyl-** (*p-tolylacetic acid*). $CH_3C_6H_4CH_2COOH$, 150.08. Col. need.f.w. **m.p.** 91, **b.p.** 266. **Soly.** sl.s.c., v.s.h.w.; v.s.al.; v.s.et.; s.bz.

For explanations and abbreviations see beginning of table.

80 **α-Toluic acid, α-methyl-.** See *Hydratropic acid.*

81 —, **α-methylene-.** See *Atropic acid.*

82 —, ***p*-nitro-.** $NO_2C_6H_4CH_2COOH$, 181.06. Col.need.f.w. **m.p.** 152–3, **b.p.** d. **Soly.** sl.s.w.; sl.s.al.; sl.s.et.

83 ***o*-Toluic anhydride.** $(CH_3C_6H_4CO)_2$-O, 254.11. Col.f.et. **m.p.** 39, **b.p.** 325. **Soly.** d.w.; d.al.; v.s.et.

84 **Toluidine, *N*-naphthyl-.** See *Naphthylamine, N-tolyl-.*

85 ***o*-Toluidine** (*o-methylaniline*). CH_3-$C_6H_4NH_2$, 107.08. Col.liq., *n* 1.57276. **D.** 1.004^{20}_{4}, **m.p.** α, −24.4; β, −16.3., **b.p.** 199.84. **Soly.** 1.50^{25}w.; ∞al.; ∞et.

86 —, ***N*-acetyl-.** See *o-Acetotoluide.*

87 —, ***N*-benzoyl-.** See *o-Benzotoluide.*

88 —, ***N, N*-diethyl-** (*1-diethylamino-2-methylbenzene*). $CH_3C_6H_4N(C_2H_5)_2$, 163.14. Pr.f.w. **m.p.** 72–3, **b.p.** 209–10(206). **Soly.** v.sl.s.w.; s.al.; s.et.

89 —,***N,N*-dimethyl-.** $CH_3C_6H_4N(CH_3)_2$, 135.11. *n* 1.5153. **D.** 0.9286^{20}_{4}, **m.p.** −60.0, **b.p.** 184.6. **Soly.** v.sl.s.w.; ∞al.; ∞et.

90 —, ***N*-methyl-.** $CH_3C_6H_4NHCH_3$, 121.09. Liq., *n* 1.5649. **D.** 0.973^{15}, **b.p.** 207. **Soly.** i.w.; ∞al.; ∞et.

91 —, **3-nitro-**(NH_2 = 1) (*2-methyl-3-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Yel.rhomb.leaf. **D.** 1.378^{15}, **m.p.** 91.5, **b.p.** 305 d. **Soly.** 1.3h.w.; v.s.al.; v.s.et.; v.s.bz.

92 —, **4-nitro-** (*2-methyl-4-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Yel. monocl.f.w. **D.** 1.366^{15}, **m.p.** 129 (127.5). **Soly.** v.sl.s.h.w.; v.s.al.; s. bz., glac.ac.a.

93 —, **5-nitro-** (*2-methyl-5-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Yel. monocl.f.al. **D.** 1.365^{15}, **m.p.** 105 (107). **Soly.** v.sl.s.w.; s.al.; s.et.

94 —, **6-nitro-** (*2-methyl-6-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Or.pr.f. al. **m.p.** 96. **Soly.** sl.s.w.; v.s.al.; v.s.et.; s.bz., chl.

95 —, **4-*o*-tolylazo-**(NH_2 = 1)(*4′-amino-2, 3′-dimethylazobenzene*). $CH_3C_6H_4N$:-$NC_6H_3(CH_3)NH_2$, 225.14. Yel.monocl. pl. **m.p.** 100. **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl.

96 —, **4-*p*-tolylazo-** (*4-amino-3, 4′-dimethylazobenzene*). $CH_3C_6H_4N:NC_6$-$H_3(CH_3)NH_2$, 225.14. Yel.pl.f.al. **m.p.** 127–8. **Soly.** i.w.; sl.s.al.; sl.s.lgr.

97 ***m*-Toluidine** (*m-methylaniline*). CH_3-$C_6H_4NH_2$, 107.08. Liq., *n* $1.57106^{22.4}$. **D.** 0.989^{20}_{4}, **m.p.** −31.5, **b.p.** 203.3. **Soly.** sl.s.w.; ∞al.; ∞et.

98 —, ***N*-acetyl-.** See *m-Acetotoluide.*

99 —, ***N*-benzoyl-.** See *m-Benzotoluide.*

00 —, ***N, N*-dimethyl-.** $CH_3C_6H_4N$-$(CH_3)_2$, 135.11. *n* 1.5492. **D.** 0.941, **b.p.** 212.5. **Soly.** v.sl.s.w.; ∞al.; ∞et.

01 —, ***N*-methyl-.** $CH_3C_6H_4NHCH_3$, 121.09. Liq. **b.p.** 206. **Soly.** i.w.; ∞al.; ∞et.

02 —, **2-nitro-**(NH_2 = 1) (*3-methyl-2-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Yel.need. **m.p.** 53. **Soly.** sl.s.w.; v.s.al.; s.a.

03 —, **4-nitro-** (*3-methyl-4-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Yel.need f.w. **m.p.** 138. **Soly.** s.h.w.; s.al., s.et.; s.a.; sl.s.CS_2.

04 —, **5-nitro-** (*3-methyl-5-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Or.need. **m.p.** 98.4. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.; s.bz.

05 —, **6-nitro-** (*3-methyl-6-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Yel.leaf. f.w. **m.p.** 109. **Soly.** s.h.w.; v.s.al.; v.s.et.; s.bz., chl.

06 —, **4-*m*-tolylazo-**(NH_2 = 1) (*4-amino-2, 3′-dimethylazobenzene*) CH_3-$C_6H_4N:NC_6H_3(CH_3)NH_2$, 225.14. Ylsh.br.need.f.al. **m.p.** 80. **Soly.** sl.s.w.; s.al.

07 ***p*-Toluidine** (*p-methylaniline*). CH_3-$C_6H_4NH_2$, 107.08. Leaf.f.w., *n* $1.55324^{59.1}$. **D.** 1.046^{20}_{4}; 0.973^{58}_{80}, **m.p.** 45(42–3), **b.p.** 200.3. **Soly.** 0.74^{21}w.; 156^{30}al.; s.et.

08 —, ***N*-acetyl-.** See *p-Acetotoluide.*

09 —, ***N*-benzoyl-.** See *p-Benzotoluide.*

10 —, **2-bromo-** (*2-bromo-4-methylaniline*). $Br(CH_3)C_6H_3NH_2$, 185.99. Leaf. **D.** 1.51^{20}, **m.p.** 26(12–3), **b.p.** 240. **Soly.** i.w.; s.al.; s.et.

11 —, **2-bromo-5-nitro-** (*2-bromo-4-methyl-5-nitroaniline*). $CH_3(NO_2)Br$-$C_6H_2NH_2$, 230.99. Yel.need.f.al. **m.p.** 121.

12 —, ***N, N*-diethyl-** (*1-diethylamino-4-methylbenzene*). $CH_3C_6H_4N(C_2H_5)_2$, 163.14. Col.liq. **D.** 0.9242^{13}_{4}, **m.p.** 229. **Soly.** v.sl.s.w.; ∞al.; ∞et.

13 —, ***N, N*-dimethyl-.** $CH_3C_6H_4N$-$(CH_3)_2$, 135.11. Liq., *n* 1.53664. **D.** 0.9287^{20}_{4}, **b.p.** 210–11. **Soly.** v.sl.s.w.; ∞al.; ∞et.

14 —, ***N*-methyl-.** $CH_3C_6H_4NHCH_3$, 121.09. Liq. **b.p.** 206–8. **Soly.** i.w.; ∞al.; ∞et.

15 —, **2-nitro-**(NH_2 = 1) (*4-methyl-2-nitroaniline; m-nitro-p-toluidine*). NO_2-$(CH_3)C_6H_3NH_2$. 152.08. Red monocl. pr.f.al. **D.** 1.312^{17}, **m.p.** 117(114). **Soly.** v.sl.s.h.w.; v.s.al.; s.conc.H_2SO_4.

* Name approved by the International Union of Chemistry.

16 ***p*-Toluidine, 3-nitro-** (*4-methyl-3-nitroaniline*). $NO_2(CH_3)C_6H_3NH_2$, 152.08. Yel.monocl.f.w. **m.p.** 77.5(81.5). **Soly.** s.w.; v.s.h.al.; s.et.; sl.s.CS_2.

17 Toluidinesulfonic acid. See *Toluenesulfonic acid, amino-*.

18 ***o*-Tolunitrile** (*2-methylbenzenecarbonitrile*; o-methylbenzonitrile*). $CH_3C_6H_4CN$, 117.06. Col.liq., *n* $1.52720^{23.1}$. **D.** 0.9941^{25}_{4}, **m.p.** −13 to −14, **b.p.** 204. **Soly.** i.w.; ∞al.; ∞et.

19 ***m*-Tolunitrile** (*m-methylbenzonitrile*). $CH_3C_6H_4CN$, 117.06. Col.liq. **D.** 0.986^{25}_{4}, **m.p.** −23, **b.p.** 214. **Soly.** 0.085c., 1.67h.w.; ∞al.; ∞et.

20 ***p*-Tolunitrile** (*4-methylbenzenecarbonitrile*; p-methylbenzonitrile*). $CH_3C_6H_4CN$, 117.06. Wh.-yel.need.f.al. **D.** 0.9805^{30}_{30}, **m.p.** 29.5, **b.p.** 217. **Soly.** i.w.; v.s.al.; v.s.et.

21 —, 2-amino- (*homoanthranilonitrile*). $CH_3C_6H_3(NH_2)CN$, 132.08. Need.f.al. **m.p.** 136. **Soly.** i.w.; v.s.al.; v.s.et.

22 ***α*-Tolunitrile** (*benzyl cyanide; phenylacetonitrile*). $C_6H_5CH_2CN$, 117.06. Col. liq., *n* 1.52105^{25}, **D.** 1.015^{18}, **m.p.** −23.8, **b.p.** 234; 107^{12}. **Soly.** i.w.; ∞al.; ∞et.

23 —, ***α*-keto-.** See *Benzoyl cyanide.*

24 —, ***o*-nitro-** (*o-nitrobenzyl cyanide*). $NO_2C_6H_4CH_2CN$, 162.06. Need.f.w. **m.p.** 82.5–4.0. **Soly.** s.h.w.; s.al.; s.et.

25 —, ***p*-nitro-.** $NO_2C_6H_4CH_2CN$, 162.06. Leaf. or pr.f.al. **m.p. 117. Soly.** i.w.; s.al.; s.et.

26 ***p*-Toluquinaldine.** See *Quinoline, 2, 6-dimethyl-**.

27 Toluquinone (*2-methylquinone; p-toluquinone*). $CH_3C_6H_3O_2$, 122.05. Yel.leaf. or need. **m.p.** 69 (65–7), **b.p.** subl. **Soly.** s.h.w.; v.s.al.; v.s.et.

28 ***α*-Toluyl chloride** (*phenylacetyl chloride*). $C_6H_5CH_2COCl$, 154.51. Col.fum.liq. **D.** 1.168^{20}_{4}, **b.p.** 170^{250}; $94–5^{12}$. **Soly.** d.w.; d.al.; v.s.et.

29 Toluylene. See *Stilbene.*

30 Toluylenediamine. See *Tolylenediamine.*

Tolyl-. For tolyl derivatives see the parent compounds (e.g., for tolylhydrazine see *Hydrazine, tolyl-*).

31 Tolyl bromide. See *Toluene, bromo-.*

32 Tolyl chloride. See *Toluene, o, m* or *p-chloro-*; see also *Xylene, α-chloro-.*

33 Tolylene. See also *Xylylene.*

34 3-*o*-Tolylenediamine (NH_2 = 1, 2) (*2, 3-toluenediamine; 2, 3-diaminotoluene; 2, 3-toluylenediamine*). $CH_3C_6H_3(NH_2)_2$, 122.09. Cr. **m.p.** 61, **b.p.** 255. **Soly.** s.w.; s.al.; s.et.

35 4-*o*-Tolylenediamine (NH_2 = 1, 2) (*3, 4-toluenediamine; 3, 4-diaminotoluene; 3, 4-toluylenediamine*). $CH_3C_6H_3(NH_2)_2$, 122.09. Col.leaf.f.lgr. **m.p.** 88.5, **b.p.** 265. **Soly.** s.w.

36 2-*m*-Tolylenediamine (NH_2 = 1, 3) (*2, 6-toluenediamine; 2, 6-diaminotoluene; 2, 6-toluylenediamine*). $CH_3C_6H_3(NH_2)_2$, 122.09. Pr.f.w. **m.p.** 105. **Soly.** s.w.; s.al.

37 4-*m*-Tolylenediamine (NH_2 = 1, 3) (*2, 4-toluenediamine; 2, 4-diaminotoluene; 2, 4-toluylenediamine*). $CH_3C_6H_3(NH_2)_2$, 122.09. Col.rhomb.; need.f.w.; pr.f.al. **m.p.** 99, **b.p.** 280. **Soly.** s.w.; v.s.al.; v.s.et.

38 5-*m*-Tolylenediamine (NH_2 = 1, 3) (*3. 5-toluenediamine; 3, 5-diaminotoluene; 3, 5-toluylenediamine*). $CH_3C_6H_3(NH_2)_2$, 122.09. Liq. **b.p.** 285. **Soly.** s.al.; s.et.

39 ***p*-Tolylenediamine** (NH_2 = 1, 4) (*2, 5-toluenediamine; 2, 5-diaminotoluene; 2, 5-toluylenediamine*). $CH_3C_6H_3(NH_2)_2$, 122.09. Leaf.f.bz. **m.p.** 64, **b.p.** 274. **Soly.** v.s.w.; v.s.al.; v.s.et.

40 Tolylene glycol. See *Hydrobenzoin.*

41 Tolyl mercaptan. See *Cresol, thio-.*

42 Tolyl mustard oil. See *Isothiocyanic acid, tolyl ester.*

43 ***o*-Tolyl phosphate** (*tri-o-cresyl phosphate*). $(CH_3C_6H_4)_3PO_4$, 368.18. Liq. **b.p.** 410 sl. d.; $263–5^{20}$. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.bz.

44 ***p*-Tolyl phosphate** (*tri-p-cresyl phosphate*). $(CH_3C_6H_4)_3PO_4$, 368.18. Need.f.w. **m.p.** 77–8. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.bz.

45 Toxicarol. $C_{23}H_{22}O_7$, 410.17. Bright yel-grn.hex.pl. or rods, *n* 1.580, 1.618, 1.768. **m.p.** 219. **Soly.** sl.s.al.; s.h.chl.

46 Tragacanthin. See *Bassorin.*

Tri-. For tribromo, triethyl, etc. derivatives see the parent compounds (e.g., *Acetic acid, tribromo-; Benzene, triethyl-*).

47 Triacetamide. $(CH_3CO)_3N$, 143.08. Need.f.et. **m.p.** 79. **Soly.** s.et.

48 Triacetin. See *Glycerol, triacetate.*

49 Triacetonamine (*2, 2, 6, 6-tetramethyl-4-piperidone*). $C_9H_{17}NO{\cdot}H_2O$, 173.16. Tetr.need.f.w. **m.p.** anh. 40; $1H_2O$ 58. **Soly.** s.w.; s.al.; s.et.

For explanations and abbreviations see beginning of table.

50 **Triacontane*** (*n-triacontane*). CH_3-$(CH_2)_{28}CH_3$, 422.48. Cr. **D.** liq. 0.7797, **m.p.** 66.1(69–70), **b.p.** 186. **Soly.** i.w.; sl.s.al.; s.et.; s.bz.

51 **Triazene, 1, 3-bis(*p*-nitrophenyl)-.** See *Diazoaminobenzene, 4, 4′-dinitro-**.

52 **—, 1, 3-di-1-naphthyl-*.** See *1, 1′-Diazoaminonaphthalene**.

53 **—, 1, 3-di-2-naphthyl-*.** See *2, 2′-Diazoaminonaphthalene**.

54 **—, 1, 3-diphenyl-*.** See *Diazoaminobenzene**.

55 **—, 1-phenyl-3-*p*-tolyl-** (*4-methyldiazoaminobenzene*). $C_6H_5N_2NHC_6$-H_4CH_3, 211.13. Ylsh.leaf. **m.p.** 90–1, **b.p.** d. **Soly.** i.w.

56 ***sym*-Triazine, hexahydro-1, 3, 5-triphenyl-** (*anhydroformaldehydeaniline; methyleneaniline, trimethylenetrianiline*). $(C_6H_5N{\cdot}CH_2)_3$, 315.19. Wh. silky need. **m.p.** 45.5, **b.p.** 185. **Soly.** v.sl.s.w.; sl.s.al.; s.et.; s.bz., chl., tol.

57 **—, 2, 4, 6-triamino-.** See *Melamine.*

58 **—, trichloro-.** See *Cyanuric chloride.*

59 ***sym*-Triazine-2, 4-diol, 6-amino-.** See *Ammelide.*

60 ***sym*-Triazinetriol.** See *Cyanuric acid.*

61 ***sym*-Triazin-2-ol, 4, 6-diamino-.** See *Ammeline.*

62 **Triazobenzene.** See *Benzene, triazo-.*

63 **1, 2, 4-Triazole** (*sym-triazole* (one form); *pyrro[ab₁]diazole*). NHN:-CHN:CH, 69.05. Need., *n* $1.48544^{25.3}$. **m.p.** 121, **b.p.** 260. **Soly.** s.w.; s.al.; sl.s.et.

64 **—, 4, 5-dihydro-1, 4-diphenyl-3, 5-phenylimino-.** See *Nitron.*

65 **Tribenzaldiamine.** See *Hydrobenzamide.*

66 **Tribenzoin.** See *Glycerol, tribenzoate.*

67 **Tribenzylamine.** $(C_6H_5CH_2)_3N$, 287.17. Monocl.f.al. **D.** 0.991^{95}_{4}, **m.p.** 92, **b.p.** 380–90. **Soly.** v.sl.s.w ; s.h.al.; s.et.

68 **Tribromohydrin.** See *Propane, 1, 2, 3-tribromo-**.

69 **Tributylamine*** (*tri-n-butylamine*). $(CH_3CH_2CH_2CH_2)_3N$, 185.22. Deliq. col.liq. **D.** 0.7782^{20}, **b.p.** 214. **Soly.** sl.s.w.; v.s.al.; v.s.et.

70 **Tricarballylic acid** (*1, 2, 3-propanetricarboxylic acid**). $HOOCCH_2CH$-$(COOH)CH_2COOH$, 176.06. Col. rhomb.pr.f.w. **m.p.** 162–3, **b.p.** d. **Soly.** 40.5w.; v.s.al.; 0.86^{15}et.

71 **—, α, β-dihydroxy-** (*1, 2-dihydroxy-1, 2, 3-propanetricarboxylic acid*; hydroxycitric acid*). $COOHCH_2COH$-$(COOH)CHOHCOOH$, 208.06. Need. **D.** 1.39^{35}, **m.p.** 160. **Soly.** v.s.w.; sl.s.al.; v.s.et.

72 **—, α-hydroxy-.** See *Isocitric acid.*

73 **—, β-hydroxy-.** See *Citric acid.*

74 **—, α, α, β-trimethyl-.** See *Camphoronic acid.*

75 **Tricarbonimide.** See *Fulminuric acid.*

76 **Tricosane*** (*n-tricosane*). CH_3-$(CH_2)_{21}CH_3$, 324.37. Glit.leaf.f.al. **D.** 0.7799^{48}, **m.p.** 47.7, **b.p.** 234^{15}. **Soly.** i.w.; sl.s.al.; s.et.

77 **12 Tricosanone*** (*dihendecyl ketone; diundecyl ketone; laurone*). $[CH_3$-$(CH_2)_{10}]_2CO$, 338.36. Sc. or pl., *n* $1.4283^{79.5}$. **D.** 0.8086^{68}_{4}, **m.p.** 69. **Soly.** i.w.; v.sl.s.al.; s.et.

78 **Tricresyl phosphate.** See *Tolyl phosphate.*

79 **Tricyanic acid.** See *Cyanuric acid.*

80 **Tricyanogen chloride.** See *Cyanuric chloride.*

81 **Tridecanal*, oxime** (*n-tridecylaldoxime*). $CH_3(CH_2)_{11}CH{:}NOH$, 231.22. Need.f.dil.al. **m.p.** 80.5. **Soly.** i.w.; sl.s.al.; v.s.et.; v.s.chl., sl.s.bz., pet. eth.

82 **Tridecane*.** $CH_3(CH_2)_{11}CH_3$, 184.22. Col.liq., *n* $1.4419^{16.8}$. **D.** 0.757, **m.p.** −6.2, **b.p.** 234. **Soly.** i.w.; v.s.al.; v.s.et.

83 **—, 1-amino-.** See *Tridecylamine**.

84 **Tridecanoic acid*** (*n-tridecoic acid; n-tridecylic acid*). $CH_3(CH_2)_{11}COOH$, 214.20. Pl. **m.p.** 51(39.5–40.5), **b.p.** 236^{100}. **Soly.** i.w.; v.s.al.; v.s.et.

85 **—, 13-(2-cyclopentenyl)-.** See *Chaulmoogric acid.*

86 **1-Tridecanol*** (*prim-n-tridecyl alcohol*). $CH_3(CH_2)_{11}CH_2OH$, 200.22. Col. cr. **D.** 0.8223^{31}_{4}, **m.p.** 30.63, **b.p.** $155–6^{15}$. **Soly.** i.w.; s.al.; s.et.

87 **2-Tridecanone*** (*hendecyl methyl ketone*). $CH_3CO(CH_2)_{10}CH_3$, 198.20. Cr. **D.** 0.8229^{28}, **m.p.** 28, **b.p.** 263. **Soly.** i.w.; v.s.al.; v.s.et.

88 **7-Tridecanone*** (*dihexyl ketone; enanthone; oenanthone*). $[CH_3(CH_2)_5]_2$-CO, 198.20. Leaf.f.al. **D.** 0.825^{30}, **m.p.** 33, **b.p.** 255^{766}(264). **Soly.** v.s.al.; v.s.et.; s.chl., lgr.

* Name approved by the International Union of Chemistry.

9 ***n*-Tridecoic acid.** See *Tridecanoic acid**.

0 ***n*-Tridecyl alcohol.** See 1-*Tridecanol**.

1 ***n*-Tridecylaldoxime.** See *Tridecanal, oxime**.

2 **Tridecylamine*** (*prim-n-tridecylamine; 1-aminotridecane*). $CH_3(CH_2)_{12}NH_2$, 199.23. **m.p.** 27, **b.p.** 265.

3 **Tridecylene.** $C_{13}H_{26}$, 182.20. Col. liq. **D.** 0.7977^{20}_{4}, **b.p.** 232.7. **Soly.** i.w.; v.s.al.; v.s.et.

4 ***n*-Tridecylic acid.** See *Tridecanoic acid**.

5 **Triethanolamine.** See *Ethanol*, 2, 2′, 2″-*nitrilotri-*.

6 **Triethylamine*.** $(C_2H_5)_3N$, 101.13. Col.liq. *n* 1.40032. **D.** 0.7229^{25}_{4}, **m.p.** −114.8, **b.p.** 89.5. **Soly.** 1.5^{20}, 1.97^{65}w.; ∞al.; ∞et.

7 —, hydrochloride (*triethylammonium chloride**). $(C_2H_5)_3N{\cdot}HCl$, 137.59. Cr. f.al. **D.** 1.0688^{21}_{4}, **m.p.** 254, **b.p.** subl. **Soly.** 150^{26}w.; s.al.; i.et.

8 —, *β*, *β*-**diethoxy-** (*diethylaminoacetal*). $(C_2H_5)_2NCH_2CH(OC_2H_5)_2$, 189.19. Liq. **D.** 0.863^{15}, **b.p.** 194–5. **Soly.** s.w.; s.al.; s.et.

9 —, *β*, *β*′-**dihydroxy-.** See *Ethanol*, 2, 2′-*ethyliminodi-*.

0 —, *β*-**hydroxy-.** See *Ethanol*, 2-*diethylamino-**.

1 —, *β*, *β*, *β*-**trihydroxy-.** See *Ethanol*, 2, 2′, 2″-*nitrilotri-*.

2 **Triethyl arsenate.** See *Ethyl arsenate*.

3 **Triethyl arsenite.** See *Ethyl arsenite*.

4 **Triethyl borate.** See *Ethyl borate*.

6 **Triethylene glycol** (2, 2′-*ethylenedioxydiethanol; glycol bis(hydroxyethyl) ether*). $(CH_2OCH_2CH_2OH)_2$, 150.11. Col.liq. **D.** 1.1254, **m.p.** −5, **b.p.** 280–90. **Soly.** ∞w.; ∞al.; sl.s.et.

7 **Triethylolamine.** See *Ethanol* 2, 2′, 2″-*nitrilotri-*.

8 **Triethyl phosphate.** See *Ethyl phosphate*.

9 **Triethyl phosphite.** See *Ethyl phosphite*.

0 **Trifuraldiamine.** See *Furfural, hydramide*.

1 **Trifurfurylamine** (*α*, *α*′, *α*″-*tri-2-furyltrimethylamine*). $(C_4H_3OCH_2)_3N$, 257.13. Col.liq. **b.p.** $133–8^{1}$. **Soly.** i.w.; s.et.

12 **Trigonelline** (*nicotinic acid N-methylbetaine*). $C_7H_7NO_2$, 137.06. Hyg.pr. f.al. **m.p.** 218 d. **Soly.** v.s.w.; s.al.; sl.s.et.; sl.s.chl.; i.bz.

13 **Triisoamylamine.** $[(CH_3)_2CHCH_2CH_2]_3N$, 227.27. Col.liq. **D.** 0.7859^{20}, **b.p.** 237(242–5). **Soly.** i.w.; v.s.al.; ∞et.

14 **Triisoamyl borate.** See *Isoamyl borate*.

15 **Triisobutylamine.** $[(CH_3)_2CHCH_2]_3N$, 185.22. Col.liq., *n* $1.42519^{17.3}$. **D.** 0.766^{25}_{25}, **m.p.** −21.8, **b.p.** 191.5 **Soly.** i.w.; v.s.al.; ∞et.

16 **Triisobutyl arsenite.** See *Isobutyl arsenite*.

17 **Triisobutyl borate.** See *Isobutyl borate*.

18 **Triketone, diphenyl-.** See *Propanetrione, diphenyl-**.

19 **Trilaurin.** See *Glycerol, trilaurate*.

20 **Trimellitic acid** (1, 2, 4-*benzenetricarboxylic acid**). $C_6H_3(COOH)_3$, 210.05. Col.need.f.w. **m.p.** 216 d. **Soly.** s.h.w.; v.s.al.; s.et.

21 **Trimesic acid** (1, 3, 5-*benzenetricarboxylic acid**). $C_6H_3(COOH)_3$, 210.05. Col.pr.f.w. **m.p.** 350(375–80), **b.p.** subl. <300. **Soly.** 2.69^{22}w.; v.s.al.; s.et.

22 —, **hydroxy-** (*phenol-2, 4, 6-tricarboxylic acid*). $HOC_6H_2(COOH)_3$, 226.05. Need.f.w. **m.p.** d. 180. **Soly.** 0.5^{10}w.; v.s.h.al.; sl.s.et.; i.chl.

23 **Trimesitic acid** (2, 4, 6-*pyridinetricarboxylic acid**). $C_5H_2N(COOH)_3$, 211.05. Pl.f.dil. H_2SO_4. **m.p.** 227 d. **b.p.** subl.d. **Soly.** s.h.w.; sl.s.et.

24 **Trimethylamine*.** $(CH_3)_3N$, 59.08. Col.gas. **D.** 0.662^{-5}, **m.p.** −124, **b.p.** 3.5. **Soly.** v.s.w.; v.s.al.; s.et.

25 —, hydrochloride (*trimethylammonium chloride**). $(CH_3)_3N{\cdot}HCl$, 95.54. Col. deliq.cr.f.al. **m.p.** 275 d. **Soly.** v.s.w.; s.al.; i.et.

26 —, *α*, *α*′, *α*″-**tri-2-furyl-.** See *Trifurfurylamine*.

27 **Trimethyl borate.** See *Methyl borate*.

28 **Trimethylene.** See *Cyclopropane**.

29 **Trimethylene bromide.** See *Propane*, 1, 3-*dibromo-**.

30 **Trimethylene bromohydrin.** See 1-*Propanol*, 3-*bromo-**.

31 **Trimethylene chloride.** See *Propane*, 1, 3-*dichloro-**.

32 **Trimethylene chlorohydrin.** See 1-*Propanol*, 3-*chloro-**.

33 **Trimethylene cyanide.** See *Glutaronitrile*.

For explanations and abbreviations see beginning of table.

34 **Trimethylenediamine.** See 1, 3-*Propanediamine**.

35 **Trimethylene dibromide.** See *Propane, 1, 3-dibromo-**.

36 **Trimethylene dichloride.** See *Propane, 1, 3-dichloro-**.

37 **Trimethylene dicyanide.** See *Glutaronitrile*.

38 **Trimethylene glycol.** See 1, 3-*Propanediol**.

39 —, diphenyl ether. See *Propane, 1, 3-diphenoxy-**.

40 —, methylene ether. See *m-Dioxane*.

41 —, α-**methyl-.** See 1, 3-*Butanediol**.

42 —, α, α, α′-**trimethyl-.** See 2, 4-*Pentanediol, 2-methyl-**.

43 **Trimethylene methylene dioxide.** See *m-Dioxane*.

44 **Trimethylenetrianiline.** See *sym-Triazine, hexahydro-1, 3, 5-triphenyl-*.

45 **Trimethylene trisulfide.** See *Formaldehyde, thio-(trimer)*.

46 **Trimethylenimine** (*tetrahydroazete; azetidine*). $\overline{CH_2CH_2CH_2NH}$, 57.06. Col.liq.; odor NH_3. **D.** 0.843, **b.p.** 63. **Soly.** ∞w.

47 **Trimethyl phosphate.** See *Methyl phosphate*.

48 **Trinitrin.** See *Nitroglycerin*.

Trinitro-. See the parent compounds (e.g., for trinitrotoluene see *Toluene, trinitro-*).

49 **Triolein.** See *Glycerol, trioleate*.

50 **Trional** (*2, 2-bis(ethylsulfonyl)butane**). $CH_3C(SO_2C_2H_5)_2CH_2CH_3$, 242.26. Col.tab.f.al. or et. **D.** $1.251^{?}_{?}$, **m.p.** 74–6, **b.p.** d. **Soly.** 0.3w.; 5.7al.; 4.71^{15}et.

51 *sym*-**Trioxane** (*1, 3, 5-trioxane; α-trioxymethylene*). $\overline{OCH_2OCH_2OCH_2}$, 90.05. Need. **m.p.** 64, **b.p.** subl. 46. **Soly.** s.w.; s.al.; s.et.

52 —, **2, 4, 6-trimethyl-.** See *Paraldehyde*.

53 *sym*-**Trioxanetriimine.** See *Cyamelide*.

54 **Trioxymethylene.** See *Polyoxymethylene*.

55 α-**Trioxymethylene.** See *s-Trioxane*.

56 **Tripalmitin.** See *Glycerol, tripalmitate*.

57 **Triphenyl.** See *Terphenyl*.

Triphenyl-. For triphenyl derivatives see the parent compounds (e.g., for triphenylmethane see *Methane, triphenyl-*).

58 **Triphenylamine*.** $(C_6H_5)_3N$, 245.13. Monocl.pr.f.et., *n* 1.353^{16}. **D.** 0.774^{0}_{4}, **m.p.** 126.5, **b.p.** 365. **Soly.** i.w.; sl.s.al.; s.et.; v.s.bz.; s.acet.

59 **Triphenylene** (*benzo[l]phenanthrene; isochrysene*). $C_{18}H_{12}$, 228.09. Wh.cr. **m.p.** 198.5. **Soly.** i.w.; s.al.; s.et.

60 **Tripropylamine***(*n*). $(CH_3CH_2CH_2)_3N$, 143.17. Col.liq., *n* $1.41756^{19.4}$, **D.** 0.757^{20}_{4}, **m.p.** −93.5, **b.p.** 156. **Soly.** v.sl.s.w.; ∞al.; s.et.

61 **Tripropyl borate.** See *Propyl borate*.

62 **Triquinoyl hydrate.** See *Cyclohexanehexone, hydrate**.

63 **Trisulfide, diallyl.** See *Allyl trisulfide*.

64 **Tritan.** See *Methane, triphenyl-*.

65 —, α-**benzyl-.** See *Ethane, 1, 1, 1, 2-tetraphenyl-*.

66 —, **4, 4′-dimethyl-.** See *Methane, phenyldi-p-tolyl-*.

67 —, α-**ethyl-.** See *Propane, 1, 1, 1-triphenyl-*.

68 —, *m* or *p*-**methyl-.** See *Methane, diphenyltolyl-*.

69 —, α-**methyl-.** See *Ethane, 1, 1, 1-triphenyl-*.

70 **Tritanol.** See *Carbinol, triphenyl-*.

71 *sym*-**Trithiane.** See *Formaldehyde, thio-*.

72 —, **2, 4, 6-trimethyl-**(α) (*α-trithioacetaldehyde; α-trimolecular thioacetaldehyde*). $\overline{SCH(CH_3)SCH(CH_3)SCHCH_3}$, 180.27. Pr. **m.p.** 101, **b.p.** 247.

73 —, **2, 4, 6-trimethyl-**(β) (*β-trithioacetaldehyde; β-trimolecular thioacetaldehyde*). $\overline{SCH(CH_3)SCH(CH_3)SCHCH_3}$, 180.27. **m.p.** 126.

74 —, **triphenyl-** (higher-melting) (*β-trithiobenzaldehyde*). $[SCH(C_6H_5)]_3$, 366.32. Need. **m.p.** 225. **Soly.** sl.s. al.; s.ac.a., bz.

75 —, **triphenyl-**(lower-melting) (*α-trithiobenzaldehyde*). $(SCHC_6H_5)_3$, 366.32. Wh.amor.powd. **m.p.** 160, **b.p.** d. **Soly.** i.w.; i.al.; v.s.chl.; s.bz.

76 **Tritopine.** See *Laudanidine*.

77 **Trityl.** See *Methyl, triphenyl-*.

* Name approved by the International Union of Chemistry.

78 **Tropacocaine** (*benzoylpseudotropeine*). $C_{15}H_{19}NO_2$, 245.16. Glit. need.f.et., *n* 1.50801$^{100.1}$. **D.** 1.043^{100}, **m.p.** 49, **b.p.** d. **Soly.** sl.s.w.; v.s.al.; v.s.et.; v.s.bz., chl., NH_4OH.

79 —, hydrochloride. $C_{15}H_{19}NO_2 \cdot HCl$, 281.62. Col.need. or pl.f.w. + al. **m.p.** 271 (276–7 d.). **Soly.** s.w.; sl.s.c.al.; i.et.

80 **Tropaic acid.** See *Tropic acid.*

81 **Tropic acid** (*α-phenylhydracrylic acid; tropaic acid*). $C_6H_5CH(COOH)CH_2OH$, 166.08. Need.or.pl.f.al. **m.p.** 117–8, **b.p.** d. **Soly.** 2^{15}w.; s.al.; s.et.; i.CS_2.

82 —, tropine ester. See *Atropine.*

83 **Tropine** (8-*methyl*-3-*nortropanol; N-methyltropoline*). $C_8H_{15}NO$, 141.13. Hyg.tab.f.et. *n* 1.48113$^{99.8}$. **D.** 1.039$^{7.6}_{4}$, **m.p.** 63, **b.p.** 233. **Soly.** v.s.w.; v.s.al.; v.s.et.; s.chl., bz.

84 —, chloroplatinate. $(C_8H_{15}NO \cdot HCl)_2 PtCl_4$ 692.24. Or.-red monocl. **m.p.** 198–200. **Soly.** s.w.; i.al.

85 **Tropinecarboxylic acid.** See *l-Ecgonine.*

86 **Tropoline, *N*-methyl-.** See *Tropine.*

87 ***dl*-Tryptophan** (*dl-β-*(3-*indyl*)*alanine; dl-α-amino-*3-*indolepropionic acid*). $C_8H_6NCH_2CH(NH_2)COOH$, 204.11. Col.hex.pl. **m.p.** 283–5. **Soly.** sl.s.c., s.h.w.; sl.s.al.

88 ***d*-Tryptophan** (*d-β-*(3-*indyl*)*alanine; d-α-amino-*3-*indolepropionic acid*). $C_8H_6NCH_2CH(NH_2)COOH$, 204.11. **m.p.** 281–2.

89 ***l*-Tryptophan** (*l-α-amino-*3-*indolepropionic acid; l-β-*3-*indylalanine*). $C_6H_4NHCH{:}CCH_2CH(NH_2)COOH$, 204.11. Col.hex.leaf. **m.p.** 293–5(289 d.). **Soly.** 1.14^{25}, 2.79^{75}w.; sl.s.al.; i.et.

90 **Tyramine** (*p-*(*β-aminoethyl*)*phenol; p-hydroxyphenethylmiane*). $HOC_6H_4CH_2CH_2NH_2$, 137.09. Need. or leaf.f.bz. **m.p.** 161, **b.p.** 180. **Soly.** 1.05c.w.; 10al.; s.bz.; sl.s.h.xylene.

91 **Tyrosine, 3, 5-diiodo-.** See *Iodogorgoic acid.*

92 ***dl*-Tyrosine** (*dl-β-p-hydroxyphenylalanine*). $HOC_6H_4CH_2CH(NH_2)COOH$, 181.09. Sh.need. **m.p.** 316. **Soly.** 0.041^{20}w.; v.sl.s.al.; i.et.

93 ***d*-Tyrosine** (*d-β-p-hydroxyphenylalanine*). $HOC_6H_4CH_2CH(NH_2)COOH$. 181.09. **m.p.** 310–4.

94 ***l*-Tyrosine** (*l-α-amino-p-hydroxyhydrocinnamic acid; l-β-*(*p-hydroxyphenyl*)*alanine*). $HOC_6H_4CH_2CH(NH_2)COOH$, 181.09. Sm.silk.need. f.w., *n* 1.550, 1.600, 1.680. **D.** 1.456$^{20}_{4}$, **m.p.** 295 d. **Soly.** 0.048^{25}, 0.238^{75}w.; 0.01^{17} 95%, i.abs.al.; i.et.; s.alk.; i.acet.

95 **Ulexine.** See *Cytisine.*

96 **Umbellic acid** (2, 4-*dihydroxycinnamic acid*). $(HO)_2C_6H_3CH{:}CHCOOH$, 180.06. Yel.powd. **m.p.** 240 d. **Soly.** sl.s.w.; s.al.; i.et.; i.bz., lgr.

97 **Umbelliferone** (7-*hydroxycoumarin*). $C_9H_6O_3$, 162.05. Need. **m.p.** 225–7, **b.p.** subl. **Soly.** 1^{100}w.; s.al.; sl.s.et.; s.H_2SO_4.

Undecan-. See *Hendecan-.*

98 **Undecene*.** See *Hendecene**.

99 **Undecenoic acid*.** See *Hendecenoic acid**.

00 *pri-n-***Undecyl alcohol.** See 1-*Hendecanol**.

01 ***n*-Undecylaldehyde.** See *Hendecanal**.

02 ***n*-Undecylamine.** See *Hendecylamine**.

03 ***n*-Undecyl cyanide.** See *Lauronitrile.*

04 ***β*-Undecylene.** See 2-*Hendecene**.

05 ***θ*-Undecylenic acid.** See 9-*Hendecenoic acid**.

06 ***n*-Undecylic acid.** See *Hendecanoic acid**.

07 **Uracil**(2, 4(1, 3)-*pyrimidinedione*). $NHCONHCOCH{:}CH$, 112.05. Need. f.w. **m.p.** 338. **Soly.** v.sl.s.c., v.s. h.w.; i.al.; s.et.; s.NH_4OH.

08 —, **5-methyl-.** See *Thymine.*

09 **Uramil** (5-*aminobarbituric acid; dialuramide; murexan*). $NHCONHCOCH(NH_2)CO$, 143.06. Need. **Soly.** sl.s.h.w.; s.NH_4OH, c.H_2SO_4, NH_3.

10 ***p*-Urazine** (*tetrahydro-sym-tetrazinedione; diurea*). $NHNHCONHNHCO$, 116.06. Monocl.pr.f.w. **m.p.** 270. **Soly.** sl.s.w.; sl.s.al.; sl.s.h.ac.a.

11 **Urea** (*carbamide*). NH_2CONH_2, 60.05. Col.tetr., *n* 1.484, 1.602. **D.** 1.335 **m.p.** 132.7, **b.p.** d. **Soly.** 78^{5}, 119.3^{25}w.; 15.8^{20}al., sl.s.et.; s.conc. HCl; i.chl.

12 —, chloride. See *Carbamyl chloride.*

For explanations and abbreviations see beginning of table.

13 **Urea, acetonyl-** (*1-ureido-2-propanone*). $CH_3COCH_2NHCONH_2$, 116.08. Pr. **D.** 0.8018^{4}, **m.p.** −41, **b.p.** 82. **Soly.** s.w.; s.al.; s.et.

14 —, **acetyl-.** $CH_3CONHCONH_2$, 102.06. Need.f.w. **m.p.** 218–9, **b.p.** d. **Soly.** 1.2^{20}w.; 1^{20}al.; sl.s.et.

15 —, ***N*-acetyl-*N'*-methyl-.** $CH_3CONHCONHCH_3$, 116.08. Col.monocl. f.w. **m.p.** 180, **b.p.** d. **Soly.** s.w.; s.al.; sl.s.et.

16 —, **acetyl-thio-** (*N-(thiocarbamyl) acetamide*). $CH_3CONHCSNH_2$, 118.12. Pr.f.w. **m.p.** 165–6. **Soly.** sl.s.w.; s.al.; sl.s.et.

17 —, **allyl-** (*2-propenylurea**). $C_3H_5NHCONH_2$, 100.08. Need.f.al. **m.p.** 85. **Soly.** v.s.w.; v.s.al.; sl.s.et.; sl.s.chl.; i.pet.eth., tol., CS_2.

18 —, ***N*-allyl-*N'*-phenyl-.** $C_3H_5NHCONHC_6H_5$, 176.11. Need.f.bz. **m.p.** 115.5. **Soly.** v.sl.s.w.; s.al.; s.bz.

19 —, **allyl-thio-** (*thiosinamine; 2-propenylthiourea; allylsulfocarbamide*). $CH_2{:}CHCH_2NHCSNH_2$, 116.14. Col. monocl. or rhomb., *n* $\gamma 1.63454^{78}$ liq. **D.** 1.219^{20}_{20}, **m.p.** 78.4. **Soly.** 3w.; s.al.; sl.s.et.; i.bz.

20 —, **amino-.** See *Semicarbazide.*

21 —, **benzoyl-thio-** (*benzoylthiocarbamide*). $C_6H_5CONHCSNH_2$, 180.14. Pr.f.al. **m.p.** 171. **Soly.** sl.s.w.; s.al.; i.et.

22 —, **benzyl-*** (*benzylcarbamide*). $C_6H_5CH_2NHCONH_2$, 150.09. Col.need. f.al. **m.p.** 147–8. **Soly.** 1.7^{46}w.; s.al.; $0.36^{22.5}$et.; 3.1^{23}acet.

23 —, **benzyl-thio-** (*benzylthiocarbamide*). $C_6H_5CH_2NHCSNH_2$, 166.15. Pr.f.w. **m.p.** 162–4. **Soly.** i.c.w.; 1.31c.al.

24 —, **carbamyl-.** See *Biuret.*

25 —, ***N, N'*-diacetyl-** (*sym-diacetylurea*). $CH_3CONHCONHCOCH_3$, 144.08. Need.f.al. **m.p.** 152, **b.p.** subl.; d. 179–80. **Soly.** v.sl.s.w.; sl.s.al.

26 —, ***N, N*-diethyl-*** (*uns-diethylurea; N, N-diethylcarbamide*). $(C_2H_5)_2NCONH_2$, 116.11. Col.deliq.need.f.al. **m.p.** 74(70). **Soly.** v.s.w.; v.s.al.; 1.86c.et.

27 —, ***N, N'*-diethyl-*** (*sym-diethylurea; N, N'-diethylcarbamide*). $CO(NHC_2H_5)_2$, 116.11. Col.deliq.need.f.al. **D.** 1.0415, **m.p.** 112(108), **b.p.** 263. **Soly.** v.s.w.; v.s.al.; v.s.et.

28 —, ***N, N'*-diethyl-thio-** (*sym-diethylthiourea; N, N'-diethylthiocarbamide*). $C_2H_5NHCSNHC_2H_5$, 132.17. Cr. **m.p.** 77, **b.p.** d. **Soly.** s.w.; s.al.; v.s.et.

29 —, ***N, N*-dimethyl-*** (*uns-dimethylurea*). $(CH_3)_2NCONH_2$, 88.08. Col monocl.pr.f.me.al. **D.** 1.255, **m.p** 182. **Soly.** v.s.w.; v.sl.s.al.; v.sl.s.et.

30 —, ***N, N'*-dimethyl-*** (*sym-dimethylurea*). $CH_3NHCONHCH_3$, 88.08. Co rhomb.pr. **D.** 1.142, **m.p.** 106(102.5) **b.p.** 270. **Soly.** v.s.w.; s.al.; i.et.

31 —, ***N, N*-diphenyl-** (*uns-diphenylurea*). $(C_6H_5)_2NCONH_2$, 212.11. Co rhomb.need. **D.** 1.276, **m.p.** 18 **b.p.** d. **Soly.** v.sl.s.w.; s.al.; s.et. s.chl.

32 —, ***N, N'*-diphenyl-.** See *Carbanilide.*

33 —, ***sym*-diphenyl-.** See *Carbanilide*

34 —, ***N, N*-diphenyl-thio-.** $(C_6H_5)_2NCSNH_2$, 228.17. Cr. **m.p.** 18 **Soly.** i.w.; s.al.

35 —, **ditolylthio-.** See *Carbanilide dimethyl-thio-.*

36 —, ***sym*-di-*o*-tolylthio-.** See *Carbanilide, thio-o, o'-dimethyl-.*

37 —, ***p*-ethoxyphenyl-.** See *Urea p-phenetyl-.*

38 —, **ethyl-*.** $NH_2CONHC_2H_5$, 88.08 Col.monocl.pr.f.al. + et. **D.** 1.213^{18} **m.p.** 92, **b.p.** d. **Soly.** v.s.w. v.s.al.; i.et.

39 —, **ethylene-** (*dihydro-2(3)-imidazolone*). $CH_2NHCONHCH_2$, 86.06. Co need. **m.p.** 131. **Soly.** s.h.al.; v.s s.et.; s.chl.

40 —, **ethylidene-** (*4-methyluretidone*) $NHCONHCHCH_3$, 86.06. Col.need **m.p.** 154, **b.p.** 160 d. **Soly.** v.sl.s.w. sl.s.al.; v.sl.s.et.

41 —, ***N*-ethyl-*N'*-phenyl-.** $C_2H_5NHCONHC_6H_5$, 164.11. Need.f.al. **m.p** 99. **Soly.** s.al.

42 —, **furfuralmalonylthio-.** See *Barbituric acid, 5-(2-fural)-2-thio-.*

43 —, **glycolyl-.** See *Hydantoin.*

44 —, **glycolyl-thio-.** See *Hydantoin 2-thio-.*

45 —, **glyoxalyl-.** See *Allanturic acid.*

46 —, **guanyl-** (*dicyan(o)diamidine; 1-carbamylguanidine*) $NH_2C(:NH)NHCONH_2$, 102.08. Pr.f.al. **m.p.** 10 **b.p.** d. at 160. **Soly.** s.w.; s.al. i.et.; s.pyr., chl., bz., CS_2, a.

47 —, **hydroxy-** (*carbamide oxide*) $NH_2CONHOH$, 76.05. Col.need.f.a **m.p.** 128–30(139–40), **b.p.** d. **Soly** v.s.w.; s.al.

48 —, **isoamyl-** (*(γ-methylbutyl)urea**) $C_5H_{11}NHCONH_2$, 130.13. Col.cr. **m.p** 89–91. **Soly.** sl.s.w.

* Name approved by the International Union of Chemistry.

49 **Urea, isobutyl-** ((*β-methylpropyl*)-*urea**). $NH_2CONHCH_2CH(CH_3)_2$, 116.11. Need.f.acet. **m.p.** 141. **Soly.** v.sl.s.et.; sl.s.acet., bz.

50 —, **α-lactyl-.** See *Hydantoin, 5-methyl-.*

51 —, **malonyl-.** See *Barbituric acid.*

52 —, **mesoxalyl-.** See *Alloxan.*

53 —, **methyl-*.** $NH_2CONHCH_3$, 74.06. Col.rhomb.pr.f.w. or al. **D.** 1.204, **m.p.** 101, **b.p.** d. **Soly.** v.s.w.; v.s.al.; 0.073et.

54 —, **methyl-thio-.** $CH_3NHCSNH_2$, 90.12. Pr. **m.p.** 118. **Soly.** s.w.; s.al.; sl.s.et.

55 —, **nitro-*.** $NH_2CONHNO_2$, 105.05. Wh.cr.f.al. or et. **m.p.** 155–6, **b.p.** exp. **Soly.** sl.s.w.; v.s.al.; v.s.et.

56 —, **oxalyl-.** See *Parabanic acid.*

57 —, **oximidomesoxalyl-.** See *Violuric acid.*

58 —, ***p*-phenetyl-** (*p-ethoxyphenylurea; dulcin*). $C_2H_5OC_6H_4NHCONH_2$, 180.11. Col.leaf. or need.f.dil.a. **m.p.** 173–4, **b.p.** d. **Soly.** 0.125c., 2h.w.; 4, 90%al.; sl.s.et.

59 —, **phenyl-*.** $C_6H_5NHCONH_2$, 136.08. Monocl., *n* α1.602, γ1.627. **D.** 1.302, **m.p.** 147, **b.p.** 238. **Soly.** sl.s.c., v.s.h.w.; v.s.al.; v.s.et.

60 —, **phenylene-.** See *2(3)-Benzimidazolone.*

61 —, **phenyl-thio-.** $C_6H_5NHCSNH_2$, 152.14. Col.need.f.w. or trim.f.al. **D.** 1.3, **m.p.** 154. **Soly.** 0.26^{18}w.; 5.66^{25}al.

62 —, **2-propenyl-*.** See *Urea, allyl-.*

63 —, **propyl-*.** $C_3H_7NHCONH_2$, 102.09. Col.cr. **m.p.** 107. **Soly.** s.w.

64 —, **tartronyl-.** See *Dialuric acid.*

65 —, **tetraethyl-*.** $(C_2H_5)_2NCON(C_2H_5)_2$, 172.17. Liq. **b.p.** 210–5. **Soly.** i.w.; s.a.; i.alk.

66 —, **tetramethyl-*.** $(CH_3)_2NCON(CH_3)_2$, 116.11. Liq. **D.** 0.972^{15}, **b.p.** 177. **Soly.** v.s.al.; v.s.et.

67 —, **tetraphenyl-** (*N, N′-diphenylcarbanilide*). $(C_6H_5)_2NCON(C_6H_5)_2$, 364.17. Col.rhomb. **D.** 1.222, **m.p.** 183. **Soly.** i.w.; s.al.

68 —, **thio-** (*thiocarbamide*). NH_2CSNH_2, 76.11. Rhomb.pr.f.al. **D.** 1.405^{20}_{4}, **m.p.** 182(174–6), **b.p.** d. **Soly.** 9.18^{13}w.; s.al.; v.sl.s.et.

69 —, **thio-*m*-tolyl-.** $CH_3C_6H_5NHCSNH_2$, 167.16. Pr.f.al. **m.p.** 110–1. **Soly.** s.h.w.; v.s.al.; v.s.et.

70 —, ***o*-tolyl-.** $CH_3C_6H_5NHCONH_2$, 151.10. Leaf.f.al. **m.p.** 190–1. **Soly.** 0.25^{45}w.; s.al.; s.et.

71 —, ***m*-tolyl-.** $CH_3C_6H_5NHCONH_2$, 151.10. Leaf.f.w. **m.p.** 142–3. **Soly.** s.w.; v.s.al.; sl.s.et.

72 —, ***p*-tolyl-.** $CH_3C_6H_5NHCONH_2$, 151.10. Need.f.w. **m.p.** 187. **Soly.** 0.31^{45}w.; s.al.; $0.062^{22.5}$et.

73 —, **trimethyl-*.** $CH_3NHCON(CH_3)_2$, 102.09. Monocl. **D.** 1.19, **m.p.** 75.5, **b.p.** 232.5. **Soly.** v.s.w.; v.s.al.; s.et.

74 **Ureaacetic acid.** See *Hydantoic acid.*

75 **Urethan.** See *Carbamic acid, ethyl ester.*

76 —, **methyl-.** See *Carbamic acid, methyl ester; Carbamic acid, methyl-, ethyl ester.*

77 —, **phenyl-.** See *Carbanilic acid, ethyl ester.*

78 —, **thio-.** See *Carbamic acid, thiol-, ethyl ester; Carbamic acid, thiono-, ethyl ester.*

79 **Uretidone, 4-methyl-.** See *Urea ethylidene-.*

80 **Uric acid** (*2, 6, 8(1, 3, 9)-purinetrione; 2, 6, 8-trioxypurine*). $C_5H_4N_4O_3$, 168.06. Sc. **D.** 1.893, **m.p.** d. **Soly.** 0.00645^{37}, 0.06h.w.; i.al.; i.et.; s.glyc., h.conc.H_2SO_4.

81 —, **1-methyl-.** $C_6H_6N_4O_3$, 182.08. Col.need. **m.p.** 400 d. **Soly.** 0.05^{100}w.; v.sl.s.al.

82 —, **3-methyl-.** $C_6H_6N_4O_3$, 182.08. Col.pr.f.w. **m.p.** >360 d. **Soly.** 0.38^{100}w.; v.sl.s.al.; s.alk.

83 —, **7-methyl-.** $C_6H_6N_4O_3$, 182.08. Col.leaf.f.w. **m.p.** 370 d. **Soly.** 1.25^{100}w.; s.alk.

84 **Urotropine.** See *Hexamethylenetetramine.*

85 ***dl*-Usnic acid** (*dl-usninic acid*). $C_{18}H_{16}O_7$, 344.12. Yel.monocl.pr. **m.p.** 193. **Soly.** i.w.; v.sl.s.al.; 0.3^{20}et.

86 ***d*-Usnic acid** (*d-usninic acid*). $C_{18}H_{16}O_7$, 344.12. Yel.pr.f.al., *n* 1.463, 1.653, 1.780. **m.p.** 203, **b.p.** d. **Soly.** i.w.; v.sl.s.al.; sl.s.et.

87 **Uvic acid, Uvinic acid.** See *Pyrotritaric acid.*

88 **Uvitic acid** (*5-methylisophthalic acid*). $CH_3C_6H_3(COOH)_2$, 180.06. Col.need.f.w. **m.p.** 290, **b.p.** subl. **Soly.** sl.s.h.w.; v.s.al.; v.s.et.

89 **Uvitonic acid** (*6-methyllutidinic acid; 2-picoline-4, 6-dicarboxylic acid*). $CH_3C_5H_2N(COOH)_2$, 181.06. Col. cr.powd. **m.p.** 274 d. **Soly.** v.sl.s.w.; s.a., aniline; v.sl.s.h.bz.

For explanations and abbreviations see beginning of table.

90 Valeraldehyde (*Pentanal*; n-valeric aldehyde; n-amyl aldehyde*). $CH_3(CH_2)_3CHO$, 86.08. Liq., *n* 1.3882. **D.** 0.8185^{11}, **m.p.** −91.5, **b.p.** 103.4. **Soly.** sl.s.w.; v.s.al.; v.s.et.

91 —, oxime (*pentanal oxime**). $CH_3(CH_2)_3CH{:}NOH$, 101.09. Cr. **m.p.** 52. **Soly.** s.w.; s.al.

92 —, γ-**keto-.** See *Levulinaldehyde.*

93 Valeramide (*pentanamide**). $CH_3(CH_2)_3CONH_2$, 101.09. Monocl.pl. **D.** 1.023, **m.p.** 114–6(105.8). **Soly.** s.w.; s.al.; s.et.

94 Valeric acid(*active*). See *Butyric acid, α-methyl-.*

95 Valeric acid (*n*) (*pentanoic acid**). $CH_3(CH_2)_3COOH$, 102.08. Col.liq., *n* 1.4086. **D.** 0.942^{20}_{4}; 0.9435^{15}_{4}, **m.p.** −59; −34.5, **b.p.** 187. **Soly.** 3.7^{16}w.; ∞al.; ∞et.

96 —, amyl ester (*amyl valerate; pentyl pentanoate**). $C_4H_9COOC_5H_{11}$, 172.16. Col.liq., *n* 1.4145. **D.** 0.881^{0}, **m.p.** −78.8, **b.p.** 203.7. **Soly.** sl.s.w.; ∞al.; ∞et.

97 —, butyl ester (*butyl valerate; butyl pentanoate**). $CH_3(CH_2)_3COOC_4H_9$, 158.14. Liq. **D.** 0.8700^{15}_{4}, **m.p.** −92.8, **b.p.** 185.6. **Soly.** v.sl.s.w.; ∞al.; ∞et.

98 —, ethyl ester. $CH_3(CH_2)_3COOC_2H_5$, 130.11. Col.liq., *n* 1.3732^{79}. **D.** 0.8756^{20}_{4}, **m.p.** −91.2, **b.p.** 145.5. **Soly.** 0.237^{25}w.; ∞al.; ∞et.

99 —, 2-furylmethyl ester (*furfuryl valerate*). $CH_3(CH_2)_3COOCH_2C_4H_3O$, 182.11. Col.liq. **D.** 1.0284^{20}_{4}, **b.p.** $228–9^{764}$; $82–3^{1}$. **Soly.** i.w.; s.al.; s.et.

00 —, isobutyl ester. (*isobutyl valerate; β-methylpropyl pentanoate**). $CH_3(CH_2)_3COOCH_2CH(CH_3)_2$, 158.14. Col.liq. **D.** 0.854, **b.p.** 167. **Soly.** i.w.; ∞al.; ∞et.

01 —, methyl ester (*methyl pentanoate*; methyl valerate*). $CH_3(CH_2)_3COOCH_3$, 116.09. Col.liq. **D.** 0.910^{0}, **m.p.** −91.0, **b.p.** 127.3. **Soly.** v.sl.s.w.; ∞al.; ∞et.

02 —, *p*-phenylphenacyl ester. $CH_3(CH_2)_3COOCH_2COC_6H_4C_6H_5$, 296.16. **m.p.** 63.5.

03 —, piperazinium salt. $C_4H_{10}N_2{\cdot}2C_4H_9COOH$, 290.25. Wh.cr. **m.p.** 112.5–13. **Soly.** s.w.; s.al.; i.et.; s.h.dioxane.

04 —, propyl ester (*n-propyl n-valerate*). $CH_3(CH_2)_3COOC_3H_7$, 144.12. Col. liq. **D.** 0.889^{0}, **b.p.** 167.5. **Soly.** i.w.; s.al.; ∞et.; s.chl.

06 —, α-**amino-** (*2-aminopentanoic acid**). $CH_3CH_2CH_2CH(NH_2)COOH$, 117.09. Leaf.f.w. **m.p.** 291.5 d., **b.p.** subl. **Soly.** 10.7^{5}w.; sl.s.al.; i.et.

07 —, γ-**amino-** (*4-aminopentanoic acid**). $CH_3CH(NH_2)CH_2CH_2COOH$, 117.09. Cr. **m.p.** 193, **b.p.** d. **Soly.** v.s.w.; sl.s.al.; i.et.; i.bz., lgr.

08 —, δ-**amino-** (*5-aminopentanoic acid**). $NH_2(CH_2)_4COOH$, 117.09. Leaf. **m.p.** 157, **b.p.** d. **Soly.** v.s.w.; sl.s.al.; i.et.

09 —, α-**amino-**δ-**guanido-.** See *Arginine.*

10 —, α-**amino-**β-**methyl-.** See *Isoleucine.*

11 —, α-**bromo-** (*2-bromopentanoic acid**). $CH_3(CH_2)_2CHBrCOOH$, 180.99. **b.p.** 67^{10}($126–30^{27}$). **Soly.** sl.s.w.; v.s.al.; s.et.

12 —, —, ethyl ester. (*ethyl 2-bromopentanoate**). $CH_3CH_2CH_2CHBrCOOC_2H_5$, 209.02. Liq. **D.** 1.226^{15}_{4}, **b.p.** 192($74–6^{11}$). **Soly.** i.w.; ∞al.; ∞et.

13 —, α, δ-**diamino-.** See *Ornithine.*

14 —, α-**ethyl-** (*2-ethylpentanoic acid*; 3-hexanecarboxylic acid; ethylpropylacetic acid*). $CH_3CH_2CH_2CH(C_2H_5)COOH$, 130.11. Col.oil. **b.p.** 209.2. **Soly.** i.w.; s.al.; s.et.

15 —, β-**ethyl-** (*3-ethylpentanoic acid*; β, β-diethylpropionic acid*). $(C_2H_5)_2CHCH_2COOH$, 130.11. Oil. **b.p.** 212.

16 —, α-**hydroxy-** (*2-hydroxypentanoic acid*; valerolactic acid*). $CH_3CH_2CH_2CHOHCOOH$, 118.08. Hyg.pl. **m.p.** 34, **b.p.** subl. **Soly.** v.s.w.; v.s.al.; v.s.et.

17 —, γ-**hydroxy-,** lactone (*4-hydroxypentanoic acid lactone; γ-valerolactone*). $CH_3CHCH_2CH_2COO$, 100.06. Liq. **D.** 1.072, **m.p.** −31, **b.p.** 206–7. **Soly.** s.w.; s.al.

18 —, γ-**keto-.** See *Levulinic acid.*

19 —, α-**methyl-** (*2-methylpentanoic acid*; methylpropylacetic acid*). $CH_3(CH_2)_2CH(CH_3)COOH$, 116.09. Col. liq. **D.** 0.928^{20}_{4}, **b.p.** 193.5. **Soly.** 0.57^{17}w.; s.al.; s.et.

20 —, β-**methyl-** (*3-methylpentanoic acid*; sec-butylacetic acid*). $C_2H_5CH(CH_3)CH_2COOH$, 116.09. Liq. **D.** 0.930^{15}, **b.p.** 195–6. **Soly.** s.al.; s.et.

21 —, α, β, γ, δ-**tetrahydroxy-.** See *Arabonic acid.*

* Name approved by the International Union of Chemistry.

22 Valeric anhydride (*pentanoic anhydride**). $[CH_3(CH_2)_3CO]_2O$, 186.14. Col.liq. **D.** 0.929^{20}_{4}, **m.p.** −56.1, **b.p.** 215. **Soly.** d.h.w.; s.d.al.; v.s.et.

23 Valerolactic acid. See *Valeric acid, α-hydroxy-.*

24 γ-Valerolactone. See *Valeric acid, γ-hydroxy-, lactone.*

25 Valerone. See 4-*Heptanone, 2, 6-dimethyl-**.

26 Valeronitrile (*pentanenitrile*; n-butyl cyanide*). $CH_3(CH_2)_3CN$, 83.08. Col. liq., *n* 1.3909. **D.** 0.8014^{20}_{4}, **m.p.** −96.0, **b.p.** 141. **Soly.** i.w.; s.al.; s.et.

27 Valerophenone (*butyl phenyl ketone*). $CH_3(CH_2)_3COC_6H_5$, 162.11. Liq. **b.p.** 239.5. **Soly.** i.w.; v.s.al.; v.s.et.

28 —, **γ-keto-** (*1-phenyl-1, 4-pentanedione; phenacylacetone; β-acetylpropiophenone; α-acetonylacetophenone*). $C_6H_5COCH_2CH_2COCH_3$, 176.09. Yel. oil. **D.** >1, **b.p.** 162^{12} d. **Soly.** sl.s.c.w.; i.alk.

29 Valeryl chloride (*pentanoyl chloride**). $CH_3(CH_2)_3COCl$, 120.53. Col. liq., *n* 1.41555. **D.** 1.016^{15}, **m.p.** −110.0, **b.p.** 128. **Soly.** d.w.; d.al.; ∞et.

30 Valerylene. See 2-*Pentyne**.

31 *dl*-Valine (*dl-α-aminoisovaleric acid; dl-2-amino-3-methylbutanoic acid**). $(CH_3)_2CHCH(NH_2)COOH$, 117.09. Monocl.leaf.f.al. **m.p.** 298(292) d., **b.p.** subl. **Soly.** 7.44^{25}, 13.31^{75}w.; 0.571^{25} 75%, 0.014^{0} 100%al.; i.et.; i.acet.

32 *d*-Valine (*α-aminoisovaleric acid*). $(CH_3)_2CHCH(NH_2)COOH$, 117.09. Hex.leaf.f.al.; pr.f.w. **m.p.** 315 d., **b.p.** subl. d. **Soly.** $9.1^{16.5}$w.; v.sl.s.al.; i.et.

33 *l*-Valine (*l-α-aminoisovaleric acid; l-2-amino-3-methylbutanoic acid**). $(CH_3)_2CHCH(NH_2)COOH$, 117.09. Leaf.f. al. **m.p.** 293 d. **Soly.** 5.3^{20}w.

34 Valylene. Mixt.(?). Col.liq. **b.p.** 50. **Soly.** i.w.; v.s.al.; ∞et.

35 Vanillaldehyde. See *Vanillin.*

36 Vanillic acid (*4-hydroxy-3-methoxybenzoic acid*). $CH_3O(HO)C_6H_3COOH$, 168.06. Col.need.f.w. **m.p.** 207, **b.p.** subl. **Soly.** 0.12^{14}, 2.5^{100}w.; v.s.al.; v.s.et.

37 —, ethyl ester. $HO(CH_3O)C_6H_3COOC_2H_5$, 196.09. Col.need. **m.p.** 44, **b.p.** 293. **Soly.** i.w.; v.s.al.; v.s. et.; s.alk.

38 Vanillin (*vanillaldehyde; 4-hydroxy-3-methoxybenzaldehyde; protocatechualdehyde 3-methyl ether*). $CH_3O(OH)C_6H_3CHO$, 152.06. Col.monocl.need.f.w. **D.** 1.056, **m.p.** 81–2, **b.p.** 285. **Soly.** i.c., 5h.w.; v.s.al.; v.s.et.; s.chl., glyc.

39 —, acetate (*4-acetoxy-3-methoxy-benzaldehyde; acetylvanillin*). $CH_3O(CH_3COO)C_6H_3CHO$, 194.08. Col. need. **m.p.** 77. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

40 —, ethyl ether. See *Benzaldehyde, 4-ethoxy-3-methoxy-.*

41 —, **acetyl-.** See *Vanillin, acetate.*

42 —, **5-bromo-** (*5-bromo-4-hydroxy-3-methoxybenzaldehyde*). $CH_3O(OH)BrC_6H_2CHO$, 230.97. Col.leaf. **m.p.** 164. **Soly.** i.w.; s.h.al.; sl.s.c.et.; sl.s. c.bz.

43 —, **5-chloro-** (*5-chloro-4-hydroxy-3-methoxybenzaldehyde*). $CH_3O(OH)ClC_6H_2CHO$, 186.51. Col.pl. **m.p.** 164–5. **Soly.** i.w.; s.h.al.

44 Vanillyl alcohol (*4-hydroxy-3-methoxybenzyl alcohol; vanillic alcohol*). $CH_3O(HO)C_6H_3CH_2OH$, 154.08. Col. need.f.w. or bz. **m.p.** 115, **b.p.** d. **Soly.** v.s.h.w.; v.s.al.; v.s.et.

45 Vasicine. $C_{11}H_{12}N_2O$, 188.11. Need. **m.p.** 198 d. **Soly.** sl.s.w.; s.al.; sl.s. et.; s.chl.; sl.s.bz.; i.pet.eth.

46 Veratraldehyde (*3, 4-dimethoxybenzaldehyde; protocatechualdehyde dimethyl ether; 3, 4-dimethoxybenzenecarbonal**). $(CH_3O)_2C_6H_3CHO$, 166.08. Col.need. f.et. **m.p.** 42–3(44–5), **b.p.** 283. **Soly.** i., sl.s.h.w.; v.s.al.; v.s.et.

47 Veratric acid (*3, 4-dimethoxybenzoic acid; protocatechuic acid dimethyl ether*). $(CH_3O)_2C_6H_3COOH$, 182.08. Cr.f.w. **m.p.** anh. 181, **b.p.** subl. **Soly.** 0.05^{14}, 0.6^{100}w.; v.s.al.; v.s.et.

48 Veratrine (crystalline) (*cevadine*). $C_{32}H_{49}NO_9$, 591.39. Col.cr.f.al., $[\alpha]^{17}_{D}$ +12.5° in al. **m.p.** 205 d. **Soly.** 0.11 c.w.; s.al.; s.chl.

50 Veratrole (*1, 2-dimethoxybenzene*; pyrocatechol dimethyl ether*). $C_6H_4(OCH_3)_2$, 138.08. Col.cr. **D.** 1.086^{15}; 1.0812^{25}, **m.p.** 22.5 (19–20), **b.p.** 206–7. **Soly.** sl.s.w.; s.al.; s.et.

51 —, **4-allyl-** (*eugenol methyl ether; methyleugenol*). $CH_2{:}CHCH_2C_6H_3(OCH_3)_2$, 178.11. Col.liq., *n* 1.5383^{17}. **D.** 1.055^{15}, **b.p.** 248–9. **Soly.** i.w.; ∞al.; ∞et.

52 —, **4-propenyl-** (*isoeugenol methyl ether*). $CH_3CH{:}CHC_6H_3(OCH_3)_2$, 178.11. Col.liq., *n* $1.5720^{11.5}$. **D.** 1.0551^{22}, **b.p.** 262–4. **Soly.** i.w.; s.al. s.et.

For explanations and abbreviations see beginning of table.

53 **Veronal.** See *Barbital.*
54 ***l*-Vicine.** $C_{10}H_{16}O_7N_4$, 304.16. Need. **m.p.** 242. **Soly.** s.w.; i.al.; s.me.al.
56 **Vinaconic acid** (*1, 1-cyclopropanedicarboxylic acid*; ethylenemalonic acid*). $CH_2CH_2C(COOH)_2$, 130.05. Tricl. need.f.et. **m.p.** 175, **b.p.** 210^{30}. **Soly.** v.s.w.; s.al.; s.et.
57 **Vinetine.** See *Oxyacanthine.*
58 **Vinyl alcohol** (*ethenol**). $CH_2{:}CHOH$, 44.03.
59 **Vinylamine** * (*ethenylamine**). $CH_2{:}CHNH_2$, 43.05. Liq. **D.** 0.832^{22}_{4}, **b.p.** 56. **Soly.** ∞w.; s.al.; ∞et.
60 **Vinyl bromide** (*bromoethene*; bromoethylene*). $CH_2{:}CHBr$, 106.94. Liq., n 1.4462. **D.** 1.5167^{14}, **m.p.** −137.8, **b.p.** 15.8. **Soly.** i.w.; ∞al.; ∞et.
61 **Vinyl chloride** (*chloroethylene; chloroethene**) $CH_2{:}CHCl$, 62.48. Gas. **D.** liq. 0.9195^{15}_{4}, **m.p.** −159.7, **b.p.** −13.9. **Soly.** sl.s.w.; s.al.; v.s.et.
62 **Vinyl cyanide.** See *Acrylonitrile.*
63 **Vinyl ether** (*ethenyloxyethene*; divinyl ether*). $(CH_2{:}CH)_2O$, 70.05. Col. liq. **D.** 0.774^{18}_{18}, **b.p.** 39(28.3). **Soly.** i.w.; ∞al.; ∞et.
64 **Vinyl iodide** (*iodoethylene; iodoethene**). $CH_2{:}CHI$, 153.94. Liq. **D.** 2.08^0, **b.p.** 56. **Soly.** i.w.; ∞al.; ∞et.; s.chl., bz., tol., CS_2.
65 **Vinyl sulfide** (*ethenylthioethene*; divinyl sulfide*). $(CH_2{:}CH)_2S$, 86.11. Oil. **D.** 0.912, **b.p.** 101. **Soly.** sl.s. w.; ∞al.; ∞et.
66 **Vinyl tribromide.** See *Ethane*, 1, 1, 2-*tribromo-**.
67 **Vinyl trichloride.** See *Ethane*, 1, 1; 2-*trichloro-**.
68 **Violuric acid** (*alloxan 5-oxime; 5-isonitrosobarbituric acid; oximidomesoxalylurea*). CONHCONHCOC:NOH, 157.05. Rhomb. **m.p.** $-H_2O$, 100; 224 d. **Soly.** s.h.w.; s.al.
69 **Vitamin C.** See *l-Ascorbic acid.*
70 **Wintergreen oil.** See *Salicylic acid, methyl ester.*
71 **Wood alcohol.** See *Methanol**.
72 **Wood sugar.** See *l-Xylose.*
73 **Xanthaline.** $C_{37}H_{36}N_2O_9$, 652.30. Cr.powd. **m.p.** 208. **Soly.** i.w.; v.sl.s. h.al.
74 **Xanthene** (*dibenzo-1, 4-pyran; diphenylmethane oxide; o, o′-methylenediphenyl ether*). $C_6H_4OC_6H_4CH_2$, 182.08. Leaf.f.al. **m.p.** 100.5, **b.p.** 315. **Soly.** v.sl.s.w.; sl.s.al.; s.et.; s.bz., chl., CS_2, H_2SO_4.
75 **9-Xanthene-*o*-benzoic acid, 9-hydroxy-,** lactone. See *Fluoran.*
76 —, **3, 4, 5, 6-tetrahydroxy-.** See *Gallin.*
77 **9-Xanthenone.** See *Xanthone.*
78 **Xanthic acid,** ethyl ester (*ethyl ethoxymethanethionothiolate*; ethyl xanthogenate*). $C_2H_5OCSSC_2H_5$, 150.20. Cr., garlic odor. **D.** 1.085^{18}_{4}, **b.p.** 200 $(91-3^{18})$.
79 **Xanthine** (*2, 6(1, 3)purinedione; 2, 6-dioxypurine*). $C_5H_4N_4O_2$, 152.06. Yel.-wh.powd.; sm.pl.become anh. at 125. **m.p.** >150 d., **b.p.** subl. d. **Soly.** 0.26^{17}w.; 0.033^{17}al.; v.s.alk.
80 —, **1, 3-dimethyl-.** See *Theophylline.*
81 —, **3, 7-dimethyl-.** See *Theobromine.*
82 —, **1, 3, 7-trimethyl-.** See *Caffeine.*
83 **Xanthogenamide.** See *Carbamic acid, thiono-, ethyl ester.*
84 **Xanthogenic acid** (*thiolthionocarbonic acid O-ethyl ester; ethylxanthogenic acid*). C_2H_5OCSSH, 122.17. Liq. **D.** >1, **m.p.** −53, **b.p.** 24 d. **Soly.** v.sl.s.(i.).w.
85 —, **ethyl-.** See *Xanthogenic acid.*
86 **Xanthone** (*9-xanthenone; diphenylene ketone oxide*). $CO{:}(C_6H_4)_2{:}O$, 196.06. Wh.need.f.al. **m.p.** 174, **b.p.** 351. **Soly.** sl.s.h.w.; 0.55c., 6.71h.al.; sl.s.et.; sl.s.bz., lgr.
87 —, **1, 7-dihydroxy-.** See *Euxanthone.*
88 —, **1, 7-dihydroxy-3-methoxy-.** See *Gentisin.*
89 **Xenylamine** (*p-biphenylamine; 4-aminobiphenyl; p-phenylaniline*). $C_6H_5C_6H_4NH_2$, 169.09. Col.leaf.f.dil. al. **D.** 1.160^{20}_{20}, **m.p.** 53, **b.p.** 302. **Soly.** sl.s.c.w.; $44.18^{19.5}$al.; v.s.et.; $58^{19.5}$me.al.; s.chl.
90 **Xenyl isothiocyanate, Xenyl mustard oil.** See *Isothiocyanic acid, xenyl ester.*
91 **Xylene, musk.** See *Benzene*, 1-*tert-butyl*-3, 5-*dimethyl*-2, 4, 6-*trinitro-*.
92 ***o*-Xylene** (*1, 2-dimethylbenzene**). $C_6H_4(CH_3)_2$, 106.08. Col.liq., n $1.50777^{15.5}$. **D.** 0.8745^{20}_{4}, **m.p.** −29 (−27.1), **b.p.** 144. **Soly.** i.w.; v.s.al.; v.s.et.
93 —, ***α*-bromo-** (*o-xylyl bromide; ω-bromo-o-xylene*). $CH_3C_6H_4CH_2Br$, 184.99. Pr. **D.** 1.381^{23}_{4}, **m.p.** 21 **b.p.** 217.7. **Soly.** i.w.; s.al.; v.s.et.

* Name approved by the International Union of Chemistry.

94 ***o*-Xylene, 4-bromo-** (*as-bromo-o-xylene*). $BrC_6H_3(CH_3)_2$, 184.99. Liq. **m.p.** −2, **b.p.** 214. **Soly.** i.w.; v.s.al.; v.s.et.

95 —, ***α*-chloro-** (*o-xylyl chloride; ω-chloro-o-xylene; o-tolyl chloride* (incorrect)). $CH_3C_6H_4CH_2Cl$, 140.53. Liq. **b.p.** 199. **Soly.** i.w.; ∞al.; ∞et.

96 —, ***α, α'*-dibromo-** (*o-xylylene bromide; o-xylylene dibromide; ω, ω'-dibromo-o-xylene*). $C_6H_4(CH_2Br)_2$, 263.89. Rhomb.cr.f.chl. **D.** 1.988. **m.p.** 95, **b.p.** d. **Soly.** i.w.; v.s.al.; 20 et.

97 —, ***α, α'*-dichloro-** (*o-xylylene (di-) chloride; ω, ω'-dichloro-o-xylene*). $C_6H_4(CH_2Cl)_2$, 174.98. Monocl.f.pet.eth. **D.** 1.393$^{0}_{4}$, **m.p.** 55, **b.p.** 241. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.chl.

98 —, **dihydro-.** See *Cantharene.*

99 —, **3, 5-dihydroxy-.** See *Resorcinol*, 4, 5-*dimethyl-.*

00 —, **3, 6-dihydroxy-.** See *Hydroquinone*, 2, 3-*dimethyl-.*

01 —, **3, 4-dinitro-** (1, 2-*dimethyl*-3, 4-*dinitrobenzene*). $(NO_2)_2C_6H_2(CH_3)_2$, 196.08. Need.f.al. **m.p.** 82, **b.p.** exp. 413. **Soly.** sl.s.al.; v.s.et.; s.chl., CS_2, bz.

02 —, **3, 5-dinitro-** (1, 2-*dimethyl*-3, 5-*dinitrobenzene*). $(NO_2)_2C_6H_2(CH_3)_2$, 196.08. Yel.need.f.al. **m.p.** 75–6. **Soly.** s.al.; v.s.bz., chl.; s.acet.

03 —, **3, 6-dinitro-** (2, 3-*dimethyl*-1, 4-*dinitrobenzene*). $(NO_2)_2C_6H_2(CH_3)_2$, 196.08. Col.cr.f.al. **m.p.** 89–90(56). **Soly.** v.sl.s.w.; s.al.; s.et.; s.chl., acet., bz.

04 —, **4, 5-dinitro-** (1, 2-*dimethyl*-4, 5-*dinitrobenzene*). $(NO_2)_2C_6H_2(CH_3)_2$, 196.08. Need.f.al. **m.p.** 115–6. **Soly.** v.sl.s.h.w.; v.sl.s.al.; s.et.; s.chl., CS_2, acet., bz.; sl.s.pet.eth.

05 —, **4-ethyl-** (4-*ethyl*-1, 2-*dimethylbenzene**). $(CH_3)_2C_6H_3C_2H_5$, 134.11. Liq. **D.** 0.869$^{20}_{4}$, **m.p.** < −20, **b.p.** 189 (183–4). **Soly.** i.w.; v.s.al.; s.et.

06 —, **3-nitro-.** $NO_2C_6H_3(CH_3)_2$, 151.08. Liq. or need.f.al. **D.** 1.147^{15}, **m.p.** 7–9, **b.p.** 245(250.8). **Soly.** i.w.; s.al.

07 —, **4-nitro-.** $NO_2C_6H_3(CH_3)_2$, 151.08. Yel.pr.f.al. **D.** 1.139^{30}, **m.p.** 30, **b.p.** 258. **Soly.** i.w.; ∞al.; s.et.

08 ***m*-Xylene** (1, 3-*dimethylbenzene**). $C_6H_4(CH_3)_2$, 106.08. Col.liq., n 1.49962$^{14.85}$. **D.** 0.8684^{15}; 0.8641$^{20}_{4}$, **m.p.** −53.6(−47.4), **b.p.** 138.8. **Soly.** i.w.; v.s.al.; v.s.et.

09 —, ***α*-bromo-** (*m-xylyl bromide; ω-bromo-m-xylene*). $CH_3C_6H_4CH_2Br$, 184.99. Liq. **D.** 1.371^{23}, **b.p.** 215.8 sl.d. **Soly.** i.w.; v.s.al.; v.s.et.

10 —, **4-bromo-** (*as-bromo-m-xylene*). $BrC_6H_3(CH_3)_2$, 184.99. Liq. **b.p.** 203. **Soly.** i.w.; v.s.al.; v.s.et.

11 —, ***α*-chloro-** (*m-xylyl chloride, ω-chloro-m-xylene; m-tolyl chloride* (incorrect)). $CH_3C_6H_4CH_2Cl$, 140.53. Liq. **D.** 1.064^{20}, **b.p.** 196. **Soly.** i.w.; ∞al.; ∞et.

12 —, **4, 6-dibromo-** (4. 6-*dibromo*-1,3-*dimethylbenzene*). $C_6H_2Br_2(CH_3)_2$, 263.89. Cr. **m.p.** 69–72, **b.p.** 255–6. **Soly.** i.w.; sl.s.c., s.h.al.

13 —, ***α, α*-dichloro-** (*m-xylylene (di-) chloride; ω, ω'-dichloro-m-xylene*). $C_6H_4(CH_2Cl)_2$, 174.98. Col.cr. **D.** 1.302$^{20}_{4}$, **m.p.** 34.2, **b.p.** 255. **Soly.** i.w.; v.s.al.; v.s.et.

14 —, **2, 4-dihydroxy-.** See *Resorcinol*, 2, 4-*dimethyl-.*

15 —, **2, 5-dihydroxy-.** See *Hydroquinone*, 2, 6-*dimethyl-.*

16 —, **4, 6-dihydroxy-.** See *Resorcinol*, 4, 6-*dimethyl-.*

17 —, **2, 5-dinitro-** (1, 3-*dimethyl*-2, 5-*dinitrobenzene**). $(NO_2)_2C_6H_2(CH_3)_2$, 196.08. Ylsh.cr.f.al. **m.p.** 101. **Soly.** s.al.; s.et.; s.CS_2, chl., bz.

18 —, **4-ethyl-** (1-*ethyl*-2, 4-*dimethylbenzene**). $(CH_3)_2C_6H_3C_2H_5$, 134.11. Col.liq. **D.** 0.8686$^{20}_{4}$, **m.p.** < −20, **b.p.** 185–6. **Soly.** i.w.; v.s.al.; s.et.

19 —, **5-ethyl-** (1-*ethyl*-3, 5-*dimethylbenzene**). $(CH_3)_2C_6H_3C_2H_5$, 134.11. Col.liq. **D.** 0.861^{20}, **m.p.** <20, **b.p.** 185. **Soly.** i.w.; s.al.; s.et.

20 —, **hexahydro-.** See *Cyclohexane*, 1, 3-*dimethyl-.*

21 —, **2-nitro-.** $NO_2C_6H_3(CH_3)_2$, 151.08. Liq. **D.** 1.112^{15}, **m.p.** 13, **b.p.** 225. **Soly.** i.w.

22 —, **4-nitro-.** $NO_2C_6H_3(CH_3)_2$, 151.08. Liq. **D.** 1.135^{15}, **m.p.** 2, **b.p.** 244. **Soly.** i.w.; s.al.; s.et.

23 —, **5-nitro-.** $NO_2C_6H_3(CH_3)_2$, 151.08. Col.need.f.al. **m.p.** 71, **b.p.** 273.7. **Soly.** i.w.; v.s.al.; v.s.et.

24 —, **2, 4, 6-trinitro-.** $(NO_2)_3C_6H(CH_3)_2$, 241.08. Rhomb.need.f.al. + bz. **D.** 1.604^{19}, **m.p.** 181.5. **Soly.** i.w.; 0.039c.al.; sl.s.et.

25 ***p*-Xylene** (1, 4-*dimethylbenzene**). $C_6H_4(CH_3)_2$, 106.08. Col.monocl. or liq. n 1.49734$^{16.2}$. **D.** 0.8612$^{20}_{4}$. **m.p.** 15–6(11–2), **b.p.** 138. **Soly.** i.w.; v.s.al.; v.s.et.

26 ***p*-Xylene, α-bromo-** (*p-xylyl bromide; ω-bromo-p-xylene*). $CH_3C_6H_4CH_2Br$, 184.99. Need.f.al. **D.** 1.3237^{20}_{4}, **m.p.** 38(34–5.5), **b.p.** 220.7. **Soly.** i.w.; v.s.al.; v.s.et.; v.s.chl.

27 —, **2-bromo-** (*eso-bromo-p-xylene*). $BrC_6H_3(CH_3)_2$, 184.99. Liq. **m.p.** 9, **b.p.** 200. **Soly.** i.w.; v.s.al.; v.s.et.

28 —, **α-chloro-** (*p-xylyl chloride; ω-chloro-p-xylene; p-tolyl chloride* (incorrect)). $CH_3C_6H_4CH_2Cl$, 140.53. Oil. **b.p.** 202. **Soly.** i.w.; ∞al.; ∞et.

29 —, **α, α′-dibromo-** (*p-xylylene bromide; p-xylylene dibromide*). $C_6H_4(CH_2Br)_2$, 263.89. Monocl.f.bz. **D.** 2.012^{0}, **m.p.** 143.5, **b.p.** 245. **Soly.** i.w.; v.s.al.; 2.65^{20}et.; s.h.chl.

30 —, **α, α′-dichloro-** (*p-xylylene (di-) chloride; ω, ω′-dichloro-p-xylene*). $C_6H_4(CH_2Cl)_2$, 174.98. Monocl.pl. or leaf. **D.** 1.417^{0}, **m.p.** 100.5, **b.p.** 240–50. **Soly.** i.w.; s.al.; v.s.et.

31 —, **2, 5-dihydroxy-.** See *Hydroquinone, 2, 5-dimethyl-*.

32 —, **2, 6-dihydroxy-.** See *Resorcinol*, 2, 5-*dimethyl-*.

33 —, **2, 3-dinitro-** (1, 4-*dimethyl*-2, 3-*dinitrobenzene*). $(NO_2)_2C_6H_2(CH_3)_2$, 196.08. Monocl.pr.f.al. **m.p.** 93. **Soly.** i.w.; s.h.al.; s.et.; s.chl., acet., bz.

34 —, **2, 5-dinitro-** (1, 4-*dimethyl*-2, 5-*dinitrobenzene*). $(NO_2)_2C_6H_2(CH_3)_2$, 196.08. Yel.need.f.al. **m.p.** 147. **Soly.** i.w.; s.h.al.; s.h.et.; s.bz., acet.

35 —, **2, 6-dinitro-** (2, 5-*dimethyl*-1, 3-*dinitrobenzene*). $(NO_2)_2C_6H_2(CH_3)_2$, 196.08. Need.f.al. **m.p.** 123–4. **Soly.** i.w.; sl.s.al.; s.et.

36 —, **2-ethyl-** (2-*ethyl*-1, 4-*dimethylbenzene**). $(CH_3)_2C_6H_3C_2H_5$, 134.11. Liq. **D.** 0.875^{22}, **m.p.** <-20, **b.p.** 185. **Soly.** i.w.; sl.s.al.; s.et.

37 —, **hexahydro-.** See *Cyclohexane*, 1, 4-*dimethyl-*.

38 —, **2-nitro-.** $NO_2C_6H_3(CH_3)_2$, 151.08. Ylsh.liq. **D.** 1.132^{15}, **b.p.** 239.9. **Soly.** i.w.; s.al.; s.et.

39 —, **2, 3, 5-trinitro-.** $(NO_2)_3C_6H(CH_3)_2$, 241.08. Col.monocl.need.f.al. **D.** 1.59^{19}, **m.p.** 140, **b.p.** exp. 410. **Soly.** v.sl.s.w.; s.h.al.; sl.s.et.

40 *α, α′*-**Xylenediol.** See *Xylylene glycol*.

41 ***o*-Xylene-4-sulfonic acid** (3, 4-*xylenesulfonic acid*). $(CH_3)_2C_6H_3SO_3H$, 186.14. Pl.f.dil.H_2SO_4. **m.p.** d. **Soly.** s.w.

42 **2, 3-Xylenol** (2, 3-*dimethylphenol; vic-o-xylenol*). $(CH_3)_2C_6H_3OH$, 122.08. Lng.need.f.w. **m.p.** 75, **b.p.** 218. **Soly.** s.w.; s.al.

43 **2, 4-Xylenol** (2, 4-*dimethylphenol; as-m-xylenol*). $(CH_3)_2C_6H_3OH$, 122.08. Col.need. **D.** 1.036^{20}_{4}, **m.p.** 26, **b.p.** 211.5. **Soly.** v.sl.s.w.; ∞al.; ∞et.

44 **2, 5-Xylenol** (2, 5-*dimethylphenol; p-xylenol*). $(CH_3)_2C_6H_3OH$, 122.08. Col. monocl.f.al. + et. **D.** 1.169^{14}_{4}, **m.p.** 74.5, **b.p.** 211.5. **Soly.** s.w.; s.al.; v.s.et.

45 **2, 6-Xylenol** (2, 6-*dimethylphenol, vic-m-xylenol*). $(CH_3)_2C_6H_3OH$, 122.08. Col.leaf. **m.p.** 49, **b.p.** 212. **Soly.** s.h.w.; s.al.

46 **3, 4-Xylenol** (3, 4-*dimethylphenol; as-o-xylenol*). $(CH_3)_2C_6H_3OH$, 122.08. Need.f.w. **D.** 1.023^{17}_{17}, **m.p.** 65, **b.p.** 225. **Soly.** s.w.; s.al.; ∞et.

47 **3, 5-Xylenol** (3, 5-*dimethylphenol; sym-m-xylenol*). $(CH_3)_2C_6H_3OH$, 122.08. Need.f.w. **m.p.** 68(64), **b.p.** 219.5. **Soly.** sl.s.w.; s.al.; s.NaOH.

48 ***vic-o*-Xylic acid.** See *Hemellitic acid*.

49 ***sym-m*-Xylic acid.** See *Mesitylenic acid*.

50 ***p*-Xylic acid.** See *Isoxylic acid*.

51 **2, 3-Xylic acid.** See *Hemellitic acid*.

52 **2, 4-Xylic acid** (2, 4-*dimethylbenzoic acid; as-m-xylic acid*). $(CH_3)_2C_6H_3COOH$, 150.08. Col.monocl. **m.p.** 126, **b.p.** 268. **Soly.** v.sl.s.h.w.; v.s.h.al.; s.et.; s.bz., acet., chl., tol.

53 **2, 5-Xylic acid.** See *Isoxylic acid*.

54 **2, 6-Xylic acid** (2, 6-*dimethylbenzoic acid; vic-m-xylic acid*). $(CH_3)_2C_6H_3COOH$, 150.08. Col.need.f.lgr. **m.p.** 116, **b.p.** 274.5. **Soly.** sl.s.w.; s.al.; v.s.et.

55 **3, 4-Xylic acid** (3, 4-*dimethylbenzoic acid; as-o-xylic acid; paraxylic acid*). $(CH_3)_2C_6H_3COOH$, 150.08. Col.pr.f. al. **m.p.** 165–6, **b.p.** subl. **Soly.** sl.s.h.w.; s.al.; s.et.; s.bz.

56 **3, 5-Xylic acid.** See *Mesitylenic acid*.

57 **2, 3-Xylidine** (2, 3-*dimethylaniline; vic-o-xylidine*). $(CH_3)_2C_6H_3NH_2$, 121.09. Liq., *n* 1.570. **D.** 0.991^{15}, **m.p.** <-15, **b.p.** 223.8. **Soly.** v.sl.s.w.; v.s.al.; v.s.et.

58 **2, 4-Xylidine** (2, 4-*dimethylaniline; as-m-xylidine*). $(CH_3)_2C_6H_3NH_2$, 121.09. Liq., *n* 1.559. **D.** 0.974^{20}_{4}; 0.9761^{15}_{4}, **b.p.** 216. **Soly.** v.sl.s.w.; s.al.; s.et.; s.bz.

* Name approved by the International Union of Chemistry.

59 **2, 5-Xylidine** (2, 5-*dimethylaniline; p-xylidine*). $(CH_3)_2C_6H_3NH_2$, 121.09. Oil. **D.** 0.980^{15}, **m.p.** 15.5, **b.p.** 217. **Soly.** v.sl.s.w.; 0.980al.; s.et.

60 **2, 6-Xylidine** (2, 6-*dimethylaniline; vic-m-xylidine*). $(CH_3)_2C_6H_3NH_2$, 121.09. Col.liq., *n* 1.561. **D.** 0.979, **b.p.** 216.9. **Soly.** i.w.; s.al.; s.et.

61 **3, 4-Xylidine** (3, 4-*dimethylaniline; as-o-xylidine*). $(CH_3)_2C_6H_3NH_2$, 121.09. Monocl.tab.f.lgr. **D.** 1.076, **m.p.** 49, **b.p.** 226. **Soly.** sl.s.w.; v.s.lgr.

62 **3, 5-Xylidine** (3, 5-*dimethylaniline; sym-m-xylidine*). $(CH_3)_2C_6H_3NH_2$, 121.09. Liq., *n* 1.558. **D.** 0.972^{20}_{4}; 0.9935^{0}, **b.p.** 221. **Soly.** sl.s.w.

63 ***p*-Xylohydroquinone.** See *Hydroquinone, 2, 5-dimethyl-*.

64 ***o*-Xyloquinone** (2, 3-*dimethylquinone*). $(CH_3)_2C_6H_2O_2$, 136.06. Yel.need. **m.p.** 55, **b.p.** subl. **Soly.** sl.s.w.; s.al.; s.et.

65 ***m*-Xyloquinone** (2, 6-*dimethylquinone*). $(CH_3)_2C_6H_2O_2$, 136.06. Yel.need. **m.p.** 73, **b.p.** subl.

66 ***p*-Xyloquinone.** See *Phlorone*.

67 ***m*-Xylorcinol.** See *Resorcinol*, 4,6-*dimethyl-*.

68 ***p*-Xylorcinol.** See *Resorcinol*, 2, 5-*dimethyl-*.

69 ***l*-Xylose** (*wood sugar*). $C_5H_{10}O_5$, 150.08. Wh.rhomb.need., *n* 1.517, 1.544, 1.546. **D.** 1.525^{20}_{4}; 1.535^{0}. **m.p.** 153(144). **Soly.** 117^{20}w.; 6.2^{20} 80 %al.; v.sl.s.et.

70 **Xylyl bromide.** See *Xylene, α-bromo-*.

71 **Xylyl chloride.** See *Xylene, α-chloro-*.

72 **Xylylene alcohol.** See *Xylylene glycol*.

73 **Xylylene bromide.** See *Xylene, α, α′-dibromo-*.

74 **Xylylene chloride.** See *Xylene, α, α′-dichloro-*.

75 **Xylylene cyanide.** See *Benzenediacetonitrile*.

76 ***o*-Xylylene glycol** (*α, α′-o-xylenediol; 1, 2-benzenedicarbinol; o-xylylene alcohol; phthalyl alcohol*). $C_6H_4(CH_2OH)_2$, 138.08. Pl.f.et. **m.p.** 62.0–4.8. **Soly.** s.w.; s.al.; 17.9et.

77 ***m*-Xylylene glycol** (*α, α′-m-xylenediol; 1, 3-benzenedicarbinol; m-xylylene alcohol*). $C_6H_4(CH_2OH)_2$, 138.08. Col. cr.f.bz. **D.** 1.161^{18}, **m.p.** 46–7. **Soly.** v.s.w.; s.et.

78 ***p*-Xylylene glycol** (*α, α′-p-xylenediol; 1, 4-benzenedicarbinol; p-xylylene alcohol*). $C_6H_4(CH_2OH)_2$, 138.08. Need. **m.p.** 112–3. **Soly.** v.s.w.; v.s.al.; v.s.et.

79 **Yara-yara.** See *Ether, methyl 2-naphthyl*.

80 **Yellow cross liquid.** See *Sulfide, β, β′-dichloroethyl*.

81 **Yohimbine** (*corynine*). $C_{21}H_{26}N_2O_3$, 354.22. Col.need.f.w. + al. **m.p.** 248 (231). **Soly.** v.sl.s.w.; v.s.al.; s.et.; s.chl., bz.

82 —, hydrochloride(*d*) (*corynine hydrochloride; aphrodine hydrochloride*). $C_{21}H_{26}N_2O_3 \cdot HCl$, 390.68. Col.cr. **m.p.** 295–300 d. **Soly.** s.w.

83 —, nitrate. $C_{21}H_{26}N_2O_3 \cdot HNO_3$, 417.23. Col.pr. **m.p.** 276.

85 **Yperite.** See *Sulfide, β, β′-dichloroethyl*.

86 **Zinc, diethyl-*** (*zinc ethyl; zinc diethyl*). $Zn(C_2H_5)_2$, 123.46. Col.liq. ign. in air. **D.** 1.182, **m.p.** −40 (−28), **b.p.** 117–8. **Soly.** d.w.; d.al.; s.et.

87 —, **dimethyl-*** (*zinc methyl; zinc methide*). $Zn(CH_3)_2$, 95.43. Col.liq. ign. **D** 1.386^{10}, **m.p.** −40, **b.p.** 46. **Soly.** d.w.; d.al.; ∞et.

88 **Zinc methide.** See *Zinc, dimethyl-**.

For explanations and abbreviations see beginning of table.

FORMULA INDEX OF ORGANIC COMPOUNDS

Numbers refer to compounds in the preceding table Physical Constants of Organic Compounds.

The arrangement of symbols in formulas is alphabetical except that C always comes first followed immediately by H if hydrogen is present. The arrangement of formulas is also alphabetical except that the number of atoms of any specific kind influences the order of compounds.

The numbers following any one formula are given in numerical order which is also the order of their occurrence in the table of physical constants.

C

$CAgNO$, 4062.
$CBrCl_3$, 5598.
$CBrN$, 2959.
CBr_3NO_2, 1983.
CBr_4, 2586.
$CClN$, 2960.
CCl_2F_2, 5617.
CCl_2O, 6876.
CCl_2S, 6878.
CCl_3F, 5683.
CCl_3NO_2, 2687.
CCl_4, 2587.
CCl_4S, 5756.
$CHBr_3$, 1981.
$CHCl_2F$, 5619.
$CHCl_3$, 2679.
CHF_3, 3993.
CHI_3, 4898.
CHN, 4783.
$CHNO$, 2952.
$CHNS$, 8185.
CHN_3O_6, 6151.
CH_2Br_2, 5743.
CH_2ClNO, 2428.
CH_2Cl_2, 5744.
CH_2I_2, 5747.
CH_2N_2, 2947, 5613.
$CH_2N_2O_3$, 4049.
$CH_2N_2O_4$, 5634.
CH_2N_4, 8163.
CH_2O, 3995.
$(CH_2O)_x$, 7050.
CH_2O_2, 4016.
CH_2S_3, 2579.
CH_3AsCl_2, 910.
CH_3AsO, 902.
CH_3Br, 5734.
CH_3Cl, 5738.
CH_3ClHg, 5544.
CH_3ClO_2S, 5713.
CH_3Cl_3Sn, 8319.
CH_3F, 5750.
CH_3I, 5752.
CH_3NO, 3999. 4003.
CH_3NO_2, 5661, 5759.
CH_3NO_3, 5758.
CH_3NS_2, 2415.
$CH_3N_3O_3$, 8755.
CH_4, 5584.
CH_4N_2O, 4004, 4048, 8711.
$CH_4N_2O_2$, 8747.
CH_4N_2S, 8768.
$CH_4N_4O_2$, 4399.
CH_4O, 5719.
CH_4O_2Si, 5710.
CH_4O_2Sn, 5711.
CH_4O_3S, 5712.
CH_4O_4S, 5769.
$CH_4O_6S_2$, 5722.
CH_4S, 5715.
CH_5As, 913.
CH_5AsO_3, 5701.
CH_5N, 5729.
CH_5NO, 4825, 5725.
CH_5N_3, 4391.
CH_5N_3O, 7880.
CH_5N_3S, 7884.
CH_5O_3P, 5709.
CH_5P, 6886.
CH_6ClN, 5730.
CH_6ClN_3O, 7881.
CH_6N_2, 4721.
CH_6N_4, 4392.
CH_6N_4O, 2558.
CH_6Si, 7895.
CIN, 2962.
CI_4, 2588.
$(CN)_x$, 6425.
CN_4O_8, 5675.
CO, 2583.
COS, 2590.
CO_2, 2563.
CS_2, 2565.

C_2

C_2Br_6, 3529.
$C_2Cl_2F_4$, 3511.
$C_2Cl_2O_2$, 6363.
$C_2Cl_3F_3$, 3556.
C_2Cl_4, 3862.
C_2Cl_4O, 324.
$C_2Cl_4O_2$, 3339.
C_2Cl_6, 3530.
C_2HBr, 333.
C_2HBr_3, 3866.
C_2HBr_3O, 1976.
$C_2HBr_3O_2$, 176.
C_2HBr_5, 3538.
C_2HCl, 336.
C_2HCl_3, 3867.
C_2HCl_3O, 323, 2665.
$C_2HCl_3O_2$, 177.
C_2HCl_5, 3539.
$C_2HI_3O_2$, 181.
C_2HI_5, 3541.
C_2HNO_2, 6382.
C_2H_2, 328.
$C_2H_2Br_2$, 3821.
$C_2H_2Br_2O$, 320.
$C_2H_2Br_2O_2$, 133.
$C_2H_2Br_4$, 3546, 3547.
$C_2H_2Cl_2$, 3822, 3823.
$C_2H_2Cl_2O$, 18, 322.
$C_2H_2Cl_2O_2$, 135.
$C_2H_2Cl_3NO$, 49.
$C_2H_2Cl_4$, 3548, 3549.
$C_2H_2I_2O_2$, 139.
$C_2H_2N_4$, 8161.
C_2H_2O, 5175.
$C_2H_2O_2$, 4363.
$C_2H_2O_3$, 4373.
$C_2H_2O_4 \cdot 2H_2O$, 6343.
C_2H_3Br, 8860.
C_2H_3BrO, 319.
$C_2H_3BrO_2$, 119.
$C_2H_3Br_3$, 3552.
$C_2H_3Br_3O_2$, 1977.
C_2H_3Cl, 8861.
C_2H_3ClO, 321.
$C_2H_3ClO_2$, 123, 4042.
$C_2H_3Cl_2NO$, 36.
$C_2H_3Cl_3$, 3553, 3555.
$C_2H_3Cl_3O$, 3633.
$C_2H_3Cl_3O_2$, 2668.
C_2H_3FO, 356.
C_2H_3I, 8864.
C_2H_3IO, 357.
$C_2H_3IO_2$, 154.
$C_2H_3I_3$, 3558.
C_2H_3N, 250, 5754.
$C_2H_3NO_3$, 6365.
C_2H_3NS, 5135, 8197.
$C_2H_3N_3$, 8563.
C_2H_4, 3809.
C_2H_4BrCl, 3495.
C_2H_4BrNO, 33.
$C_2H_4Br_2$, 3505, 3871.
C_2H_4ClNO, 34.
$C_2H_4Cl_2$, 3507, 3874.
$C_2H_4Cl_2O$, 3607, 3670.
$C_2H_4I_2$, 3513. 3894.
$C_2H_4N_2O_2$, 4370, 6371.
$C_2H_4N_2O_3$, 262.
$C_2H_4N_2O_4$, 3516, 4303.
$C_2H_4N_2O_6$, 4302.
$C_2H_4N_4$, 4394.
$C_2H_4N_4O_2$, 985, 8701.
C_2H_4O, 10, 3899, 8858.
$(C_2H_4O)_x$, 5575.
C_2H_4OS, 173.
$C_2H_4O_2$, 86, 4031, 4343.
$C_2H_4O_2S$, 160.
$C_2H_4O_3$, 4346.
$C_2H_4O_5S$, 171.
$C_2H_4O_6S_2$, 3781.
C_2H_5Br, 3804.
C_2H_5BrO, 3601.
C_2H_5Cl, 3806.
C_2H_5ClHg, 5543.
C_2H_5ClO, 3605, 3691.

FORMULA INDEX OF ORGANIC COMPOUNDS
(Continued)

$C_2H_5ClO_2S$, 3583.
C_2H_5F, 3903.
C_2H_5I, 3912.
C_2H_5N, 3901, 8859.
C_2H_5NO, 14, 31.
$C_2H_5NO_2$, 2398, 3537, 3918, 4269, 4344.
$C_2H_5NO_3$, 3627, 3917.
C_2H_5NS, 47.
$C_2H_5N_3O_2 \cdot H_2O$, 1927.
C_2H_5NaS, 3587.
C_2H_6, 3488.
C_2H_6AsCl, 2276.
$C_2H_6AsCl_3$, 2281.
$C_2H_6N_2$, 50.
$C_2H_6N_2O$, 3282, 8753.
$C_2H_6N_2O_2$, 3281.
$C_2H_6N_2S$, 8754.
$C_2H_6N_4O$, 8746.
C_2H_6O, 3785, 5749.
$C_2H_6O_2$, 4290.
$C_2H_6O_2S$, 3579.
$C_2H_6O_3S$, 3580, 5767.
$C_2H_6O_4S$, 3936, 4922, 5764.
$C_2H_6O_6S_2$, 3575.
C_2H_6S, 3586, 5766.
$C_2H_6S_2$, 3576, 5741.
C_2H_6Se, 5763.
C_2H_6Te, 5770.
C_2H_6Zn, 8987.
C_2H_7As, 911, 912.
$C_2H_7AsO_2$, 2278.
$C_2H_7BO_2$, 1936.
C_2H_7N, 3276, 3787.
C_2H_7NO, 27, 3598, 3783, 4823.
$C_2H_7NO_3S$, 8109.
$C_2H_7N_5$, 1821.
$C_2H_7O_2P$, 6893.
C_2H_7P, 6883, 6884.
C_2H_8BrN, 3788.
C_2H_8ClN, 3278, 3789.
$C_2H_8N_2$, 3879, 4713.
$C_2H_8N_2 \cdot H_2O$, 3880.
C_2H_8Si, 7892.
$C_2H_{10}Cl_2N_2$, 3881.
C_2I_4, 3863.
C_2N_2, 2958.
C_2N_2S, 8191.
$C_2N_4O_6$, 260.

C_3

$C_3Cl_3N_3$, 2968.
$C_3H_2Cl_4O \cdot 2H_2O$, 7206.
$C_3H_2N_2$, 5469.
$C_3H_2N_2O_3$, 6419.
C_3H_2O, 7257.
$C_3H_2O_2$, 7258.
$C_3H_2O_5$, 5567.
C_3H_3Br, 7373.
$C_3H_3BrO_4$, 5435.
C_3H_3Cl, 7374.
$C_3H_3ClO_2$, 389, 390.
$C_3H_3ClO_4$, 5439.
$C_3H_3Cl_3O_2$, 179.
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$C_8H_{20}Si$, 7896.
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CONSTANTS OF VEGETABLE AND ANIMAL

No.	Common name	Scientific name	Class†
1	Almond	*Prunus amygdalus*	I
2	Beef marrow	*Adeps bovis*	IX
3	Beef tallow	*Adeps bovis*	IX
4	Beechnut	*Fagus sylvatica F. Americana*	V
5	Beeswax	*Apis mellifera*	XII
6	Black mustard	*Sinapis nigra*	II
7	Bone fat	*Sevum ossis*	IX
8	Butter fat	*Vaccae lactis adeps*	IX
9	Candlenut	*Aleurites moluccana*	VI
10	Candlenut	*Aleurites triloba*	VI
11	Carnauba wax	*Corypha cerifera*	XI
12	Castor	*Ricinus communis*	III
13	Chaulmoogra	*Taraktogenos Kurzii*	V
14	Chaulmoogra	U. S. P. 10th Revision	V
15	Chinese insect wax	*Coccus cerifera*	XII
16	Chinese vegetable tallow	*Stillingia sebifera*	VIII
17	Coconut	*Cocos butyracea, C. nucifera*	VIII
18	Cocoa butter (Cacao)	*Theobroma cacao*	VIII
19	Cod liver	*Gadus morrhua*	VII
20	Corn (maize)	*Zea mais*	V
21	Cotton seed	Species *Gossypium*	V
22	Cotton seed stearin	*Gossypium*	VIII
23	Croton	*Croton tiglium*	V
24	Goose fat	*Anser cinereus*	IX
25	Grape seed	*Vites vinefera*	III
26	Hazelnut	*Corylus avellana*	I
27	Hemp seed	*Cannabus sativa*	VI
28	Horse fat	*Equus caballus*	IX
29	Human fat		IX
30	Japan wax	*Rhus succedaneum*	VIII
31	Lard oil	*Oleum adipis*	IV
32	Lard oil (fatty tissue)	*Adeps*	IX
33	Laurel (bayberry)	*Laurus nobilis*	VIII
34	Linseed	*Linum usitatissimum*	VI
35	Menhaden	*Alosa menhaden (Brevortia tyrannus)*	VII
36	Mutton tallow	*Adeps ovis*	IX
37	Myrtle wax	*Myrica cerifera (M. Carolinensis)*	VIII
38	Neat's foot	*Oleum pedis bovis*	IV
39	Nutmeg butter (mace)	*Myristica officinalis*	VIII
40	Olive	*Olea Europaea sativa*	I
41	Palm	*Elaeis guineensis*	VIII
42	Palm kernel	*Elaeis guineensis* (W. Africa)	VIII
43	Palm kernel	*Elaeis guineensis* (S. America)	VIII
44	Peach kernel	*Amygdalus Persica*	I
45	Peanut	*Arachis hypogaea*	I
46	Poppy seed	*Papaver somniferum*	VI
47	Porpoise (body oil)	*Delphinus phocaena*	VII
48	Pumpkin seed	*Cucurbita pepo*	V
49	Rabbit fat	*Lepus cuniculus*	IX
50	Rape seed	*Brassica campestris*	II
51	Safflower	*Carthamus tinctorius*	VI
52	Seal	*Species Phoca*	VII
53	Sesame	*Sesamum indicum*	V

OILS, FATS AND WAXES

No.	Specific gravity at $\frac{15°}{15°}$ C.	Solidifying point °C.	Saponification value	Iodine value	Hehner's number
1	0.914–0.921	−15 to −20	183.3–207.6	93–103.4	96.0
2	0.9311–0.938	31 to 29	196–199.6	39–55.4	....
3	0.895	31 to 38	196–200	35.4–42.3	96–96.5
4	0.922	−17	191–196	97–111	95–96
5	0.961–0.968	60.5 to 62	88–96	8.8–10.7	....
6	0.915–0.919	−17	173–175	99–110	96
7	0.914–0.916	15 to 17	190–196	50–55	94–95
8	0.907–0.912$\frac{40°}{15°}$	19 to 24.5	210–230	26–28	87.6–89.6
9	0.925	<-18	189–195	163–164	95–96
10	0.927	<-18	202–204	139–143.8	....
11	0.995–0.999	80 to 87	79–84	13.5	....
12	0.960–0.967	−12 turbid; −17 to −18 solid	175–183	84	....
13	0.943–0.954	20 to 25	196–213	97.6–110.4	....
14	ca 0.950$^{25°}$	<25	196–213	98–104	....
15	0.809–0.811	80 to 81	80.4–91.7	1.4	....
16	0.918–0.922	24 to 34	179–206	23–40.5	95.3
17	0.926	14 to 22	253.4–262	6.2–10	82.3–90.5
18	0.964–0.974	21.5 to 27.3	192.8–195	32.8–41.7	94–95
19	0.922–0.931	−3	171–189	137–166	95.3
20	0.921–0.928	−10 to −20	187–193	111–128	93–95
21	0.917–0.918$\frac{25°}{25°}$	+12 to −13	194–196	103–111.3	95.7
22	0.9188–0.923	16 to 22	195	89–103	95.9
23	0.942–0.944	−8 to −18	193–215	108–109	89.0
24	0.923–0.930	22 to 24	191–193	58–67	94.5–95.3
25	0.917–0.933	−10 to −17	171–191	94.3–135	92
26	0.917	−17 to −18	191–197	87	95.5
27	0.928–0.934	−15 to −28	190–195	145–161.7	....
28	0.919–0.933	20 to 45	195–200	75–86	95–96
29	0.9179	15	193.3–199	64	....
30	0.970–0.980	40.5 to 46	206.6–237.5	4.9–12.8	90–91
31	0.913–0.915	+4 to −2	193–198	62.5–79	97
32	0.934–0.938	27.1 to 29.9	195–203	47–66.5	93–95
33	0.880$^{100°}$	24 to 25	198–199	68–80	....
34	0.930–0.938	−19 to −27	188–195	175–202	94.5–95.5
35	0.923–0.933	−5	189–192.9	148–185	......
36	0.937–0.953	36 to 41	195–196	48–61	95.5
37	0.995	39 to 43	205.5–211.7	3.9–9.5	92–94
38	0.913–0.918	−2 to +10	193–199	57.5–75	94.8–95.9
39	0.945–0.996	40 to 44	154–178	59.3–65	......
40	0.915–0.920	+2 turbid; −6 solid	185–196	79–88	95
41	0.924	....	200–205	49.2–58.9	94.5–97
42	0.866–0.873$^{100°}$	20 to 24	243–255	10.5–17.5	91–91.5
43	....	27.4	220.2–231.4	25.5–31.6	....
44	0.918–0.925	−20	191–193	92–99.7	94–96
45	0.917–0.926	3	186–194	88–98	95
46	0.924–0.926	−16 to −18	193–195	128–141	95.4
47	0.926	−16	203.4	126.9	68.4
48	0.923–0.925	−15	188–193	121–130	96
49	0.934–0.936	22 to 24	199–203	70–99.8	99.5
50	0.913–0.917	−10	168–179	94–105	94.5–96.3
51	0.925–0.928	−13 to −18	188–203	122–141	95
52	0.915–0.926	3	187.5–196.2	130–152	93–96
53	0.919$\frac{25°}{25°}$	−4 to −16	188–193	103–117	95

CONSTANTS OF VEGETABLE AND ANIMAL

No.	Common name	Maumene' number	Acid value	Acetyl value	Refractive index at 25° C.
1	Almond	51–53	0.5–3.5	9.6	1.4593–1.4646*
2	Beef marrow	.....	1.6	....	1.4628
3	Beef tallow	.....	0.25	2.7–8.6	....
4	Beechnut	.....	....	....	1.4698
5	Beeswax	.....	16.8–20.6	15.2	1.4538–1.4566*
6	Black mustard	43	5.7–7.3	....	1.4718
7	Bone fat	.....	....	11.3	....
8	Butter fat	.....	0.45–35.4	1.9–8.6	1.4555–1.4578*
9	Candlenut	.....	2	9.8	1.4760–1.4790
10	Candlenut	.....	....	....	1.4760–1.4790
11	Carnauba wax	.....	4–8	55.2	1.4672–1.4701*
12	Castor	46–47	0.12–0.8	146–150.5	1.4771
13	Chaulmoogra	.....	0.79–21.5	....	1.4777–1.4779
14	Chaulmoogra	.....	....	....	....
15	Chinese insect wax	.....	63	....	....
16	Chinese vegetable tallow	.....	2.4	....	1.4470–1.4579*
17	Coconut	21	2.5–10.0	2.3–6.9	1.4477–1.4495*
18	Cocoa butter (Cacao)	.....	1.1–1.9	1.97	1.4537–1.4580*
19	Cod liver	102–115	5.6	1.15	1.4758–1.4783
20	Corn (maize)	81–86	1.37–2.02	7.5–11.5	1.4733
21	Cotton seed	75–90	0.6–0.9	21–25	1.4743–1.4752 15°
22	Cotton seed stearin	.....	....	....	....
23	Croton	.....	27–30.9	19.8–38.6	1.4710*
24	Goose fat	.....	0.59	....	1.4583–1.4626*
25	Grape seed	53	0.75	13.5–14.5	1.4713–1.4725
26	Hazelnut	36	....	3.2	1.4667
27	Hemp seed	97	0.45	....	1.4740–1.4745*
28	Horse fat	.....	0–2.44	....	1.4618–1.4696*
29	Human fat	.....	....	....	1.459–1.4613*
30	Japan wax	.....	11–12	17.25–26.5	1.4560–1.4591*
31	Lard oil	41–45	1.56	....	1.4607*
32	Lard oil (fatty tissue)	.....	0.5–0.8	2.6	1.4609–1.4620
33	Laurel (bayberry)	.....	26.3	....	1.4783
34	Linseed	103–126	1–3.5	....	1.4797–1.4802
35	Menhaden	123–128	5–8	....	1.4787
36	Mutton tallow	.....	1.7–14	....	1.4545–1.4585*
37	Myrtle wax	.....	3–4.4	....	1.4511*
38	Neat's foot	43–49	0.1–0.6	7.7–9.3	1.4643–1.4685
39	Nutmeg butter (mace)	.....	17.2	....	1.4704*
40	Olive	41.5–47	0.3–1.0	10.5	1.4657–1.4667
41	Palm	.....	10	15.7	1.4603–1.4639*
42	Palm kernel	.....	5–22	7.6	1.4492–1.4543*
43	Palm kernel	.....	0.33–0.55	....	....
44	Peach kernel	42.5	1–1.5	6.5	1.4682–1.4701
45	Peanut	45–67	0.8	3.5	1.4620–1.4653*
46	Poppy seed	86–88	2.5	....	1.4739–1.4742
47	Porpoise (body oil)	50–61	1.2	....	1.4622–1.4625
48	Pumpkin seed	.....	....	....	1.4724–1.4739
49	Rabbit fat	.....	6.2–7.2	....	1.459*
50	Rape seed	51–64	0.36–1.0	14.75	1.4649–1.4659*
51	Safflower	.....	0.6	16.1	1.4769
52	Seal	.....	....	....	1.4742–1.4762
53	Sesame	65.5	9.8	....	1.4704–1.4717
54	Soja bean (Soya, Soy)	87–88	0.3–1.8	4.9	1.4723–1.4756

OILS, FATS AND WAXES (Continued)

No.	Reichert Meissl number	Unsaponifiable matter	Insoluble fatty acids: Melting point °C.	Insoluble fatty acids: Solidifying point °C.	Insoluble fatty acids: Iodine value	Insoluble fatty acids: Acid value
1	0.5	0.75	13–14	9.5–11.8	93.5–96.5	204
2	2.2	....	45–46	37.9–40	55.5	204.5
3	....	....	42.5–44	37.9–46.2	41.3	197.2
4	....	....	23–24	17	114	....
5	....	....	67.2	....	....	....
6	....	3.3	16–17	13.4–13.7	87–93	179.2
7	0.2–1.7	0.5–1.5	42.5–44	28	55.7–57.4	200
8	17.0–34.5	0.3–0.45	38–41	33–39	28–31	210–220
9	1.2	0.5–0.9	20–21	13	185.7	....
10	....	....	....	17.8	....	....
11	....	54–55	85	....	....	....
12	1.4	0.6	13	3	86.6–88.3	192.1
13	....	....	....	....	....	....
14	....	....	....	....	....	....
15	....	....	92.2	....	....	....
16	0.2–0.9	....	39–57	45.2–47.2; 50.9–52.5	34.2	182–208.5
17	6.6–7.5	0.2	24–27	21.2–25.2	8.4–8.8	258
18	0.3–1	....	48–53	47.2–49.2	32.6–39	190
19	0.2	0.54–2.68	21.8–38	17.5–24.3	164–171	204–207
20	4.3	1.5–2.8	17–20	14–16	113–125	198.4
21	0.95	1.1	34.5	32–35	111–115	201.6–203.9
22	....	....	27–30	35.1	94	....
23	12–13.6	0.55	....	17–19	111–112	201
24	0.2–0.98	....	36.6–40	31–34	65.3	202.4
25	0.46	1.6	23–25	18–20	99–132	187.4
26	0.99	0.5	22–25	19–20	87.5–90.1	200.6
27	....	1.08	17–21	15.6–16.6	141	....
28	1.64–2.14	....	31.3–53.4	37.7	83.9–87.1	202.6
29	0.25–0.55	....	35.5	30.5	64	....
30	....	1.1–1.6	54.5–59.6	53–56.5	....	213.7
31	....	0.6	33–38.4	27–33	....	....
32	....	....	37–46.6	36–42.4	....	....
33	1.6	....	....	....	81.6–82	....
34	0.95	0.4–1.2	20–24	16–20.6	179–209.8	196–198.8
35	1.2	0.6–1.43	....	....	....	....
36	....	....	33.5–49	40–48.5	34.8	198
37	0.5	....	47–48	46	....	230.9
38	0.9–1.2	0.12–0.65	29–41	16–26.5	62–77	201.2–206.3
39	1.1–4.2	....	42.5	40–45	31.6	....
40	0.6–1.5	0.4–1.0	26–30	16.9–26.4	86–90	193
41	0.9–1.9	....	50	42.5–45.5	53.3	204–207
42	5–6.8	....	25–28.5	20–25.5	12	251–265
43	....	....	....	....	....	....
44	....	....	10–18.9	13–13.5	94.1–101.9	205–209.9
45	0.4	0.5–0.9	....	30.5–39	95.5–103.4	201.6
46	0.6	0.43	20.5	17–19	139	199
47	46.9	16–17	....	....	126	207
48	4.45	....	26.5–29.8	26–28	....	....
49	0.7–2.8	....	39–50	35–41	64.4–101.1	210–218
50	0–0.79	1.48	18.5–20	11.7–13.6	100–106	....
51	0–0.2	....	11–17	7–12	132.5–148.2	199
52	0.2	0.3–1.0	22–23	13–17	186.5–201.8	190.4–198
53	1.1–1.2	0.95–1.32	25–35	23–32	109–112	196–201.6
54	0.5–2.8	1.27–1.54	26.2–27.5	21.2	122	....

CONSTANTS OF VEGETABLE AND ANIMAL

No.	Common name	Scientific name	Class†
1	Soja bean (Soya, Soy)	*Soja hispida* (*Dolichos hispida*)	V
2	Sperm	*Physeter macrocephalus*	X
3	Spermaceti	*Cetacea Oils*	XII
4	Sunflower	*Helianthus annus*	VI
5	Tung (China wood)	*Aleurites Fordii*	VI
6	Tung (China wood)	*Aleurites montana*	VI
7	Walnut	*Juglans regia*	VI
8	Whale	*Balaena mysticetus*	VII
9	White mustard seed	*Sinapis alba*	II
10	Wool fat	*Adeps lanae*	XII

† Class I, Non-drying vegetable oil of the olive oil type; Class II, non-drying vegetable oil of the rape oil type; Class III, non-drying vegetable oil of the castor oil type; Class IV, non-drying animal oil; Class V, semi-drying vegetable oil; Class VI, drying vegetable oil; Class VII, fish and marine animal oil; Class VIII, vegetable fat; Class IX, animal fat; Class X, sperm oil; Class XI, vegetable non-glyceridic wax; Class XII, animal wax.

No.	Common name	Maumene' number	Acid value	Acetyl value	Refractive index at 25° C.
1	Sperm	51	13.2	4.5–6.4	1.4573
2	Spermaceti	.....	0.5–2.8	2.6	....
3	Sunflower	72	11.2	....	1.4659–1.4721*
4	Tung (China wood)	.....	2	....	1.515–1.520
5	Tung (China wood)	.....	2	....	1.515–1.520
6	Walnut	96–110	2.5	....	1.4770
7	Whale	85–92	1.9	11–23	1.4679–1.4724
8	White mustard seed	44–49	5.4	....	1.4649
9	Wool fat	.....	59.8	23	1.4784–1.4822*

* Refractive index at 40° C

OILS, FATS AND WAXES (Continued)

No.	Specific gravity at $\frac{15°}{15°}$ C.	Solidifying point °C.	Saponification value	Iodine value	Hehner's number
1	0.924–0.927	−10 to −16	189–193.5	122–134	93–94.5
2	0.878–0.884	15.5	120–137	80–84	....
3	0.905–0.945	42 to 49	126–135	3.5–9.3	....
4	0.924–0.926	−17	188–193	129–136	95
5	0.939–0.949	2 to 3	190–197	163–171	96.2
6	0.925	....	189–195	163–164	95–96
7	0.925–0.927	−27.5	190.1–197	139–150	93.4–95.4
8	0.917–0.924	0 to −2	160–202	90–146	93–95
9	0.912–0.916	−8 to −16	171–174	94–98.4	96–97
10	0.970–0.973	....	82–130	17–29	....

No.	Reichert Meissl number	Unsaponifiable matter	Insoluble fatty acids			
			Melting point °C.	Solidifying point °C.	Iodine value	Acid value
1	....	39–42	13.4	16.1	88–99	23.6
2	....	51.5	....	....	....	....
3	0.5	0.31	22–24	18–19.8	124–134	201.6
4	1.10	0.4–0.8	40–43.8	31.2–37	145–159.4	188.8
5	0.35	0.4–0.8	....	....	....	....
6	0.92	0.5–1.0	15–20	14.3	150	....
7	14	1–4	14–27	10–24	130.3–132	....
8	....	....	15–16	9–10	94.7–110.4	181–185.8
9	8	39–44	41.8	40	17	....

PHYSICAL AND CHEMICAL CONSTANTS OF

The following abbreviations are used: Class I, Resins; Class II, Oleo-acid; al, alcohol; bz, benzene; chl., chloroform; eth., ether; eth. acet., ethyl oil of turpentine; p. sol., partly soluble; sol., soluble; sl. sol., slightly soluble;

Name	Class	Specific Gravity	Melting Point °C.	Saponification No.	Iodine No.	Acid No.
Amber	I	1.05–1.10	250–325	85–150	62	15–35
Ammoniacum	III	1.2	.....	160–77	....	100–6
Anime (East Indian)	I	1.03	230–40	60–90	128–37	18–27
Anime (West Indian)	I	....	.....	150–60	....	45–7
Benzoin	I	1.2	75–100	155–270	....	90–190
Canada Balsam	II	....	.....	90–6	....	80–90
Caoutchouc	I	....	.....	.....	71	81
Colophony	I	1.07–.09	120–50	150–200	112–7	150–80
Copaiba (Para)	II	0.9–1.0	.....	.....	....	30–68
Copaiba (Maracaibo)	II	0.9–1.0	.....	.....	....	79–91
Copaiba (Maranham)	II	0.9–1.0	.....	.....	....	72–90
Copal (Benin)	I	1.06–.08	120–66	125–150	61	100–34
Copal (Loango)	I	....	.....	126–34	....	106–15
Copal (Sierra Leone)	I	....	.....	146–50	....	109–14
Copal (Manilla)	I	....	.....	178	....	128
Dammar	I	1.00–.05	95–190	20–65	....	18–60
Dragon's Blood	I	1.2	120	150–60	....	....
Elemi	....	1.02–.08	75–120	25–45	....	18–25
Galbanum	III	1.11–.13	.....	75–225	....	5–65
Guaiacum	I	1.2	85–90	.....	....	70–80
Jalap	I	1.14–.15	150	.....	....	12–25
Mastic	I	1.04–.07	105–20	82–92	64	50–71
Myrrh	III	1.12–.28	.....	160–200	....	59–72
Olibanum	III	1.2	.....	65–120	....	45–88
Sandarac	I	1.04	135–50	143	....	140–55
Shellac	I	1.08–.13	.....	194–213	....	48–64
Storax	I	1.12	.....	130–230	....	35–175
Tolu	II	1.1	.....	154–220	....	112–68
Turpentine (Common)	II	....	.....	100–75	....	110–50
Turpentine (Larch)	II	1.1–1.2	.....	75–125	....	75–100

RESINS, OLEO-RESINS AND GUM-RESINS

Resins; Class III, Gum-Resins; a, acid; acet., acetone; acet. a., glacial acetic acetate; insol., insoluble; lgr., ligroin; meth. al., methyl alcohol; oil turp., w., water.

Ester No.	% Volatile at 100° C.	% Ash	Solubility
71–91	.....	0.3	p. sol. in CS_2, oil turp; sl. sol. in al., meth. al., amyl al., bz., eth; insol. in acet. a., acet., chl.
60–70	2–15	2–7	p. sol. w., al., eth.
47–62	.....	......	
100–15	.....	0.05–.1	
30–175	4–10	0.2–3.0	sl. sol. w.; p. sol. al.
4–8	.....	......	sol. in bz., chl., eth. acet., oil turp.; p. sol. in al., eth., lgr.
.....	.....	......	sol. bz.; insol. acet.
7–22	0–0.5	0.02–.05	sol. in acet., al., meth. al., amyl al., bz., acet. a., chl., eth., eth. acet., CS_2, oil turp.; p. sol in lgr.
2–18	.....	......	sol. in bz., chl., eth., oil turp.; p. sol. al., lgr., eth. acet., CS_2; insol. w.
1–8	.....	......	sol. chl., eth., lgr.; p. sol. in al., eth. acet., oil turp.; insol. w.
2–18	.....	......	sol. in bz., chl., eth., oil turp.; p. sol. al., lgr., eth. acet., CS_2; insol. w.
.....	0.5–2.5	0.25–2.0	p. sol. acet. a., bz., chl., eth., oil turp.; insol. in acet., al., meth. al., lgr., CS_2.
.....	.....	......	98.7 % sol. in eth.-al. mixture.
.....	.....	......	92.9 % sol. in eth.-al. mixture.
.....	.....	......	
.....	0.1–1.0	0.01–.1	sol. in bz., chl., CS_2; p. sol. in al., eth., acet., amyl al., lgr.
.....	.....	3.6	sol. in al., eth., bz.; p. sol. in chl., eth. acet., lgr.
6–26	12–20	0.02–.1	sol., in eth., chl. bz., amyl al., CS_2; sl. sol. in lgr.; p. sol. in acet. a., acet., al., meth. al., eth. acet., oil turp.
50–175	1–30	1–25	15–20 % sol. in w.; p. sol. in al.
.....	.....	1–5	p. sol. in al., bz., eth., lgr., CS_2
120–5	.....	......	sol. in al.; p. sol. in acet. a., eth., chl.; insol. in w., bz., oil turp., CS_2
29	0.1–1.5	0.1–.2	p. sol. in acet. a., acet., al., meth. al. chl., oil turp.; sl. sol. in CS_2; sol. in amyl al., bz., eth.; insol. w.
108–31	.....	1–8	p. sol. in w., al.
7–72	.....	......	p. sol. in al., acet., meth. al., amyl al., chl., eth., eth. acet., oil turp.; sl. sol. in acet. a., bz.
1–33	0.05–.2	0.04–.1	sol. in acet., amyl al.; p. sol. in acet. a., al., meth. al., bz., chl., eth., lgr., CS_2; sl. sol. in oil turp.
137–63	.....	0.72–1.4	p. sol. in acet. a., meth. al., amyl. al., bz., chl., eth., lgr., eth. acet., oil turp., CS_2
70–185	5–35	0–2	sol. in acet. a., al., meth. al., amyl al.; sl. sol. in acet., bz., oil turp.; insol. in eth., lgr., CS_2
25–70	.....	......	sol in al., chl., eth. acet.; sl. sol. in w.; p. sol. in bz., eth., lgr., oil turp.
5–55	.....	......	sol. in al., bz., chl., eth., eth acet., oil turp.; p. sol. in lgr., CS_2
0–50	.....	......	sol. in acet. a., al., meth. al., amyl al., bz., chl., eth., eth. acet., oil turp.; p. sol. in lgr., CS_2

PHYSICAL CONSTANTS OF MINERALS

The following table presents data for about 350 of the more common minerals.

In order to avoid duplication and save space, very few cross references are given in the body of the table. If the name sought is not found in the table, consult the **synonym index** given below.

Specific gravities are given at normal atmospheric temperatures, a more precise statement being valueless considering the large variations in natural minerals.

Hardness is given in terms of Mho's scale. (See under Hardness.)

Indices of refraction for the sodium line, λ = 5893 Å, unless otherwise indicated. Li, λ = 6708 Å. Indices will invariably be given in the order ω, ϵ or α, β, γ. Uniaxial crystals are considered positive if $\epsilon > \omega$, negative if $\omega > \epsilon$. Biaxial crystals are considered positive if β is nearer α in value than it is γ and negative if β is nearer γ than α.

ABBREVIATIONS

amor	amorphous	grnsh	greenish	refl	reflection
bet	between	hex	hexagonal	rhbdr	rhombohedral
bl	blue	int	internal	rhomb	rhombic
blk	black	inter	intermediate	sl	slightly
blksh	blackish	iridesc	iridescent	somet	sometimes
blsh	bluish	lt	light	st	steel
br	brown	monocl	monoclinic	tarn	tarnishes
brnsh	brownish	oft	often	tetr	tetragonal
col	colorless	opt	optically	tricl	triclinic
cub	cubic	pa	pale	trig	trigonal
dk	dark	prob	probably	var	variety
emer	emerald	purp	purple	wh	white
expos	exposure	(R)	radioactive	yel	yellow
gold	golden	rar	rarely	yelsh	yellowish
grn	green	redsh	reddish		

SYNONYM INDEX

Compound sought	Listed	Compound sought	Listed
Aegirite	Acmite	+Fe Bronzite	Enstatite
Alalite	Diopside	Brown hematite	Limonite
Allanite	Orthite	Calcium-chromium garnet	Uvarovite
Alum stone	Alunite	Calcspar	Calcite
Amphibole	Hornblende	Caporcianite	Laumonite
Amphigene	Leucite	Carbonado	Diamond
Antimonite	Stibnite	Carborundum, ar.if.	Moissanite
Aphthitalite	Arcanite	Carbuncle, Al-Fe' garnet	Almandite
Arsenic nickel	Niccolite	Chalybite	Siderite
Asparagus-stone	Apatite	Chessylite	Azurite
Beauxite	Bauxite	Chile saltpeter	Soda niter
Black hematite	Psilomelane	China clay	Kaolinite
Black lead	Graphite	Chlorite	Clinochlorite
Black mica	Biotite	Chrome-spinel	Picotite
Blue iron ore	Vivianite	Cobalt bloom	Erythrite
Blue malachite	Azurite	Cobalt glance	Cobaltite
Blue stone	Chalcanthite	Copper pyrites	Chalcopyrite
Blue vitriol	Chalcanthite	Copper uranite	Torbernite (R)
Bortz	Diamond		
Brimstone	Sulfur		

SYNONYM INDEX (Continued)

Compound sought	Listed	Compound sought	Listed
Copperas	Melanterite	Magnetic pyrites	Pyrrhotite
Cromfordite	Phosgenite	Malacolite	Diopside
Crysolite	Olivine	Manganblende	Alabandite
Cymophane	Chrysoberyl	Manganese-aluminum garnet	Spessartite
Dark red silver ore	Pyrargyrite	Meershaum	Sepiolite
Desmine	Stilbite	Menaccanite	Ilmenite
Dialogite	Rhodochrosite	Microcosmic salt	Stercorite
Dichroite	Cordierite	Mispickel	Arsenopyrite
Disthene	Cyanite	Molybdenum glance	Molybdenite
Dry bone	Smithsonite	Needle zeolite	Natrolite
Elaeolite	Nephelite	Nickelin	Niccolite
Emerald	Beryl	Nigrine	Rutile
Epsom salt	Epsomite	Niobite	Columbite
Erubescite	Bornite	Noumeite	Garnierite
Facellite	Kaliophilite	Octahedrite	Anatase
Fahlerz	Tetrahedrite	Peanut ore	Wolframite
Fibrolite	Sillimanite	Pearl spar	Dolomite
Flint	Chalcedony	Pencil stone agalmatolite	Pyrophyllite
Fluorapatite	Apatite	Peridot	Olivine
Fluorspar	Fluorite	Pistacite	Epidote
Fool's gold	Pyrite	Plumbago	Graphite
Fowlerite	Rhodonite	Polianite	Pyrolusite
Glance	Galena	Potassium feldspar	Orthoclase
Glaserite	Arcanite	Purple copper ore	Bornite
Glauber salt	Mirabilite	Red copper ore	Cuprite
Grammatite	Tremolite	Red zinc ore	Zincite
Gray copper ore	Tetrahedrite	Rock salt	Halite
Gray manganese ore	Manganite	Ruby	Corundum
Green carbonate of copper	Malachite	Ruby silver ore	Proustite
Green lead ore	Pyromorphite	Sapphire	Corundum
Harmotomite	Harmotome	Silver glance	Argentite
Hebronite	Amblygonite	Soapstone	Talc
Hessonite	Grossularite	Soda-microcline	Anorthoclase
Hiddenite	Spodumene	Sodium feldspar	Albite
Horn mercury	Calomel	Spathic iron	Siderite
Horn silver	Cerargyrite	Sphene	Titanite
Hyacinth	Zircon	Stassfurtite	Boracite
Hydrargillite	Gibbsite	Steatite	Talc
Hydrohematite	Turgite	Stream tin	Cassiterite
Hypersthene	Enstatite	Tabular spar	Wollastonite
Ice stone	Cryolite	Tincal	Borax
Iceland spar	Calcite	Tinstone	Cassiterite
Idocrase	Vesuvianite	Titanic iron ore	Ilmenite
Iolite	Cordierite	Troosite, var. cont. Mn	Willemite
Iron pyrites	Pyrite	Urao	Trona
Iron spinel	Hercynite	Vermilion, natural	Cinnabar
Jargon	Zircon	Websterite	Aluminite
Kunzite	Spodumene	Wernerite	Scapolite
Lapis-Lazuli	L. zurite	Wheel ore	Bournonite
Lead carbonate	Cerussite	White iron pyrites	Marcasite
Lead oxide	Litharge	White lead ore	Cerussite
Leonhardite	Laumontite	White mica	Muscovite
Lime feldspar	Anorthite	Wood tin	Cassiterite
Lime-soda feldspar	Oligoclase	Zincblende	Sphalerite
Lithiophyllite	Triphylite	Zinc-spinel	Gahnite
Lithium mica	Lepidolite	Zinc vitriol	Goslarite
Lodestone	Magnetite		
Magnesium mica	Phlogopite		

PHYSICAL CONST-

No.	Name	Synonym	Formula	Sp. gr.
1	Acmite	aegirite	$Na_2O.Fe_2O_3.4SiO_2$	3.5–3.56
2	Actinolite		$Ca(Mg, Fe)_3(SiO_3)_4$	2.9–3.2
3	Agate See *chalcedony*			
4	Alabandite	manganblende	MnS	3.95–4.04
5	Albite	sodium feldspar	$Na_2O.Al_2O_3.6SiO_2$	2.61–2.64
6	Almandite	carbuncle, Al-Fe garnet	$Al_2O_3.3FeO.3SiO_2$	3.688–4.33
7	Aluminite	websterite	$Al_2O_3.SO_3.9H_2O$	1.66
8	Alunite	alum stone	$K_2Al_6(OH)_{12}(SO_4)_4$	2.58–2.75
9	Alunogenite	alunogen	$Al_2(SO_4)_3.18H_2O$	1.6–1.8
10	Amblygonite	hebronite	$AlPO_4.LiF$	2.98–3.15
11	Analcite	analcime	$Na_2O.Al_2O_3.4SiO_2.2H_2O$	2.22–2.29
12	Anatase	octahedrite	TiO_2	3.82–3.95
13	Andalusite		Al_2SiO_5 or $Al_2O_3.SiO_2$	3.1–3.2
14	Andesine	feldspar group	$(CaO,Na_2O)Al_2O_3.4SiO_2$	2.647–2.69
15	Andradite	common garnet, black garnet	$3CaO.Fe_2O_3.3SiO_2$	3.64–3.9
16	Anglesite		$PbSO_4$	6.12–6.39
17	Anhydrite		$CaSO_4$	2.899–2.985
18	Anorthite	lime feldspar	$CaO.Al_2O_3.2SiO_2$	2.703–2.763
19	Anorthoclase	feldspar group, soda-microcline	$(Na,K)_2O.Al_2O_3.6SiO_2$	2.56–2.651
20	Anthophyllite		$(Mg,Fe)SiO_3$	2.857–3.2
21	Antigorite		$3MgO.3SiO_2.2H_2O$	2.55–2.62
22	Apatite	fluorapatite, asparagus-stone	$CaF_2.3Ca_3P_2O_8$	3.151–3.270
23	Apophyllite		$K_2O.8CaO.16SiO_2.16H_2O$	2.3–2.4
24	Aragonite		$CaCO_3$	2.85–2.94
25	Arcanite	aphthitalite, glaserite	$(K,Na)_2SO_4$	2.662
26	Argentite	silver glance	Ag_2S	7.24–7.40
27	Arsenic	native arsenic	As	5.64–5.78
28	Arsenopyrite	mispickel	$FeS_2.FeAs_2$	5.89–6.20
29	Atacamite		$3CuO.CuCl_2.3H_2O$	3.77–3.94
30	Augelite		$2Al_2O_3.P_2O_5.3H_2O$	2.77
31	Augite		$CaMg(SiO_3)_2+(Mg,Fe)(AlFe)_2SiO_6$	3.2–3.6
32	Autunite	lime uranite	$CaO.2UO_3.P_2O_5.8H_2O$	3.05–3.19
33	Axinite		$HCa_3Al_2BSi_4O_{16}$	3.22–3.314
34	Azurite	blue malachite, chessylite	$2CuCO_3.Cu(OH)_2$	3.77–3.83
35	Baddeleyite		ZrO_2	5.50–6.03
36	Barite	barytes	$BaSO_4$	4.3–4.6
37	Barysilite		$Pb_3Si_2O_7$	6.53–6.707
38	Bauxite	beauxite	$Al_2O_3.2H_2O$	2.55
39	Beccarite		$ZrO_2.SiO_2$	6.54–6.74
40	Benitoite		$BaTiSi_3O_9$	3.64–3.65
41	Bertrandite		$4BeO.2SiO_2.H_2O$	2.571–2.60
42	Beryl		$3BeO.Al_2O_3.6SiO_2$	2.63–2.91
43	Beryllonite		$NaBePO_4$	2.845
44	Biotite	black mica	$(K,H)_2(Mg,Fe)_2(Al,Fe)_2(SiO_4)_3$	2.69–3.16

ANTS OF MINERALS

No.	Hard-ness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V ° ′
1	6.0–6.5	monocl., blk., brnsh. or redsh.	1.763, 1.799, 1.813	62 13
2	5–6	monocl., grn., gray-grn. or br.	1.611, 1.627, 1.636	75
3				
4	3.5–4.0	cub., iron-blk.	(Li) 2.70	....
5	6.0–6.5	tricl., gray, or rarely colored	1.525, 1.529, 1.536	70
6	7.0–7.5	cub., deep red to brnsh.-red or blk.	1.801	....
7	1–2	monocl.	1.459, 1.464, 1.470	....
8	3.5–4.0	hex. (trig.), col., wh., yelsh., gray or redsh.	1.572, 1.592	....
9	1.5–2.0	monocl. wh., yelsh. or redsh.	1.474, 1.476, 1.483	....
10	6	tricl., wh. to grnsh., blsh., yelsh., grayish or brnsh. wh.	1.579, 1.593, 1.597	50
11	5.0–5.5	cub., col. or wh., yelsh, redsh or grnsh.	1.4874	....
12	5.5–6.0	tetr., br., bl., blk.	2.554, 2.493	....
13	7.0–7.5	rhomb., gray, redsh., grnsh., blsh.	1.632, 1.638, 1.643	84 30
14	5–6	tricl., wh., gray, grnsh., yelsh., flesh red	1.549, 1.553, 1.556	88
15	6.5–7.0	cub., brnsh. red. br., blk., also yel. or grn.	1.857	....
16	2.75–3.0	rhomb. or monocl., wh., gray, yel., bl., grn., (col.)	1.8771, 1.8823, 1.8937	75 24
17	3.0–3.5	rhomb. or monocl., col., wh., gray, bl., br. or redsh.	1.5693, 1.5752, 1.6130	43 41
18	6.0–6.5	tricl., col., wh. or grayish. (yelsh. blsh. or redsh.)	1.5755, 1.5832, 1.5885	77
19	6.0–6.5	tricl.	1.523, 1.529, 1.531	....
20	5.5–6.0	rhomb., br., yelsh. or grnsh., to emer. grn.	1.633, 1.642, 1.657	83 54
21	3–4	rhomb., brnsh. grn.	1.490, 1.502, 1.511	....
22	4–5	hex., br., grn., gray, yel., red or wh.	1.634, 1.632	....
23	4.5–5.0	tetr., col. or wh., grn., yel. or redsh.	1.537, 1.535	....
24	3.5–4.0	rhomb., col., wh., yel., redsh., blsh. or blk.	1.5299, 1.6809, 1.6854	18
25	....	rhbdr., wh.	1.4935, 1.4947, 1.4973	....
26	2.0–2.5	cub., dk. lead gray	....	....
27	3–4	hex., tin-wh., tarn. dk. gray to blk.	....	....
28	5.5–6.0	rhomb., silver-wh. to grayish-wh.	....	....
29	3.0–3.5	rhomb., bright or blksh. grn.	1.831, 1.861, 1.880	....
30	4.5–5.0	monocl., col. to wh.	1.574, 1.576, 1.588	50 49
31	5–6	monocl., dk. grn. to blk.	1.712, 1.717, 1.733	60
32	2.0–2.5	rhomb., yel.	1.553, 1.575, 1.577	....
33	6.5–7.0	tricl., br., bl., gray, yel.	1.678, 1.685, 1.688	72
34	3.5–4.0	monocl., bl.	1.730, 1.758, 1.838	....
35	6.5	monocl., col.-yel., br., blk.	2.13, 2.19, 2.20	....
36	2.5–3.5	rhomb., col., wh., yel., bl., br. or red	1.6369, 1.6381, 1.6491	37 28
37	3	trig., wh.	2.070, 2.050	....
38	1–3	amor., wh., br., yel. or redsh.	1.570	....
39	....	....	1.9272, 1.9277, 1.9320	....
40	6.0–6.5	hex., trig., bl., col.	1.757, 1.804	....
41	6–7	rhomb., col., pa. yel.	1.591, 1.605, 1.614	74 51
42	7.5–8.0	hex., grn., bl., yel., redsh.	1.581, 1.575	....
43	5.5–6.0	rhomb., col. to wh., pa. yel.	1.5520, 1.5579, 1.5608	67 56
44	2.5–3.0	monocl., blk. or dk. br. or grn.	1.541, 1.574, 1.574	....

PHYSICAL CONSTANTS OF

No.	Name	Synonym	Formula	Sp. gr.
1	Bismuth	native bismuth	Bi	9.70–9.83
2	Bloedite	blödite	$MgSO_4.Na_2SO_4.4H_2O$	2.22–2.28
3	Boracite	stassfurtite	$Mg_7Cl_2B_{16}O_{30}$	2.9–3.0
4	Borax	tincal	$Na_2B_4O_7.10H_2O$	1.69–1.72
5	Bornite	purple copper ore, erubescite	$FeS.2Cu_2S.CuS$	4.9–5.4
6	Bournonite	wheel ore	$PbCuSbS_3$	5.7–5.9
7	Brochantite		$CuSO_4.3Cu(OH)_2$	3.8–3.9
8	Bromyrite		$AgBr$	5.8–6.0
9	Brookite		TiO_2	3.87–4.084
10	Brucite		$MgO.H_2O$	2.38–2.4
11	Bunsenite		NiO	6.398
12	Cacoxenite		$FePO_4.Fe(OH)_3.4\frac{1}{2}H_2O$	3.38
13	Calamine See *hemi*	*morphite, smithsonite*		
14	Calcite	calcspar, iceland spar	$CaCO_3$	2.711
15	Caledonite		$2(Pb,Cu)O.SO_3.H_2O$	6.4
16	Calomel	horn mercury	$HgCl$	6.482
17	Cancrinite		$4Na_2O.CaO.4Al_2O_3.$- $2CO_2.9SiO_2.3H_2O$	2.42–2.50
18	Carnallite		$KCl.MgCl_2.6H_2O$	1.60
19	Carnotite		$K_2O.2U_2O_3.V_2O_5.3H_2O$	....
20	Cassiterite	incl. tinstone, stream tin, wood tin	$SnSnO_4$	6.8–7.1
21	Celestite	celestine	$SrSO_4$	3.84–3.97
22	Cerargyrite	horn silver	$AgCl$	5.552
23	Cerussite	white lead ore	$PbCO_3$	6.46–6.57
24	Chabazite		$CaAl_2Si_6O_{16}.8H_2O$ (+Na,K)	2.06–2.16
25	Chalcanthite	blue vitriol, blue stone	$CuSO_4.5H_2O$	2.12–2.30
26	Chalcedony	flint, agate	SiO_2	2.55–2.63
27	Chalcopyrite	copper pyrites	$CuFeS_2$	4.1–4.3
28	Chiolite		$5NaF.3AlF_3$	2.84–3.005
29	Chondrodite		$[Mg(F,OH)]_3Mg_3[SiO_4]_2$	3.10–3.22
30	Chromite		$FeO.Cr_2O_3$	4.32–4.57
31	Chrysoberyl	cymophane	$BeO.Al_2O_3$	3.50–3.84
32	Chrysocolla		$CuSiO_3.2H_2O$	2.40–2.42
33	Cinnabar	natural vermilion	HgS	8.0–8.2
34	Claudetite		As_2O_3	3.85–4.151
35	Cleveite (R)	A cryst. var. of uraninite		7.49
36	Clinochlorite	clinochlore	$H_8Mg_5Al_2Si_3O_{18}$	2.65–2.78
37	Cobaltite	cobalt glance	$CoAsS$	6.0–6.3
38	Colemanite		$Ca_2B_6O_{11}.5H_2O$	2.417–2.428
39	Columbite	niobite	$(Fe,Mn)(Cb,Ta)_2O_6$	5.26–7.30
40	Connellite		$CuSO_4.2CuCl_2.19Cu$- $(OH)_2.H_2O$	3.4
41	Copiapite		$2Fe_2O_3.5SO_3.18H_2O$	2.1–2.2
42	Copper	native copper	Cu	8.8–8.9
43	Coquimbite		$Fe_2(SO_4)_3.9H_2O$	2.07–2.105
44	Cordierite	iolite, dichroite	$4(Mg,Fe)O.4Al_2O_3.$- $10SiO_2.H_2O$	2.57–2.66
45	Corundum	ruby, sapphire	Al_2O_3	3.95–4.10

MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V ° ′
1	2.0–2.5	hex., redsh. wh.	....	....
2	2.5	monocl., col. to grnsh., yelsh or red	1.486, 1.488, 1.489	....
3	7	rhomb., wh., gray, yel. or grn.	1.662, 1.667, 1.673	83 33
4	2.0–2.5	monocl., wh., grayish, blsh. or grnsh.	1.4468, 1.4686, 1.4715	39
5	3	cub., dk. redsh. br., tarn. blue, purp. or iridesc.	....	....
6	2.5–3.0	rhomb., st. gray to iron blk.	....	....
7	3.5–4.0	rhomb., emer. to bksh. grn.	1.730, 1.778, 1.803	77
8	2–3	cub., yel. to grn. or gray	2.253	....
9	5.5–6.0	rhomb., br., yelsh, redsh. to iron blk.	2.583, 2.586, 2.741	....
10	2.5	trig., wh., gray, blue or grn.	1.559, 1.580	....
11	5.5	cub., grn.	(Li) 2.18	....
12	3–4	hex., yel. or brnsh.	1.582, 1.645	....
13				....
14	3	hex., col., wh. or yelsh.; rar. pa. gray, red, grn., bl., vlt.	1.6583, 1.4864	....
15	2.5–3.0	rhomb., deep grn.	1.818, 1.866, 1.909	....
16	1–2	tetr., wh., yelsh, gray or br.	1.97325, 2.6559	....
17	5–6	hex., wh., gray, yel., grn., bl., redsh.	1.524, 1.496	....
18	1	rhomb., wh. or redsh.	1.466, 1.475, 1.494	70
19	1–2	hex., rhomb., yel.	1.750, 1.925, 1.95	....
20	6–7	tetr., br. or blk., somet. red, gray, wh. or yel.	1.997, 2.093	....
21	3.0–3.5	rhomb., col., wh. or yel., oft. blsh., redsh. or grnsh.	1.6220, 1.6237, 1.6309	51 12
22	1–1.5	cub. wh., gray, yelsh., grnsh., turns vlt., br. or blk. in light	2.0710	....
23	3.0–3.5	rhomb., col., wh. or gray	1.8037, 2.0763, 2.0780	8 34
24	4–5	hex. (rhbdr.), col., wh., redsh., yelsh. or br.	1.480, 1.482	65 ±
25	2.5	tricl., bl. or grnsh. bl.	1.5140, 1.5368, 1.5433	56 2
26	6	wh., grayish bl., br.-blk.	1.537 (1.533–1.539), 1.530	....
27	3.5–4.0	tetr., brass to gold. yel. tarn. to bl., purp. tints	....	....
28	3.5–4	tetr., wh.	1.349, 1.342	....
29	6.0–6.5	monocl., wh., yel., red.-br.	1.607, 1.619, 1.639	80
30	5.5	cub., blk.-brnsh. blk.	....	2.15
31	8.5	rhomb., grn.-yel.	1.747, 1.748, 1.757	....
32	2–4	amor., tetr. or hex., grn.-bl.-blk.	1.46–1.57	....
33	2.0–2.5	hex., scarlet, redsh.-br., blk.	2.854, 3.201	....
34	2.5	monocl.	1.871, 1.92, 2.01	....
35	5.5	cub.	....	....
36	2.0–2.5	monocl., grn. to yelsh. or wh.	1.585, 1.586, 1.596	....
37	5–6	cub., silv. wh., redsh. or grayish	....	....
38	4.0–4.5	monocl., col. to wh. or yelsh.	1.5863, 1.5920, 1.6139	55 20
39	6	rhomb., br. to blk.	2.26, 2.29, 2.34	....
40	....	hex., blue	1.724, 1.746	....
41	2.5	monocl., yel.	1.530, 1.543, 1.595	....
42	2.5–3.0	cub., red	....	....
43	2.0–2.5	hex. (trig.), wh., yelsh., brnsh.	1.5519, 1.5575	....
44	7.0–7.5	rhomb., lt.-dk. blue	1.534, 1.538, 1.540	70 23
45	9	hex. (trig. rhbdr.) col., red, yel., bl., br. or gray	1.768, 1.760	....

PHYSICAL CONSTANTS OF

No.	Name	Synonym	Formula	Sp. gr.
1	Cotunnite		$PbCl_2$	5.84
2	Cristobalite		SiO_2	2.27–2.34
3	Crocoite	crocoisite	$PbCrO_4$	5.9–6.1
4	Cryolite	ice stone	Na_3AlF_6 or $3NaF.AlF_3$	2.95–3.00
5	Cryolithionite		$3NaF.3LiF.2AlF_3$	2.777–2.778
6	Cuprite	red copper ore	Cu_2O	5.85–6.15
7	Cyanite	disthene	Al_2SiO_5 or $Al_2O_3.SiO_2$	3.559–3.675
8	Danburite		$CaO.B_2O_3.2SiO_2$	2.93–3.02
9	Datolite		$Ca(B.OH)SiO_4$	2.89–3.00
10	Derbylite		$6FeO.Sb_2O_3.5TiO_2$	4.512–4.530
11	Diamond	bortz, carbonado	C	3.150–3.525
12	Diaspore		$Al_2O_3.H_2O$	3.3–3.5
13	Diopside	malacolite, alalite	$CaMg(SiO_3)_2$	3.20–3.38
14	Dioptasite	dioptase	$H_2O.CuO.SiO_2$	3.05–3.35
15	Dolomite	pearl spar	$CaCO_3MgCO_3$	2.80–2.99
16	Douglasite		$2KCl.FeCl_2.2H_2O$	2.16
17	Dysanalite		CaO,FeO,TiO_2, etc.	4.02–4.26
18	Eglestonite		Hg_4Cl_2O	8.327
19	Embolite		$Ag(Br,Cl)$	5.31–5.81
20	Emery	mix. of corundum, magnetite, hematite, quartz and spinel		3.75–4.31
21	Enargite		$3Cu_2S.As_2S_5$	4.43–4.55
22	Erythrite	cobalt bloom	$Co_3(AsO_4)_2.8H_2O$	2.912–2.948
23	Euclasite		$Be(AlOH)SiO_4$	3.051–3.103
24	Eudialite		$6Na_2O.6(Ca,Fe)O.20(Si,Zr)O_2.NaCl$	2.8–3.1
25	Eulytite		$3SiO_2.2Bi_2O_3$	6.106
26	Enstatite	+Fe, bronzite, hypersthene	$MgO.SiO_2$	3.10–3.43
7	Epidote	pistacite	$4CaO.3(AlFe)_2O_3.6SiO_2.H_2O$	3.07–3.50
28	Epsomite	epsom salt	$MgSO_4.7H_2O$	1.68
29	Fayalite		Fe_2SiO_4	3.91–4.34
30	Feldspars See *ortho*	*clase, microline, albite, labr*	*adorite, andesine, anorthocl*	*ase or anorthite*
31	Ferberite		$FeWO_4$	6.801–7.109
32	Fluorite	fluorspar	CaF_2	2.97–3.25
33	Forsterite		Mg_2SiO_4	3.191–3.33
34	Franklinite		$(Fe,Mn,Zn)(FeO_2)_2$	5.07–5.22
35	Gahnite	zinc-spinel	$ZnAl_2O_4$	4.478–4.602
36	Galena	galenite, glance	PbS	7.3–7.6
37	Ganomalite		$4CaO.6PbO.6SiO_2.H_2O$	5.57–5.7
38	Garnet See *alman*	*dite, andradite, grossularit*	*e, spessartite, uvarovite*	
39	Garnierite	noumeite	$H_2(Ni,Mg)SiO_4$ (variable)	2.27–2.87
40	Gay-Lussite		$CaCO_3.Na_2CO_3.5H_2O$	1.93–1.95
41	Gehlenite		$CaO.MgO.Al_2O_3.SiO_2$	2.9–3.07
42	Geikielite		$(Mg,Fe)O.TiO_2$	3.98–4.0
43	Gibbsite	hydrargillite	$Al_2O_3.3H_2O$	2.3–2.42
44	Glauberite		$Na_2SO_4.CaSO_4$	2.7–2.85
45	Glaucophane	glaucophanite	$NaAl(SiO_3)_2.(Fe,Mg)SiO_3$	2.991–3.15
46	Gold	native gold	Au	14.56–19.33

MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V ° ′
1	soft	rhomb., wh., yelsh.	2.1992, 2.2172, 2.2596	....
2	6–7	pseudo-isometric?	1.486	....
3	2.5–3.0	monocl., red.	(Li): 2.31, 2.37, 2.66	....
4	2.5	monocl., col. to wh.; rar. redsh , brnsh. or blk.	β 1.364	....
5	2.5–3.0	....	1.339	....
6	3.5–4.0	cub., red.; rar. br.-blk.	2.705	....
7	4–7	tricl., bl., gray, wh., grn. or blk.	1.712, 1.720, 1.728	82
8	7	rhomb., yel.-col.	1.632, 1.634, 1.636	88
9	5.0–5.5	monocl., col., wh., yelsh., redsh., grnsh.	1.625, 1.653, 1.669	74
10	5	rhomb., blk.	(Li): 2.45, 2.51	....
11	10	cub., col. or sl. yelsh., also yel., red, grn., blue or blk.	2.4173	....
12	6.5–7.0	rhomb., gray, wh., pink, yel., br.	1.702, 1.722, 1.750	84
13	5–6	monocl., lt. to dk. grn., col., gray, yel., rar. bl.	1.664, 1.671, 1.694	59
14	5	trig., emer. grn.	1.644, 1.697	....
15	3.5–4.5	hex. (trig. rhbdr.), wh., yel., redsh., br., blk., rar. col.	1.6817, 1.5026	....
16	....	....	1.488, 1.500	....
17	5–6	cub., iron blk.	2.330	....
18	2–3	cub., brnsh., yel., blk. on expos.	(Li) 2.49	....
19	1–1.5	grayish grn. to yelsh-grn., yel.	2.15	....
20	7–9	dk. gray to blk.	....	....
21	3	rhomb., gray to blk.	....	....
22	1.5–2.5	monocl., red., pink or pearl gray	1.6263, 1.6614, 1.6986	....
23	7.5	monocl., col., pa. grn , blue	1.652, 1.655, 1.671	....
24	5–6	hex., red to br.	1.606, 1.611	
25	4.5	cub., br. to yel. or col.	2.05	....
26	5–6	rhomb., grayish or yelsh., wh., grnsh. or brnsh.	1.650, 1.653, 1.658	31
27	6–7	monocl., yelsh to blksh. grn ; rar. red or col.	1.729, 1.754, 1.768	....
28	2.0–2.5	rhomb., col. or wh.	1.4326, 1.4554, 1.4609	51 25
29	6.5	rhomb., yel.-blk.	1.835, 1.877, 1.886	....
30				
31	4.0–4.5	monocl., br. to blk.	(Li) β 2.40	....
32	4	cub., col., oft. yel., bl., grn., vlt.; rar. red	1.4339	....
33	6–7	rhomb., wh., grnsh, yelsh.	1.635, 1.651, 1.670	....
34	5.5–6.5	cub., iron blk.	(Li) 2.360	....
35	7.5–8.0	cub., grn., br., blk.	1.780	....
36	2.5	cub., lead gray to blk.	3.912	....
37	3	tetr., col., gray.	1.910, 1.91, 1.945	....
38				
39	2–3	amor., bright grn., pa. grn. to wh.	1.59	....
40	2–3	monocl., wh. to yelsh	1.4435, 1.5156, 1.5233	33 46
41	5.5–6.0	tetr., grayish grn. to br.	1.666, 1.661	....
42	6	hex. (trig.), bluish or brnsh. blk.	2.31, 1.95	....
43	2.5–3.5	monocl., wh., grnsh., redsh. to yel.	1.566, 1.566, 1.587	....
44	2.5–3.0	monocl., pa. yel., gray, or red	1.515, 1.532, 1.536	7
45	6.0–6.5	monocl., blue	1.621, 1.638, 1.638	43 58
46	2.5–3.0	cub., yel.	....	....

PHYSICAL CONSTANTS OF

No.	Name	Synonym	Formula	Sp. gr.
1	Goslarite	zinc vitriol	$ZnSO_4.7H_2O$	1.9–2.1
2	Göthite		$Fe_2O_3.H_2O$	4.0–4.4
3	Graphite	plumbago, black lead	C (traces of Fe, SiO_2, etc.)	2.09–2.25
4	Grossularite	hessonite	$3CaO.Al_2O_3.3SiO_2$	3.4–3.6
5	Gummite (R)		$(Pb,Ca,Ba)SiU_3O_{12}.5H_2O(?)$	3.9–5.16
6	Gypsum		$CaSO_4.2H_2O$	2.314–2.328
7	Halite	rock salt	$NaCl$	2.135–2.170
8	Hambergite		Be_2HBO_4	2.347–2.36
9	Hanksite		$9Na_2SO_4.2Na_2CO_3.KCl$	2.562
10	Harmotome	harmotomite	$(K_2,Ba)O.Al_2O_3.5SiO_2.5H_2O$	2.345–2.50
11	Hausmannite		Mn_3O_4	4.722–4.856
12	Haüynite		$5(Na_2,Ca)O.3Al_2O_3.6SiO_2.2SO_3$	2.4–2.5
13	Helvite		$3(Be,Mn,Fe)_2SiO_4.(Mn,Fe)S$	3.16–3.37
14	Hematite		Fe_2O_3	4.9–5.3
15	Hemimorphite	calamine	$2ZnO.SiO_2.H_2O$	3.45
16	Hercynite	iron spinel	$FeAl_2O_4$	3.91–3.95
17	Herderite		$CaPO_4.BeFOH$	2.952–3.012
18	Heulandite		$CaO.Al_2O_3.6SiO_2.5H_2O$	2.16–2.249
19	Hopeite		$3ZnO.P_2O_5.4H_2O$	3.03
20	Hornblende	amphibole	$Ca(Mg,Fe)_3(SiO_3)_4,Al_2(Mg,Fe)_2(AlO_3)_2(SiO_3)_2,Fe(Mg,Fe)_2(FeO_3)_2(SiO_3)_2$	3.0–3.5
21	Hübnerite		$MnO.WO_3$	7.2–7.5
22	Hutchinsonite		$(Tl,Ag,Cu)_2S.As_2S_3 + PbS.As_2S_3(?)$	4.6
23	Hydronephelite		$HNa_2Al_3Si_3O_{12}.3H_2O$	2.263–2.48
24	Hydrotalcite		$MgCO_3.5Mg(OH)_2.2Al(OH)_3.4H_2O$	2.04–2.091
25	Ilmenite	menaccanite, titanic iron ore	$FeO.TiO_2$	4.44–4.90
26	Iodyrite	iodargyrite	AgI	5.60–5.707
27	Jarosite		$K_2Fe_6(OH)_{12}.(SO_4)_4$	3.15–3.26
28	Kainite		$MgSO_4.KCl.3H_2O$	2.067–2.188
29	Kaliophilite	phacellite	$KAlSiO_4$	2.49–2.67
30	Kaolinite	china clay, kaolin	$Al_2O_3.2SiO_2.2H_2O$	2.60–2.63
31	Kieserite		$MgSO_4.H_2O$	2.57
32	Labradorite	Labrador feldspar, inter. bet. albite and anorthite	$NaAlSi_3O_8$, $CaAl_2Si_2O_8$, ratio 1:1 to 1:3	2.70–2.72
33	Lanarkite		$Pb_2O.(SO_4)$	6.3–6.8
34	Lanthanite		$La_2(CO_3)_3.9H_2O$	2.6–2.74
35	Laubanite		$Ca_2Al_2Si_5O_{15}.6H_2O$	2.23
36	Laumontite	leonhardite, caporcianite	$CaO.Al_2O_3.4SiO_2.4H_2O$	2.23–2.42
37	Laurionite		$PbCl_2.Pb(OH)_2$	6.24
38	Lazulite		$(Fe,Mg)O.Al_2O_3.P_2O_5.H_2O$	3.057–3.122
39	Lazurite	lapis-lazuli	$3Na_2O_3.3Al_2O_3.6SiO_2.2Na_2S$	2.38–2.45
40	Leadhillite		$Pb(OH)_2.PbSO_4.2PbCO_3$	6.26–6.44

MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V ° ′
1	2.0–2.5	rhomb., wh. or yelsh.	1.457, 1.480, 1.484	....
2	5.0–5.5	rhomb., yel., red or br.	2.26, 2.39, 2.40	....
3	1–2	hex., blk., dk. gray.	....	....
4	6.5–7 0	cub., yel., grn., br., red or wh.	1.735	....
5	2.5–3.0	gumlike masses, redsh. yel. to brnsh.	1.61	....
6	1.5–2.0	monocl., wh.; oft. yel., red, br., blk.	1.5205, 1.5226, 1.5296	58 5
7	2.5	cub., col.-yelsh.; oft. redsh.-bl., gray or blk.	1.5442	....
8	7.5	rhomb., grayish wh.	1.5595, 1.5908, 1.6311	....
9	3.0–3.5	hex., wh. to yel.	1.481, 1.461	....
10	4.5	monocl., wh., gray, yel., red or br.	1.503, 1.505, 1.508	43
11	5.0–5.5	tetr., brnsh.-blk. to blk.	(Li): 2.46, 2.15	....
12	5.5–6.0	cub., bl., grn., red, yel.	1.496	....
13	6.0–6.5	cub., yel., yelsh.-br., grn. or redsh.-br.	1.739	....
14	5.5–6.5	hex. (trig.), st. gray-blk.	(Li): 3.01, 2.94	....
15	4.5–5.0	rhomb. wh., yel., br., blsh. or grnsh.	1.614, 1.617, 1.636	46 10
16	7.5–8.0	cub., blk.	1.800	....
17	5	monocl., yel., grnsh. wh.	1.592, 1.612, 1.621	68 2
18	3.5–4.0	monocl., wh., red, gray, brown	1.498, 1.499, 1.505	....
19	2.5–3.0	rhomb., grayish wh.	1.572, 1.590, 1.590	54 44
20	5–6	monocl., dk. grn. to blk.	1.629, 1.642, 1.653	84
21	4.5–5.5	monocl., brnsh. red, yel. to blk.	2.170, 2.220, 2.320	....
22	1.5–2.0	rhomb., scarlet to red	3.078, 3.176, 3.188	....
23	4.5–6.0	hex., wh., dk. gray	1.490, 1.502	....
24	2	hex., wh.	1.512, 1.498	....
25	5–6	hex. (trig.), iron-brnsh. blk.	....	....
26	1	hex., pa. yel. or grn.	2.21, 2.22	....
27	2.5–3.5	rhomb., ocher-yel., br.	1.820, 1.715	....
28	2.5–3.0	monocl., wh.-gray or redsh.	1.494, 1.505, 1.516	....
29	6	hex. or fine threads, col.	1.537, 1.533	....
30	2.0–2.5	monocl., wh., yelsh., redsh., blsh., grnsh., brnsh.	1.561, 1.565, 1.567	....
31	3.0–3.5	monocl., col.-wh. or yelsh.	1.523, 1.535, 1.586	57
32	5.0–6.0	tricl., gray, br. or grnsh.	1.559, 1.563, 1.568	
33	2.0–2.5	monocl., grnsh., wh., pa. yel. or gray	1.93, 1.99, 2.02	....
34	2.5–3.0	rhomb., grayish wh., pink, yelsh.	1.520, 1.587, 1.613	....
35	4.5–5.0	wh.	1.475, 1.486	....
36	3–4	monocl., wh., yel., gray or red	1.513, 1.524, 1.525	....
37	3.0–3.5	rhomb., col.	2.0767, 2.1161, 2.1580	....
38	5–6	monocl., azure-blue	1.603, 1.632, 1.639	69
39	5.0–5.5	cub., dk.-lt. bl., vlt. or grnsh. bl.	1.500	....
40	2.5	monocl.	1.87, 2.00, 2.01	....

PHYSICAL CONSTANTS OF

No.	Name	Synonym	Formula	Sp. gr.
1	Lepidocrocite		$Fe_2O_3.H_2O$	4.09
2	Lepidolite	lithium mica	$KLi[Al(OH,F)_2]Al(SiO_3)_3$	2.799–2.9
3	Leucite	amphigene	$K_2O.Al_2O_3.4SiO_2$	2.45–2.51
4	Lewisite		$5CaO.2TiO_2.3Sb_2O_5$	4.950
5	Limonite	brown hematite	$2Fe_2O_3.3H_2O$	3.6–4.0
6	Litharge	lead oxide, lithargite	PbO	9.13
7	Magnesite		$MgCO_3$	2.95–3.2
8	Magnetite	lodestone	Fe_3O_4	4.967–5.180
9	Malachite	green carbonate of copper	$CuCO_3.Cu(OH)_2$	3.90–4.03
10	Manganite	gray manganese ore	$Mn_2O_3.H_2O$	4.2–4.4
11	Manganosite		MnO	5.18
12	Marcasite	white iron pyrites	FeS_2	4.61–4.90
13	Marialite		$3NaO_2.3Al_2O_3.18SiO_2.2NaCl$	2.50–2.692
14	Marshite		CuI	5.59–5.62
15	Mascagnite		$(NH_4)_2SO_4$	1.76–1.77
16	Matlockite		$PbO.PbCl_2$	7.21
17	Meionite		$4CaO.3Al_2O_3.6SiO_2$	2.70–2.815
18	Melanterite	copperas	$FeSO_4.7H_2O$	1.89–1.90
19	Melilite		$Na_2(Ca,Mg)_{11}(Al,Fe)_4(SiO_4)_9$	2.9–3.4
20	Mellite		$Al_2O_3.C_{12}O_9.18H_2O$	1.55–1.65
21	Mendipite		$2PbO.PbCl_2$	7–7.1
22	Microcline		$K_2O.Al_2O_3.6SiO_2$	2.54–2.57
23	Microlite		$6CaO.3Ta_2O_5.CbOF_3$	5.405–5.562
24	Miersite		$4AgI.CuI$	5.64
25	Milarite		$K_2O.4CaO.2Al_2O_3.24SiO_2.H_2O$	2.5–2.59
26	Mimetite		$9PbO.3As_2O_5.PbCl_2$	6.98–7.25
27	Mirabilite	glauber salt	$Na_2SO_4.10H_2O$	1.40–1.481
28	Moissanite	carborundum, artificial	SiC	3.2
29	Molybdenite	molybdenum glance	MoS_2	4.7–4.8
30	Monazite		$(Ce,Nd,Pr,La)PO_4 (+Th_3[PO_4]_4)$	5.2(4.9–5.3)
31	Monetite		$HCaPO_4$	2.75–2.863
32	Monticellite		$CaMgSiO_4$	3.03–3.25
33	Montroydite		HgO	11.14
34	Muscovite	white mica	$K_2O.3Al_2O_3.6SiO_2.2H_2O$	2.76–3.00
35	Nantokite		$CuCl$	3.930
36	Natrolite	needle zeolite	$Na_2O.Al_2O_3.3SiO_2.2H_2O$	2.18–2.25
37	Nephelite	nepheline, elaeolite	$(Na,K)_8Al_8Si_9O_{34}$ or $NaAlSiO_4$	2.55–2.65
38	Newberyite		$HMgPO_4.3H_2O$	2.10
39	Niccolite	arsenic nickel, nickelin	$NiAs$	7.33–7.67
40	Noselite	nosean	$5Na_2O.3Al_2O_3.6SiO_2.2SO_3$	2.25–2.4
41	Oligoclase	lime-soda feldspar	$NaAlSi_3O_8 + CaAl_2Si_2O_8$	2.62–2.672
42	Olivenite		$4CuO.As_2O_5.H_2O$	4.1–4.4
43	Olivine	chrysolite, peridot	$(Mg,Fe)_2SiO_4$	3.26–3.40
44	Opal		$SiO_2.xH_2O$	2.1–2.3

MINERALS (Continued)

No.	Hard-ness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V ° ′
1	....	rhomb.	1.94, 2.20, 2.51	....
2	2.5–4.0	monocl., pink, oft. wh.-gray or vlt.	1.560, 1.598, 1.605	....
3	5.5–6.0	cub., wh., gray	1.508, 1.509	....
4	5.5	cub., yel.	2.20	....
5	5.0–5.5	prob. amor., br.-yelsh.	....	....
6	2	tetr., yel.	2.510, 2.610, 2.710	....
7	3.5–4.5	hex. (trig. rhbdr.), col., wh.-yelsh., br.-blk.	1.700, 1.509	....
8	5.5–6.5	cub., iron blk.	....	....
9	3.5–4.0	monocl., lt-dk. grn.	1.655, 1.875, 1.909	....
10	4–5	rhomb., iron blk. to steel gray	2.24, 2.24 (Li), 2.53	....
11	5–6	cub., emer. grn., blk. on expos.	2.16	....
12	6.0–6.5	rhomb., pa. yel. to steel gray	....	....
13	5.5–6.0	tetr.	1.539, 1.537	....
14	2.5–3.0	cub., br.	2.346	....
15	2.0–2.5	rhomb., lem. yel., yelsh., gray	1.5209, 1.5230, 1.5330	....
16	2.5–3.0	tetr., yelsh. or grnsh.	2.150, 2.040	....
17	5.5–6.0	tetr. col. to wh.	1.597, 1.560	....
18	2	monocl., var. shades of grn. to yel.	1.4713, 1.4782, 1.4856	85 27
19	5–6	tetr., wh., yel., grnsh., redsh., br.	1.634, 1.629	....
20	2.0–2.5	tetr., yel.	1.539, 1.511	....
21	2.5–3.0	rhomb., wh.	2.24, 2.27, 2.31	....
22	6.0–6.5	tricl., wh., yelsh., gray, grn. or red.	1.522, 1.526, 1.530	83
23	5.5	cub., yel., br., rar. red	1.925	....
24	2	cub., bright yel.	2.20	....
25	5.5–6.0	hex. col., grn., glassy	1.532, 1.529	....
26	3.5	hex., yel., br., wh. or col.	2.135, 2.118	....
27	1.5–2.0	monocl., wh.	1.394, 1.396, 1.398	76
28	9.5	hex., grn., bluish-blk.	2.654, 2.697	....
29	1.0–1.5	hex., blue gray	....	....
30	5.0–5.5	monocl., red or yelsh. br.	1.786, 1.788, 1.837	14
31	3.5	tricl., yel., wh.	1.515, 1.518, 1.525	....
32	5.0–5.5	rhomb., col. to gray	1.651, 1.662, 1.668	....
33	1.5–2.0	rhomb., orange red	2.37, 2.50, 2.65	....
34	2.5–3.0	monocl., col. or pa. yel., gray or br.; rar. rose	1.561, 1.590, 1.594	40 (?)
35	2.0–2.5	cub., col. to wh. or grayish	1.93	....
36	5.0–5.5	rhomb. wh. also redsh., yelsh., grnsh.	1.480, 1.482, 1.493	63
37	5.5–6.0	hex. col. wh., yelsh., gray or red	1.542, 1.538	....
38	3.0–3.5	rhomb., wh. cryst.	1.514, 1.518, 1.533	....
39	5.0–5.5	hex., lt. copper-red	....	....
40	5.5	cub., grayish, blsh., brnsh.	1.495	....
41	6–7	tricl., wh., gray, grnsh., redsh.	1.539, 1.543, 1.547	....
42	3	rhomb., olv. grn., dk. grn. to br.	1.747, 1.788, 1.829	....
43	6.5–7.0	rhomb., olv. grn., or grayish grn. to yelsh. br.	1.662, 1.680, 1.699	88 54
44	5.5–6.5	amor., col., wh., yel., br., red, grn.; int. refl.	1.41–1.46	....

PHYSICAL CONSTANTS

No.	Name	Synonym	Formula	Sp. gr.
1	Orpiment		As_2S_3	3.4–3.5
2	Orthite	allanite	$Ca_2(Al,Ce,Fe)_2(Al.OH)(SiO_4)_3$	3.0–4.2
3	Orthoclase	potassium feldspar	$K_2O.Al_2O_3.6SiO_2$	2.56
4	Parisite		$CaO.2CeOF.3CO_2$	4.320–4.42
5	Pectolite		$HNaCa_2(SiO_3)_3$	2.74–2.88
6	Penfieldite		$PbO.2PbCl_2$	
7	Penninite		$5(Mg,Fe)O.Al_2O_3.3SiO_2.4H_2O$	2.6–2.85
8	Percylite		$PbCl_2.CuO.H_2O$	4.675–4.71
9	Periclase		MgO	3.64–3.674
10	Perovskite		$CaO.TiO_2$	3.95–4.039
11	Petalite		$Li_2O.Al_2O_3.8SiO_2$	2.386–2.465
12	Pharmocosiderite		$3Fe_2O_3.2As_2O_3.13H_2O$	2.9–3.0
13	Phenacite		$2BeO.SiO_2$	2.944–3.041
14	Phlogopite	magnesium mica	$(K,H)_3Mg_3Al(SiO_4)_3$...(+Na,Fe,F)	2.737–2.869
15	Phosgenite	cromfordite	$PbCl_2,PbCO_3$	6.0–6.305
16	Picotite	chrome-spinel	$(Mg,Fe)O.(Al,Cr)_2O_3$	4.08
17	Pitchblende (R)	See *uraninite*		
18	Platinum	native platinum	Pt	13.35–19.00
19	Pleonaste	iron-magnesium spinel	$(Mg,Fe)O.Al_2O_3$	3.5–3.6
20	Pollucite		$2Cs_2O.2Al_2O_3.9SiO_2.H_2O$	2.868–2.901
21	Powellite		$CaO.MoO_3$	4.356–4.526
22	Prehnite		$2CaO.Al_2O_3.3SiO_2.H_2O$	2.80–2.95
23	Proustite	ruby silver ore	$3Ag_2S.As_2S_3$	5.51–5.64
24	Pseudobrookite		$2Fe_2O_3.3TiO_2$	4.4–4.9
25	Psilomelane	black hematite	MnO_2,BaO,H_2O,K_2O, etc.	3.7–4.7
26	Pyrargyrite	dark red silver ore	$Ag_6Sb_2S_6$	5.77–5.86
27	Pyrite	iron pyrites, fool s gold	FeS_2	4.95–5.17
28	Pyrochlorite	pyrochlore	$RNb_2O_6.R(Ti,Th)O_3$	4.2–4.36
29	Pyrochroite		$Mn(OH)_2$	3.258
30	Pyrolusite	polianite	$MnO_2(+nH_2O)$	4.73–4.86
31	Pyromorphite	green lead ore	$PbCl_2.3Pb_3(PO_4)_2$	6.50–7.12
32	Pyrophyllite	pencil stone agalmatolite	$Al_2O_3.4SiO_2.H_2O$	2.66–2.90
33	Pyrrhotite	magnetic pyrites	Fe_6S_6 to $Fe_{16}S_{17}$	4.53–4.66
34	Quartz		SiO_2	2.59–2.660
35	Raspite		$PbO.WO_3$	
36	Realgar		AsS	3.56
37	Rhodochrosite	dialogite	$MnCO_3$	3.30–3.76
38	Rhodonite	fowlerite	$MnO.SiO_2$	3.40–3.68
39	Rutile	nigrine	TiO_2	4.18–5.13
40	Sassolite		$B(OH)_3$	1.48
41	Scapolite	wernerite	$nNa_4Al_3Si_9O_{24}Cl + mCa_4Al_6Si_6O_{25}$	2.6–2.8
42	Scheelite		$CaWO_4$	5.88–6.14
43	Schorlomite		$3CaO.(Fe,Ti)_2O_3.3(Si,Ti)O_2$	3.783–3.88
44	Scolecite		$CaO.Al_2O_3.3SiO_2.3H_2O$	2.16–2.4

OF MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V °	′
1	1.5-2.0	monocl., lem. yel.	(Li) β 2.72	....	
2	5.5-6.0	monocl., br. to blk.	β 1.682	....	
3	6	monocl., col., wh., pa. yel., flesh red to gray.	1.518, 1.524, 1.526	69	43
4	4.5	trig., rhbdr., brnsh., yel.	1.5690, 1.6700	....	
5	4.5-5.0	monocl., col., wh., grayish wh.	1.595, 1.606, 1.634	60	
6	....	hex., wh.	2.13, 2.21	....	
7	2.0-2.5	pseudo-rhbdr., grn., vlt., pink, rose red; rar. yelsh. or silver wh.	1.576, 1.579	....	
8	2.0-2.5	cub., blue	2.05	....	
9	5.5-6.0	cub.	1.7364	....	
10	5.5	cub., yel., redsh. br., grayish blk.	β 2.38	....	
11	6.0-6.5	monocl., col., wh., gray; rar. redsh or grnsh.	1.504, 1.510, 1.516	83	34
12	2 5	monocl., grn., yelsh. br.	β 1.676	....	
13	7.5-8.0	tricl., col., yel., red, br.	1.6542, 1.6700	....	
14	2.5-3.0	monocl., wh.-gray., yelsh. br. to brnsh. red	1.562, 1.606, 1.606	....	
15	2.75-3.0	tetr., col., gray or yel.	2.114, 2.140	....	
16	....	yelsh. br., grnsh. br. to blk.	2.950	....	
17					
18	4-6	cub., silvery metal	....	....	
19	....	br., blk., dk. grn.	....	....	
20	6.5	cub., col.	1.521	....	
21	3.5	tetr., yel., grn. or blsh.	1.967, 1.978	....	
22	6.0-6.5	rhomb., lt. grn., wh. or gray	1.616, 1.626, 1.649	67	
23	2.0-2.5	hex., scarlet to vermilion	3.0877, 2.7924	....	
24	6	rhomb., dk. br. to blk.	(Li): 2.38, 2.39, 2.42	....	
25	5-6	cryptocryst., iron blk. to gray	....	....	
26	2.5	hex. (trig.), dk. red to gray or blk.	(Li): 3.084, 2.881	....	
27	6.0-6.5	cub., pa. brass to gold yel.	....	....	
28	5.0-5.5	cub. br.-blk.	1.960-2.000	....	
29	2.5	trig., rhbdr., wh.; dk. on expos.	1.723, 1.681	....	
30	2.0-2.5	rhomb., blk., steel gray	....	....	
31	3.5-4.0	hex., grn., yel., gray, br. or wh.	2.042, 2.050, 2.050	....	
32	1-3	monocl., wh., grn., yelsh., grayish	1.552, 1.588, 1.600	....	
33	3.5-4.5	hex., yel., red to dk. br.	....	....	
34	7	hex. (trig.), col. or yel., rose, br., grn., bl., gray	1.544, 1.553	....	
35	....	monocl., brnsh. yel.	2.27, 2.27, 2.30	....	
36	1.5-2.0	monocl., red, yel.	(Li): 2.46, 2.59, 2.61	....	
37	3.5-4.5	hex. (trig), red, pink, gray, br.; rar. col.	1.817, 1.5973	....	
38	5.5-6.5	tricl., red, pink, yelsh., grnsh., brnsh., blk.	1.733, 1.740, 1.744	....	
39	6.0-6.5	tetr., redsh. br., red, yelsh., blsh., vlt., blk.	2.6158, 2.9029	....	
40	1	tricl., wh. scales	1.340, 1.456, 1.459	....	
41	5-6	tetr., col., wh., gray, grnsh., blsh., redsh.	1.570, 1.549	....	
42	4.5-5.0	tetr., col., wh., yel., br., grn., redsh.	1.918, 1.934	....	
43	7.0-7.5	blk.	1.980	....	
44	5.0-5.5	monocl.	1.512, 1.519, 1.519	36	

PHYSICAL CONSTANTS

No.	Name	Synonym	Formula	Sp. gr.
1	Scorodite		$FeAsO_4.4H_2O$	3.1–3.3
2	Selenite, colorless transparent gypsum, which see			
3	Sellaite		MgF_2	2.972–3.170
4	Senarmontite		Sb_2O_3	5.22–5.30
5	Sepiolite	meerschaum	$2MgO.3SiO_2.2H_2O$	2.02
6	Serpentine	incl. chrysotile or asbestos and verd-antique	$3MgO.2SiO_2.2H_2O$	2.50–2.65
7	Siderite	spathic iron, chalybite	$FeCO_3$	3.00–3.88
8	Sillimanite	fibrolite	$Al_2O_3.SiO_2$	3.23–3.25
9	Silver	native silver	Ag	10.1–11.1
10	Smaltite		$CoAs_2$	6.4–6.6
11	Smithsonite	calamine, dry bone	$ZnCO_3$	4.30–4.45
12	Sodalite		$Na_4(AlCl)Al_2(SiO_4)_3$	2.14–2.40
13	Soda niter	Chile saltpeter	$NaNO_3$	2.24–2.290
14	Spessartite	manganese-aluminum garnet	$3MnO.Al_2O_3.3SiO_2$	4.0–4.3
15	Sphalerite	zincblende	ZnS	3.90–4.11
16	Spinel		$MgO.Al_2O_3$	3.5–4.1
17	Spodumene	hiddenite, kunzite	$Li_2O.Al_2O_3.4SiO_2$	β2.644–2.649
18	Staurolite		$5Al_2O_3.2FeO.4SiO_2.H_2O$	3.65–3.77
19	Stercorite	microcosmic salt	$HNa(NH_4)PO_4.4H_2O$	1.615
20	Stibiotantalite		$Sb_2O_3.Ta_2O_5$	6.6–7.9
21	Stibnite	antimonite	Sb_2S_3	4.52–4.62
22	Stilbite	desmine	$(Na_2,Ca)O.Al_2O_3.6SiO_2.6H_2O$	2.09–2.24
23	Stolzite		$PbO.WO_3$	7.87–8.13
24	Strengite		$FePO_4.2H_2O$	2.84–2.87
25	Strontianite		$SrCO_3$	3.680–3.714
26	Struvite		$(NH_4)_2O.2MgO.P_2O_5.12H_2O$	1.65–1.72
27	Sulfur	brimstone	S	2.05–2.09
28	Sylvite	sylvine	KCl	1.988
29	Talc	soapstone, steatite	$3MgO.4SiO_2.H_2O$	2.7–2.8
30	Tantalite		$(Fe,Mn)[(Cb,Ta)O_3]_2$	6.5–8.20
31	Tapiolite		$Fe(Ta,Nb)_2O_6$	7.3–7.8
32	Terlinguaite		Hg_2ClO	8.723–8.728
33	Tetrahedrite	gray copper ore, fahlerz	$4Cu_2S.Sb_2S_3$	4.4–5.1
34	Thaumasite		$3CaO.SiO_2.CO_2.SO_3.15H_2O$	1.83–1.877
35	Thenardite		Na_2SO_4	2.68–2.69
36	Thermonatrite		$Na_2CO_3.H_2O$	1.5–1.6
37	Thomsenolite		$NaF.CaF_2.AlF_3.H_2O$	2.93–3.0
38	Thomsonite		$(Na_2Ca)O.Al_2O_3.2SiO_2.3H_2O$	2.196–2.4
39	Thorianite (R)		$(ThU)O_2$(+He,Ce,La,Pb, Fe)	9.32–9.33
40	Thorite (R)		$ThSiO_4$(+He)	blk. 4.5–5 yel. 5.2–5.4
41	Titanite	sphene	$CaO.TiO_2.SiO_2$	3.40–3.56
42	Topaz		$(AlF)_2SiO_4$ or $[Al(F,OH)]_2SiO_4$	3.4–3.65
43	Torbernite (R)	copper uranite	$Cu(UO_2)_2P_2O_8.12H_2O$	3.22–3.60
44	Tourmaline		$(H,Li,Na,K)_9Al_3[B.OH]_2Si_4O_{19}(+Fe_2O_3,FeO,MgO,MnO)$?	2.9–3.2
45	Tremolite	grammatite	$CaMg_3(SiO_4)_3$	2.9–3.2
46	Tridymite		SiO_2	2.28–2.33

MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V ° ′
1	3.5–4 0	rhomb., grn., br.	1.765, 1.774, 1.797	....
2				
3	5	tetr., col.	1.378, 1.390	....
4	2.0–2.5	cub., col. to grayish	2.087	....
5	2.0–2.5	monocl., wh., yelsh., grayish	β, 1.55	....
6	2.5–4.0	monocl. (opt.), fibrous var., asbestos; gray to grnsh. or brnsh.	1.490–1.571	....
7	3.5–4.5	hex., brnsh. to blk., gray, grn., wh.	1.875, 1.633	....
8	6.0–7.5	rhomb., gray, br., yelsh., grnsh.	1.638, 1.642, 1.653	25–30
9	2.5–3.0	cub., wh.; tarn. to gray or blk.	0.18	....
10	5.5–6.0	cub., tin wh. to lt. steel gray	....	....
11	4.5–5.0	hex. (trig.), wh.-yel. or br.; rar. grn., bl.	1.818, 1.618	....
12	5.5–6.0	cub., bl., wh., grn., redsh. or gray	1.483	....
13	1.5–2.0	hex., col., wh., yelsh., gray, redsh., br.	1.5874, 1.3361	....
14	....	cub., dk. red to brnsh. red	1.811	....
15	3.5–4.0	cub., wh., yel., br., blk.	2.368	....
16	8	cub., col. or red, bl., grn., yel., br., blk.	1.723	....
17	β 5.5–6.0	monocl., wh., gray, grn., pink or purp.	1.660, 1.666, 1.676	....
18	7.0–7.5	rhomb., redsh. br., blk., yelsh. br., gray	1.736, 1.741, 1.746	88
19	2	monocl., wh.	1.439, 1.441, 1.469	....
20	5.0–5.5	rhomb., br., redsh. yel., yel.	2.374, 2.404, 2.457	....
21	2	rhomb., lead gray or blk.	3.194, 4.046, 4.303	....
22	3.5–4.0	monocl., col., wh., also br., yel., redsh.	1.494, 1.498, 1.500	30
23	2.75–3.0	tetr., grn. to gray or br.	2.2685, 2.182	....
24	3–4	rhomb., pa. red	1.730, 1.732, 1.762	....
25	3.5–4.0	rhomb., col., wh., gray, yel., grn.	1.516, 1.664, 1.666	....
26	2	rhomb., wh. or yelsh.	1.495, 1.496, 1.504	....
27	1.5–2.5	rhomb., yel.	1.95047,2.03832,2.24052	68 58
28	2	cub., col., wh., blsh. or yelsh.-red	1.4903	....
29	1.0–1.5	monocl., wh., grnsh. wh., lt. grn.	1.539, 1.589, 1.589	....
30	6	rhomb., blk. to redsh. br.	2.26, 2.29, 2.34	....
31	6	tetr., blk.	(Li): 2.270, 2.420	....
32	2–3	monocl., yel. to olive grn.	(Li): 2.35, 2.64, 2.66	....
33	3.0–4.5	cub., st. gray to iron blk.	....	....
34	3.5	hex.	1.507, 1.468	....
35	2–3	rhomb., wh. to brnsh.	1.464, 1.474, 1.485	....
36	1.0–1.5	rhombic	1.420, 1.495, 1.518	....
37	2	monocl.	1.407, 1.414, 1.415	....
38	5.0–5.5	rhomb., wh., redsh. grn. to br.	1.497, 1.503, 1.525	53 50
39	6.5	cub., blk.	....	....
40	4.5–5.0	tetr., blk. or or. yel. (orangite)	....	....
41	5.0–5.5	monocl., yel., grn., br., redsh. or blk.	1.900, 1.907, 2.034	23 9
42	8	rhomb., col. or yel., lt. blue, grn. or pink	1.619, 1.620, 1.627	65 17
		Brazil	1.6294, 1.6308, 1.6375	49 31
43	2.0–2.5	tetr., grn.	1.592, 1.582	....
44	7.0–7.5	hex. (rhbdr.), blk.-br.-bl.-grn., red; rar. wh. or col.	1.6366, 1.6193 (col.)	....
45	5–6	monocl., wh., gray, grnsh., yelsh.	1.609, 1.623, 1.635	88
46	7	rhomb., col. or wh.	1.469, 1.47, 1.473	....

PHYSICAL CONSTANTS OF

No.	Name	Synonym	Formula	Sp. gr.
1	Triphylite-lithiophyllite	....	$Li(Fe,Mn)PO_4$	3.42–3.56
2	Tr gerite (R)	....	$(UO_2)_3As_2O_8.12H_2O$	3.3
3	Trona	urao	$Na_2CO_3.HNaCO_3.2H_2O$	2.11–2.147
4	Turgite	hydrohematite	$2Fe_2O_3.H_2O$	4.29–5.00
5	Turquois	....	$H_5(CuOH)[Al(OH)_2]_6(PO_4)_4$	2.60–2.89
6	Uraninite (R)	pitchblende; incl. cleveite (+Th,A,He), nivenite (+Yt), Bröggerite (+Th)	$UO_3.UO_2$,PbO, etc.	6.5–9.7
7	Uranite lime (R)	See autunite		
8	Uvarovite	calcium-chromium garnet	$3CaO.Cr_2O_3.3SiO_2$	3.418–3.81
9	Valentinite	....	Sb_2O_3	5.566
10	Vanadinite	....	$9PbO.3V_2O_5.PbCl_2$	6.7–7.2
11	Variscite	....	$AlPO_4.2H_2O$	2.47–2.54
12	Vesuvianite	idocrase	$Ca_6[Al(OH,F)]Al_2(SiO_4)_5$	3.35–3.45
13	Villiaumite	....	NaF	2.79
14	Vivianite	blue iron ore	$Fe_3(PO_4)_2.8H_2O$	2.58–2.693
15	Wagnerite	....	$Mg_3P_2O_8MgF_2$	2.985–3.14
16	Wavellite	....	$4AlPO_4.2Al(OH)_3.9H_2O$	2.316–2.356
17	Whewellite	....	$CaC_2O_4.H_2O$	2.23
18	Willemite	troosite, var. cont. Mn	Zn_2SiO_4, (+Mn)	3.89–4.19
19	Witherite	....	$BaO.CO_2$	4.28–4.35
20	Wolframite	peanut ore	$(Fe.Mn)WO_4$	7.14–7.54
21	Wollastonite	tabular spar	$CaSiO_3$	2.80–2.92
22	Wulfenite	....	$PbMoO_4$	6.7–7.0
23	Xenotime	xenotimite	$Y_2O_3.P_2O_5$	4.45–4.56
24	Zeunerite (R)	....	$Cu(UO_2)_2As_2O_8.8H_2O$	3.28
25	Zincite	red zinc ore	ZnO	5.43–5.70
26	Zircon	hyacinth, jargon	$ZrSiO_4$	4.02–4.86

MINERALS (Continued)

No.	Hard-ness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V ° ′
1	4.5–5.0	rhomb., grnsh. gray, bluish, pink, yel. to br.	1.688, 1.688, 1.692	....
2	soft	monocl.	1.585, 1.630, 1.630	....
3	2.5–3.0	monocl., gray or yelsh. wh.	1.410, 1.492, 1.542	....
4	5.5–6.0	dk. redsh. blk. or br., red.	(Li): 2.450, 2.550, 2.550	....
5	5	tricl., blue, grn.	1.61, 1.62, 1.65	....
6	5.5	cub. or amor., gray, br.-blk.	....	....
7				
8	6.5–7.5	cub., emer. grn.	1.838	....
9	2.5–3.0	rhomb., wh., gray	2.18, 2.35, 2.35	....
10	3	hex., yel., br. or red	2.354, 2.299	....
11	4	rhomb., grn.	1.551, 1.558, 1.582	....
12	6.5	tetr., yel., grn., br., rar. bl., red., blk.	1.716, 1.718	....
13	3.5	cub.	1.336	....
14	1.5–2.0	monocl., col. to bl. or blsh. grn. on expos.	1.579, 1.603, 1.633	....
15	5.0–5.5	monocl., col., yel., grayish, grnsh., redsh.	1.569, 1.570, 1.582	37 49
16	3.5–4.0	rhomb., col., gray., yel., grn., blue, blk.	1.525, 1.534, 1.552	....
17	2.5	monocl., col.	1.491, 1.555, 1.650	....
18	5.5	hex. (trig.-rhbdr.), wh. or grn. yel.-redsh.-br.	1.694, 1.723	....
19	3.00–3.75	rhomb., col , grayish wh. or yelsh.	1.529, 1.676, 1.677	....
20	5.0–5.5	monocl., dk. gray or brnsh. blk.	2.310, 2.360, 2.460	....
21	4.5–5.0	monocl., wh -gray, yel., red or br.	1.616, 1.629, 1.631	40
22	2.5–3.0	tetr., yel., red, grn., gray, wh.	(Li): 2.402, 2.304	....
23	4–5	tetr., yel.-br., brnsh. red-gray	1.721, 1.816	....
24	2.0–2.5	tetr.	1.643–1.623	....
25	4.0–4.5	hex., red or yel.	2.008, 2.029	....
26	7.5	tetr., col., pa. yel., gray, yelsh. grn., br., redsh.-br.	1.9239, 1.9682	....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Aluminum				
99.2Al	Aluminum 2S	2.71	23.94×10^{-6}	660
97Al, 3Cu	.....	.....	24	640
95Al, 5Cu	Lynite, body alloy	.....	26	650
95Al, 4.2Cu, 0.6Mn, 0.5Si, 0.4Fe	Zeppelin rod	.....	.....	.....
95Al, 2Cu, 1.5Mg, 0.8Fe, 0.2Si, 0.01Mn	Lynite, piston	.....	.....	.....
94Al, 4Cu, 0.5Mg, 0.5Mn, coated with 99.7 + Al	Alclad 17 ST	2.96	21.96	538–46
93Al, 7–8.5Cu, $\not>$1.7 other elements	Lynite, 146	.....	.....	.....
92Al, 9.3–11Cu, $\not>$2 other elements	Lynite, 122	.....	.....	.....
90Al, 7.8Cu, 1.5Zn, 1.3Fe	Lynite, crank case	.....	.....	.....
89Al, 11Cu, 0.5Mg	Lynite, piston	.....	.....	.....
89Al, 12–14Cu, $\not>$2 other elements	Lynite, 109	.....	.....	.....
99Al, 0.4Fe, 0.4Si, 0.1Zn, 0.06Cu	Zeppelin braces	.....	.....	.....
90 Al, 10Mg	Magnalium	2.50	24	600
70Al, 30Mg	Magnalium	2.00	.....	435
98Al, 1.25Mn	Aluminum Alloy 3S	2.74	23.04	640–55
95Al, 5Si	Aluminum-silicon 43	2.58	21.96	577–630
91Al, 9Zn	.....	2.80	26	650
90Al, 7.8Zn, 0.7Cu, 0.5Fe, 0.4Si, 0.3Mn, 0.1Sn	Zeppelin angles	.....	.....	.....
89Al, 9Zn, 0.7Cu, 0.5Si, 0.5Mn, 0.4Fe, 0.2Sn	Zeppelin channels	.....	.....	.....
77Al, 21Zn, 1.1Cu, 0.5Fe, Pb, Sn	Liberty pistons	.....	.....	.....
70Al, 30Zn	.....	.....	26	610
Bismuth				
53Bi, 32Pb, 15Sn	Eutectic fusible alloy	.....	.....	96
52Bi, 40Pb, 8Cd	Eutectic fusible alloy	.....	.....	91.5
50Bi, 27.1Pb, 22.9Sn	Rose metal	.....	.....	.....
50Bi, 27Pb, 13Sn, 10Cd	Eutectic fusible alloy; Lipowitz alloy	.....	.....	70–4
50Bi, 25Pb, 12.5Sn, 12.5Cd	Wood's metal	9.70	.....	65.5
40Bi, 40Pb, 20Sn	Bismuth solder	.....	.....	111
54Bi, 26Sn, 20Cd	Eutectic fusible alloy	.....	.....	103
45Bi, 17Sn, 30Pb, 5–10Hg	Fusible tea spoons	.....	.....	.....
Cerium				
70–3Ce, 17–24Zn, 1.6–6Fe, 0–2.4Al, Mn	Ignition pin alloy	.....	.....	.....
61Ce, 37Fe	Ignition pin alloy	.....	.....	.....
Cobalt				
56Co, 34–40Cr, 9.2W, 1.2–2C, 0–1Fe	Stellite No. 2	.....	.....	.....
55Co, 20–3Cr, 15–20W, 3–5Fe, 1.5–4C	Stellite, No. 3	.....	.....	.....
35Co, 26Cr, 13W, 10Fe, 10Mo, 1.8C	Stellite	.....	.....	.....
45–61Co, 24–40Mo, 13–15 Cr, Fe	Stellite	.....	.....	.....
40–80Co, 20–35Cr, 0–25W, 0.75–2.5C	Stellite	8.50	14.99	1150

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Copper				
99.9 + Cu	Deoxidized copper	8.50	17.71×10^{-6}	1082
99.90 + Cu, 0.01P	Deoxidized copper	8.91	17.71	1082
90Cu, 10Al	Aluminum bronze	7.6	16.5	1050
90Cu, 9Al, 1Fe	Resistac	.....	....	1066
80–90Cu, 8–10Al, 6–7Fe	Ampco Metal	7.20	....	649
88–96.1Cu, 2.3–10.5Al, Fe, Sn	Aluminum bronze	7.50–8.19	....	1038–71
55–80Cu, 20–35Cr, 0–10W	Stellite	.....	....	.....
50Cu, 25Au, 25Ag	Cooper's pen metal	.....	....	.....
47Cu, 33Au, 20Ag	Gold 8 carat	.....	....	.....
40Cu, 31Au, 19Ag, 10Pd	Palladium gold	.....	....	.....
77Cu, 15Pb, 8Sn	"B" Alloy, P.R.R.	.....	....	.....
95Cu, 5Mn	Manganese bronze	8.8	....	1060
82–6Cu, 4–15Mn, 2–12Ni, Fe	Manganin	.....	....	.....
82Cu, 15Mn, 3Ni	Manganin	8.5	....	.....
70Cu, 25Mn, 5Ni	Manganin	.....	....	.....
61Cu, 26Mn, 13Al	Magnetic alloy	.....	....	.....
88.5Cu, 5Ni, 5Sn, 1.5Si	Barberite	8.80	....	1070
80Cu, 20Ni	Nickeline	8.5	....	1185
75 Cu, 25Ni	Nickel coinage, U.S.A.	.....	....	1205
75Cu, 20Ni, 5Zn	Ambrac A	8.58	16.40	1150
65Cu, 18Ni, 17Zn	Nickel silver 18% A	8.75	18.36	1110
60Cu, 40Ni	Constantan	8.4	....	1290
55–65Cu, 12–18Ni, 11–17Zn, 8–12 Fe, 0.5–1Si	Glass mold alloy, U.S.P. 1,360,773	.....	....	.....
57Cu, 20Ni, 20Zn, 3Al	Typewriter metal	.....	....	.....
55Cu, 18Ni, 27Zn	Nickel silver 18% B	8.69	....	1055
45–60Cu, 40–55Ni, 0–1.4Mn, 0.1C, Fe	Constantan	.....	....	.....
45Cu, 33Ni, 16Sn, 5.5Zn, 1Bi	Sea water bronze	.....	....	.....
67–81Cu, 19–30Pt, 0–4Zn	Cooper's gold	.....	....	.....
94.8–96Cu, 3–4Si, 1–1.2Mn	Everdur	8.46	16.99	1000
98.55Cu, 1.40Sn, 0.05Si	Phono-electric wire	.....	....	.....
95.5Cu, 4.3Sn, 0.2P	Phosphor bronze 30	8.91	18.90	1050
95Cu, 4Sn, 1Zn	Coinage bronze	8.96	....	.....
92–7Cu, 1–8Sn, 0–2Zn	Medal bronze	.....	....	.....
91.6Cu, 8.25Sn, 0.15P	Phosphor bronze 47	8.91	....	.....
90Cu, 10Sn, trace P	Phosphor bronze 209	9.00	....	.....
90Cu, 10Sn	Bronze, gun metal	8.8	18	1000
88Cu, 10Sn, 2Zn	U.S. Government bronze, spec. G	.....	....	.....
82Cu, 16Sn, 2Zn	Bronze bearings	.....	....	.....
83Cu, 14Sn, 3.5Pb	Naval journal bearing, spec. HX	.....	....	.....
83Cu, 14Sn, 3.5Zn	Naval journal bearing, spec. H	.....	....	.....
83Cu, 14Sn, 3Zn, 0.8Pb	U.S. Government bronze, spec. H	.....	....	.....
79.7Cu, 10Sn, 9.5Sb, 0.8P	Phosphor bronze	8.8	....	.....
78Cu, 22Sn	Bell metal	8.7	....	870
67Cu, 33Sn	Bronze, speculum metal	8.6	18.6	745
58Cu, 28Sn, 9.5Pt, 3.5Zn, 1.5As	Cooper's mirror	.....	....	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Copper				
90Cu, 10Zn	Commercial bronze; red brass	8.80	18.18×10^{-6}	1050
89Cu, 9Zn, 2Pb	Hardware bronze	8.83	18.18	1050
85Cu, 15Zn	Red brass	8.75	18.72	1030
85Cu, 13Zn, 2Sn	Pen metal	.....	....	.....
84Cu, 16Zn	Medal metal	.....	....	.....
70Cu, 29Ni, 1Sn	Adnic	.....	16.29	1205
70Cu, 29Zn, 1Sn	Admiralty	8.17	20.16	935
67-72Cu, 28-33Zn, Pb, Fe	Spring brass	.....	....	.....
67-70Cu, 30-33Zn, Pb, Fe	Cartridge brass	.....	....	.....
67Cu, 33Zn	Brass, ordinary yellow	8.40	18.5	940
64Cu, 25Zn, 8.5Pb, 2.5Sn	Ship nail brass	.....	....	.....
61.2Cu, 37.3Zn, 0.9Sn, 0.4Pb, 0.2Fe	Tobin bronze	.....	....	.....
61Cu, 39Zn	Pin wire brass	.....	....	905
60-1Cu, 31-7Zn, 1.4Sn, 0.7-.9Pb	Pewter, for clock work	.....	....	.....
60Cu, 40Zn	Muntz metal	.....	....	840
60Cu, 25Zn, 15Ni	German silver	.....	18.4	.....
60Cu, 19Zn, 10Al, 6Fe, 5Mn	Hytensl bronze	.....	....	980
58Cu, 42Zn	Solder, very refractory	.....	....	850
58Cu, 17.5Zn, 11.5Ni, 11Co, 2Ag	Chinese silver	.....	....	.....
57Cu, 28Zn, 15Sn	Solder, very soft, white	.....	....	.....
55Cu, 45Zn	For brazing	.....	....	880
55Cu, 25Zn, 20Ni	German silver, common formula	.....	....	.....
53Cu, 43Zn, 1.3Sn, 0.3Pb	Solder, hard yellow	.....	....	.....
53Cu, 39Zn, 2.7Sn, 2.5Ni, 1.7Mn, 0.2Al	Manganin	.....	....	.....
52Cu, 26Zn, 22Ni	German silver	8.45	....	.....
51Cu, 32Zn, 9.5Pb, 6.4Ni, 1.6Sn	Dienett's German silver	.....	....	.....
50Cu, 50Zn	Solder, refractory	.....	....	900
50-7Cu, 43-50Zn	Solder, hard	.....	....	.....
50-62Cu, 20-32Zn, 12-30Ni	German silver, Birmingham	.....	....	.....
50-60Cu, 20-5Zn, 20-5Ni	German silver, Austrian (Gersdorf)	.....	....	.....
46Cu, 34Zn, 20Ni	German silver, best	.....	....	.....
Gold				
79Au, 21Al	Roberts-Austen (purple gold)	.....	....	750
92Au, 8Cu	Standard gold, Great Britain	.....	....	900
90Au, 10Cu	Coinage	17.17	....	940
84Au, 16Cu	Jewelry	.....	....	895
75Au, 24Cu	Jewelry	.....	....	925
67Au, 25Cu, 8Ag	Pen metal	.....	....	.....
67Au, 8-27Cu, 6.6-26Ag	Gold 16 carat	.....	....	.....
62Au, 13Cu, 11Ag	Gold 15 carat	.....	....	.....
58Au, 14-28Cu, 4-28Ag	Gold 14 carat	.....	....	.....
50Au, 50Cu	Dark red gold	.....	....	1000
50Au, 35Cu, 15Ag	Gold solder 12 carat	.....	....	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point C.
Gold				
42Au, 38–46Cu, 12–20Ag	Gold 10 carat	.....	....	.....
86Au, 5.7–17Fe, 0–8.6Ag	Gray gold	.....	....	.....
75Au, 25Fe	Blue gold	.....	....	1165
75–85Au, 8–10Ni, 2–9Zn	White gold	.....	....	.....
90Au, 10Pd	White gold, palladium gold	.....	....	1265
60–90Au, 10–40Pd	Rhotanium	.....	....	.....
80Au, 20Pd	Palau	.....	....	1375
60Au, 40Pt	Platinum gold, white	.....	....	1500
92Au, 4.9Ag, 3.1Cu	Gold 22 carat dental, dark	.....	....	.....
91.66Au, 4.16Ag, 4.16Cu	Gold 22 carat	.....	....	.....
92Au, 0–8.3Ag, 0–8.3Fe	Pale yellow gold	.....	....	.....
84Au, 8.3–11Ag, 6–8.3Cu	Gold 20 carat	.....	....	.....
75Au, 17Ag, 8.3Cu	Gold solder 16 carat	.....	....	.....
75Au, 10–20Ag, 5–15Cu	Gold 18 carat	.....	....	.....
63–75Au, 13–31Ag, 6.3–12Cu	Gold solder 18 carat	.....	....	.....
70Au, 25Ag, 5Ni or Pt	Platinum substitute, electrical	.....	....	.....
68Au, 25Ag, 7.5Pt	Platinum substitute, electrical	.....	....	.....
63Au, 23Ag, 15Cu	Gold solder, best	.....	....	.....
58Au, 30Ag, 12Cu	Gold 14 carat dental	.....	....	.....
55Au, 32Ag, 14Cu	Gold solder, easy melt	.....	....	.....
50 Au, 33Ag, 17Cu	Gold solder 14 carat	.....	....	.....
41Au, 37Ag, 21Cu, 0.6 brass	Gold solder 10 carat	.....	....	.....
40Au, 37Ag, 23Cu	Gold solder 8 carat	.....	....	.....
Iridium				
95Ir, 5Pt	....	22.38	....	....
Iron				
99.94Fe, 0.025S, 0.017Mn, 0.012C, 0.005P	Armco ingot iron	7.86	....	1530
98.5Fe	Wrought iron	7.70	....	1510
80Fe, 20Al	Ferro-aluminum	6.30	....	1480
99Fe, 1C	Steel	7.83	12.0	1430
97Fe, 3C	Cast iron, white	7.60	....	1150
94Fe, 3.5C, 2.5Si	Cast iron, gray	7.0	11.2	1230
Fe, 30–40Co, 5–9W, 1.5–3-Cr, 0.4–0.8C	K. S. Magnet steel	.....	....	.....
Fe, 0.45Cu, 0.07Mo, 0.03C	Toncan copper; molybdenum iron	7.83	11.99	1525
Fe, + 10Cr, < 0.5Mn, + 0.25C	Stainless steel	7.75	....	1510
90–2Fe, +8Cr, 0.4Mn, < 0.12C	Stainless steel	7.75	11.00	1450
90Fe, +8Cr, 0.4Mn, < 0.12C	Stainless iron	7.75	11.00	1450
88Fe, 16–7Cr, 0.4Mn, 0.1C max	Stainless iron	.....	9.99	.....
86–8Fe, 12–4Cr, 0.3C	Carpenter stainless steel 2	7.75	....	1425
86–8Fe, 12–4Cr, <0.5Mn, < 0.1C, trace Ni	Defirust rustless iron	7.75	....	1480

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Iron				
86–8Fe, 12–4Cr, 0.1C	Carpenter stainless steel 1	7.78	....	1490
85–9 Fe, 10–4 Cr, <0.5Mn, <0.13C	Stainless iron	7.78	10.19	1490
82–6Fe, 12–6Cr, <0.5Ni, <0.05Si, <0.5 Mn, <0.12C	Ascoloy 33	7.64	10.89	1495
86.7Fe, 12.5Cr, 0.35Mn, 0.35Ni, 0.12C	Sterling stainless steel T	7.75	9.99	1430
86.4Fe, 13.5Cr, 0.1C	Stainless I	7.75	10.91	.....
84–6Fe, 12.5–4.5Cr, 0.5Mn max., 0.5Si max., 0.5Ni min., 0.12–0.18C	Enduro S15	7.86	10.89	1475
84–6Fe, 12.5–4.5Cr, 0.5Mn max., 0.5Si max., 0.25Ni, 0.05–.12C	Enduro S	7.86	10.89	1500
85.8Fe, 13.5Cr, 0.35Mn, 0.35C	Sterling stainless steel A	7.75	10.30	1425
85.6Fe, 14Cr, 0.35C	Stainless A	7.75	10.91	.....
85Fe, 13–4Cr, 2Ni max., 0.3–.6Mn, 0.12C max	Enduro KM1	7.75	9.99	1490
82–4Fe, 16–8Cr, <0.5Mn, C	Duraloy B	7.61	....	1510
84.3Fe, 12Cr, 2.15C, 0.75V, 0.75Co	Crocar	.....	....	.....
82–4Fe, 16–8Cr, <0.5Mn, <0.1C, trace Ni	Special defirust rustless iron	7.75	....	1480
81–3Fe, 16.5–8.5Cr, 0.75Si, 0.1C max	Enduro A	7.64	11.00	1510
82.8Fe, 16.5Cr, 0.65C	Stainless B	.....	....	.....
82.5Fe, 16.5Cr, 0.65C, 0.35Mn	Sterling stainless steel B	7.72	10.91	1425
82Fe, 16–8Cr, 0.5Mn, 0.5Ni, 0.35C	Sweetaloy 16	7.83	11.00	1495
79–82Fe, 16–9Cr, <0.5Mn, <0.5Ni, <0.5Si, <0.12C	Ascoloy 66	7.64	....	.....
79–82Fe, 16.5–8.5Cr, 0.5Mn max., 0.5–1.25Si max., 0.25Ni max., 0.1C max	Enduro A	7.86	10.80	1490
79–81Fe, 16.5–18Cr, 1–1.1C, 0.75–1Si, 0.35–.5Mn	Delhi hard	7.75	9.99	1500
78.7Fe, 20Cr, 1Cu, 0.3C	Carpenter stainless steel 3	7.70	....	1475
71–6Fe, 17–9Cr, 7–10Ni, <0.05Mn, 0.2C	Defistain rustless iron	7.83	....	1455
71–5Fe, 17–9Cr, 8–9Ni, <0.5Mn, 0.06–.25C	Midvale V2A	7.89	16.99	1450
70–5Fe, 25–30Cr, <0.5Mn, 0.25C, trace Ni	Defiheat rustless iron	7.89	....	1595
Fe, 17–20Cr, 7–10Ni, <0.5Mn, <0.5Si, <0.2C	Allegheny metal	7.86–.95	17.30	1430–70
69–75Fe, 16.5–9.5Cr, 7–10Ni, 0.75Si max., 0.5Mn max., 0.15C max	Enduro KA2	7.86	15.98	1400

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Iron				
74Fe, 18Cr, 8Ni, 0.18C...	Stainless N...........	....	18.00×10^{-6}	.....
71-4Fe, 17.5-19Cr, 8-9Ni, 0.5Mn, 0.15C max......	Rezistal KA2.........	7.86	15.98	.....
73.5Fe, 18Cr, 8Ni, 0.35Mn, 0.15C...............	Sterling nirosta steel...	7.92	16.99	1425
73Fe, 18Cr, 9Ni, 0.5Mn, C	Duraloy 18-8..........	7.86	14.99	1475
70-3Fe, 27-30Cr, 0.5Mn, C	Duraloy A............	7.61	....	1510
72.4Fe, 18Cr, 9.5Ni, 0.1C	Carpenter stainless steel 4....................	7.72	....	1400
70-2Fe, 17.5-19Cr, 8-9Ni, 2-2.5Si, 0.1-.2C........	Rezistal 2C..........	7.86	15.98	.....
68-72Fe, 26-30Cr, <1Mn, <0.6Ni, <0.6Si, <0.25C	Ascoloy 55............	7.61	10.19	.....
70Fe, 28Cr, 0.5Mn, 0.5Ni, 0.5C.................	Sweetaloy 19.........	7.86	11.00	1495
70Fe, 19Cr, 9Ni, 1Cu, 1Mo, 0.2C.................	Stainless U...........	.....	18.00	.....
69Fe, 18-20Cr, 8-10Ni, 0.5 Mn, 0.15C............	Sweetaloy 17..........	7.86	15.98	1450
68.1Fe, 20Cr, 7Ni, 4W, 0.35C, 0.5Mn..........	Midvale HR..........	8.03	....	.....
60-6Fe, 22-5Cr, 10-3Ni, <1Mn, <0.5Si, <0.2C.	Ascoloy 44............	7.86-.95	16.20	1400-25
57-62Fe, 28-30Cr, 8-10Ni, 1.5Si, 0.5-.7C, 0.4-.5Mn	Misco C...............	7.89	....	1540
60Fe, 28Cr, 10Ni, 0.5Mn, 0.35C.................	Sweetaloy 22..........	7.97	....	1495
50Fe, 50Cr..............	Ferro-chromium........	6.9	....	1460
50-4Fe, 25-6Cr, 19-21Ni, 2-3Si, 0.2C............	Rezistal 7............	.....	....	.....
85-8Fe, 11-4Mn, 1-1.3C..	Rol-Man Manganese steel	.....	....	1290
86Fe, 13Mn, 1C..........	Manganese steel........	7.81	....	1510
50Fe, 50Mn.............	Ferro-manganese.......	.....	....	1325
96.5Fe, 3.5Ni............	Nickel steel...........	.....	....	1530
95.1Fe, 3Ni, 1.5Cr, 0.4C..	Nickel-chrome steel....	.....	....	.....
79Fe, 15Ni, 2.5Cr, 3Si, 0.6C...................	Durimet D............	.....	....	1450
74.2Fe, 25Ni, 0.8C.......	Ferro-nickel..........	8.1	18	1500
70.9Fe, 20Ni, 8Cr, 0.75Mn, 0.4C..................	Cyclops 17 Metal......	8.00	....	1425-80
70Fe, 25Ni, 5Si, 0.25C....	Durimet A............	7.89	....	1500
67.8Fe, 32Ni, 0.2C........	Ferro-nickel, valve steel	8.0	4	1480
67Fe, 22Ni, 10Cr, 0.5Mn, 0.2C..................	Sweetaloy 18..........	7.97	18.90	1450
63.8Fe, 36Ni, 0.2C........	Invar.................	8.0	0.8	1495
57-61Fe, 24-6Ni, 10-2Cr, 4.5-5.5Si, 0.15C........	Rezistal 255C.........	7.81	....	.....
51-8Fe, 25-8Ni, 13-5Cr, 3-4W, 1-1.5Mn, 0.4-0.5-C.....................	Midvale ATV 3........	8.11	....	.....
57Fe, 25Ni, 15Cr, 0.3C....	Pyrasteel.............	7.89	17.10	1450
47-56Fe, 33-9Ni, 10-2Cr, 1.1-1.8Mn, 0.25-.35C..	Midvale ATV 1........	8.06	....	1450
53-6Fe, 24-6Ni, 17-8Cr, 2.5Si, 0.15-.25C........	Rezistal 4............	7.78	16.29	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Iron				
53.85Fe, 46Ni, 0.15C	Platinite	8.2	7.5×10^{-6}	1470
47–52Fe, 34–6Ni, 10–2Cr, 4.5–5.5Si, 0.15C	Rezistal 355C	7.81	....	.....
Fe, 35–7Ni, 15–7Cr, 1.4–1.6Si, 0.6–.8Mn, 0.5–.7C	Standard Misco	7.97	13.50	1540
50Fe, 35Ni, 15Cr	Chromax castings	7.81	12.19	1480
48Fe, 35Ni, 12Cr, 5Si, 0.25C	Durimet B	7.89	....	1500
45Fe, 36Ni, 18Cr, 0.5Mn, 0.3C	Sweetaloy 20	7.97	....	1495
97.6Fe, 2Si, 0.4C	Silicon steel	.....	....	.....
73–97Fe, 1–24Si, 2–3C, 0.1P, 0.04–.14S	Meehanite metal	.....	....	.....
84.86Fe, 13.5Si, 1C, 0.4Mn, 0.18P, 0.05S	Tantiron	7.83	....	1315
84.3Fe, 14.5Si, 0.85C, 0.35Mn	Duriron	7.00	15.59	1265
94.5Fe, 5W, 0.5C	Tungsten steel	.....	....	.....
75Fe, 18W, 6Cr, 0.3V, 0.7C	High speed steel	.....	....	.....
66Fe, 17W, 10Cr, 3.5C, 2.5Mo	Cristite 1	7.61	15.59	.....
Lead				
99.8Pb, 0.2As	Lead shot	.....	....	.....
94Pb, 6Sb	Battery plates	.....	....	300
92–4Pb, 6–8Sb	Antimonial lead	11.0	27.00	245–90
90Pb, 10Sb	Magnolia	.....	....	270
85Pb, 15Sb	....	10.4	19.5	250
84.33Pb, 14.38Sb, 0.61Fe, 0.68Zn	Car box metal	.....	....	.....
82Pb, 15Sb, 3Sn	Type metal	.....	....	.....
75Pb, 19Sb, 5Sn, 1Cu	White metal	9.5	....	238
70Pb, 18Sb, 10Sn, 2Cu	Type metal	.....	....	.....
92Pb, 8Cd	Aluminum solder, U.S.P. 1,333,666	.....	....	310
99.93Pb, 0.08Cu	Chemical lead	11.35	28.98	327
87Pb, 13Sn, 1Cu	Lead foil (Calin)	.....	....	.....
72Pb, 21Sn, 7Sb	Marine babbitt	.....	....	.....
67Pb, 33Sn	Solder, plumber's	9.4	25.0	275
56–60Pb, 10–40Sn, 4.5–30Sb	Type metal, common	.....	....	.....
58Pb, 26Sn, 15Sb, 1Cu	Type metal, standard	.....	....	.....
50Pb, 50Sn	Solder, half and half	.....	24	225
Mercury				
80Hg, 20Bi	Bismuth amalgam	.....	....	90
70Hg, 30Cu	Dentist's amalgam	.....	....	.....
Nickel				
99–99.5Ni(+Co), 1–0.25C, 1–0.25Si, 1–0.3Mn, 1–0.55Fe, 1–0.25Cu	Nickel	8.86	....	1450
Ni–Cr steel alloy of high Si content	Elcomet	8.03	....	.....
80Ni, 20Cr	Chromel A	8.4	....	.....
80Ni, 20Cr	Tophet A	8.50	13.00	1345
80Ni, 20Cr	Nichrome IV	8.50	13.21	1395

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Nickel				
63Ni, 21Cr, 6.5Cu, 5Mo, 2W, 1Fe, 1Mn, 1Al......	Illium.................	.....	....	.....
60Ni, 25Cr, 7Cu.........	Illium G...............	8.31	13.50	1300
60Ni, 20Cr, 10Fe, 1.75Mn, 0.5C.................	Firearmor.............	8.00	13.99	1330
73Ni, 17.5Co, 6 5Fe, 2.5Ti, 0.2Mn............	Konel.................	8.61	10.66	1450–1500
90Ni, 3Cu, 1.5Al, 10 ± Si.	Hastelloy D...........	7.81	11.59	1160
60–70Ni, 25–35Cu, 1–3Fe, 0.25–2Mn, 0.02–1.5Si, 0.5–.3C...............	Monel metal...........	8.80	....	1330
60Ni, 33Cu, 6.5Fe........	Monel metal...........	8.90	14	1360
75Ni, 12Fe, 11Cr, 2Mn....	Nichrome wire or ribbon	.....	....	.....
61Ni, 23Fe, 16Cr.........	Chromel C............	8.24	....	.....
60–2Ni, 23–6Fe, 10–11Cr, 2–2.5W, 1.2–1.5Mn, 0.3–.35C..................	Midvale BTG..........	8.47	....	1450
60Ni, 28Fe, 12Cr.........	Tophet C.............	8.19	13.70	1350
60Ni, 25Fe, 15Cr, 0.7C....	Nichrome castings......	8.08	12.10	.....
60Ni, 24Fe, 16Cr, 0.1C....	Nichrome.............	8.17	13.70	1350
60Ni, 20Fe, 20Mo........	Hastelloy A...........	8.80	10.71	1300
35Ni, 17Fe, 15Cr, 1.75Mn, 0.5C.................	Zorite................	7.92	....	1300
Ni, 2–6Mn, Fe, Cu.......	Spark plug wire........	.....	....	.....
Ni, Fe, Mo..............	Hastelloy C...........	8.91	....	1350
60Ni, 20Pt, 10Pd, 10V....	Palau................	.....	....	.....
Magnesium				
94Mg, 5.8Al, 0.2Mn......	Dowmetal E...........	.....	....	.....
92Mg, 8Al...............	Dowmetal A...........	.....	....	600
90Mg, 8Al, 1Cu, 1Cd.....	Dowmetal R...........	.....	....	.....
90Mg, 3-7Al, 2-5Zn, 0.5Mn.	Electron..............	.....	....	.....
88Mg, 12Al..............	Dowmetal B...........	.....	....	575
88Mg, 8.3Al, 2.0Cu, 1.0Cd, 0.5Zn, 0.2Mn..........	Dowmetal D...........	.....	....	.....
85Mg, 15Al..............	Dowmetal C...........	.....	....	590
92Mg, 3.8Cu, 2Cd, 0.2Mn.	Dowmetal T...........	.....	....	.....
95Mg, 4–5Zn, 0–0.6Cu....	Electron..............	.....	....	.....
Palladium				
67Pd, 33Ag..............	Palladium alloy.........	.....	....	1415
90Pd, 10Rh..............	Palladium alloy.........	.....	....	.....
Platinum				
80–100Pt, 0–20Ir.........	Platinum-iridium.......	.....	7.5–8.8	.....
90Pt, 10Ir...............	Platinum-iridium.......	21.61	8.8	.....
55Pt, 28Ir, 7Rh, 3Cu, 4Fe, Pd, As............	Platinum-iridium (natural)...............	.....	....	.....
80–100Pt, 0–20Rh.........	Platinum-rhodium for thermocouples.......	.....	8.8	.....
90Pt, 10Rh..............	Platinum-rhodium......	.....	....	.....
50Pt, 38Ag, 12Cu........	Cooper's pen metal.....	.....	....	.....
Silver				
92.5Ag, 7.5Cu...........	Standard silver.........	.....	18	920
92.5Ag, 5.75Cu, 1.75Cd...	Standard cadmium silver	.....	....	.....
92Ag, 8Cu...............	Silver-rupee...........	.....	....	920
90Ag, 10Cu..............	Silver U.S. coins.......	10.3	....	890

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Silver				
80Ag, 20Cu	Jewelry	.....	18×10^{-6}	820
80Ag, 13Cu, 6.8Zn	Silver solder, hard	.....	....	.....
70–5Ag, 20–3Cu, 5–7.5Zn	Silver solder, medium	.....	....	.....
66Ag, 23Cu, 10Zn	Silver solder, French	.....	....	.....
63Ag, 30Cu, 7.5Zn	Silver solder, common	.....	....	.....
55Ag, 29Cu, 12Au, 5.5Zn	Gold solder, very easy melt	.....	....	.....
70Ag, 25Pd, 5Co	Platinum substitute (Cooper's)	.....	....	.....
73Ag, 27Pt	Platinum solder	.....	....	1160
70 Ag, 25Pt, 5Ni	Platinum substitute (Cooper's)	.....	....	.....
66.7Ag, 33.3Pt	Platinum silver	.....	....	1230
40Ag, 40Sn, 14Cu, 6Zn	Silver solder, Bu. Stands.	.....	....	.....
Tantalum				
99.5Ta	Tantalum	16.6	6.50	2850
Tin				
78Sn, 9Al, 8Zn, 5Cd	Aluminum solder, Bu. Stands. SN1	.....	....	.....
70–94Sn, 3.7–15Sb, 1.8–5-Cu, 0–9Pb, 0–5Zn	Brittania metal, German	.....	....	.....
90–1Sn, 7–8Sb, 1.4Cu	Brittania metal, plate	.....	....	.....
90Sn, 10Sb	Brittania	.....	....	255
90Sn, 7Sb, 3Cu	Babbitt	.....	....	.....
85–90Sn, 9–11Sb, 0–3Zn, 0.2–1Cu	Brittania metal, cast	.....	....	.....
85–90Sn, 5–10Sb, 1–3Cu, 0–3Zn, 0–2Bi	Brittania metal, English	.....	....	.....
89Sn, 7.3Sb, 3.7Cu	Babbitt metal	.....	....	.....
85–8Sn, 5.6–15Sb, 1–5Bi, 0.1–3.7 Cu, 0–1.5Zn	Brittania metal, spoons	.....	....	.....
82Sn, 12Sb, 6Cu	White metal	.....	....	.....
80Sn, 20Sb	....	.....	....	320
75Sn, 12.5Sb, 12.5Cu	Antifriction	7.53	....	233
72Sn, 24Sb, 3.9Cu	Brittania metal, plate (Ludenscheidt)	.....	....	.....
68Sn, 32Cd	....	7.70	....	180
85Sn, 6.8Cu, 6Bi, 1.7Sb	Pewter	.....	....	.....
83Sn, 8.4Cu, 8.3Sb	Hard babbitt	.....	....	.....
97Sn, 3Cu	Rhine metal	7.35	....	300
74–89Sn, 0–20Pb, 0–7.6Sb, 0–3.5Cu, Zn	Pewter	.....	....	.....
88Sn, 8Pb, 4Cu, 0.5Sb	Tinfoil	.....	....	.....
67Sn, 33Pb	Solder, tinman's	.....	....	240
60Sn, 40Pb	Tinsel	.....	....	.....
50Sn, 32Pb, 18Cd	Eutectic fusible alloy	.....	....	145
86Sn, 9Zn, 5Al	Aluminum solder, Bu. Stands. SN4	.....	....	.....
86Sn, 9Zn, 5Al, 0.25P	Aluminum solder, Bu. Stands. SN3	.....	....	.....
73Sn, 21Zn, 5Pb, 1P, Sn	Aluminum solder, Seifert	.....	....	.....
69Sn, 26Zn, 2.4Al, 2.4P	Aluminum solder, Bu. Stands. SN2	.....	....	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Tin				
62Sn, 15Zn, 11Al, 8.3Pb, 2.5Cu, 1.2Sb	Aluminum solder, Sterling	.....	....	.....
55Sn, 33Zn, 11Al, 1Cu	Aluminum solder, Soluminum	.....	....	.....
48Sn, 48Zn, 3Cu, 1Pb, 1Sb	Brittania metal, cast	.....	....	.....
41Sn, 28Zn, 3Cu, 0.6Mn, 0.1Al	Aluminum solder, U.S.P. 1,332,899	.....	....	.....
Tungsten				
W	Plymite	.....	....	1500
W_2C	Blackor	14.0	....	.....
W, 0.5–0.75ThO_2	Tungsten filaments	.....	....	.....
WC + 13% Co	Carboloy	14.10	6	.....
Zinc				
96Zn, 4Al, .05Mg	ASTM Alloy XXIII SAE Alloy 903 Zamak-3	6.7	.0000269	380.9
95Zn, 4Al, 1Cu, .05Mg	Zamak-5	6.7	.0000274	380.6
93Zn, 4Al, 3Cu, .05Mg	ASTM Alloy XXI SAE Alloy 902 Zamak-2	6.8	.0000277	379.5
95Zn, 5Al	....	6.80	28	380
90Zn, 6Al, 4Cu	Aluminum solder, Geophysical Lab., Carnegie Inst.	.....	....	.....
65Zn, 20Al. 15Cu	Aluminum solder, Wüst No. 2	.....	....	.....
50Zn, 30Al, 20Cu	Aluminum solder, Wust	.....	....	.....
75Zn, 20Cd, 5Al	Aluminum solder, Bu. Stands. ZN1	.....	....	.....
67Zn, 33Cu	Solder, readily fusible	.....	20	795
60Zn, 40Cu	Solder, white	.....	21	840
50Zn, 44Cu, 3.3Sn, 1.2Pb	Solder, nearly white	.....	....	.....
45–57Zn, 35–45Cu, 8–10Ni	Solder, brazing	.....	....	.....
69Zn, 26Sn, 5Cu, 3Sb	Zinc babbitt	.....	....	.....
63Zn, 21Sn, 12Pb, 3.2Cu	Battery plates	.....	....	.....
50Zn, 49Sn, 0.7Sb, 0.2Cu	Aluminum solder, Roesch	.....	....	.....

PROPERTIES OF COMMERCIAL PLASTICS

Compiled by Lauchlin M. Currie—1936

Commercial Plastics

Name	Type	Manufacturer
Ameroid	TP—Casein	American Plastics Corp., 50 Union Sq., N.Y.
Bakelite	TS—Phenol Formaldehyde (Filled)	Bakelite Corp., River Road, Bound Brook, N.J.
Bakelite	TS—Phenol Formaldehyde (Pure hardened resinoid)	Bakelite Corp., River Road, Bound Brook, N.J.
Beetle	TS—Urea Formaldehyde	Beetleware Division, American Cyanamid Co., 30 Rockefeller Plaza, N.Y.
Catalin	TS—Phenol Formaldehyde	American Catalin Corp., One Park Ave., N.Y.
Celluloid	TP—Cellulose Nitrate	Celluloid Corp., 290 Ferry St., Newark, N.J.
Diakon	TP—Acrylate Resin	Imperial Chem. Industries Ltd., Millbank, London, S.W. 1
Durez	TS—Phenol Formaldehyde	General Plastics Inc., North Tonawanda, N.Y.
Fiberloid	TP—Cellulose Nitrate	Fiberloid Corp., Indian Orchard, Mass.
Fiberlon	TS—Phenol Formaldehyde	Fiberloid Corp., Indian Orchard, Mass.
Fibestos	TP—Cellulose Acetate	Fiberloid Corp., Indian Orchard, Mass.
Leukon	TP—Acrylate Resin	Imperial Chem. Industries Ltd., Millbank, London, S.W. 1
Lumarith	TP—Cellulose Acetate	Celluloid Corp., 290 Ferry St., Newark, N.J.
Perspex	TP—Acrylate Resin	Imperial Chem. Industries Ltd., Millbank, London, S.W. 1
Phenalin	TS—Phenol Formaldehyde (Cast Resin)	Du Pont Viscoloid Co., Empire State Bldg., 350 Fifth Ave., N.Y.
Plaskon	TS—Urea Formaldehyde	Plaskon Co., 2112-24 Sylvan Ave., Toledo, Ohio
Plastacele	TP—Cellulose Acetate	Du Pont Viscoloid Co., Empire State Bldg., 350 Fifth Ave., N.Y.
Plioform	TP—Rubber Derivative	Goodyear Tire and Rubber Co., Akron, Ohio
Protectoid	TP—Cellulose Acetate	Celluloid Corp., 290 Ferry St., Newark, N.J.
Pyralin	TP—Cellulose Nitrate	Du Pont Viscoloid Co., Empire State Bldg., 350 Fifth Ave., N.Y.
Resoglaz	TP—Polystyrene	Advance Solvents & Chem. Corp., 245 Fifth Ave., N.Y.
Tenite	TP—Cellulose Acetate	Tennessee Eastman Corp., Kingsport, Tenn.
Textolite	TS—Phenol Formaldehyde	General Electric Co., Plastics Dept., 920 Western Ave., W. Lynn, Mass.
Tornesit	TP—Rubber Derivative	Hercules Powder Co., Wilmington, Delaware
Trolitul	TP—Polystyrene	F. A. Hughes & Co., Ltd., Abbey House, Baker St., London, N.W. 1
Unyte	TS—Urea Formaldehyde	Unyte Corp., 521 Fifth Ave., N.Y.
Victron	TP—Polystyrene	Naugatuck Chemical Division of U. S. Rubber Products Inc., 1790 Broadway, N.Y.
Vinylite	TP—Vinyl Polymer	Carbide and Carbon Chem. Corp., 30 E. 42nd St., N.Y.

TP—thermoplastic, TS—thermosetting.

The data given in the following tables have been secured directly from the manufacturers of the plastics listed. The wide range in test values for certain tests should not be taken as indicating non-uniform materials. The data actually represent a number of different grades which, together, cover the range shown. For details regarding special grades, contacts should be made direct with the manufacturers, as shown in the preceding section.

PROPERTIES OF

	Material—Trade Name Composition	DUREZ Phenol Formaldehyde	BAKELITE Phenol Formaldehyde Filled	TEXTOLITE Phenol Formaldehyde Filled
1	Forms Available............ Cs—cast forms, F—films, I—impregnating varnishes, L—laminations, Lq—lacquers, M—molded articles, P—powder or granules, R—rods, S—sheets, T—tubes	I, P............	L, M, P, R, S, T	L, M, R, S, T...
2	Colors and Clarity.......... C—colorless, Cd—colored, Mo—mottled, O—opaque, T—transparent, Tl—translucent	Cd, Mo, O......	Cd, Mo, O......	Cd, O..........
3	Odor......................	None...........	None to sl. phenolic	Characteristic...
4	Taste......................	None...........	None...........	Characteristic...
	Working Properties			
5	General Type.............. TP—thermoplastic, TS—thermosetting	TS.............	TS.............	TS.............
6	Molding Qualities..........	Excellent........	Excellent—good.	Good...........
7	Molding Conditions			
a	Temperature..............	300° F..........	280°–450° F.....	325° F..........
b	Pressure lb./sq. in.........	3000............	500–5000........	500–4000........
8	Compression Ratio.......... $\frac{\text{Vol. loose powder}}{\text{Vol. solid}}$	2.1–7.0..........	2.0–7.5..........	2.5–4.0..........
9	Shrinkage Behavior—Allowance in molding	.005″–.009″/in...	.002″–.012″/in...	.006″–.008″/in...
10	Tendency to Cold Flow.....	None...........	None...........	None...........
11	Machining Qualities.........	Good...........	Good—fair......	Good—poor.....
12	Extruding Qualities.........	Spec. grades for ext.	Poor—fair.......	Poor............
13	Other Forming Qualities..... B—blowing, E—extrusion, I—injection, Sh—shearing, Sp—spinning, Sw—swaging, TM—transfer molding	E, TM..........	....	....
	Physical Properties			
14	Specific Gravity............	1.33–1.80........	1.30–2.0.........	1.36–1.85........
15	Specific Volume in.^{3}/lb......	20.9–15.4........	21.4–13.9........	20–15...........
16	Refractive Index N_D........	....	....	....
17	Thermal Properties			
a	Burning Rate............	Will not support comb.	Will not support comb.	Extremely low...
b	Effect of Heat—dry.......	No effect up to 200°–235° C.	Withstands 250° C.	Slight ....
	—moist.....	Pimples at high temperatures	Slight shrinkage and hardening	Varies..........
c	Heat Distortion..........	None..........	115°–140° C.....	Above 160° C....
d	Softening Point (s) or Melting Point (m)	Infusible after curing	Infusible.......	....
e	Specific Heat cal./gram °C.	0.30–0.40........	0.27–0.40........	....
f	Thermal Conductivity..... cal. sec.$^{-1}$ cm^{-1} (°C.)$^{-1}$	$(100-180)\times 10^{-5}$	$(30-130)\times 10^{-5}$	....
g	Thermal Expansion$\times 10^5$/°C.	2–3............	....	2.5–3.0..........

COMMERCIAL PLASTICS (Continued)

	FIBERLON Phenol Formaldehyde	CATALIN Phenol Formaldehyde Casting Resin	BAKELITE Phenol Formaldehyde Pure Hardened Resinoid	PHENALIN Phenol Formaldehyde Cast Resin
1	Cs, L, R, S, T	Cs, I, L, R, S, T	Cs, I, Lq, R, S	Cs, R, S, T
2	C, Cd, Mo, O, T, Tl	C, Cd, Mo, O, T, Tl	C, Cd, Mo, O, T, Tl	C, Cd, Mo, O, T, Tl
3	None	None	None	...
4	None	None	None	...
5	TS	TS	TS	TS
6	None	None	None	Not moldable
7				
a	...	...	...	...
b	...	...	...	...
8	...	...	...	...
9	...	...	...	...
10	None	None	None	...
11	Good	Excellent	Good	Good
12	None	...	...	...
13	None	Can be bent, formed and blanked when heated	...	Sw—to limited degree
14	1.325–1.335	1.317–1.321	1.20–1.33	1.25–1.30
15	20.9–20.0	20.5	23.0–20.8	22.0–21.0
16	1.65–1.68	1.46 (Prystal only)	1.56–1.70	...
17				
a	Will not support comb.	Nil	Very low	Will not support comb.
b	None	Withstands 70° C.	Withstands 120° C. with slight hardening and shrinkage	Softens slightly, darkens on long heating
	Whitens	...	Same as for dry heat	Clouds and darkens on long heating
c	Above normal temp.	60° C.	115°–135° C.	...
d	...	Moist heat 100° C. (s)	Infusible	...
e	...	...	0.33–0.36	0.33–0.36
f	...	24×10^{-5}	$(30-40)\times10^{-5}$	...
g	...	8.2—9.1	...	...

PROPERTIES OF

	Material—Trade Name	DUREZ (Continued)	BAKELITE (Filled) (Continued)	TEXTOLITE (Continued)
18	Mechanical Properties			
a	Tensile Strength—lbs./in.²	$(4-6)\times 10^3$	$(4-20)\times 10^3$	$(7-12)\times 10^3$
b	Elongation—%			
c	Impact Strength—ft. lbs. C—Charpy, I—Izod, N—notched, U—unnotched	N 0.12–0.50 (I)	N 0.13–3.0 (I)	
d	Modulus of Elasticity—lbs./in.²	$(10-25)\times 10^5$	$(5-45)\times 10^5$	10^6
e	Modulus of Rupture—lbs./in.²		$(6-20)\times 10^3$	$(8-21)\times 10^3$
f	Hardness—Brinell No.		30–45 2.5 mm ball	
19	Electrical Properties			
a	Electrical Resistivity (Volume) at 30° C., ohm cm	10^8-10^{13}	10^9-10^{15}	
b	Breakdown Voltage 60 cycle, volts per mil	350–650	200–400 (step)	150–1000
c	Dielectric Constant			
	60–1000 cycle		5–20 (60)	
	R. F.	2.2–5.5	5–9 (10^6)	4.7–7.0
d	Power Factor			
	60–1000 cycle—%		.02–.25 (60)	
	R. F.—%	0.7–5.0	.006–.100 (10^6)	.035–.10
	Physical-Chemical Properties			
20	Effects of Sunlight	None on black	Slight darkening and reduction of surface resistivity	Darkens
a	Ultraviolet Light	Some change in colors		Darkens
21	Effect of Aging—room temp.	None	Improves elec. and mech. properties	Improves elec. prop.
22	Effect of Water—hot	None to pimpled	Reduces insulation value	Variable
	—cold	None to pimpled	Reduces insulation value	Variable
23	Water Absorption 24 hrs. immersion—25° C.	0.1–0.8%	.01–0.6%	.05–2.0%
24	General Resistance to			
a	Acids—weak	Excellent to poor	Good	Good
b	Acids—strong	Poor	Poor	Poor
c	Alkalies—weak	Good to poor	Good	Fair
d	Alkalies—strong	Poor	Poor	Poor
e	Alcohols	Good to fair	Good	Excellent
f	Ketones	Fair to poor	Excellent	Excellent
g	Esters	Excellent	Excellent	Excellent
h	Hydrocarbons—aromatic	Excellent	Excellent	Excellent
i	Hydrocarbons—aliphatic	Excellent	Excellent	Excellent
j	Oils—mineral	Excellent	Excellent	Excellent
k	Oils—animal	Excellent	Excellent	Excellent
l	Oils—vegetable	Excellent	Excellent	Excellent

COMMERCIAL PLASTICS (Continued)

	FIBERLON (Continued)	CATALIN (Continued)	BAKELITE (Pure Resinoid) (Continued)	PHENALIN (Continued)
18				
a	$(6-11)\times10^3$	$(3-5)\times10^3$	$(4-10)\times10^3$	$(8-11)\times10^3$
b	Very slight	...	...	...
c	...	U 9–17/sq. in. (I)	N 0.10–1.0 (I)	...
d	...	$(3-3.75)\times10^5$	$(5-25)\times10^5$	...
e	...	$(7-12)\times10^3$	$(6-10)\times10^3$	$(10-12)\times10^3$
f	30–45	30–70 3 mm ball—25 kg	10–50 2.5 mm ball	...
19				
a	...	10^{12}–10^{13}	10^9–10^{16}	...
b	250–700	300–400	250–500 (step)	250–700
c	4.5–7.0 (60) ...	7.4–9.0 (1000 kc.) ...	4.5–6.0 (60) 4.5–5.5 (10^6)	... 4.5–7.0
d	0.2–3.0 (60) ...	... 4.4–7.0 (1000 kc.)	.05–.25 (60) .001–0.10 (10^6)	... 0.5–5.0
20	...	Slight fading non-fast colors	Slight	Darkens
a	Yellows on exposure	Prystal transmits 18% U.V.	Slight	Darkens
21	Slight	Improves elec. prop. —slight hardening	None	Slight darkening
22	Softens and whitens	None	No change to some absorption	Pits
	None	None	None	Slight deterioration on long immersion
23	.05–.07%	Very slight	.05–.07%	.05–.07%
24				
a	Good	Good	Good	Good
b	Fair	Decomposes slowly	Poor	Discolors
c	Fair	Softens on complete immersion	Fair	Fair
d	Poor	Decomposes slowly	Poor	Discolors
e	Good	Slight swelling on long immersion	Excellent	Good
f	Excellent	Excellent	Good	Good
g	Excellent	Excellent	Good	Good
h	Excellent	Excellent	Excellent	Good
i	Excellent	Excellent	Excellent	Good
j	Excellent	Excellent	Excellent	Good
k	Excellent	Excellent	Excellent	Excellent
l	Excellent	Excellent	Excellent	Excellent

PROPERTIES OF

	Material—Trade Name Composition	CELLULOID Cellulose Nitrate	FIBERLOID Cellulose Nitrate	PYRALIN Cellulose Nitrate
1	Forms Available. . . . . Cs—cast forms, F—films, I—impregnating varnishes, L—laminations, Lq—lacquers, M—molded articles, P—powder or granules, R—rods, S—sheets, T—tubes	F, M, R, S, T. . .	I, L, Lq, R, S, T	F. M. R. S, T. . .
2	Colors and Clarity. . . . . C—colorless, Cd—colored, M—mottled, O—opaque, T—transparent, Tl—translucent	C, Cd, Mo, O, T, Tl	C, Cd, Mo, O, T, Tl	C, Cd, Mo, O, T, Tl
3	Odor.	Camphor.	Camphor.	Slight camphor. .
4	Taste.	Slight.	None.	None. . . . .
	Working Properties			
5	General Type. . . . . TP—thermoplastic, TS—thermosetting	TP.	TP.	TP. . . . .
6	Molding Qualities.	Good.	Good.	Good. . . . .
7	Molding Conditions			
a	Temperature.	250° F.	180°–212° F.	185°–250° F. . . . .
b	Pressure lb./sq. in.	2000.	100–500.	2000–5000. . . . . . .
8	Compression Ratio. . . . . $\frac{\text{Vol. loose powder}}{\text{Vol. solid}}$	. . . .	. . . .	. . . .
9	Shrinkage Behavior—Allowance in molding	. . . .	. . . .	. . . .
10	Tendency to Cold Flow.	None.	None.	. . . .
11	Machining Qualities.	Excellent.	Good.	Good. . . . .
12	Extruding Qualities.	Good in unseasoned state	Good.	. . . .
13	Other Forming Qualities. . . . . B—blowing, E—extrusion, I—injection, Sh—shearing, Sp—spinning, Sw—swaging, TM—transfer molding	B, E, Sh, Sw, TM	B, E, I, Sh, Sw, TM	B, Sw. . . . .
	Physical Properties			
14	Specific Gravity.	1.35–1.60.	1.34–1.60.	1.35–1.60. . . . .
15	Specific Volume in.^{3}/lb.	20.5–17.3.	17.3–20.6.	17.0–20.0. . . . .
16	Refractive Index N_D.	1.50.	1.46 ± .03	1.46 ± .03 . . . .
17	Thermal Properties			
a	Burning Rate.	Rapid.	Rapid.	Very high. . . . . . .
b	Effect of Heat—dry. . . . . . . —moist.	Decomposes between 100°–150° C.	Decomposes on continued heating at 100° C.	Softening with decomposition on prolonged heating
c	Heat Distortion.	. . . .	. . . .	. . . .
d	Softening Point (s) or Melting Point (m)	70°–90° C. (s). . .	Decomposes at 133° C. in 30 minutes	71°–90° C. (s). . .
e	Specific Heat cal./° C. gram	0.34–0.38.	. . . .	0.34–0.38. . . . . .
f	Thermal Conductivity. . . . cal. sec.$^{-1}$ cm^{-1} (°C.)$^{-1}$. .	$(31-51)\times 10^{-5}$. .	. . . .	$(31-51)\times 10^{-5}$. .
g	Thermal Expansion$\times 10^5$/°C.	12.0–16.0.	. . . .	12.0–16.0. . . . .

COMMERCIAL PLASTICS (Continued)

	TENITE Cellulose Acetate	LUMARITH Cellulose Acetate (Protectoid)	FIBESTOS Cellulose Acetate	PLASTACELE Cellulose Acetate
1	P, S	F, M, P, R, S, T	L, R, S, T	F, M, P, R, S, T
2	C, Cd, Mo, O, T, Tl	C, Cd, Mo, O, T, Tl	C, Cd, Mo, O, T, Tl	C, Cd, Mo, O, T, Tl
3	None	None	None to mild aromatic	None
4	None	None	None	None
5	TP	TP	TP	TP
6	Excellent	Excellent	Excellent	Excellent
7				
a	285°–305° F. (*360°–370° F.)	270°–365° F	180°–240° F	260°–340° F
b	2000–5000 (*10000–20000)	2000 and up	100–500	500–3000
8	2.5	2.2–2.8		2.5–3.5
9	.002″–.009″/in	.001″–.005″/in		.008″–.010″/in
10	Slight	Slight	None—very slight	Slight—varies
11	Good	Excellent	Good	Very good
12	Good	Excellent	Excellent	Very good
13	B, E, I, Sh, Sw all good	B, E, I, Sh, Sw all good	B, E, I, Sh, Sw, TM all good	B, I, Sw
14	1.27–1.37	1.27–1.60	1.24–1.60	1.24–1.35
15	21.9–20.2	21.7–16.8	22.4–17.4	22.0–20.0
16	1.47	1.49–1.51	1.48–1.51	1.49–1.50
17				
a	Slow	Slow to non-burning	Slow	Slow
b		Decomposes above 190° C.	Little or none	Softens
		Decomposes above 190° C.	Slight swelling	Lowers softening point
c			50°–100° C	
d	70°–77° C. (s)	65°–110° C. (s)	82.0°–190°C.(s)	80°–120° C. (s)
e	0.45	0.31–0.37		0.3–0.4
f	$(50-63)\times 10^{-5}$	$(54-87)\times 10^{-5}$		$(47-87)\times 10^{-5}$
g	16.4	14.0–16.0		14.0–16.0

* For injection molding.

PROPERTIES OF

	Material—Trade Name	CELLULOID (Continued)	FIBERLOID (Continued)	PYRALIN (Continued)
18	Mechanical Properties			
a	Tensile Strength—lbs./in.^{2}	$(5-10)\times 10^3$	$(6-9)\times 10^3$	$(5-10)\times 10^3$
b	Elongation—%	10–40	4–20	3–40
c	Impact Strength—ft. lbs. C—Charpy, I—Izod, N—notched, U—Unnotched	...	...	...
d	Modulus of Elasticity—lbs./in.^{2}	$(2.0-3.9)\times 10^5$	$(2.0-3.9)\times 10^5$	$(2.0-4.0)\times 10^5$
e	Modulus of Rupture—lbs./in.^{2}	...	...	...
f	Hardness—Brinell No.	7–16 2.5 mm ball—10 kg	10–20	...
19	Electrical Properties			
a	Electrical Resistivity (Volume) at 30° C., ohm cm	$(7-15)\times 10^{10}$ (26° C.—63% rel. hum.)	$(2-30)\times 10^{10}$	$(2-10)\times 10^{10}$
b	Breakdown Voltage 60 cycle, volts per mil	660–780	750–900	300–780
c	Dielectric Constant			
	60–1000 cycle	6.7–9.2 (60)	6.9–8.8 (60)	7.0–10.0 (60)
	R. F.	6.8	...	6.0–9.0
d	Power Factor			
	60–1000 cycle—%	6.2–14.4 (60)	3.0–4.6 (60)	6.0–14.0 (60)
	R. F.—%	6.8	...	5.0–10.0
	Physical-Chemical Properties			
20	Effects of Sunlight	Discolors and becomes brittle	Yellows and decomposes on long exposure	Discolors and becomes brittle
a	Ultraviolet Light	Discolors and becomes brittle		Discolors and becomes brittle
21	Effect of Aging—room temp.	...	...	None in absence of U.V.
22	Effect of Water—hot	Softening and slight swelling	Softens, slight shrinkage	Softens
	—cold	Slight swelling	No effect	Very slight
23	Water Absorption 24 hrs. immersion—25° C.	1.5–3.0%	1.3–2.6%	1.0–3.0%
24	General Resistance to			
a	Acids—weak	Varies	Good	Good
b	Acids—strong	Poor	Poor	Poor—decomposes
c	Alkalies—weak	Good	Poor	Good
d	Alkalies—strong	Poor	Poor	Poor—decomposes
e	Alcohols	Poor—dissolves	Poor—dissolves	Slight softening
f	Ketones	Poor—dissolves	Poor—dissolves	Poor—dissolves
g	Esters	Poor—dissolves	Poor—dissolves	Poor—dissolves
h	Hydrocarbons—aromatic	Excellent	Good	Good
i	Hydrocarbons—aliphatic	Excellent	Good	Good
j	Oils—mineral	Excellent	Good	Good
k	Oils—animal	Excellent	Good	Good
l	Oils—vegetable	Excellent	Good	Good

COMMERCIAL PLASTICS (Continued)

	TENITE (Continued)	LUMARITH (Continued)	FIBESTOS (Continued)	PLASTACELE (Continued)
18				
a	$(4.3-5.0)\times 10^3$	$(4.0-12.5)\times 10^3$	$(6.0-6.8)\times 10^3$	$(3-8)\times 10^3$
b	30–35	50–10	10–50	4–35
c	N 5.2 (C), N 1.2 (I)	N 2–8 (C)		
d	2.9×10^5	$(1.1-2.9)\times 10^5$		$(1-3)\times 10^5$
e	$(6-7)\times 10^3$			$(6-7)\times 10^3$
f	8.5–12.5 5 mm ball—500 kg	7–16 2.5 mm ball—10 kg	10–20	
19				
a	10^{11} (27° C—43% rel. hum.)	$(48-430)\times 10^{10}$ (26° C.)		
b	700–800	500–1200	540–1800	590–620
c	4.6–4.7 (60)	7.5–12 (60) 4.3–5.3	1.12–3.9 (60)	7.1–8.4 (60) 4.3–5.4
d	8.0 (60) 6.0	7.0–15.3 (60) 5.7–13.7	0.5–1.1 (60)	9.1–10.5 (60) 6.8–10
20	No change in base material		Practically none	Very slight discoloration
a	Depends on dyes	Discolors slightly	Very slight	Very slight discoloration
21	No commercial effect	Slight brittleness	Slight shrinkage	None in absence of U.V.
22		Softens and swells	Softens and swells	Softens
	Very slight swelling	Slight swelling	No effect	
23	1.4–1.7%	1.5–3.0%	3.5–5.0%	1.5–4.0%
24				
a	No effect (0.5%)	Good	Fair	Fair—good
b	Poor	Poor	Poor	Poor—decomposes
c	No effect (0.5%)	Good at room temp.	Poor	Fair—good
d	Poor	Poor	Poor	Poor—decomposes
e	Affected by lower members, decreasing as carbon content increases	Good—fair	Slowly softens	Softens
f		Poor—dissolves	Poor—dissolves	Poor—dissolves
g		Varies	Softens	Poor—dissolves
h	Good	Good	Good	Very good
i	Good	Good	Good	Very good
j	Excellent	Excellent	Excellent	Excellent
k	Excellent	Excellent	Excellent	Excellent
l	Excellent	Excellent	Excellent	Excellent

PROPERTIES OF

	Material—Trade Name Composition	TORNESIT Rubber Derivative	PLIOFORM Rubber Derivative
1	Forms Available. Cs—cast forms, F—films, I—impregnating varnishes, L—laminations, Lq—lacquers, M—molded articles, P—powder or granules, R—rods, S—sheets, T—tubes	P	Lq, M, P
2	Colors and Clarity. C—colorless, Cd—colored, Mo—mottled, O—opaque, T—transparent, Tl—translucent	Cd, Mo, O, Tl	Cd, Mo, O, T, Tl
3	Odor	Slight	None
4	Taste	Slight	None
	Working Properties		
5	General Type. TP—thermoplastic, TS—thermosetting	TP	TP
6	Molding Qualities		
7	Molding Conditions		
a	Temperature	212° F.	260°-300° F.
b	Pressure lb./sq. in.		1200-1500
8	Compression Ratio $\frac{\text{Vol. loose powder}}{\text{Vol. solid}}$	2-3	3
9	Shrinkage Behavior—Allowance in molding		None
10	Tendency to Cold Flow	None	Very slight
11	Machining Qualities		Good
12	Extruding Qualities	Fair	Good
13	Other Forming Qualities. B—blowing, E—extrusion, I—injection, Sh—shearing, Sp—spinning, Sw—swaging, TM—transfer molding		
	Physical Properties		
14	Specific Gravity	1.5	1.06
15	Specific Volume in.^{3}/lb	18.4	25.0
16	Refractive Index N_D	1.56	
17	Thermal Properties		
a	Burning Rate	Not flamable	Slow
b	Effect of Heat—dry	Decomposes noticeably above 120° C.	None
	—moist		None
c	Heat Distortion	60° C	75°-105° C.
d	Softening Point (s) or Melting Point (m)	79°-110° C.	75°-105° C. (s)
e	Specific Heat cal./° C. gram		
f	Thermal Conductivity cal. sec.$^{-1}$ cm^{-1} (° C.)$^{-1}$		$(25.9-29.3)\times 10^{-5}$
g	Thermal Expansion $\times 10^5$/° C.		7-8

COMMERCIAL PLASTICS (Continued)

	VICTRON Polystyrene	RESOGLAZ Polystyrene	TROLITUL Polystyrene	AMEROID Casein
1	Lq, P, S	P	F, M, R, S, T	R, S
2	C, Cd, O, T, Tl	C, T	C, Cd, Mo, T	Cd, Mo, O, Tl
3	None	Aromatic	None	None (horny smell when burned)
4	None	None	None	None
5	TP	TP	TP	Must be machined TP
6				None
7				
a	280°–300° F	375° F	266°–302° F	
b	500–1000	1000	*11370–14223	
8	2.5		2.31	
9	None necessary		.0035″/in	
10	None below 70° C	Slight	Slight	
11	Excellent	Poor		Good
12		Good		None
13	I	E	E, I	Sw (limited)
14	1.054	1.05	1.05	1.34
15		26.3	26.3	
16	1.67		1.67	
17				
a	Moderate	Slow	Very high	
b	Softens under high heat	Softens	Softens	
		Softens	Softens	
c				
d	90° C. (s)	Above 65° C. (s)	134° C. (s)	
e			0.324	
f		19×10^{-5}	38×10^{-5}	
g	9.9	10.2	10.2	

* Injection process.

PROPERTIES OF

	Material—Trade Name	TORNESIT (Continued)	PLIOFORM (Continued)
18	Mechanical Properties		
a	Tensile Strength—lbs./in.²		4.3×10^3
b	Elongation—%		.013%
c	Impact Strength—ft. lbs. C—Charpy, I—Izod, N—notched, U—unnotched	U 3.0+(C)	N 2.6 (I)
d	Modulus of Elasticity—lbs./in.²	Not determined	47×10^5
e	Modulus of Rupture—lbs./in.²	Not determined	6.0×10^3
f	Hardness—Brinell No.	Not determined	85–90 (Shore—hard rubber)
19	Electrical Properties		
a	Electrical Resistivity (Volume) at 30° C., ohm cm	Not determined	$(5-7) \times 10^{16}$
b	Breakdown Voltage 60 cycle, volts per mil	2300	
c	Dielectric Constant		
	60—1000 cycle	Approximately 3.0 (film)	2.7 (60)
	R. F.	Not determined	2.68 (1000)
d	Power Factor		
	60—1000 cycle—%	.003 (film)	0.6 (60)
	R. F.—%	Not determined	0.16
	Physical-Chemical Properties		
20	Effects of Sunlight	Gradual darkening	Slight surface crazing
a	Ultraviolet Light	Gradual darkening	None
21	Effect of Aging—room temp.	Slight embrittlement	None
22	Effect of Water—hot	Varies with composition	Softens
	—cold	None	None
23	Water Absorption 24 hrs. immersion—25° C.	None	.02%
24	General Resistance to		
a	Acids—weak	Excellent	Good
b	Acids—strong	Excellent	Good (HCl, H_2SO_4)
c	Alkalies—weak	Excellent	Good
d	Alkalies—strong	Excellent	Good
e	Alcohols	Excellent	Good
f	Ketones	Poor	Good
g	Esters	Poor	Good
h	Hydrocarbons—aromatic	Poor	Poor
i	Hydrocarbons—aliphatic	Good	Poor
j	Oils—mineral	Good	Poor
k	Oils—animal	Poor	Poor
l	Oils—vegetable	Poor	Poor

COMMERCIAL PLASTICS (Continued)

	VICTRON (Continued)	RESOGLAZ (Continued)	TROLITUL (Continued)	AMEROID (Continued)
18				
a	$(6-7)\times 10^3$	5.6×10^3	5.8×10^3	
b			1.0%	
c			U 5.0 (I)	
d			4.6×10^5	
e	$(12-13)\times 10^3$			
f			30.0	
19				
a			10^{20}	
b	517	10^5	2×10^4	425
c		2.4 (800)	2.3	
	2.96		2.3	
d		.001 (800)	.01	
	.02		.015	
20	Slight surface oxidation	None	None	
a		None	None	Slight fading
21	None	None		Drier and harder
22	None	None	None	Softens slowly
	None	None	None	Softens very slowly
23	None	None	.00	Approximately 8.0%
24				
a	Good	Good	Good	Good
b	Good	Good	Good	Good
c	Good	Good	Good	Good—fair
d	Good	Good	Good	Fair
e	Good	Good	Good	Good
f	Fair	Poor	Poor	Good
g	Poor—soluble	Poor—soluble	Poor—soluble	Good
h	Poor—soluble	Poor—soluble	Poor—soluble	Good
i		Poor—swells	Poor—soluble	Good
j	Excellent	Poor—swells	Good	Good
k	Excellent	Swells slightly	Good	Good
l	Excellent	Swells slightly	Good	Good

PROPERTIES OF

	Material—Trade Name Composition	VINYLITE Vinyl Resin Unfilled	VINYLITE Vinyl Resin Filled
1	Forms Available Cs—cast-forms, F—films, I—impregnating varnishes, L—laminations, Lq—lacquers, M—molded articles, P—powder or granules, R—rods, S—sheets, T—tubes	F, I, L, Lq, M, P, R, S, T	L, M, P, R, S, T
2	Colors and Clarity C—colorless, Cd—colored, Mo—mottled, O—opaque, T—transparent, Tl—translucent	C, Cd, Mo, O, T Tl	Cd, Mo, O, Tl
3	Odor	None	None
4	Taste	None	None
	Working Properties		
5	General Type TP—thermoplastic, TS—thermosetting	TP	TP
6	Molding Qualities	Excellent	Excellent
7	Molding Conditions		
a	Temperature	115°–135° C	120°–150° C
b	Pressure lb./sq. in	1500–2000	2000–2500
8	Compression Ratio $\frac{\text{Vol. loose powder}}{\text{Vol. solid}}$	2.0	1.5-3.5
9	Shrinkage Behavior—Allowance in molding	.001″/in	None
10	Tendency to Cold Flow	Slight	Very slight
11	Machining Qualities	Very good	Excellent
12	Extruding Qualities	Very good	Excellent
13	Other Forming Qualities B—blowing, E—extrusion, I—injection, Sh—shearing, Sp—spinning, Sw-swaging, TM—transfer molding	B, E, I, Sh, Sp, Sw all good	E, Sh all good
	Physical Properties		
14	Specific gravity	1.34–1.36	1.35–2.50
15	Specific Volume in.³/lb	20.5	20.5–11.0
16	Refractive Index N_D	1.53	
17	Thermal Properties		
a	Burning Rate	Does not support comb.	Does not support comb
b	Effect of Heat—dry	Darkens on prolonged exposure	Darkens on prolonged exposure
	—moist	Softens at higher temps., i.e. > 65° C.	Softens at higher temps. i.e. > 65° C.
c	Heat Distortion	60°–65° C	60°–70° C
d	Softening Point (s) or Melting Point (m)	Softens over wide range	Softens over wide range
e	Specific Heat cal./° C. gram	0.244	Varies
f	Thermal Conductivity cal. sec.$^{-1}$ cm^{-1} (° C.)$^{-1}$	54×10^{-5}	
g	Thermal Expansion$\times10^6$/° C.	7.0	

COMMERCIAL PLASTICS (Continued)

	PLASKON Urea Formaldehyde	UNYTE Urea Formaldehyde	BEETLE Urea Formaldehyde	DIAKON Acrylate Resin (Leukon-Perspex)
1	M, P	P	I, L, M, P	Perspex—Cs, R, S, T Diakon—F, Lq, M
2	C, Cd, Mo, Tl	Cd, Mo, O, Tl	C, Cd, O, Tl	Perspex—C, T Diakon—C, Cd, Mo
3	None	None	None	None
4	None	None	None	None
5	TS	TS	TS	TP
6	Good	Good	Good	Good
7				
a	290°–315° F	300°–325° F	300° F	280°–340° F
b	1500–6000	2000–3000	3000 minimum	2000–3000
8	3	2.2–3.7	2.5–2.6	1.3–1.4
9	.008″/in	.007″–.010″/in	.010″/in	.002″–.003″/in
10	None	None	None	Very slight
11	Fair	Fair	Fair	Very good
12	Fair	Fair	Poor	Good
13			Not recommended	I, Sp, TM
14	1.48–1.50	1.48	1.48–1.49	1.19
15	19.0–18.0	18.0–19.0	19.0	23.05
16	1.54		1.6	1.503
17				
a	Will not support comb.	Will not support comb.	Will not support comb.	Slow
b	Slight shrinkage	None up to 150° C.	Not recommended for conditions where temperature exceeds 95° C.	Decomposes above 200° C.
	Slight swelling	None up to 150° C.		Decomposes above 200° C.
c	Starts at 127° C.		None below 95° C. on short exposure	
d		None	None	55°–90° C. (Martens)
e				0.45
f				$(43-68) \times 10^{-5}$
g				7.0

PROPERTIES OF

	Material—Trade Name	VINYLITE (Unfilled) (Continued)	VINYLITE (Filled) (Continued)
18	Mechanical Properties		
a	Tensile Strength—lbs./in.²	$(8-10)\times 10^3$	$(6-12)\times 10^3$
b	Elongation—%		
c	Impact Strength—ft. lbs C—Charpy, I—Izod, N—notched, U—unnotched	N 0.3–0.6 (I)	N 0.1–0.7 (I)
d	Modulus of Elasticity—lbs./in.²	$(3.5-4.1)\times 10^5$	$(3.5-8.5)\times 10^5$
e	Modulus of Rupture—lbs./in.²	$(10-13)\times 10^3$	$(7.5-12)\times 10^3$
f	Hardness—Brinell No.	12–15 550 lbs.—3 min.	15–25 550 lbs.—3 min.
19	Electrical Properties		
a	Electrical Resistivity (Volume) at 30° C., ohm cm	$>10^{14}$	10^{11}
b	Breakdown Voltage 60 cycle, volts per mil	650	
c	Dielectric Constant		
	60–1000 cycle		4.7 (1000)
	R. F.	4.0	4.0
d	Power Factor		
	60–1000 cycle—%	1.43 (1000)	2–15 (1000)
	R. F.—%	1.75	2–6.5
	Physical-Chemical Properties		
20	Effects of Sunlight	Darkens on prolonged, intense exposure	Darkens on prolonged, intense exposure
a	Ultraviolet Light	Darkens on prolonged, intense exposure	Darkens on prolonged, intense exposure
21	Effect of Aging—room temp.	Strength not affected	Strength not affected
22	Effect of Water—hot	Softens	Softens
	—cold	None	Varies
23	Water Absorption 24 hrs. immersion—25° C.	.05–.15%	1.5–4.0%
24	General Resistance to		
a	Acids—weak	Excellent	
b	Acids—strong	Excellent	
c	Alkalies—weak	Excellent	
d	Alkalies—strong	Excellent	
e	Alcohols	Excellent	
f	Ketones	Poor—dissolves	Poor—dissolves
g	Esters	Poor—dissolves	Poor—dissolves
h	Hydrocarbons—aromatic	Poor—swells	Poor—swells
i	Hydrocarbons—aliphatic	Excellent	Excellent
j	Oils—mineral	Excellent	Excellent
k	Oils—animal	Excellent	Excellent
l	Oils—vegetable	Excellent	Excellent

COMMERCIAL PLASTICS (Continued)

	PLASKON (Continued)	UNYTE (Continued)	BEETLE (Continued)	DIAKON (Continued)
18				
a	$(8-13)\times 10^3$	$(6.4-9.4)\times 10^3$	$(5.0-6.4)\times 10^3$	$(8-9)\times 10^3$
b				<1.0%
c	U 0.7–1.2 (C)	U 2.0–2.4 (I)	U 1.0–1.5 (C)	N 0.26 (I)
d	$(1.55-1.65)\times 10^6$	$(1.2-1.3)\times 10^6$		$.45\times 10^5$
e	$(10-14)\times 10^3$	$(10-14)\times 10^3$	$(9-13)\times 10^3$	$(14-17)\times 10^3$
f	48–50 500 kg—10 mm ball 80–95 (Shore) 1.14 mm Firth hardometer	90 (Sceleroscope)		20.0 10 mm ball
19				
a	$(2.0-2.8)\times 10^{13}$	1.44×10^6		$>10^{15}$
b	400–550	500	300–400	480
c	5.0–7.0 (60) 6.0	7.0–10.0 (60)	5.0–6.0 (60)	3.0 (50) 2.8
d	1.0–3.0 (60) 1.0–3.0		1.0–3.0 (60)	3.2 (50) 2.0
20	None	None	None	Does not yellow—20 hours
a	None	None	None	
21		Sections over ½″ thick, possible surface crazing		None
22	Swells	Slight absorption	30 min. boiling—no effect	None
	Slight swelling	Slight absorption	Little or no effect	None
23	1.0–2.0%	.003 g/cm²	.003 g/cm²	Very slight
24				
a	Fair	Fair	Fair	No effect below 50° C.
b	Poor	Poor	Fair	No effect below 50° C.
c	Good	Fair	Fair	No effect below 50° C.
d	Poor	Poor	Poor	No effect below 50° C.
e	Excellent	Good	Excellent	Poor—fair
f	Excellent	Good	Excellent	Poor—dissolves
g	Excellent	Good	Excellent	Poor—dissolves
h	Excellent	Good	Excellent	Poor—dissolves
i	Excellent	Good	Excellent	Good
j	Excellent	Good	Excellent	Excellent
k	Excellent	Good	Excellent	Excellent
l	Excellent	Good	Excellent	Excellent

PHYSICAL PROPERTIES OF COMMON WOODS

Values of density marked * are for air dry samples.

Common name	Botanical name	Density, oven-dry		Modulus of rupture, air dry kg/mm²	Modulus of elasticity, air dry kg/mm²
		g/cm³	lbs./ft.³		
Applewood or wild apple	*Pyrus malus*	0.745	46.51	8.96	894.
Ash, black	*Fraxinus nigra*	0.526	32.84	8.97	1126.
Ash, blue	*Fraxinus quadrangulata*	0.603	37.65	9.82	984.
Ash, green	*Fraxinus pennsylvanica lanceolata*	0.610	38.08	10.04	1170.
Ash, white	*Fraxinus americana*	0.638	39.83	11.01	1249.
Aspen	*Populus tremuloides*	0.401	25.03	6.04	838.
Aspen, large tooth	*Populus grandidentata*	0.412	25.72	6.38	996.
Balsa (Tropical America)	*Ochroma*	*0.12–0.20	7.49–12.49		
Basswood	*Tilia glabra* or *Tilia americanus*	0.398	24.85	6.13	1029.
Beech	*Fagus granaifolia* or *Fagus americana*	0.655	40.89	10.25	1180.
Beech, blue	*Carpinus caroliniana*	0.717	44.76	8.48	752.
Birch, gray	*Betula populifolia*	0.552	34.46	6.88	797.
Birch, paper	*Betula papyrifera*	0.600	37.46	8.79	1119.
Birch, sweet	*Betula lenta*	0.714	44.58	11.81	1520.
Birch, yellow	*Betula lutea*	0.668	41.70	11.88	1482.
Buckeye, yellow	*Aesculus octandra*	0.383	23.91	5.36	829.
Butternut	*Juglans cinerea*	0.404	25.22	5.72	830.
Cedar, eastern red	*Juniperus virginiana*	0.492	30.72	6.07	612.
Cedar, northern white	*Thuja occidentalis*	0.315	19.67	4.56	568.
Cedar, southern white	*Chamaecyparis thyoides*	0.352	21.98	4.77	655.
Cedar, (Tropical American)	*Cedrela odorata*	*0.37–0.70	23.10–43.70		
Cedar, western red	*Thuja plicata*	0.344	21.48	5.38	819.
Cherry, black	*Prunus serotina*	0.534	33.34	8.81	1046.
Cherry, wild red	*Prunus pennsylvanica*	0.425	26.53	6.10	892.
Chestnut	*Castanea dentata*	0.454	28.34	6.16	870.
Corkwood	*Leitneria floridana*	0.207	12.92		
Cottonwood, eastern	*Populus deltoides*	0.433	27.03	6.14	972.

PHYSICAL PROPERTIES OF COMMON WOODS

Values of density marked * are for air dry samples.

Common name	Botanical name	Density, oven-dry g/cm³	Density, oven-dry lbs./ft.³	Modulus of rupture, air dry kg/mm²	Modulus of elasticity, air dry kg/mm²
Cypress, southern	*Taxodium distichum*	0.482	30.09	7.44	1010.
Dogwood (flowering)	*Cornus florida*	0.796	49.69	10.72	1085.
Douglas fir (coast type)	*Pseudotsuga taxifolia*	0.512	31.96	8.44	1357.
Douglas fir (mountain type)	*Pseudotsuga taxifolia*	0.446	27.84	6.72	981.
Ebony, Andaman marble-wood (India)	*Diospyros kurzii*	*0.978	61.06	7.80	1270.
Ebony, Ebène marbre (Mauritius, E. Africa)	*Diospyros melanida*	*0.768	47.95	5.55	1007.
Elm, American	*Ulmus americana*	0.554	34.59	8.44	948.
Elm, rock	*Ulmus racemosa* or *Ulmus thomasi*	0.658	41.08	10.55	1086.
Elm, slippery	*Ulmus fulva* or *pubescens*	0.568	35.46	9.29	1050.
Eucalyptus, Karri (W. Australia)	*Eucalyptus diversicolor*	*0.829	51.75	12.16	1885.
Eucalyptus, Mahogany (New South Wales)	*Eucalyptus hemilampra*	*1.058	66.05	11.50	1608.
Eucalyptus, West Australian mahogany	*Eucalyptus marginata*	*0.787	49.13	10.54	1462.
Fir, balsam	*Abies balsamea*	0.414	25.85	5.42	879.
Fir, Douglas (See Douglas Fir)					
Fir, silver	*Abies amabilis*	0.415	25.91	6.69	1076.
Greenheart (British Guiana)	*Nectandra rodioei*	*1.06–1.23	66.18–76.79		
Gum, black	*Nyssa sylvatica*	0.552	34.46	6.82	839.
Gum, blue	*Eucalyptus globulus*	0.796	49.69	11.75	1683.
Gum, red	*Liquidambar styraciflua*	0.530	33.09	8.40	1045.
Gum, tupelo	*Nyssa aquatica*	0.524	32.71	6.85	889.
Hemlock, eastern	*Tsuga canadensis*	0.431	26.91	6.06	846.
Hemlock, mountain	*Tsuga martensiana*	0.480	29.97	6.95	797.
Hemlock, western	*Tsuga heterophylla*	0.432	26.97	6.51	1015.
Hickory, bigleaf shagbark	*Hicoria laciniosa*		50.53	12.91	1335.

PHYSICAL PROPERTIES OF COMMON WOODS

Values of density marked * are for air dry samples.

Common name	Botanical name	Density, oven-dry		Modulus of rupture, air dry kg/mm²	Modulus of elasticity, air dry kg/mm²
		g/cm³	lbs./ft.³		
Hickory, mockernut	*Hicoria alba*		51.21	13.56	1570.
Hickory, pignut	*Hicoria glabra*		51.21	14.25	1603.
Hickory, shagbark	*Hicoria ovata*		52.17	14.39	1525.
Hornbeam	*Ostrya virginiana*	0.762	47.57	10.22	1199.
Ironwood, black	*Rhamnidium ferreum*	1.077	67.24	61.28	2100.
Jacarandá, Brazilian rosewood	*Dalbergia nigra*	*0.85	53.07		
Larch, western	*Larix occidentalis*	0.587	36.65	8.24	1188.
Locust, black or yellow	*Robinia pseudacacia*	0.708	44.20	13.63	1448.
Locust, honey	*Gleditsia triacanthos*	0.666	41.58	10.59	1165.
Magnolia, cucumber	*Magnolia acuminata*	0.516	32.21	8.91	1276.
Mahogany (W. Africa)	*Khaya ivorensis*	*0.668	41.70	< 12.38	1079.
Mahogany (E. India)	*Swietenia macrophylla*	*0.54	33.71	6.73	817.
Mahogany (E. India)	*Swietenia mahogani*	*0.54	33.71	7.10	890.
Maple, black	*Acer nigrum*	0.620	38.71	9.37	1141.
Maple, red	*Acer rubrum*	0.546	34.09	9.35	1155.
Maple, silver	*Acer saccharinum*	0.506	31.59	6.34	805.
Maple, sugar	*Acer saccharum*	0.676	42.20	10.97	1290.
Oak, black	*Quercus velutina*	0.669	41.77	9.66	1153.
Oak, bur	*Quercus macrocarpa*	0.671	41.89	7.21	723.
Oak, canyon live	*Quercus chrysolepis*	0.838	52.32	9.26	1149.
Oak, chestnut	*Quercus montana*	0.674	42.08	9.45	1114.
Oak, laurel	*Quercus laurifolia*	0.703	43.89	8.98	1182.
Oak, live	*Quercus virginiana*	0.977	60.99	12.95	1381.
Oak, pin	*Quercus palustris*	0.677	42.27		
Oak, post	*Quercus stellata* or *Quercus minor*	0.738	46.07	9.30	1063.
Oak, red	*Quercus borealis*	0.657	41.02	10.02	1274.
Oak, scarlet	*Quercus coccinea*	0.709	44.26		
Oak, swamp chestnut	*Quercus prinus*	0.756	47.20	9.73	1247.

PHYSICAL PROPERTIES OF COMMON WOODS

Values of density marked * are for air dry samples.

Common name	Botanical name	Density, oven-dry		Modulus of rupture, air dry kg/mm²	Modulus of elasticity, air dry kg/mm²
		g/cm³	lbs./ft.³		
Oak, swamp white	*Quercus bicolor* or *Quercus platanoides*	0.792	49.44	12.36	1446.
Oak, white	*Quercus alba*	0.710	44.33	10.68	1251.
Persimmon	*Diospyros virginiana*	0.776	48.45	12.72	1443.
Pine, eastern white	*Pinus strobus*	0.373	23.29	6.26	898.
Pine, jack	*Pinus banksiana* or *Pinus divaricata*	0.461	28.78	5.70	868.
Pine, loblolly	*Pinus taeda*	0.593	37.02	9.09	1354.
Pine, longleaf	*Pinus palustris*	0.638	39.83	10.90	1445.
Pine, pitch	*Pinus rigida*	0.542	33.84	7.40	965.
Pine, red	*Pinus resinosa*	0.507	31.65	8.81	1264.
Pine, shortleaf	*Pinus echinata*	0.584	36.45	9.34	1345.
Poplar, balsam	*Populus balsamifera* or *Populus candicans*	0.331	20.66	4.76	716.
Poplar, yellow	*Liriodendron tulipifera*	0.427	26.66	6.52	1058.
Redwood	*Sequoia sempervirens*	0.436	27.22	7.56	958.
Sassafras	*Sassafras variafolium*	0.473	29.53	6.43	790.
Satinwood (Ceylon)	*Chloroxylon swietenia*	*1.031	64.37	9.68	1101.
Sourwood	*Oxydendrum arboreum*	0.593	37.02	8.24	1083.
Spruce, black	*Picea mariana*	0.428	26.72	7.24	1069.
Spruce, red	*Picea rubra* or *Picea rubens*	0.413	25.78	7.15	1071.
Spruce, white	*Picea glauca*	0.431	26.91	6.38	1001.
Sycamore	*Platanus occidentalis*	0.539	33.65	7.12	1002.
Tamarack	*Larix laricina* or *Larix americana*	0.558	34.84	8.23	1154.
Teak (India)	*Tectona grandis*	*0.582	36.33	9.04	1195.
Walnut, black	*Juglans nigra*	0.562	35.09	10.42	1185.
Willow, black	*Salix nigra*	0.408	25.47	4.42	513.

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ

Common Name	Chemical Name	Formula
Acetic ether	Ethyl acetate	$CH_3CO_2C_2H_5$
Acid of sugar	Oxalic acid	$(CO_2H)_2$
Aldehyde	Acetaldehyde	CH_3CHO
Alum	Generally refers to potassium aluminum sulfate	$K_2Al_2(SO_4)_4 \cdot 24H_2O$
Alum flour		
Alum meal		
Alumina	Aluminum oxide	Al_2O_3
Alumino-ferric	A mixture of aluminum and sodium sulfates	....
Alundum	Fused alumina	Al_2O_3
Aniline	Phenyl amine	$C_6H_5NH_2$
Aniline salt	Aniline hydrochloride	$C_6H_5NH_2 \cdot HCl$
Antichlor	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Antifebrin	Acetanilide	$C_6H_5NHCOCH_3$
Antimony bloom	Antimony trioxide	Sb_2O_3
Antimony black	Antimony trisulfide	Sb_2S_3
Antimony glance		
Antimony red	Antimonous oxysulfide	$Sb_2S_3 + Sb_2O_3$
Antimony vermilion		
Antimony white	Antimonous oxide	Sb_2O_3
Antimony yellow	Basic lead antimonate	$PbO \cdot Sb_2O_5$
Aqua fortis	Nitric acid	HNO_3
Aqua regia	Nitric acid and hydrochloric acid	$HNO_3 + 3HCl$
Argol	Crude potassium acid tartrate	$KHC_4H_4O_6$
Arsenic glass	Arsenous oxide	As_2O_3
Aspirin	Acetyl-salicylic acid	$C_6H_4(CO_2H)(OCOCH_3)$
Azurite	Basic copper carbonate	$2CuCO_3 \cdot Cu(OH)_2$
Bakelite	Resin from phenol + formaldehyde	....
Baking soda	Sodium bicarbonate	$NaHCO_3$
Barium white	Barium sulfate	$BaSO_4$
Baryta	Barium oxide	BaO
Barytes	Barium sulfate (natural)	$BaSO_4$
Bauxite	Hydrated alumina	$Al_2O_3 \cdot 2H_2O$
Beet sugar	Sucrose	$C_{12}H_{22}O_{11}$
Bentonite	Impure aluminum silicate	....
Benzine	Gasoline, petrol	....
Benzol	Benzene	C_6H_6
Bichrome	Potassium dichromate	$K_2Cr_2O_7$
Bitter salt	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
Black ash	Impure sodium carbonate	....
Blanc-fixe	Barium sulfate (artificial)	$BaSO_4$
Bleaching powder	Calcium chloro-hypochlorite	$CaOCl_2$
Blende	Natural zinc sulfide	ZnS
Blue copperas		
Blue stone	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Blue vitriol		
Blue salts	Nickel sulfate	$NiSO_4 \cdot 7H_2O$
Blue verditer	Basic copper carbonate	$2CuCO_3 \cdot Cu(OH)_2$
Bone ash	Impure calcium phosphate	....
Bone black	Crude animal charcoal	C
Boracic acid	Boric acid	H_3BO_3
Borax	Sodium tetraborate	$Na_2B_4O_7 \cdot 10H_2O$
Bremen blue	Basic copper carbonate	$xCuCO_3 \cdot yCu(OH)_2$
Brimstone	Sulfur	S

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ (Continued)

Common Name	Chemical Name	Formula
Burnt alum	Anhydrous potassium aluminum sulfate	$K_2Al_2(SO_4)_4$
Burnt lime	Calcium oxide	CaO
Burnt ochre Burnt ore	Ferric oxide	Fe_2O_3
"Butter of"	Refers to the chloride	
Cadmium yellow	Cadmium sulfide	CdS
Calamine	Zinc silicate	$2ZnO \cdot SiO_2 \cdot H_2O$
Calcite	Mineral calcium carbonate	$CaCO_3$
Caliche	Impure sodium nitrate	$NaNO_3$
Calomel	Mercurous chloride	$HgCl$
Camphor, artificial	Pinene hydrochloride	$C_{10}H_{17}Cl$
Cane sugar	Sucrose	$C_{12}H_{22}O_{11}$
Carbolic acid	Phenol	C_6H_5OH
Carbonic acid Carbonic anhydride	Carbon dioxide	CO_2
Carborundum	Silicon carbide	SiC
Carnallite	Magnesium potassium chloride	$MgCl_2 \cdot KCl \cdot 6H_2O$
"Caustic"	Refers to the hydroxide of a metal	
Ceruse	Basic lead carbonate	$2PbCO_3 \cdot Pb(OH)_2$
Chalk	Calcium carbonate	$CaCO_3$
Chili niter Chili saltpeter	Sodium nitrate	$NaNO_3$
China clay	Aluminum silicate	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$
Chinese red	Basic lead chromate	$PbCrO_4 \cdot PbO$
Chinese white	Zinc oxide	ZnO
Chloramine T	Sodium p-toluene-sulfochloramide	$(CH_3C_6H_4SO_2NCl\text{-}Na) \cdot 3H_2O$
Chloride of lime	Calcium chloro-hypochlorite	$CaOCl_2$
Chloride of soda	Sodium hypochlorite solution	$NaOCl$
Chrome alum	Potassium chromium sulfate	$K_2Cr_2(SO_4)_4 \cdot 24H_2O$
Chrome green	Chromium oxide	Cr_2O_3
Chrome red	Basic lead chromate	$PbCrO_4 \cdot PbO$
Chrome yellow	Lead chromate	$PbCrO_4$
Chromic acid	Chromium trioxide	CrO_3
Cinnabar	Mercuric sulfide	HgS
Cobalt black	Cobalt oxide	CoO
Cobalt green	Cobalt zincate	$CoZnO_2$
Common salt	Sodium chloride	$NaCl$
Copperas	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Corn sugar	Glucose	$C_6H_{12}O_6 \cdot H_2O$
Corrosive sublimate	Mercuric chloride	$HgCl_2$
Corundum	Aluminum oxide	Al_2O_3
Cream of tartar	Potassium hydrogen tartrate	$KHC_4H_4O_6$
Cresylic acid	Mixture of *o*, *m*, and *p*-cresol	$CH_3C_6H_4OH$
Cupferron	Nitrosophenylhydroxylamine	$C_6H_5N(NO)OH$
Dekaline	Decahydronaphthalene	$C_{10}H_{18}$
Derby red	Basic lead chromate	$PbO \cdot PbCrO_4$
Derinatol	Basic bismuth gallate	$Bi(OH)_2 \cdot C_7H_5O_5$
Dextrose	Glucose	$C_6H_{12}O_6 \cdot H_2O$
Dutch liquid	Ethylene chloride	$(CH_2Cl)_2$

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ (Continued)

Common Name	Chemical Name	Formula
Eau-de-Javelle	Potassium hypochlorite solution	$KOCl$
Eau-de-Labarraque	Sodium hypochlorite solution	$NaOCl$
Emerald green	Copper aceto-arsenite	$Cu(C_2H_3O_2)_2 \cdot 3Cu\text{-}As_2O_4$
Emery powder	Impure aluminum oxide	Al_2O_3
Epsom salts	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
Essence of bitter almonds	Benzaldehyde	C_6H_5CHO
Essence of mirbane	Nitrobenzene	$C_6H_5NO_2$
Everitt's salt	Potassium ferrous ferrocyanide	$K_2Fe_2(CN)_6$
Feldspar	Potassium aluminum silicate	$K_2Si_3O_7 \cdot Al_2Si_3O_9$
Ferro prussiate	Potassium ferrocyanide	$K_4Fe(CN)_6$
Fixed white	Barium sulfate	$BaSO_4$
Flowers of sulfur	Sulfur	S
"Flowers of" a metal is a	synonym for the oxide	
Fluorspar	Calcium fluoride	CaF_2
Formalin	Forty per cent solution of formaldehyde in water	$HCHO$
Formin	Hexamethylene tetramine	$(CH_2)_6N_4$
Freezing salt	Crude sodium chloride	$NaCl$
French chalk	Hydrated silicate of magnesium	$Mg_3Si_4O_{11} \cdot H_2O$
French verdigris	Basic copper acetate	$Cu_2(C_2H_3O_2)_2(OH)_2$
Fruit sugar	Fructose	$C_6H_{12}O_6$
Fuller's earth	Hydrated magnesium and aluminum silicates	....
Fulminating mercury	Mercuric fulminate	$Hg(ONC)_2$
Fusel oil	Mixed amyl alcohols	$C_5H_{11}OH$
Gasoline	Benzine, petrol	....
Galena	Natural lead sulfide	PbS
Glauber's salt	Sodium sulfate	$Na_2SO_4 \cdot 10H_2O$
Glucose	Dextrose	$C_6H_{12}O_6 \cdot H_2O$
Glycerin	Glycerol	$C_3H_5(OH)_3$
Grain alcohol	Ethyl alcohol	C_2H_5OH
Grape sugar	Glucose	$C_6H_{12}O_6 \cdot H_2O$
Green verditer	Basic copper carbonate	$CuCO_3 \cdot Cu(OH)_2$
Green vitriol	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Gypsum	Calcium sulfate	$CaSO_4 \cdot 2H_2O$
Hartshorn salt	Ammonium carbonate carbamate	$NH_4HCO_3 \cdot NH_4CO_2\text{-}NH_2$
Heavy spar	Barium sulfate	$BaSO_4$
Hexamine	Hexamethylene tetramine	$(CH_2)_6N_4$
Horn silver	Silver chloride	$AgCl$
Hydrosulfite	Sodium sulfite formaldehyde	$NaHSO_2 \cdot CH_2O \cdot 2H_2O$
Hypo	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Iron black	Precipitated antimony	Sb
Indian red	Ferric oxide	Fe_2O_3
Iron mordant	Ferric sulfate	$Fe_2(SO_4)_3$
Kainit	Double salt of potassium magnesium sulfate and magnesium chloride	$K_2Mg(SO_4)_2 \cdot MgCl_2 \cdot 6H_2O$
Kaolin	Aluminum silicate	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$
Kieselguhr	Siliceous earth	SiO_2
Kieserite	Mineral magnesium sulfate	$MgSO_4$
King's yellow	Arsenous sulfide	As_2S_3
Lampblack	Impure carbon	C

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ (Continued)

Common Name	Chemical Name	Formula
Lanolin	Cholesterol	$C_{27}H_{46}O$
Laughing gas	Nitrous oxide	N_2O
Lemon chrome	Barium chromate	$BaCrO_4$
Levulose	Fructose	$C_6H_{12}O_6$
Lime	Calcium oxide	CaO
Litharge	Lead monoxide	PbO
Lithopone	Zinc sulfide + barium sulfate	$ZnS + BaSO_4$
Liver of sulfur	Mixed potassium sulfides	....
Lunar caustic	Silver nitrate	$AgNO_3$
Lysol	Cresol soap solution	....
Magnesia	Magnesium oxide	MgO
Magnesite	Magnesium carbonate	$MgCO_3$
Malachite	Basic copper carbonate	$CuCO_3{\cdot}Cu(OH)_2$
Manganese black	Manganese dioxide	MnO_2
Marble	Calcium carbonate	$CaCO_3$
Marsh gas	Methane	CH_4
Massicot	Lead monoxide	PbO
Methanol	Methyl alcohol	CH_3OH
Metol	*p*-Monomethylamine-*m*-cresol sulfate or chloride	$[C_6H_3(OH)CH_3NH\text{-}CH_3]_2{\cdot}H_2SO_4$
Microcosmic salt	Sodium ammonium hydrogen phosphate	$Na(NH_4)HPO_4{\cdot}4H_2O$
Milk of barium	Barium hydroxide	$Ba(OH)_2$
Milk of lime	Calcium hydroxide	$Ca(OH)_2$
Milk of magnesium	Magnesium hydroxide	$Mg(OH)_2$
Milk of sulfur	Precipitated sulfur	S
Milk sugar	Lactose	$C_{12}H_{22}O_{11}{\cdot}H_2O$
Minium	Lead tetroxide	Pb_3O_4
Mohr's salt	Ferrous ammonium sulfate	$Fe(NH_4)_2(SO_4)_2{\cdot}6H_2O$
Molybdenite	Molybdenum disulfide	MoS_2
"Muriate of" a metal	Chloride of the metal	....
Muriatic acid	Hydrochloric acid	HCl
Naphtha (Petroleum)	A petroleum distillate	....
Naphtha (Solvent)	A coal tar distillate	....
Natron	Sodium carbonate	$Na_2CO_3{\cdot}10H_2O$
Niter	Potassium nitrate	KNO_3
Nitro-lime	Calcium cyanamide	$CaNCN$
Nitrous ether	Ethyl nitrite	C_2H_5ONO
Nordhausen acid	Fuming sulfuric acid	$H_2SO_4 + SO_3$
Oil of bitter almond	Benzaldehyde	C_6H_5CHO
Oil of garlic	Allyl sulfide	$(C_3H_5)_2S$
Oil of mirbane	Nitrobenzene	$C_6H_5NO_2$
Oil of mustard, artificial	Allyl isothiocyanate	C_3H_5NCS
Oil of pears	Amyl acetate	$CH_3CO_2C_5H_{11}$
Oil of pineapple	Ethyl butyrate	$C_3H_7CO_2C_2H_5$
Oil of vitriol	Concentrated sulfuric acid	H_2SO_4
Oil of wintergreen, artificial	Methyl salicylate	$o\text{-}HOC_6H_4CO_2CH_3$
Oleum	Fuming sulfuric acid	$H_2SO_4 + SO_3$
Olifiant gas	Ethylene	C_2H_4
Orpiment	Arsenic trisulfide	As_2S_3
Paris blue	Ferric ferrocyanide	$Fe_4[Fe(CN)_6]_3$
Paris green	Copper aceto-arsenite	$Cu(C_2H_3O_2)_2{\cdot}3CuAs_2O_4$
Pearl ash	Potassium carbonate	K_2CO_3
Permanent white	Barium sulfate	$BaSO_4$
Permutit	Artificial hydrated aluminum silicate with replaceable sodium	....

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ (Continued)

Common Name	Chemical Name	Formula
Petroleum ether	Benzine	....
Phenic acid	Phenol	C_6H_5OH
Phosgene	Carbonyl chloride	$COCl_2$
Pnosphate rock	Calcium phosphate	$Ca_3(PO_4)_2$
Picric acid	*sym*-Trinitrophenol	$C_6H_2(NO_2)_3OH$
Plaster of Paris	Calcium sulfate	$CaSO_4 \cdot \frac{1}{2}H_2O$
Plumbago	Graphite	C
Precipitated chalk	Calcium carbonate	$CaCO_3$
Prussian blue	Ferric ferrocyanide	$Fe_4[Fe(CN)_6]_3$
Prussic acid	Hydrocyanic acid	HCN
Putty powder	Impure stannic oxide	SnO_2
Pyrites	Ferrous sulfide	FeS_2
Pyroligneous acid	Crude acetic acid	CH_3CO_2H
Pyroligneous spirit	Methyl alcohol	CH_3OH
Pyrolusite	Manganese dioxide	MnO_2
Quick lime	Calcium oxide	CaO
Quicksilver	Mercury	Hg
Quinol	Hydroquinone	$C_6H_4(OH)_2(1, 4)$
Realgar	Arsenic disulfide	As_2S_2
Rectified spirit	Alcohol 90–5%	C_2H_5OH
Red antimony	Antimony oxysulfide	$Sb_2O_3 \cdot 2Sb_3S$
Red lead	Lead tetroxide	Pb_3O_4
Red liquor	Aluminum acetate solution	$Al(C_2H_3O_2)_3$
Red precipitate	Oxide of mercury	HgO
Red prussiate of potash	Potassium ferricyanide	$K_3Fe(CN)_6$
Rochelle salt	Potassium sodium tartrate	$KNaC_4H_4O_6 \cdot 4H_2O$
Rock salt	Sodium chloride	NaCl
Rouge	Ferric oxide	Fe_2O_3
Saccharin	Benzoic sulfimide	$o\text{-}C_6H_4 \cdot SO_2 \cdot NHCO$
Sal ammoniac	Ammonium chloride	NH_4Cl
Salol	Phenyl salicylate	$C_6H_4(OH)(CO_2C_6H_5)(1, 2)$
Salt	Sodium chloride	NaCl
Salt cake	Impure sodium sulfate	Na_2SO_4
Salt of amber	Succinic acid	$(CH_2CO_2H)_2$
Salt of lemon Salt of sorrel	Potassium acid oxalate	$KHC_2O_4 \cdot H_2O$
Salt of tartar Salt of wormwood	Potassium carbonate	K_2CO_3
Salt peter	Potassium nitrate	KNO_3
Salvarsan	3, 3′-Diamino-4, 4′-dihydroxy-arsenobenzene dihydrochloride	$[(HO)(NH_2)C_6H_3As]_2 \cdot 2HCl$
Satin white	Calcium sulfate	$CaSO_4 \cdot 2H_2O$
Scheele's green	Copper hydrogen arsenite	$CuHAsO_3$
Schlippe's salt	Sodium thioantimonate	$Na_3SbS_4 \cdot 9H_2O$
Silica	Silicon dioxide	SiO_2
Slaked lime	Calcium hydroxide	$Ca(OH)_2$
Soda (washing)	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Soda crystals	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Soda lime	Mixture of calcium oxide and sodium hydroxide	CaO + NaOH
Sodium hyposulfite	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Soft soap	Potash soap	....
Soluble glass	Sodium silicate	$Na_2SiO_3 + H_2O$
Soluble tartar	Potassium tartrate	$2K_2C_4H_4O_6 \cdot H_2O$
Spirit of hartshorn	Ammonia solution	NH_4OH
Spirit of salt	Hydrochloric acid	HCl
Spirit of wine	Ethyl alcohol	C_2H_5OH

COMMON NAMES OF CHEMICALS, THEIR CORRECT CHEMICAL NAMES AND FORMULÆ (Continued)

Common Name	Chemical Name	Formula
Stassfurtite	Magnesium borate and chloride double salt	$2Mg_3B_2O_{15}\cdot MgCl_2$
Sugar of lead	Lead acetate	$Pb(C_2H_3O_2)_2\cdot 3H_2O$
Sugar of milk	Lactose	$C_{12}H_{22}O_{11}\cdot H_2O$
Sulfuric ether	Diethyl ether	$(C_2H_5)_2O$
Superphosphate	Impure calcium acid phosphate	$CaH_4(PO_4)_2$
Sylvine	Potassium chloride	KCl
Sylvinite	Sylvine with rock salt	....
Table salt	Sodium chloride	$NaCl$
Talc	Hydrated magnesium silicate	$Mg_3Si_4O_{11}\cdot H_2O$
Tartar	Crude potassium bitartrate	$KHC_4H_4O_6$
Tartar emetic	Potassium antimonyl tartrate	$2K(SbO)C_4H_4O_6\cdot H_2O$
Tetralin	Tetrahydronaphthalene	$C_{10}H_{12}$
Tin crystals	Stannous chloride	$SnCl_2$
Tin white	Stannic hydroxide	$Sn(OH)_4$
T. N. T.	Trinitrotoluene	$C_6H_2(CH_3)(NO_2)_3$ (1, 2, 4, 6)
Toluol	Toluene	$C_6H_5CH_3$
Trona	Natural sodium carbonate	$Na_2CO_3\cdot NaHCO_3\cdot 3H_2O$
Turnbull's blue	Ferrous ferricyanide	$Fe_3[Fe(CN)_6]_2$
Ultramarine yellow	Barium chromate	$BaCrO_4$
Unslaked lime	Calcium oxide	CaO
Vanillin	Methyl ether of protocatechualdehyde	$C_6H_3(OH)(OCH_3)\text{-}CHO$(1, 2, 4)
Venetian red	Ferric oxide	Fe_2O_3
Verdigris	Basic copper acetate	$2Cu(C_2H_3O_2)_2 + CuO$(?)
Vermilion	Red mercuric sulfide	HgS
Vitriol	Sulfuric acid	H_2SO_4
"Vitriolate of"	"Sulfate of"	....
Washing soda	Sodium carbonate	$Na_2CO_3\cdot 10H_2O$
Water glass	Sodium silicates dissolved in water	....
White acid	Hydrofluoric acid and ammonium fluoride	$H_2F_2 + NH_4F$
White arsenic	Arsenous oxide	As_2O_3
White lead	Basic lead carbonate	$2PbCO_3 + Pb(OH)_2$
White vitriol	Zinc sulfate	$ZnSO_4\cdot 7H_2O$
Whiting	Calcium carbonate	$CaCO_3$
Witherite	Barium carbonate	$BaCO_3$
Wood alcohol, Wood naphtha, Wood spirit	Methyl alcohol	CH_3OH
Xylol	Xylene	$C_6H_4(CH_3)_2$
Yellow prussiate of potash	Potassium ferrocyanide	$K_4Fe(CN)_6\cdot 3H_2O$
Zinc blende	Mineral zinc sulfide	ZnS
Zinc vitriol	Zinc sulfate	$ZnSO_4\cdot 7H_2O$
Zinc white	Zinc oxide	ZnO

Pigments named in the above list refer to the pure substance and not to mixtures often sold under the same name.

TRADE NAMES OF DYESTUFF INTERMEDIATES

Trade Name	Chemical Name
A acid	1, 7-Dihydroxy-8, 6-disulfonic acid
Alizarin	1, 2-dihydroxyanthraquinone
Amino-G acid	2-Naphthylamine-6, 8-disulfonic acid
Amino-R acid	2-Naphthylamine-3, 6-disulfonic acid
Andresen's acid	1-Naphthol-3, 8-disulfonic acid
Anisidine	o-Aminophenol methyl ether
Anthrachrysone	1, 3, 5, 7-Tetrahydroxyanthraquinone
Anthraflavic acid	2, 6-Dihydroxyanthraquinone
Anthranilic acid	o-Aminobenzoic acid
Anthrarufin	1, 5-Dihydroxyanthraquinone
Armstrong's acid	Naphthalene-1, 5-disulfonic acid
Badische acid	2-Naphthylamine-8-sulfonic acid
Bayer's acid	2-Naphthol-8-sulfonic acid
Benzidine	p, p′-Diamino-diphenyl
Brönner's acid	2-Naphthylamine-6-sulfonic acid
β acid	Anthraquinone-2-sulfonic acid
Chromotrope acid	1, 8-Dihydroxynaphthalene-3, 6-disulfonic acid
Chrysazin	1, 8-Dihydroxyanthraquinone
Cleve's acids	1-Naphthylamine-6- and -7-sulfonic acids
Cleve's acid	1-Naphthylamine-5-sulfonic acid
Cleve's acid	1-Naphthylamine-6-sulfonic acid
Cleve's acid	1-Naphthylamine-3-sulfonic acid
Cleve's acid	1-Naphthylamine-7-sulfonic acid
Cresotic acids	Cresol carboxylic acids
Croceine acid	2-Naphthol-8-sulfonic acid
Dahl's acid	2-Naphthylamine-5-sulfonic acid
Dahl's acid II	1-Naphthylamine-4, 6-disulfonic acid
Dahl's acid III	1-Naphthylamine-4, 7-disulfonic acid
Disulpho acid S	1-Naphthylamine-4, 8-disulfonic acid
DTS	Dehydrothio-p-toluidine sulfonic acid
δ acid	1-Naphthol-4, 8-disulfonic acid 1-Naphthylamine-4, 8-disulfonic acid
Ebert and Merz's acid	Naphthalene-2, 7-disulfonic acid
Ebert and Merz's acid	Naphthalene-2, 6-disulfonic acid
Ewer and Pick's acid	Naphthalene-1, 6-disulfonic acid
ϵ acid	1-Naphthol-3, 8-disulfonic acid 1-Naphthylamine-3, 8-disulfonic acid
F acid	2-Naphthol-7-sulfonic acid
Freund's acid	1-Naphthylamine-3, 6-disulfonic acid
G acid	2-Naphthol-6, 8-disulfonic acid
Gallic acid	3, 4, 5-Trihydroxybenzoic acid
γ-acid	2-Amino-8-naphthol-6-sulfonic acid
H acid	1-Amino-8-naphthol-3, 6-disulfonic acid
Histazarin	2, 3-Dihydroxyanthraquinone
Isoanthraflavic acid	2, 7-Dihydroxyanthraquinone
J acid	2-Amino-5-naphthol-7-sulfonic acid
K acid	1-Amino-8-naphthol-4, 6-disulfonic acid
Kalle's acid	1-Naphthylamine-2, 7-disulfonic acid
Ketone base	Tetramethyldiaminobenzophenone
Koch's acid	1-Naphthylamine-3, 6, 8-trisulfonic acid
L acid	1-Naphthol-5-sulfonic acid
Laurent's acid	1-Naphthylamine-5-sulfonic acid
Lepidine	4-Methylquinoline
Leucotrope	Phenyldimethylbenzylammonium chloride
M acid	1-Amino-5-naphthol-7-sulfonic acid
Mesidine	2, 4, 6-Trimethylaniline
Metanilic acid	Aniline-m-sulfonic acid
Michler's ketone	Tetramethyldiaminobenzophenone
Naphthazarin	5, 6-Dihydroxy-1, 4-naphthoquinone
Naphthionic acid	1-Naphthylamine-4-sulfonic acid
o-Naphthionic	1-Naphthylamine-2-sulfonic acid
Naphthol A. S.	Anilide of -hydroxynaphthoic acid

TRADE NAMES OF DYESTUFF INTERMEDIATES
(Continued)

Trade Name	Chemical Name
Naphthoresorcin	1, 3-Dihydroxynaphthalene
Nevile and Winther's acid	1-Naphthol-4-sulfonic acid
Nigrotic acid	1, 7, 3, 6-Dihydroxysulfonaphthoic acid
Nitroso base	p-Nitrosodimethylaniline
NW acid	Nevile and Winther's acid
Peri acid	1-Naphthylamine-8-sulfonic acid
p-Phenetidine	p-Aminophenol ethyl ether
Phenyl-gamma acid	2-Phenylamino-8-naphthol-6-sulfonic acid
Phenyl Peri acid	Phenyl-1-naphthylamine-8-sulfonic acid
Phosgene	Carbonyl chloride
Phthalic acid	o-Benzenedicarboxylic acid
Picramic acid	2-Amino-4, 6-dinitrophenol
Picric acid	2, 4, 6-Trinitrophenol
Primuline base	p-Toluidine heated with sulfur.
Purpurin	1, 2, 4-Trihydroxyanthraquinone
Pyrogallol	1, 2, 3-Trihydroxybenzene
Quinaldine	2-Methylquinoline
Quinazarin	1, 4-Dihydroxyanthraquinone
R acid	2-Naphthol-3, 6-disulfonic acid
2 R acid	2-Amino-8-naphthol-3, 6-disulfonic acid
Red acid	1, 5-Dihydroxynaphthalene-3, 7-disulfonic acid
RG acid	1-Naphthol-3, 6-disulfonic acid
Resorcinol	1, 3-Dihydroxybenzene
S acid	1-Amino-8-naphthol-4-sulfonic acid
2 S acid	1-Amino-8-naphthol-2, 4-disulfonic acid
Salicylic acid	o-Hydroxybenzoic acid
Schäffer's acid	2-Naphthol-6-sulfonic acid
Schollkopf's acid	1-Naphthol-4, 8-disulfonic acid 1-Naphthylamine-4, 8-disulfonic acid 1-Naphthylamine-8-sulfonic acid
Sulfanilic acid	Aniline-p-sulfonic acid
Thiocarbanilide	Diphenylthiourea
Tobias acid	2-Naphthylamine-1-sulfonic acid
Tolidine	Di-p-aminoditolyl
Toluidine	Amino toluene
Xylidine	Amino xylene
Yellow acid	1, 3-Dihydroxynaphthalene-5, 7-disulfonic acid

THE PRONUNCIATION OF CHEMICAL WORDS

Reprinted by permission from a report of the Nomenclature, Spelling, and Pronunciation Committee of the American Chemical Society* as published in News Edition, Industrial and Engineering Chemistry, **12**, 202 (1934).

Generalizations

(1) Accenting names of chemical substances on the final syllable is to be discouraged in all cases where the preference for such an accent is not emphatic. The names *amine, arsine, quinone,* and *sulfone* and words ending in these names (also the suffix *-phenone*) represent most of the exceptions. The general trend of the accent in the English language is recognized by authorities to be away from the end and toward the beginning of the word. However, when the last syllable of a word is a significant suffix, as *-al* for aldehydes, it is not slurred by chemists.

(2) In the interest of uniformity and in accordance with a general trend of English pronunciation in America, the ending *-ide* should be pronounced *-īd.* This appears to be uniformly the practice in inorganic chemistry. Many organic names are so pronounced also. Certain organic terms, however, are pronounced *-ĭd* by many, as *acetanilide, imide, phthalimide, lipide, amide,* and several words ending in *-amide.*

(3) For chemical names ending in *-ine,* usage is divided between the pronunciations *-ēn* and *-ĭn,* with a tendency in favor of *-ēn.* Since a distinction in spelling is made by many between names of bases ending in *-ine* and names of nonbases ending in *-in,* the pronunciation *-ēn* for the ending *-ine* is to be encouraged. (It is unfortunate that this conflicts in sound with the pronunciation of the ending *-ene,* but it is believed that this will cause confusion only with a very few words, as benzine and benzene, fluorine and fluorene. As to the pronunciation *-īn,* usage, at least in America, is very strongly against it, and it would conflict with the pronunciation of the new ending *-yne* adopted for names of acetylene hydrocarbons.) Quinine, because of strong popular usage, is an exception.

(4) The pronunciation *-ōl* for the ending of names of alcohols and phenols (except the word alcohol itself!), whether regrettable or not, seems firmly fixed and should be recognized. Emphasis on a significant ending is probably an influence in this practice. Chemical terms not belonging to the above classes, but generally pronounced *-ōl,* should be spelled with a final *e*; examples, *mole, pyrrole.* This is in accordance with the recommendation of the International Committee on Organic Nomenclature. For *sol* and words ending in *-sol,* the spelling *-ol* and the pronunciation *-ŏl* should be encouraged.

(5) The ending *-yl* should be pronounced *-ĭl.* The pronunciation *-ēl* is apparently a Germanism and, although still in use

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THE PRONUNCIATION OF CHEMICAL WORDS (Continued)

to some extent, is to be discouraged. The pronunciation *-ĭl*, apparently common in England, is seldom heard in the United States.

(6) The ending *-ile* (as in nitrile). Usage is divided among the pronunciations *-īl*, *-ĭl*, and *-ēl*. The second of these is identical with the pronunciation recommended for *-yl*, and the third is apparently a Germanism. The pronunciation *-īl* should be favored.

(7) The endings *-acic*, *-alic*, *-anic*, *-aric*, *-elic*, *-enic*, *-eric*, *-etic*, *-idic*, *-ilic*, *-inic*, *-isic*, *-onic*, *-opic*, *-oric*. A rather extensive study of the pronunciation of such endings shows a preference for a *short* vowel preceding *-ic* in all but a few cases. This result is in accord with age-old general English usage and is to be approved. *Acetic* (ă-sē′tĭk) is a very emphatic exception. Other exceptions are *cetic* (sē′tĭk) and *ceric* (sē′rĭk) and adjectives derived from the names of unsaturated hydrocarbons (because of the influence of the significant *-ene* ending).

(8) The ending *-olic*. This ending is an exception to the rule for words ending in *-ic* [compare (7)], perhaps owing to the influence of words ending in *-ol*. Inasmuch as ten cases out of twelve studied favor the long *ō*, some of them by very large majorities, it is recommended that this ending be uniformly pronounced *-ō′lik*.

(9) Adjectives ending in *-ic* should be accented on the next to the last syllable, as glycer′ic, not gly′ceric. In names of salts the accent, following the trend indicated in (1) above, usually moves one syllable (occasionally more) towards the beginning of the word, as gly′cerate, sal′icylate.

(10) The ending *-ime*. In oxime, at least, this should be pronounced *-ēm*, to accord with usage, though this is contrary to the normal English trend.

(11) The ending *-oin* should be pronounced as two syllables, *-ō-ĭn*, with the accent coming on the preceding syllable (as, bĕn′zō-ĭn, fū′rō-ĭn). In certain words where the addition of a chemical suffix causes two vowels to come together there is a natural tendency to merge them and thus change their sound, as thebaine, linalool. While concession must be made to usage in particular cases, as cocaine, the pronunciation of such vowels separately is to be encouraged. The use of the dieresis is helpful, as linaloöl.

(12) Words ending in *-valent* should be so pronounced that the last two syllables are -vā′lĕnt; as trī-vā′lĕnt (not trĭv′ă-lĕnt).

The Word List

The words listed below are, except for a few deletions, the ones on which the committee's study was based. After each word there is given one or more pronunciations (shown by respelling and the use of symbols as explained at the head of

THE PRONUNCIATION OF CHEMICAL WORDS (Continued)

the list). When only a single pronunciation is shown this means that usage and perhaps other influences are so strongly in favor of it that no alternative is proposed. When more than one pronunciation is shown an attempt has been made to place these in the order of preference. The provision of two, occasionally three, pronunciations indicates that usage is divided without a marked show of preference (this is true of many words throughout the English language), or that there is some conflict between usage and the other influences properly taken into consideration. The word "usage" in parentheses following a pronunciation signifies that usage supports it to a considerable extent, notwithstanding other dictates.

Again let it be said that there is no attempt to proclaim "This pronunciation is right and this one is wrong." Usage, chemical nomenclature considerations, derivation, and the rules of good English (a compromise has sometimes been necessary) suggest certain preferences and these we have tried to ascertain.

Key to Pronunciation

The symbols used in the respelling for pronunciation have the following values: āle, senâte, ăm, ăccount, ärm; ēve, ēvent, ĕnd, recĕnt, makẽr; īce, ĭll; ōld, ōbey, ôrb, ŏdd, cŏnnect; ūse, ūnite, ûrn, ŭp, circŭs; fōōd; oil; chair; go; thin.

abietic	ăb′ĭ-ĕt′ĭk	
acetal	ăs′ĕt-ăl	
acetaldehyde	ăs′ĕt-ăl′dē-hīd	
acetaldoxime	ăs′ĕt-ăl-dŏk′sēm	
acetamide	ăs′ĕt-ăm′īd	ăs′ĕt-ăm′ĭd (*usage*) ă-sĕt′ă-mīd
acetanilide	ăs′ĕt-ăn′ĭ-līd	ăs′ĕt-ăn′ĭ-lĭd (*usage*)
acetic	ă-sē′tĭk	
acetoacetate	ăs′ē-tō-ăs′ē-tāt	ă-sē′tō-ăs′ē-tāt
acetoacetic	ăs′ē-tō-ă-sē′tĭk	ă-sē′tō-ă-sē′tĭk
acetone	ăs′ē-tōn	
acetonitrile	ăs′ē-tō-nī′trīl	ăs′ē-tō-nī′trĭl (*usage*)
acetonyl	ă-sĕt′ō-nĭl	ăs′ē-tō-nĭl
acetophenone	ăs′ē-tō-fē-nōn′	ă-sē′tō-fē-nōn′
acetoxime	ăs′ĕt-ŏk′sēm	
acetyl	ăs′ē-tĭl	
acetylene	ă-sĕt′ĭ-lēn	
aci-	ăs′ĭ-	
acrolein	ă-krō′lē-ĭn	
acyclic	â-sī′klĭk	
acyl	ăs′ĭl	
adiabatic	ăd′ĭ-ă-băt′ĭk	
adrenaline	ăd-rĕn′ă-lēn	ăd-rĕn′ă-lĭn (*usage*)
alantolic	ăl′ăn-tō′lĭk	

THE PRONUNCIATION OF CHEMICAL WORDS (Continued)

alizarin	*ă*-lĭz′*ă*-rĭn	
alkaline	ăl′k*ă*-lĭn	ăl′k*ă*-līn
allotropy	*ă*-lŏt′rô-pĭ	ăl′ô-trō′pĭ
allylamine	ăl′ĭl-*ă*-mēn′	
aluminum	*ă*-lōō′mĭ-n*ŭ*m (*usage*)	*ă*-lū′mĭ-n*ŭ*m
amide	ăm′īd	ăm′ĭd (*usage*)
amido	*ă*-mē′dô	ăm′ĭ-dô
amine	*ă*-mēn′	
amino	*ă*-mē′nô	
ammine	ăm′ēn	
ammino	ăm′ĭ-nō	*ă*-mē′nō (*usage*)
amyl	ăm′ĭl	
anhydride	ăn-hī′drīd	
aniline	ăn′ĭ-lēn	ăn′ĭ-lĭn (*usage*)
anisic	*ă*-nĭs′ĭk	
anthranil	ăn′thr*ă*-nĭl	
anthranilate	ăn-thrăn′ĭ-lāt	
anthranilic	ăn′thr*ă*-nĭl′ĭk	
antimonic	ăn′tĭ-mŏn′ĭk	ăn′tĭ-mō′nĭk (*usage*)
antimonyl	ăn′tĭ-mô-nĭl	
aqua	ăk′wâ	
aqueous	ā′kwê-*ŭ*s	
arabitol	*ă*-răb′ĭ-tōl	
arabonic	ăr′*ă*-bŏn′ĭk	
arachidic	ăr′*ă*-kĭd′ĭk	
arecoline	*ă*-rē′kô-lēn	*ă*-rē′kô-lĭn (*usage*)
arsenic (acid)	är-sĕn′ĭk	är′sê-nĭk (*usage*)
arsine	är-sēn′	
arsonic	är-sŏn′ĭk	
asphalt	ăs′fôlt	
assay	ăs′ā (*usage*)	*ă*-sā′
asymmetric	ā′sĭ-mĕt′rĭk	ăs′ĭ-mĕt′rĭk
atropine	ăt′rô-pēn	
auricyanide	ô′rĭ-sī′*ă*-nīd	ô′rĭ-sī′*ă*-nīd (*usage*)
avitaminosis	â-vī′t*ă*-mĭn-ō′sĭs	
azelaic	ăz′ê-lā′ĭk	
azide	ăz′īd	
azine	ăz′ēn	
azobenzene	ăz′ô-bĕn′zēn	
barium	bā′rĭ-*ŭ*m	băr′ĭ-*ŭ*m
behenic	bê-hĕn′ĭk	
benzamide	bĕn-zăm′īd	bĕn-zăm′ĭd (*usage*)
benzanilide	bĕn-zăn′ĭ-līd	bĕn-zăn′ĭ-lĭd (*usage*)
benzene	bĕn′zēn	
benzil	bĕn′zĭl	
benzilic	bĕn-zĭl′ĭk	
benzine	bĕn′zēn	

THE PRONUNCIATION OF CHEMICAL WORDS (Continued)

benzohydrol	bĕn′zō-hī′drōl	bĕn′zō-hī-drōl′ (*usage*)
benzoin	bĕn′zō-ĭn	
benzophenone	bĕn′zō-fē-nōn′	
benzoyl	bĕn′zō-ĭl	bĕn′zō-ēl (*usage*)
benzyl	bĕn′zĭl	
betaine	bē′tā-ēn	
betulinamaric	bĕt′ū-lĭn-ă-măr′ĭk	
biuret	bī′ū-rĕt′ (*usage*)	bī′ū-rĕt
bivalent	bī-vā′lĕnt	
borneol	bôr′nē-ōl	
boron	bō′rŏn	bôr′ŏn
bromal	brō′măl	
bromide	brō′mīd	
bromine	brō′mēn	
buret	bū-rĕt′	
butadiene	bū′tă-dī′ēn	
butanolide	bū-tăn′ō-līd	bū-tăn′ō-lĭd (*usage*)
butyl	bū′tĭl	
butyronitrile	bū′tĭ-rō-nī′trīl	bū′tĭ-rō-nī′trĭl (*usage*)
cacodyl	kăk′ō-dĭl	
cacodylate	kăk′ō-dĭl-āt	kăk′ō-dĭl′āt
caffeine	kăf′ē-ēn	kăf′ē-ĭn (*usage*) kăf′ēn (*popular*)
calorimetric	kăl′ō-rĭ-mĕt′rĭk	
camphanic	kăm-făn′ĭk	
campholenic	kăm′fō-lē′nĭk	kăm′fō-lĕn′ĭk
campholic	kăm-fō′lĭk	
caproate	kăp′rō-āt	
caprylate	kăp′rĭ-lāt	
carbamate	kär′bă-māt	kär-băm′āt (*usage*)
carbamide	kär-băm′īd	kär-băm′ĭd (*usage*)
carbanilide	kär-băn′ĭ-līd	kär-băn′ĭ-lĭd (*usage*)
carbethoxy	kär′bĕth-ŏk′sĭ	
carbinol	kär′bĭ-nōl	
carbonyl	kär′bō-nĭl	
cataphoresis	kăt′ă-fō-rē′sĭs	
catechol	kăt′ē-chōl	kăt′ē-kōl (*usage*)
cerebroside	sĕr′ē-brō-sīd	sē-rē′brō-sīd
ceric	sē′rĭk	sĕr′ĭk
cetic	sē′tĭk	
cetyl	sē′tĭl	sĕt′ĭl
chalcone	kăl′kōn	chăl′kōn (*usage*)
chelidonic	kĕl′ĭ-dŏn′ĭk	kē′lĭ-dŏn′ĭk (*usage*)
chloral	klō′răl	
chloride	klō′rīd	
chlorophyllide	klō′rō-fĭl′īd	
cholesterol	kō-lĕs′tĕr-ōl	
cholic	kō′lĭk	

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

choline	kō′lēn	
choloidanic	kŏl′oi-dăn′ĭk	
chromyl	krō′mĭl	
cinene	sī′nen	sĭn′ēn
cinnamal	sĭn′*ă*-măl	
cinnamate	sĭn′*ă*-māt	sĭ-năm′āt
cinnamic	sĭ-năm′ĭk	
citrate	sĭt′rāt	
clupeine	klōō′pē-ēn	
cobalticyanide	kō-bôl′tī-sī′*ă*-nīd	kō-bôl′tĭ-sī′*ă*-nīd (*usage*)
cocaine	kō-kān′ (*popular*)	kō′kā-ēn
codeine	kō′dē-ēn	
colchicine	kŏl′chĭ-sēn (*usage*)	kŏl′kĭ-sēn
colloid	kŏl′oid	
comenic	kō-mĕn′ĭk	
coniceine	kō-nĭs′ē-ēn	
coniine	kō′nĭ-ēn	
constitutive	kŏn′stĭ-tū′tĭv	kŏn-stĭt′ū-tĭv
convallamarin	kŏn-văl′*ă*-măr′ĭn	
coumaric	kōō-măr′ĭk	kū-măr′ĭk (*usage*)
coumarin	kōō′m*ă*-rĭn	kū′m*ă*-rĭn (*usage*)
creatine	krē′*ă*-tēn	krē′*ă*-tĭn (*usage*)
cresol	krē′sōl	
cresyl	krĕs′ĭl	krē′sĭl
crotonic	krō-tŏn′ĭk	
cyanamide	sī′ăn-ăm′īd	sī′ăn-ăm′ĭd (*usage*) sī-ăn′*ă*-mīd
cyanogen	sī-ăn′ō-jĕn	
cyclic	sī′klĭk	
cyclohexane	sī′klō-hĕk′sān	
cysteine	sĭs′tē-ēn	
decyl	dĕs′ĭl	
decylene	dĕs′ĭ-lēn	
desoxy	dĕs-ŏk′sĭ	
diacetyl	dī-ăs′ē-tĭl	
diazo	dī-ăz′ō	
dichromate	dī-krō′māt	
diethylamine	dī-ĕth′ĭl-*ă*-mēn′	
dinaphthol	dī-năf′thōl	
dioxindole	dī′ŏk-sĭn′dōl	dī-ŏk′sĭn-dōl
diphenic	dī-fĕn′ĭk	
diphenylethane	dī-fĕn′ĭl-ĕth′ān	
dipropargyl	dī′prō-pär′jĭl	
distillate	dĭs′tĭ-lāt	dĭs′tĭ-lāt
dynamite	dī′n*ă*-mīt	
elaidic	ĕl′ā-ĭd′ĭk	
elemolic	ĕl′ē-mō′lĭk	
enol	ē′nōl	

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

enolic	ê-nō′lĭk	
enterokinase	ĕn′tēr-ô-kī′nās	ĕn′tēr-ô-kĭn′ās
enzyme	ĕn′zīm	
enzymic	ĕn-zī′mĭk	
ephedrine	ĕf′ê-drēn	ê-fĕd′rĭn (*usage*)
ergosterol	ẽr-gŏs′tēr-ōl	
erythrose	ĕr′ĭ-thrōs	ê-rĭth′rōs
ethoxide	ĕth-ŏk′sīd	
ethyl	ĕth′ĭl	
ethylidene	ĕth-ĭl′ĭ-dēn	ĕth′ĭl-ĭ-dēn
ferricyanide	fĕr′ī-sī′ă-nīd	
fluorene	flōō′ô-rēn	
fluorescein	flōō′ô-rĕs′ê-ĭn	flōō-ôr′ē-sēn (*usage*)
fluorine	flōō′ô-rēn	
formamide	fôrm-ăm′īd	fôrm-ăm′ĭd (*usage*)
fructose	frŭk′tōs	
fulminic	fŭl-mĭn′ĭk	
fumaric	fû-măr′ĭk	
furan	fū′răn	
furfural	fûr′fŭr-ăl	
furoin	fū′rô-ĭn	
galalith	găl′ă-lĭth	
geraniol	jê-rā′nĭ-ōl	
gitogenic	jĭt′ô-jĕn′ĭk	
gluconic	glōō-kŏn′ĭk	
glucosamine	glōō′kōs-ă-mēn′	
glucoside	glōō′kô-sīd	
glutamic	glōō-tăm′ĭk	
glutaric	glōō-tăr′ĭk	
glutathione	glōō′tă-thī′ōn	
glyceric	glĭ-sĕr′ĭk	
glycine	glī′sēn	glī-sēn′ (*usage*)
glycolic	glī-kō′lĭk	glī-kŏl′ĭk (*usage*)
glycyl	glī′sĭl	
glycyrrhetic	glĭs′ĭ-rĕt′ĭk	
glyoxal	glī-ŏk′săl	glī′ŏk-săl′ (*usage*)
glyoxyl	glī-ŏk′sĭl	
guaiacol	gwī′ă-kōl	
guanidine	gwä′nĭ-dēn	
guanine	gwä′nēn	
gulose	gū′lōs	
hafnium	hăf′nĭ-ŭm	
halide	hăl′īd	hā′lĭd (*usage*)
halogen	hăl′ô-jĕn	
haloid	hăl′oid	hā′loid
haloquinonoid	hăl′ô-kwĭn′ô-noid	hăl′ô-kwĭ-nō′noid
hematin	hĕm′ă-tĭn (*usage*)	hē′mă-tĭn
hemoglobin	hē′mô-glō′bĭn	hĕm′ô-glō′bĭn

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

heroine	hĕr′ō-ēn	hĕr′ō-ĭn (*usage*)
hydantoin	hī-dăn′tō-ĭn	
hydrazide	hī′dră-zīd	
hydrazine	hī′dră-zēn	
hydrazo	hī-drăz′ō	
hydrazoic	hī-dră-zō′ĭk	
hydriodic	hī′drĭ-ŏd′ĭk	
hydrofluoric	hī′drō-flōō-ŏr′ĭk	
hydroquinone	hī′drō-kwĭ-nōn′	
hydrosol	hī′drō-sŏl	
hydroxylamine	hī-drŏk′sĭl-ă-mēn′	
hyenic	hī-ĕn′ĭk	
hypoiodous	hī′pō-ī-ō′dŭs	
iatrochemistry	ī-ăt′rō-kĕm′ĭs-trĭ	
idose	ī′dōs	
illinium	ĭ-lĭn′ĭ-ŭm	
imide	ĭm′īd	ĭm′ĭd (*usage*)
imido	ĭ-mē′dō	ĭm′ĭ-dō
imino	ĭ-mē′nō	ĭm′ĭ-nō
indigotin	ĭn-dĭg′ō-tĭn	ĭn′dĭ-gō tĭn
indoxyl	ĭn-dŏk′sĭl	
inositol	ĭn-ō sĭ-tōl	
iodine	ī′ō-dēn	
iodoso	ī′ō-dō′sō	
iodous	ī-ō′dŭs	
ionone	ī′ō-nōn′ (*usage*)	
irone	ī-rōn′ (*usage*)	
isatide	ī′să-tīd	
isatin	ī′să-tĭn	
iso	ī′sō	
isotropic	ī′sō-trŏp′ĭk	ī′sō-trō′pĭk
itaconic	ĭt′ă-kŏn′ĭk	
labile	lā′bĭl	
lauronolic	lô′rō-nō′lĭk	
leucine	lōō′sēn (*usage*)	lū′sēn
linaloöl	lĭn-ăl′ō-ōl	
linalyl	lĭn′ă-lĭl	
linoleic	lĭn′ō-lē′ĭk	
linolenic	lĭn′ō-lĕn′ĭk	lĭn′ō-lē′nĭk (*usage*)
lipase	lī′pās	
lipide	lī′pīd	lĭp′ĭd (*usage*)
lipoid	lī′poid	lĭp′oid (*usage*)
litharge	lĭth′ärj	
lutidine	lōō′tĭ-dēn (*usage*)	lū′tĭ-dēn
maleic	mă-lē′ĭk	
malic	măl′ĭk	
malonic	mă-lŏn′ĭk	mă-lō′nĭk (*usage*)
malonyl	măl′ō-nĭl	

THE PRONUNCIATION OF CHEMICAL WORDS (Continued)

mandelic	măn-dĕl'ĭk	
manganese	măn'gă-nēs	
manganic	măn-găn'ĭk	
mannonic	mă-nŏn'ĭk	
margaric	mär-găr'ĭk	mär-gär'ĭk (*usage*)
meconic	mė-kŏn'ĭk	
melissyl	mė-lĭs'ĭl	
mellophanic	mĕl'ȯ-făn'ĭk	
menthol	mĕn'thōl	
mercaptal	mẽr-kăp'tăl	
mercaptan	mẽr-kăp'tăn	
mercuric	mẽr-kū'rĭk	
mercurous	mẽr-kū'rŭs	
mesaconic	mĕs'ă-kŏn'ĭk	
mesityl	mĕs'ĭ tĭl	
mesitylene	mė-sĭt'ĭl-ēn	
mesitylenic	mė-sĭt'ĭ-lē'nĭk	mė-sĭt'ĭ-lĕn'ĭk
mesotartaric	mĕs'ȯ-tär-tăr'ĭk	mĕs'ȯ-tär-tär'ĭk (*usage*)
mesothorium	mĕs'ȯ-thō'rĭ-ŭm	
mesoxalic	mĕs'ŏk-săl'ĭk	mĕz'ŏk-săl'ĭk (*usage*)
metarsenic	mĕt'är-sĕn'ĭk	
methanol	mĕth'ă-nōl	
methyl	mĕth'ĭl	
methylal	mĕth'ĭl-ăl	mĕth'ĭl-ăl' (*usage*)
methylamine	mĕth'ĭl-ă-mēn'	
micro	mī'krȯ	
mole	mōl	
molecule	mŏl'ė-kūl	
monacetin	mŏn-ăs'ė-tĭn	mȯ-năs'ė-tĭn
mono	mŏn'ȯ	mō'nȯ
monoxide	mŏn-ŏk'sīd	mȯ-nŏk'sīd
morphine	môr'fēn	
naphthalide	năf'thă-l d	năf'thă-lĭd (*usage*)
naphthenic	năf-thē'nĭk	năf-thĕn'ĭk
naph hol	năf'thōl	
nascent	năs'ĕnt	nā'sĕnt
neurine	nōō'rēn (*usage*)	nū'rēn
niton	nī'tŏn	
nitrato	nī-trā'tȯ	
nitrile	nī'trīl	nī'trĭl (*usage*)
nitro	nī'trȯ	
nitrosamine	nī'trȯ-să-mēn'	
nitrosyl	nī'trȯ-sĭl	nī-trō'sĭl (*usage*)
nitroxyl	nī-trŏk'sĭl	
nonane	nō'nān	
nucleic	nū-klē'ĭk	
nucleotide	nū'klė-ȯ-tīd	
oleic	ȯ-lē'ĭk	

THE PRONUNCIATION OF CHEMICAL WORDS (Continued)

orcinol	ôr′sĭ-nōl	
ortho	ôr′thŏ	
osazone	ō′să-zōn	ō′să-zōn′ (*usage*)
osmium	ŏz′mĭ-ŭm	
oxalic	ŏk-săl′ĭk	
oxazine	ŏk′să-zēn	
oxide	ŏk′sīd	
oxime	ŏk′sēm	
oxindole	ŏk-sĭn′dōl	ŏk′sĭn-dōl
oxozonide	ŏk-sō′zŏ-nīd	
ozone	ō′zōn	
palladio	pă-lā′dĭ-ŏ	
pelargonic	pĕl′är-gŏn′ĭk	
pentitol	pĕn′tĭ-tōl	
peptide	pĕp′tīd	
periodic (acid)	pûr′ī-ŏd′ĭk	
permutite	pûr′mū-tīt	
peroxide	pẽr-ŏk′sīd	
phenate	fē′nāt	fĕn′āt
phenazine	fĕn′ă-zēn	
phenetidine	fĕn-ĕt′ĭ-dēn	
phenol	fē′nōl	
phenolic	fê-nō′lĭk	
phenolphthalein	fē′nōl-thăl′ê-ĭn	fē′nōl-thăl′ēn (*usage*)
pheophorbide	fē′ŏ-fôr′bīd	
phloretic	flŏ-rĕt′ĭk	
phlorizin	flôr′ĭ-zĭn	
phosphatide	fŏs′fă-tīd	
phosphorous	fŏs-fō′rŭs	fŏs′fŏ-rŭs (*usage*)
phthalein	thăl′ê-ĭn	thăl′ēn (*usage*)
phthalic	thăl′ĭk	
phthalide	thăl′īd	
phthalimide	thăl-ĭm′īd	thăl-ĭm′ĭd (*usage*)
phytol	fī′tōl	
phytosterol	fī-tŏs′tẽr-ōl	
picric	pĭk′rĭk	
pilocarpine	pī′lŏ-kär′pēn	
pimalic	pĭ-măl′ĭk	
pimaric	pĭ-măr′ĭk	
pimelic	pĭ-mĕl′ĭk	
pinacolone	pĭn-ăk′ŏ-lōn	
piperamide	pĭp′ẽr-ăm′īd	pĭp′ẽr-ăm′ĭd (*usage*) pĭ-pĕr′ă-mīd
piperidine	pĭ-pĕr′ĭ-dēn	pĭp′ẽr-ĭ-dēn
polymerism	pŏl′ĭ-mẽr-ĭz′m	pŏ-lĭm′ẽr-ĭz′m
polymerize	pŏl′ĭ-mẽr-īz	pŏ-lĭm′ẽr-īz
porphyrin	pôr′fĭ-rĭn	
praseodymium	prā′zê-ŏ-dĭm′ĭ-ŭm	

THE PRONUNCIATION OF CHEMICAL WORDS (Continued)

propiolic	prō′pĭ-ō′lĭk	
propionamide	prō′pĭ-ŏn-ăm′īd	prō′pĭ-ŏn-ăm′ĭd (*usage*)
propionic	prō′pĭ-ŏn′ĭk	
propionyl	prō′pĭ-ō-nĭl	
propyl	prō′pĭl	
propylidene	prō-pĭl′ĭ-dēn	prō′pĭl-ĭ-dēn
protein	prō′tē-ĭn	
ptomaine	tō′mān (*popular*)	tō′mâ-ēn
pyrazoline	pĭr-ăz′ō-lēn	
pyrogallol	pī′rō-găl′ōl	
pyrrole	pĭr′ōl	pĭr-ōl′ (*usage*)
pyrrolidine	pĭ-rō′lĭ-dēn	pĭ-rŏl′ĭ-dēn
pyruvic	pī-rōō′vĭk	
quadrivalent	kwŏd′rĭ-vā′lĕnt	
quinine	kwī′nīn (*popular*)	kwĭn′ēn
quinone	kwĭn-ōn′	
quinonoid	kwĭn′ō-noid	kwĭ-nō′noid
racemize	răs′ē-mīz	
resorufin	rĕz′ō-rōō′fĭn	
rhamnitol	răm′nĭ-tōl	
ribonic	rĭ-bŏn′ĭk	
ribose	rī′bōs	
ricin	rī′sĭn	
rosaniline	rōz-ăn′ĭ-lēn	rōz-ăn′ĭ-lĭn (*usage*)
rosolic	rōz-ō′lĭk	rōz-ŏl′ĭk (*usage*)
sabinene	săb′ĭ-nēn	
saccharic	să-kăr′ĭk	
saccharide	săk′ă-rīd	
salicylate	săl′ĭ-sĭl-āt	să-lĭs′ĭ-lāt
saligenin	să-lĭj′ē-nĭn	
samarium	să-măr′ĭ-ŭm	să-mā′rĭ-ŭm
santalic	săn-tăl′ĭk	
sebacic	sē-băs′ĭk	
selenate	sĕl′ē-nāt	
selenic	sē-lĕn′ĭk	sē-lē′nĭk (*usage*)
selenide	sĕl′ē-nīd	
semicarbazide	sĕm′ĭ-kär′bă-zīd	sĕm′ī-kär′bă-zīd
serine	sĕr′ēn	
skatole	skā′tōl	
solute	sŏl′ūt	
stannonic	stă-nŏn′ĭk	
stearic	stē-ăr′ĭk	
stearin	stē′ă rĭn	
stearolic	stē′-ă-rō′lĭk	
stibine	stĭb′ēn	
strontium	strŏn′shĭ-ŭm	
strychnine	strĭk′nēn	strĭk′nĭn (*usage*)
styrene	stī′rēn	

THE PRONUNCIATION OF CHEMICAL WORDS (Concluded)

sulfinic	sŭl-fĭn′ĭk	
sulfonal	sŭl′fō̆-năl	
sulfone	sŭl-fōn′	sŭl′fōn
sulfonic	sŭl-fŏn′ĭk	
sulfurous	sŭl-fū′rŭs	
sulfuryl	sŭl′fū̆-rĭl	
tartaric	tär-tăr′ĭk	tär-tär′ĭk (*usage*)
taurocholic	tô′rō̆-kō′lĭk	
terephthalic	tĕr′ĕf-thăl′ĭk	
tetrolic	tē̆-trō′lĭk	
thebaine	thē′bâ-ēn	
theine	thē′ēn	
titanic	tī-tăn′ĭk	
titanium	tī-tā′nĭ-ŭm	
titanous	tī-tăn′ŭs	
titanyl	tī′tăn-ĭl	
titer	tī′tẽr	
titrate	tī′trāt	
trional	trī′ō̆-năl	
trivalent	trī-vā′lĕnt	
univalent	ū′nĭ-vā′lĕnt	
uranyl	ū′ră-nĭl	
urea	ū̆-rē′ȧ	
ureide	ū′rē̆-ĭd	
valeric	vă-lĕr′ĭk	
valine	văl′ēn	vā′lēn
vanadate	văn′ă-dāt	
vanillin	văn′ĭ-lĭn	
veratrole	vĕr′ă-trōl	
vinyl	vī′nĭl	
vitamin	vī′tă-mĭn	
vitellin	vī-tĕl′ĭn	
xenon	zē′nŏn	
xylitol	zī′lĭ-tōl	

GENERAL CHEMICAL TABLES

SPECIFIC GRAVITY AND PROPERTIES OF MATTER

QUALITATIVE ANALYSIS SCHEME

(From A. A. Noyes' Qualitative Analysis, published by the Macmillan Co., N. Y., by permission)

Basic Constituents

Separation of the Basic Constituents into Groups

<table>
<tr><td colspan="7">Solution in dilute nitric acid containing all the common basic constituents. Add NH_4Cl.</td></tr>
<tr><td rowspan="4">Precipitate:
Silver-Group
(Pb, Ag, Hg),
as chlorides.*</td><td colspan="6">Filtrate: Saturate with H_2S gas.</td></tr>
<tr><td colspan="2" rowspan="2">Precipitate: Copper-Group and Tin-Group as sulfides.
Treat with Na_2S-Na_2S_2 solution.</td><td colspan="4">Filtrate: Add NH_4OH and $(NH_4)_2S$.</td></tr>
<tr><td colspan="2">Precipitate: Aluminum-Group and Iron-Group, as hydroxides and sulfides. Dissolve in acid, add NaOH and Na_2O_2.</td><td colspan="2">Filtrate †: Add $(NH_4)_2CO_3$.</td></tr>
<tr><td>Residue:
Copper-Group
(Pb, Bi, Cu, Cd),
as sulfides.</td><td>Solution:
Tin-Group
(Hg, As, Sb, Sn),
as sodium
sulfo-salts.</td><td>Filtrate:
Aluminum-Group
(Al, Zn, Cr),
as sodium salts.</td><td>Precipitate:
Iron-Group
(Mn, Fe, Co, Ni),
as hydroxides.</td><td>Precipitate:
Alkaline-Earth
Group
(Ba, Sr, Ca, Mg),
as carbonates.</td><td>Filtrate:
Alkali-Group
(NH_4, K, Na),
as nitrates
and chlorides.</td></tr>
</table>

* Lead is precipitated with the silver-group only when a large quantity is present, and then only partially; mercury is precipitated only when it is in the mercurous state.

† Evaporate filtrate to 10 cc., cool, filter, add 15 cc. 95% alcohol and 15 cc. $n(NH_4)_2CO_3$.

QUALITATIVE ANALYSIS SCHEME (Continued)

Analysis of the Silver-Group

<table>
<tr><td colspan="3">Precipitate: $PbCl_2$, $AgCl$, Hg_2Cl_2. Treat with hot water.</td></tr>
<tr><td>Solution: $PbCl_2$. Add K_2CrO_4.</td><td colspan="2">Residue: $AgCl$, Hg_2Cl_2. Pour NH_4OH through the filter.</td></tr>
<tr><td rowspan="2">Precipitate: $PbCrO_4$.</td><td rowspan="2">Black residue: Hg and $Hg{Cl \atop NH_2}$.</td><td>Solution: $Ag(NH_3)_2Cl$. Add HNO_3.</td></tr>
<tr><td>Precipitate: $AgCl$.</td></tr>
</table>

Separation of the Copper and Tin Groups

<table>
<tr><td colspan="3">Hydrogen Sulfide Precipitate: PbS, Bi_2S_3, CuS, CdS. HgS, As_2S_3, As_2S_5, Sb_2S_3, Sb_2S_5, SnS, SnS_2. Treat with Na_2S–Na_2S_2 solution.</td></tr>
<tr><td rowspan="2">Residue: PbS, Bi_2S_3, CuS, CdS.</td><td colspan="2">Solution: Na_2HgS_2, Na_3AsS_4, Na_3SbS_4, Na_2SnS_3. Acidify with HCl.</td></tr>
<tr><td>Precipitate: HgS, As_2S_5, Sb_2S_5, SnS_2, S.</td><td>Filtrate: NaCl. Reject.</td></tr>
</table>

Analysis of the Copper-Group

<table>
<tr><td colspan="5">Residue from the Sodium Sulfide Treatment: PbS, Bi_2S_3, CuS, CdS. Boil with HNO_3.</td></tr>
<tr><td colspan="5">Solution: Pb, Bi, Cu, Cd as nitrates. Add H_2SO_4, evaporate, add water.</td></tr>
<tr><td rowspan="3">Precipitate: $PbSO_4$.
Dissolve in NH_4Ac,
add K_2CrO_4.</td><td colspan="4">Filtrate. Add NH_4OH.</td></tr>
<tr><td rowspan="2">Precipitate: $Bi(OH)_3$.
Add Na_2SnO_2.</td><td colspan="3">Filtrate: $Cu(NH_3)_4SO_4$, $Cd(NH_3)_4SO_4$.</td></tr>
<tr><td>To a small part add HAc and $K_4Fe(CN)_6$</td><td colspan="2">To the remainder add H_2SO_4 and Fe.</td></tr>
<tr><td rowspan="2">Yellow precipitate: $PbCrO_4$.</td><td rowspan="2">Black residue: Bi.</td><td rowspan="2">Red precipitate:
$Cu_2Fe(CN)_6$.
White precipitate:
$Cd_2Fe(CN)_6$.</td><td rowspan="2">Precipitate: Cu.</td><td>Solution: $CdSO_4$.
Add H_2S.</td></tr>
<tr><td>Yellow precipitate:
CdS.</td></tr>
</table>

QUALITATIVE ANALYSIS SCHEME (Continued)

Analysis of the Tin-Group

Precipitate from Sodium Sulfide Solution: S, HgS, As_2S_5, Sb_2S_5, SnS_2. Heat with 12 n. HCl.			
Residue: S, HgS, As_2S_5. Add NH_4OH.		Solution: $SbCl_3$, H_2SnCl_6. Dilute, heat, pass in H_2S.	
Residue: S, HgS. Add HCl and $KClO_3$.	Solution. Evaporate, add HNO_3, then NH_4OH	Orange precipitate: Sb_2S_3. Dissolve in HCl, add Sn.	Solution: H_2SnCl_6. Partly neutralize, pass in H_2S
Solution: $HgCl_2$. Add $SnCl_2$.	Solution: $(NH_4)_3AsO_4$. Add $Mg(NO_3)_2$.	Black deposit: Sb. Add NaOBr.	Precipitate: SnS_2. Evaporate without filtering.
Precipitate: Hg_2Cl_2 or Hg.	Precipitate: $MgNH_4AsO_4$. Add $AgNO_3$.	Black deposit: Sb.	Solution: H_2SnCl_6. Boil with Sb.
	Red residue: Ag_3AsO_4.		Solution: $SnCl_2$. Add $HgCl_2$.
			Precipitate: Hg_2Cl_2.

Separation of the Aluminum and Iron Groups

Filtrate from the Hydrogen Sulfide Precipitate. Add NH_4OH in excess.		
Precipitate *: $Al(OH)_3$, $Cr(OH)_3$, $Fe(OH)_{2-3}$: $Mn(OH)_3$ after exposure to air. Solution: Salts of $Zn(NH_3)_4$, $Ni(NH_3)_4$, Co, Mn, Ba, Sr, Ca, Mg, K, and Na. Add $(NH_4)_2S$ and filter.		
Precipitate *: $Al(OH)_3$, $Cr(OH)_3$, FeS, ZnS, MnS, CoS, NiS. Dissolve in HCl and $KClO_3$, add NaOH.		Filtrate: Alkaline-Earth and Alkali Groups.
Precipitate *: $Fe(OH)_3$, $Mn(OH)_2$, $Co(OH)_2$, $Ni(OH)_2$. Solution: $NaAlO_2$, $NaCrO_2$, Na_2ZnO_2. Add Na_2O_2 and filter.		
Filtrate: Aluminum-Group. $NaAlO_2$, Na_2ZnO_2, Na_2CrO_4.	Precipitate *: Iron-Group. $MnO(OH)_2$, $Fe(OH)_3$, $Co(OH)_3$, $Ni(OH)_2$.	

* When phosphate is present in the solution, these precipitates may contain the phosphates of the elements otherwise precipitated as hydroxides, and also the phosphates of barium, strontium, calcium, and magnesium.

QUALITATIVE ANALYSIS SCHEME (Continued)

Analysis of the Aluminum-Group

<table>
<tr><td colspan="3">Filtrate from the Sodium Hydroxide and Peroxide Treatment: $NaAlO_2$, Na_2ZnO_2, Na_2CrO_4. Acidify with HCl, add NH_4OH.</td></tr>
<tr><td>Precipitate: $Al(OH)_3$. Dissolve in HNO_3, add $Co(NO_3)_2$, evaporate, ignite.</td><td colspan="2">Filtrate: $Zn(NH_3)_4Cl_2$, Na_2CrO_4. Add Na_2CO_3, boil to expel NH_3.</td></tr>
<tr><td rowspan="2">Blue residue: $Co(AlO_2)_2$.</td><td>Precipitate: $ZnCO_3xZn(OH)_2$. Dissolve in HCl, add NH_4OH and $(NH_4)_2S$.</td><td>Filtrate: Na_2CrO_4. Add HAc and $PbAc_2$.</td></tr>
<tr><td>White precipitate: ZnS.</td><td>Yellow precipitate: $PbCrO_4$.</td></tr>
</table>

Analysis of the Iron-Group

<table>
<tr><td colspan="4">Precipitate Produced by Sodium Hydroxide and Peroxide:
A. Phosphate absent: $MnO(OH)_2$, $Fe(OH)_3$,* $Zn(OH)_2$, $Co(OH)_3$, $Ni(OH)_2$.
B. Phosphate present: Also $FePO_4$, and alkaline-earth phosphates and carbonates.
Heat with HNO_3 and $KClO_3$.</td></tr>
<tr><td>Precipitate: MnO_2.
Add HNO_3 and H_2O_2.</td><td colspan="3">Solution:
A. $Fe(NO_3)_3$, $Zn(NO_3)_2$, $Co(NO_3)_2$, $Ni(NO_3)_2$. Add NH_4OH (P. 63).
B. Also $Ba(NO_3)_2$, etc., and H_3PO_4. Nearly neutralize with NH_4OH, add NH_4Ac and $Fe(NO_3)_3$, dilute, and boil.†</td></tr>
<tr><td>Solution: $Mn(NO_3)_2$.
Add PbO_2.</td><td rowspan="2">Precipitate:
A. $Fe(OH)_3$.
B. Also $FePO_4$.</td><td colspan="2">Filtrate. Add NH_4OH, pass in H_2S.</td></tr>
<tr><td>Purple color: $HMnO_4$.</td><td>Precipitate:
ZnS, CoS, NiS.</td><td>Filtrate:
A. NH_4 salts. Reject.
B. Ba, Ca, Sr, Mg, and NH_4 salts.</td></tr>
</table>

* All the zinc may be carried into this precipitate by elements of the iron-group when they are present in large quantity.
† First testing a small portion of the solution for iron with $K_4Fe(CN)_6$.

QUALITATIVE ANALYSIS SCHEME (Continued)

Separation of Zinc, Nickel and Cobalt

<table>
<tr><td colspan="4">Hydrogen Sulphide Precipitate: ZnS, CoS, NiS. Treat with cold 1 n. HCl.</td></tr>
<tr><td colspan="3">Solution: $ZnCl_2$, $CoCl_2$ *, $NiCl_2$ *. Add $NaOH$ and Na_2O_2.</td><td rowspan="2">Residue: CoS, NiS.</td></tr>
<tr><td>Filtrate: Na_2ZnO_2. Add $(NH_4)_2S$.</td><td colspan="2">Precipitate: $Co(OH)_3$, $Ni(OH)_2$.</td></tr>
<tr><td rowspan="2">White precipitate: ZnS.
Dissolve in HNO_3, add $Co(NO_3)_2$ and Na_2CO_3, ignite.</td><td colspan="3">Add HCl and $KClO_3$.</td></tr>
<tr><td colspan="3">Solution: $CoCl_2$, $NiCl_2$. Evaporate, add HAc and KNO_2.</td></tr>
<tr><td rowspan="2">Green residue: $CoZnO_2$.</td><td rowspan="2">Yellow precipitate: $K_3Co(NO_2)_6$.</td><td colspan="2">Filtrate: $NiCl_2$. Add $(CH_3)_2C_2(NOH)_2$.</td></tr>
<tr><td colspan="2">Red precipitate:
$[(CH_3)_2C_2(NOH)NO]_2Ni$.</td></tr>
</table>

* A small proportion of the cobalt and nickel present always dissolves in the dilute HCl.

Analysis of the Alkaline-Earth Group

<table>
<tr><td colspan="5">Ammonium Carbonate Precipitate: $BaCO_3$, $SrCO_3$, $CaCO_3$, $MgCO_3 \cdot (NH_4)_2CO_3$.
Dissolve in HAc, add NH_4Ac and K_2CrO_4.</td></tr>
<tr><td rowspan="2">Precipitate: $BaCrO_4$.
Dissolve in HCl, evaporate, add HAc, NH_4Ac, and K_2CrO_4.</td><td colspan="4">Filtrate. Add NH_4OH and C_2H_5OH.</td></tr>
<tr><td colspan="2">Precipitate: $SrCrO_4$, $(CaCrO_4)$.†
Boil with $(NH_4)_2CO_3$ and $K_2C_2O_4$.</td><td colspan="2">Filtrate: Ca and Mg salts. Add $K_2C_2O_4$.</td></tr>
<tr><td rowspan="3">Precipitate: $BaCrO_4$.</td><td colspan="2">Residue: $SrCO_3$, (CaC_2O_4). Treat with HAc.</td><td>Precipitate:
CaC_2O_4, (MgC_2O_4).
Treat with H_2SO_4.</td><td>Filtrate.
Add Na_2HPO_4.</td></tr>
<tr><td>Solution: $SrAc_2$.
Add Na_2SO_4.</td><td rowspan="2">Residue:
(CaC_2O_4).</td><td>Solution: $CaSO_4$, $(MgSO_4)$.
Add C_2H_5OH.</td><td rowspan="2">Precipitate:
$MgNH_4PO_4$.</td></tr>
<tr><td>Precipitate: $SrSO_4$.</td><td>Precipitate: $CaSO_4$.</td></tr>
</table>

† Substances whose formulas are within parentheses are not normally found at the point indicated, but their presence (arising from faulty procedure or an excessive proportion of the element in the substance) is provided for in the confirmatory tests.

QUALITATIVE ANALYSIS SCHEME (Continued)

Analysis of the Alkali-Group

SHORTER LESS EXACT METHOD

<table>
<tr><td colspan="3">Filtrate from the Ammonium Carbonate Precipitate: NH_4, K, Na salts. Evaporate, ignite, add HCl, ignite again.</td></tr>
<tr><td rowspan="4">Vapor: NH_4 salts.</td><td colspan="2">Residue: KCl, NaCl. Add 3 cc. of water, and treat portions as follows:</td></tr>
<tr><td>Add $Na_3Co(NO_2)_6$.</td><td>Add KH_2SbO_4.</td></tr>
<tr><td>Yellow precipitate: $K_2NaCo(NO_2)_6$. Test in flame.</td><td rowspan="2">Crystalline precipitate: NaH_2SbO_4.</td></tr>
<tr><td>Violet color: K.</td></tr>
</table>

EXACT METHOD

<table>
<tr><td colspan="4">Filtrate from the Ammonium Carbonate Precipitate: NH_4, K, Na salts. Evaporate, and ignite the residue. Dissolve in water, add $BaCl_2$ (to remove sulfate), then $(NH_4)_2CO_3$ (to remove barium). Evaporate and ignite again.</td></tr>
<tr><td rowspan="4">Vapor: NH_4 salts.</td><td colspan="3">Residue: KCl. NaCl. Add $HClO_4$, evaporate, add alcohol.</td></tr>
<tr><td rowspan="2">Residue: $KClO_4$. Dissolve in hot water, add $Na_3Co(NO_2)_6$.</td><td colspan="2">Solution: $NaClO_4$. Saturate with HCl gas.</td></tr>
<tr><td>Precipitate: NaCl. Dissolve in water, add KH_2SbO_4.</td><td rowspan="2">Filtrate: Reject.</td></tr>
<tr><td>Yellow precipitate: $K_2NaCo(NO_2)_6$.</td><td>Crystalline precipitate: NaH_2SbO_4.</td></tr>
</table>

QUALITATIVE ANALYSIS SCHEME (Continued)

Supplementary Procedures for Basic Constituents

Boil the substance with NaOH solution.	Boil the substance with H_2SO_4; treat portions of the solution as follows:				
Vapor: NH_3. Absorb in water; add K_2HgI_4.	Add $K_3Fe(CN)_6$.	Add KSCN.	Add $HgCl_2$.	Add HCl.	
	Blue precipitate: $Fe_3(Fe(CN)_6)_2$. (Shows ferrous iron.)	Red color: $Fe(SCN)_3$. (Shows ferric iron.)	Precipitate: Hg_2Cl_2. (Shows stannous tin.)	Precipitate: Hg_2Cl_2 or AgCl. Add NH_4OH.	Filtrate. $HgCl_2$. Add $SnCl_2$.
Orange precipitate: $HgO\cdot Hg_{NH_2}^{I}$. (Shows ammonium.)				Black residue: Hg and $Hg_{NH_2}^{Cl}$. (Shows mercurous mercury.)	Precipitate: Hg_2Cl_2 or Hg. (Shows mercuric mercury.)

Acidic Constituents

Detection of Groups of Acidic Constituents

Sodium Carbonate solution containing all acidic constituents. Treat portions as follows:			
Add $AgNO_3$, $NaNO_2$, and HNO_3	Add HAc, $BaCl_2$, and $CaCl_2$.	Add $MnCl_2$ and HCl.	Add HCl, $FeCl_3$, and $K_3Fe(Cn)_6$.
Precipitate: Chloride-group (S, CN, $Fe(CN)_6{}^{iv}$, $Fe(CN)_6{}^{iii}$, SCN, Cl, Br, I, ClO_3, ClO), as Ag salts.	Precipitate: Sulfate-group (SO_4, SO_3, CrO_4, F, C_2O_4), as Ba and Ca salts.	Dark Color: $MnCl_3$. Shows oxidizing constituents: $Fe(CN)_6{}^{iii}$, ClO_3, ClO, CrO_4, NO_3, NO_2.	Blue precipitate: $Fe_4(Fe(CN)_6)_3$. Shows reducing constituents: S, $Fe(CN)_6{}^{iv}$. I, SO_3, NO_2.

QUALITATIVE ANALYSIS SCHEME (Continued)

Separation of the Chloride-Group into Subgroups

<table>
<tr><td colspan="4">Sodium Carbonate solution containing all acidic constituents. To a portion add $Pb(NO_3)_2$.</td></tr>
<tr><td rowspan="4">Black Precipitate: PbS.
(Shows sulfide.)</td><td colspan="3">Filtrate. Add HAc and $Ni(NO_3)_2$.</td></tr>
<tr><td rowspan="3">Precipitate: $Ni_2Fe(CN)_6$, $Ni_3(Fe(CN)_6)_2$, $Ni(CN)_2$.
(Shows simple or complex cyanide.)</td><td colspan="2">Filtrate: NaSCN, NaI, NaBr, NaCl, $NaClO_3$.
Add $AgNO_3$ and HNO_3.</td></tr>
<tr><td rowspan="2">Precipitate: AgSCN, AgI, AgBr, AgCl.
(Shows halide or thiocyanate.)</td><td>Filtrate: $AgClO_3$. Add $NaNO_2$.</td></tr>
<tr><td>Precipitate: AgCl.
(Shows chlorate or hypochlorite.)</td></tr>
</table>

Detection of the Separate Cyanides

<table>
<tr><td colspan="4">Nickel Precipitate: $Ni_2Fe(CN)_6$, $Ni_3(Fe(CN)_6)_2$, $Ni(CN)_2$. Add NH_4OH.</td></tr>
<tr><td colspan="4">Solution: $(NH_3)_4Ni(OH)_2$, $(NH_4)_4Fe(CN)_6$, $(NH_4)_3Fe(CN)_6$, NH_4CN. Add $AgNO_3$ and Na_2SO_3.</td></tr>
<tr><td>Precipitate: $Ag_4Fe(CN)_6$.
Add HCl and $Fe(NO_3)_3$.</td><td colspan="3">Filtrate: $NH_4Ag(CN)_2$, $Ni(NO_3)_2$, $AgNO_3$, and NH_4NO_3. Add HNO_3.</td></tr>
<tr><td rowspan="3">Blue residue: $Fe_4(Fe(CN)_6)_3$ and AgCl.
(Shows ferro or ferricyanide.)</td><td colspan="2">Precipitate: $Ag_2(CN)_2$. Add $(NH_4)_2S$.</td><td rowspan="3">Filtrate: Ni, Ag, and NH_4 nitrates. Reject.</td></tr>
<tr><td rowspan="2">Residue: Ag_2S.
Reject.</td><td>Solution: NH_4CNS.
Add $Fe(NO_3)_3$.</td></tr>
<tr><td>Red color: $Fe(CNS)_3$.
(Shows cyanide.)</td></tr>
</table>

QUALITATIVE ANALYSIS SCHEME (Continued)

Detection of Thiocyanate, Iodide, Bromide, and Chloride

<table>
<tr><td colspan="6">Silver Precipitate: $AgSCN$, AgI, $AgBr$, $AgCl$. Treat with NH_4OH and $(NH_4)_2S$.</td></tr>
<tr><td rowspan="4">Residue:
Ag_2S.</td><td colspan="5">Solution: NH_4SCN, NH_4I, NH_4Br, NH_4Cl. Add HNO_3, $Fe(NO_3)_3$, and CCl_4.</td></tr>
<tr><td rowspan="3">CCl_4 layer: I_2.
(Purple color shows iodide.)</td><td colspan="4">Water layer: I_2, HBr, HCl, $Fe(SCN)_3$. (Red color shows thiocyanate.)
Boil; then cool and add $KMnO_4$ and CCl_4.</td></tr>
<tr><td rowspan="2">Vapor: I_2.</td><td rowspan="2">CCl_4 layer: Br_2.
(Orange color shows bromide.)</td><td colspan="2">Water layer: Br_2, HCl, H_2SO_4.
Boil; then add $AgNO_3$.</td></tr>
<tr><td>Vapor: Br_2.</td><td>Precipitate: $AgCl$.
(Shows chloride.)</td></tr>
</table>

Detection of Sulfate, Sulfite, Chromate, Fluoride, and Oxalate

<table>
<tr><td colspan="4">Sodium Carbonate solution containing all acidic constituents. Acidify with HCl, and add $BaCl_2$.</td></tr>
<tr><td rowspan="6">Precipitate: $BaSO_4$.
(Shows sulfate.)</td><td colspan="3">Filtrate: Na_2SO_3, $Na_2Cr_2O_7$, NaF, $Na_2C_2O_4$, $BaCl_2$. Add Br_2.</td></tr>
<tr><td rowspan="5">Precipitate: $BaSO_4$.
(Shows sulfite.)</td><td colspan="2">Filtrate: $Na_2Cr_2O_7$, NaF, $Na_2C_2O_4$, $BaCl_2$. Add NaAc and $CaCl_2$.</td></tr>
<tr><td colspan="2">Yellow precipitate: $BaCrO_4$.
White precipitate: CaF_2, CaC_2O_4.
Treat portions as follows:</td></tr>
<tr><td>Heat with SiO_2 and H_2SO_4.</td><td>Dissolve in HNO_3, add $KMnO_4$, distill.</td></tr>
<tr><td>Gas: SiF_4. Test with water.</td><td>Vapors: CO_2. Collect in $Ba(OH)_2$.</td></tr>
<tr><td>Turbidity: H_2SiO_3. (Shows fluoride.)</td><td>Precipitate: $BaCO_3$. (Shows oxalate.)</td></tr>
</table>

QUALITATIVE ANALYSIS SCHEME (Continued)

Detection of Nitrate, Nitrite, Borate, Arsenate, and Arsenite

Sodium Carbonate solution containing all the acidic constituents. Treat portions as follows:					
Boil with NaOH and Al.	Add HAc and CSN_2H_4.		Add HCl, C_2H_5OH, and turmeric.	Add HCl, NH_4OH, and $Mg(NO_3)_2$.	
Vapor: NH_3. Test with K_2HgI_4.	Gas: N_2.	Solution: NH_4SCN. Add $FeCl_3$.	Orange color. (Shows borate.)	Precipitate: $MgNH_4AsO_4$. Treat with $AgNO_3$.	Filtrate: NH_4AsO_2. Pass in H_2S.
Red precipitate: $HgO \cdot HgNH_2I$. (Shows nitrate or nitrite.)		Red color: $Fe(SCN)_3$.		Red residue: Ag_3AsO_4. (Shows arsenate.)	Yellow precipitate, As_2S_3. (Shows arsenite.)
	(Show nitrite.)				

Detection of Phosphate and the Separate Halides

To portions of the HNO_3 solution of the substance.				
Add $(NH_4)_2MoO_4$.	Add $FeCl_3$.	Add NaAc, HAc, $KMnO_4$ and $CHCl_3$.		
Yellow precipitate: $(NH_4)_3PO_4$, $12MoO_3$. (Shows phosphate.)	Red color: $Fe(SCN)_3$. (Shows thiocyanate.)	Chloroform layer, purple: I_2. (Shows iodide.)	Water layer: add H_2SO_4, more $KMnO_4$ and $CHCl_3$.	
			Chloroform layer, orange: Br_2. (Shows bromide.)	Water layer: Boil out the Br_2, add HNO_3 and $AgNO_3$.

Detection of Readily Volatile Acidic Constituents

Heat the substance with dilute H_2SO_4.

Vapors: CO_2, SO_2, H_2S, NO_2, Cl_2, Br_2, I_2, HCN. Expose to the vapors:

$Ba(OH)_2$ solution.	PbAc paper	Starch and KI paper.	$Fe(OH)_2$ or $Fe(OH)_3$ and NaOH on paper.
White turbidity: $BaCO_3$ or $BaSO_3$. (Shows carbonate, sulphite or thiosulphate.)	Black color: PbS. (Shows sulphide.)	Blue color: I_2 (Shows nitrite, hypochlorite, chlorate, bromate, or iodide.)	Formation of $Na_4Fe(CN)_6$. Dip in HCl.
			Blue color: $Fe_4(Fe(CN)_6)_3$. (Shows cyanide.)

QUALITATIVE ANALYSIS SCHEME (Continued)

ANALYSIS OF NATURAL SUBSTANCES AND IGNEOUS PRODUCTS

Detection of Sulfate, Carbonate, Sulfide, and Cyanide

<table>
<tr><td colspan="3">Boil 0.5 g. of the substance with HCl and Zn, collecting the distillate in $Ba(OH)_2$ solution; filter the mixture left in the distilling flask.</td></tr>
<tr><td>Filtrate from mixture in distilling flask.
Add $BaCl_2$.</td><td colspan="2">Distillate. Precipitate: $BaCO_3$. (Shows carbonate.) Solution: BaS, $Ba(CN)_2$.</td></tr>
<tr><td rowspan="2">Precipitate: $BaSO_4$. (Shows sulfate.)</td><td>To a part of the mixture add HAc and $PbAc_2$.</td><td>To the rest of the mixture add $FeCl_2$, boil, add HCl.</td></tr>
<tr><td>Black precipitate: PbS.
(Shows sulfide.)</td><td>Blue precipitate: $Fe_4(FeCN_6)_3$.
(Shows cyanide.)</td></tr>
</table>

Detection of Chloride, Fluoride, and Borate

<table>
<tr><td colspan="3">Distill 1 g. of the substance, first (A) with H_2SO_4 alone, then (B) with addition of CH_3OH.</td></tr>
<tr><td colspan="2">A. First distillate.</td><td rowspan="2">B. Second distillate: $B(OCH_3)_3$.
Add HCl, C_2H_5OH, and turmeric.</td></tr>
<tr><td>To a portion add $AgNO_3$.</td><td>To the remainder add NaAc and $CaCl_2$.</td></tr>
<tr><td>Precipitate: AgCl. (Shows chloride.)</td><td>Precipitate: CaF_2. (Shows fluoride.)
Confirm by special test.</td><td>Orange or red color. (Shows borate.)</td></tr>
</table>

FLAME AND BEAD TESTS

Flame Colorations

Violet

Potassium compounds. Purple red through blue glass. Easily obscured by sodium flame. Bluish green through green glass. Rubidium and Caesium compounds impart same flame as potassium compounds.

Blues

Azure.—Copper chloride. Copper bromide gives azure blue followed by green. Other copper compounds give same coloration when moistened with hydrochloric acid.

Light Blue.—Lead, Arsenic, Selenium.

Greens

Emerald.—Copper compounds except the halides, and when not moistened with hydrochloric acid.

Pure Green.—Compounds of thallium and tellurium.

Yellowish.—Barium compounds. Some molybdenum compounds. Borates, especially when treated with sulphuric acid or when burned with alcohol.

Bluish.—Phosphates with sulphuric acid.

Feeble.—Antimony compounds. Ammonium compounds.

Whitish.—Zinc.

Reds

Carmine.—Lithium compounds. Violet through blue glass. Invisible through green glass. Masked by barium flame.

Scarlet.—Strontium compounds. Violet through blue glass. Yellowish through green glass. Masked by barium flame.

Yellowish.—Calcium compounds. Greenish through blue glass. Green through green glass. Masked by barium flame.

Yellow

Yellow.—All sodium compounds. Invisible with blue glass.

Borax Beads

Abbreviations employed: s., saturated; s.s., supersaturated; n.s., not saturated; h., hot; c., cold.

Substance	Oxidizing flame	Reducing flame
Aluminum	Colorless (h.c., n.s.); opaque (s.s.)	Colorless; opaque (s.)
Antimony	Colorless; yellow or brownish (h., s.s.)	Gray and opaque
Barium	Colorless (n.s.)	....
Bismuth	Colorless; yellow or brownish (h., s.s.)	Gray and opaque
Cadmium	Colorless	Gray and opaque
Calcium	Colorless (n.s.)	....
Cerium	Red (h.)	Colorless (h.c.)
Chromium	Green (c.)	Green
Cobalt	Blue (h.c.)	Blue (h.c.)
Copper	Green (h.); blue (c.)	Red (c.): opaque (s.s.): colorless (h.)

Borax Beads (Continued)

Substance	Oxidizing flame	Reducing flame
Iron	Yellow or brownish red (h., n.s.)	Green (s.s.)
Lead	Colorless; yellow or brownish (h., s.s.)	Gray and opaque
Magnesium	Colorless (n.s.)	....
Manganese	Violet (h.c.)	Colorless (h.c.)
Molybdenum	Colorless	Yellow or brown (h.)
Nickel	Brown; red (c.)	Gray and opaque
Silicon	Colorless (h.c.); opaque (s.s.)	Colorless; opaque (s.)
Silver	Colorless (n.s.)	Gray and opaque
Strontium	Colorless (n.s.)	....
Tin	Colorless (h.c.); opaque (s.s.)	Colorless; opaque (s.)
Titanium	Colorless	Yellow (h.); violet (c.)
Tungsten	Colorless	Brown
Uranium	Yellow or brownish (h., n.s.)	Green
Vanadium	Colorless	Green

Beads of Microcosmic Salt $NaNH_4HPO_4$

Substance	Oxidizing flame	Reducing flame
Aluminum	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Antimony	Colorless (n.s.)	Gray and opaque
Barium	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Bismuth	Colorless (n.s.)	Gray and opaque
Cadmium	Colorless (n.s.)	Gray and opaque
Calcium	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Cerium	Yellow or brownish red (h., s.)	Colorless
Chromium	Red (h., s.); green (c.)	Green (c.)
Cobalt	Blue (h.c.)	Blue (h.c.)
Copper	Blue (c.); green (h.)	Red and opaque (c.)
Iron	Yellow or brown (h., s.)	Colorless; yellow or brownish (h.)
Lead	Colorless (n.s.)	Gray and opaque
Magnesium	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Manganese	Violet (h.c.)	Colorless
Molybdenum	Colorless; green (h.)	Green (h.)
Nickel	Yellow (c.); red (h., s.)	Yellow (c.); red (h.); gray and opaque
Silicon	(Swims undissolved)	(Swims undissolved)
Silver	....	Gray and opaque
Strontium	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Tin	Colorless; opaque (s.)	Colorless
Titanium	Colorless (n.s.)	Violet (c.); yellow or brownish (h.)
Uranium	Green; yellow or brownish (h., s.)	Green (h.)
Vanadium	Yellow	Green
Zinc	Colorless (n.s.)	Gray and opaque

Sodium Carbonate Bead

Manganese	Green	Colorless

PREPARATION AND PROPER CONCENTRATION OF LABORATORY REAGENTS FOR GENERAL USE

Dilute Acids. Sulfuric acid. One volume concentrated acid to 6 volumes water.

Nitric Acid. One volume concentrated acid to 2 volumes water.

Hydrochloric acid. Five volumes concentrated acid to 8 volumes water.

Acetic acid. One volume concentrated acid to $2\frac{1}{2}$ volumes water.

Dilute Bases. Potassium hydroxide. 280 grams per liter of solution with water.

Sodium hydroxide. 200 grams per liter of solution with water.

Ammonium hydroxide. One volume concentrated ammonia (sp. gr. 90) to 2 volumes water.

Other Reagents. Ammonium sulfide. 600 cc. ammonium hydroxide is saturated with hydrogen sulfide. Dilute to one liter with ammonium hydroxide.

Sodium sulfide. Dissolve 200 grams sodium hydroxide in 800 cc. water. Saturate 400 cc. of this solution with hydrogen sulfide. Add the remaining 400 cc. of sodium hydroxide and dilute the whole to one liter.

Ammonium chloride. 267.5 grams per liter of solution with water.

Ammonium carbonate. 200 grams solid salt dissolved in 350 cc. ammonium hydroxide and dilute with water to 1 liter.

Ammonium acetate. Dilute 300 cc. concentrated acetic acid with 300 cc. water and neutralize with concentrated ammonia. Dilute to 1 liter.

Sodium acetate, 136.14 grams per liter with water.

Sodium phosphate, 119.45 grams per liter with water.

Calcium chloride, 109.51 grams per liter with water.

Magnesium sulfate, 123.28 grams per liter with water.

Barium chloride, 122.17 grams per liter with water.

Ferric chloride, 54.11 grams per liter with water and add sufficient HCl to keep in solution.

Potassium ferrocyanide, 105.72 grams per liter with water.

Lead acetate, 189.51 grams per liter with water.

Stannous chloride, 112.72 grams of the solid salt plus 200 cc. 5N HCl diluted to 1 liter with water. Add metallic tin to the solution in the bottle to keep it from oxidizing.

Mercurous nitrate, 262.34 grams per liter with water. Add sufficient nitric acid to keep solution clear and put metallic mercury in the bottle to prevent oxidation.

Cobalt nitrate, 145 grams per liter with water.

Ammonium oxalate, 35.5 grams per liter with water.

Mercuric chloride, 67.8 grams per liter with water.

Zinc sulfate, 71.9 grams per liter with water.

Manganese sulfate, 55.78 grams per liter with water.

Nickel sulfate, 70.22 grams per liter with water.

Cadmium sulfate, 64.05 grams per liter with water.

Copper sulfate, 62.4 grams per liter with water.

Miscellaneous Reagents. Aqua regia, mix 1 part concentrated HNO_3 with three parts of concentrated HCl.

Silver nitrate N/10, 17 grams per liter with water.

Magnesia mixture, dissolve 68 grams crystallized $MgCl_2$ and 165 grams NH_4Cl in 300 cc. water. Add 300 cc. dilute ammonium hydroxide and dilute to 1 liter.

Molybdate solution, dissolve 60 grams molybdic oxide (MoO_3) in 440 cc. of water and 60 cc. concentrated ammonia (sp. gr. 90). Pour into 500 cc. of cold nitric acid which has been diluted 250 cc. concentrated acid to 250 cc. water. Let stand in a warm place several days. Decant or filter before using.

Phenolsulfonic acid, dissolve 150 grams of phenol in 600 grams of concentrated sulfuric acid.

Yellow ammonium sulfide, 50 to 75 grams of sulfur to a liter of colorless ammonium sulfide.

Ferrous sulfate, dissolve 200 grams $FeSO_4.7H_2O$ in a liter of water. Place scraps of iron in the solution and add a few drops of H_2SO_4 from time to time.

SPECIAL SOLUTIONS AND REAGENTS

Acid Cuprous Chloride. Cover the bottom of a two-liter flask with copper oxide, extend from the top to the bottom of the bottle several pieces of copper wire, and fill the bottle with 1.10 sp. gr. hydrochloric acid. Shake occasionally, and when solution becomes nearly colorless pour into reagent bottles containing copper wire. The stock bottle should be kept filled with 1.10 hydrochloric acid.

Ammoniacal Cuprous Chloride. The acid solution, described above, is treated with ammonia until a slight odor of this reagent is noticeable. Copper wire should be kept in the solution.

Ammonium Molybdate. Mix well 100 gm. of molybdic acid with 400 cc. of distilled water and add 80 cc. of ammonia (sp. gr. 0.90). When complete solution has taken place pour slowly and with stirring into a mixture of 400 cc. of nitric acid (sp. gr. 1.42) and 600 cc. of distilled water. Add 50 milligrams of microcosmic salt, allow to stand 24 hrs. and filter.

Cochineal. Extract 1 gm. of cochineal for four days with 20 cc. of alcohol and 60 cc. of distilled water. Filter.

Congo Red. Dissolve 0.5 gm. of congo red in 90 cc. of distilled water and 10 cc. of alcohol.

Eschka's Compound. Two parts of calcined magnesia are thoroughly mixed with one part of anhydrous sodium carbonate.

Fehling Solution. A. *The Copper Sulphate Solution.* Dissolve 34.66 gm. of copper sulphate ($CuSO_4 \cdot 5H_2O$) in water and dilute to 500 cc. B. *The Alkaline Tartrate Solution.* Dissolve

173 gm. of potassium sodium tartrate (Rochelle salt, $KNaC_4H_4O_6 \cdot 4H_2O$) and 50 gm. of sodium hydroxide in water and dilute when cold to 500 cc. For use, mix equal volumes of the two solutions at the time of using.

Formaldehyde-Sulfuric Acid (Marquis Reagent). Add 10 cc. formaldehyde solution to 50 cc. sulfuric acid.

Fuchsin-Sulfurous Acid. To a solution of 0.5 gm. of fuchsin and 9 gm. of sodium bisulphite in 500 cc. of water add 10 cc. of hydrochloric acid. Keep in well-stoppered bottles and away from light.

Iodo-potassium Iodide (Wagner's Reagent). Dissolve 2 gm. of iodine and 6 gm. of potassium iodide in 100 cc. of water.

Litmus. Extract powder three times with boiling alcohol, each treatment consuming an hour. Treat residue with an equal weight of cold water and filter; then exhaust with five times its weight of boiling water, cool and filter.

Magnesia Mixture. Dissolve 110 gm. of magnesium chloride in a small amount of water. To this solution add 280 gm. of ammonium chloride and 700 cc. of ammonia (sp. gr. 0.90), and dilute to 2000 cc. After standing several hours the solution is filtered. From time to time filter off any silica that may accumulate from the reagent bottle.

Mayer's Reagent. Dissolve 1.35 gm. of mercuric chloride in 60 cc. of water and add to a solution of 5 gm. potassium iodide in 10 cc. of water; add sufficient water to make 100 cc.

Methyl Orange Solution. Dissolve 1 gm. of methyl orange in 1000 cc. of water.

Methyl Red. Dissolve 0.20 gm. of methyl red in 100 cc. of alcohol.

Millon's Reagent. Dissolve 1 part of mercury in 1 part of cold fuming nitric acid. Dilute with twice the volume of water and decant the clear solution after several hours.

Nessler's Solution. Dissolve 50 gm. of potassium iodide in the smallest possible quantity of cold water. Add a saturated solution of mercuric chloride until an excess is indicated by the formation of a precipitate. Add 400 cc. of a 50% solution of potassium hydroxide. Make up to 1 liter, allow to settle, and draw off the clear solution.

Phenolphthalein. Dissolve 1 gm. of phenolphthalein in 50 cc. of alcohol and add 50 cc. water.

Phosphomolybdic Acid (Sonnenschein's Reagent). Prepare ammonium phosphomolybdate and after washing with water, boil with nitric acid and expel NH_3; evaporate to dryness and dissolve in 10% nitric acid.

Phosphotungstic Acid (Scheibler's Reagent). Dissolve 20 gm. sodium tungstate and 15 gm. sodium phosphate in 100 cc. water containing a little nitric acid.

Picric Acid (Hager's Reagent). Dissolve 1 gm. picric acid in 100 cc. water.

Potassium-cadmium Iodide (Marme's Reagent). Add 2 gm. cadmium iodide to a boiling solution of 4 gm. potassium iodide

in 12 cc. water and then mix with an equal volume of saturated potassium iodide solution.

Rosolic Acid. Dissolve 1 gm. rosolic acid in 10 cc. alcohol and add 100 cc. water.

Soap Solution. Dissolve 100 gm. of dry castile soap in 1 liter of 80% alcohol. Allow to stand several days and dilute with 70% to 80% alcohol until 6.4 cc. produces a permanent lather with 20 cc. of standard calcium solution. The latter solution is made by dissolving 0.2 gm. of calcium carbonate in a small amount of dilute hydrochloric acid, evaporating to dryness, and making up to 1 liter.

Sodium Cobaltic Nitrite. Dissolve 4 gm. of cobalt nitrate and 10 gm. of sodium nitrite in 50 cc. of water, add 2 cc. of 36% acetic acid and make up to 100 cc.

Sodium Nitroprusside. Use a freshly prepared solution of 1 gm. sodium nitroprusside in 10 cc. of water.

Sulfanilic Acid. Dissolve 0.5 gm. sulfanilic acid in a mixture of 15 cc. glacial acetic acid and 135 cc. of recently boiled water.

Sulfomolybdic Acid (Froehde's Reagent). Dissolve 10 gm. molybdic acid or sodium molybdate in 100 cc. concentrated sulfuric acid.

Starch. Dissolve 5 gm. of soluble starch in cold water, pour the solution into 2 liters of hot water and boil for a few minutes. Keep in a glass-stoppered bottle.

Starch Solution from other than soluble starch. One part of starch is made into an emulsion with water and this is poured into 200 parts of boiling water, the boiling continued a few minutes, then the solution allowed to stand. Use only the clear solution.

Tannic Acid. Dissolve 1 gm. of tannic acid in 1 cc. of alcohol, and make up to 10 cc. with water.

Tincture of Iodine. To 50 cc. of water add 70 gm. of iodine and 50 gm. of potassium iodide. Make up to 1 liter with alcohol.

Trinitrophenol Solution. Dissolve 1 gm. of trinitrophenol in 100 cc. of water. Cool and filter.

Turmeric Tincture. Digest the ground turmeric root with several small quantities of water which are discarded. Dry the residue and digest it several days with six times its weight of alcohol and filter.

Turmeric Paper. Impregnate white, unsized paper with the tincture, and dry.

STANDARD SOLUTIONS FOR VOLUMETRIC ANALYSIS

Acids

Decinormal Succinic Acid. $H_2C_4H_4O_4$ (5.9023 g. per liter) Dry 5–6 g. of pure succinic acid in an open weighing bottle at 105° for about 10 hours; cool in a desiccator. Weigh out accurately 2.9512 g., brush into a 400 cc. beaker and dissolve in 150–200 cc. of water; pour the solution into a 500 cc. graduated flask, rinsing out the beaker several times to insure complete transference of the acid. Dilute to exactly 500 cc. and mix thoroughly. This prepares an exact decinormal solution.

Standard Hydrochloric Acid Solutions by the Method of G. A. Hulett and W. D. Bonner. *Jour. Am. Chem. Soc.* 31, 390 (1909). Standard HCl is easily prepared by starting with HCl of about d 1.10, made up with an ordinary hydrometer, distilling off and discarding the first three-fourths of the liquid taken; the distillate which is then collected does not differ by more than one part in 10,000 from the values in the table below. This constant boiling acid is not hygroscopic or noticeably volatile and is easily weighed in a small flask. By the use of a capillary pipette, to adjust the last amount of acid, it is a very simple matter to weigh out 180.155 g. to less than 10 mg. and this furnishes sufficient acid to make a liter of normal solution with an accuracy that is seldom attained even with very elaborate precautions.

Bonner and Titus, J.A.C.S., 52, 633 (1930).

Press.	B.P.	Dens.	% HCl	Press.	B.P.	Dens.	% HCl	g for 1 l of N Sol.
100	59.340	1.1095	22.97	600	102.209	1.0980	20.638	176.72
200	75.580	1.1058	22.202	700	106.424	1.0966	20.360	179.13
300	84.970	1.1034	21.269	760	108.584	1.0959	20.222	180.35
400	92.080	1.1010	21.235	800	110.007	1.0955	20.155	180.95
500	97.578	1.0993	20.916	1000	116.185	1.0933	19.734	
				1200	122.363	1.0915	19.394	

Normal Hydrochloric Acid. (36.465 g. per liter) (*a*) 180.155 g. of constant boiling point (760 mm.) acid diluted to 1 liter gives an exactly normal solution. (*b*) Concentrated HCl diluted to d 1.020 is approximately normal. (*c*) Concentrated HCl. contains about one-third of its weight of HCl and 120 g. diluted with water to 1 liter will give an acid slightly greater than normal. Solutions prepared as in *b* or *c* are most accurately standardized by precipitation as AgCl.

Normal Sulfuric Acid. (49.04 g. per liter) Take 30 cc. of pure, concentrated H_2SO_4, d 1.84 and pour it cautiously and slowly into about 3–4 volumes of water, cool, mix thoroughly and dilute to 1 liter. Standardize by titration with standard NaOH or KOH solutions with phenolphthalein as indicator. For a decinormal solution use 3 cc. H_2SO_4 per liter and proceed as above. Sulfuric acid is obtained easily in a pure form; the normal acid solution is not affected by boiling (advantage over similar HNO_3

or HCl solutions); when used with lime or similar compounds it gives precipitates and for such cases HCl is preferable.

Normal Nitric Acid. (63.016 g. per liter) Use a colorless acid, d 1.3±, free from chlorine and nitrous acid; a yellow color due to lower oxides of nitrogen is removed by adding about 2 volumes of water, boiling, cooling and then diluting to volume. 65 cc. or 93 g. of acid, d 1.42 diluted to 1 liter gives an acid slightly greater than normal. Standardize by titration with standard alkali.

Normal Oxalic Acid. $H_2C_2O_4$ (63.023 g. $H_2C_2O_4.2H_2O$ or 45.008 g. $H_2C_2O_4$ per liter) Because of the uncertainty in the amount of water of crystallization, standards can not be prepared directly by dissolving a weighed quantity of acid; it is necessary to standardize the solution against alkali of known concentration using phenolphthalein as an indicator. Decinormal or less concentrated solutions are unstable and should be prepared fresh when needed; more concentrated solutions may deposit some of the acid when cooled to low temperatures but they are fairly stable at room temperature when protected from light.

Alkalis

Normal Sodium Hydroxide. * (40.005 g. per liter) Dissolve about 42 g. NaOH in cold water which has been previously boiled to expel CO_2 and dilute to 1 liter with CO_2 free water; a small amount of $BaCl_2$ or $Ba(OH)_2$ solution may be added and after allowing the $BaCO_3$ to settle, the clear supernatant solution is decanted. In preparing the solution exposure to air should be avoided as much as possible. Standardize with normal H_2SO_4 using methyl orange indicator. Solutions thus prepared are slightly greater than normal but after preliminary titration with acid are easily adjusted by the addition of the proper amount of water. The solution must be kept in a bottle with the stopper lubricated with a small amount of vaseline.

Normal Potassium Hydroxide.* (56.108 g. per liter) Proceed as with normal sodium hydroxide using 58 g. KOH.

Decinormal Potassium Hydroxide.* (5.6108g. per liter) Dissolve 7 g. KOH in about 400 cc. of water, add a little $BaCl_2$ solution to precipitate the carbonate and allow to stand about 15 minutes until the $BaCO_3$ settles, filter into a 1 liter flask and without washing the precipitate, dilute to 1 liter with CO_2 free water. Standardize with 0.1 N sulfuric, hydrochloric or succinic acids, using phenolphthalein or methyl orange indicator. Solutions thus prepared are slightly greater than 0.1 N but after preliminary titration with acid are easily adjusted by the addition of the proper amount of water.

Decinormal Sodium Hydroxide.* (4.0005 g. per liter) Dissolve 6 g. NaOH in water and proceed as with 0.1 N KOH.

* The correction factors of NaOH or KOH solutions may change rapidly because of absorption of CO_2 and for this reason should be protected as much as possible from exposure to the air. It is best to standardize these alkaline solutions just before use and when phenolphthalein is used as the indicator to use water which has been boiled recently to expel CO_2 and then cooled. The presence of CO_2 is without effect when methyl orange is the indicator.

Half Normal Ammonium Hydroxide. (17.524 g. per liter) Dilute 28 cc. of ammonium hydroxide, d 0.880 to 1 liter and standardize with sulfuric or hydrochloric acid using cochineal or methyl orange as indicator. Normal solutions of ammonium hydroxide are likely to lose NH_3 at room temperatures.

Oxidizing and Reducing Solutions

Decinormal Potassium Permanganate. $Mn^{vii} \rightarrow Mn^{ii}$ (3.1606 g. per liter) Dissolve 3.3 g. dry $KMnO_4$ in 1 liter distilled water and allow to stand at least 24 hours in a clean glass stoppered bottle. The reasons for not using the freshly prepared solution are: 1st the reducing agents in the water (dust, etc.) are thus all oxidized, and 2nd any MnO_2 formed by this reduction is permitted to settle. The solution is then carefully siphoned through a clean glass tube into clean beakers, discarding the first 25 cc. of solution and the last inch of the solution in the bottle which contains the precipitated MnO_2; the $KMnO_4$ solution should never be permitted to come in contact with rubber, filter paper or other organic matter. The solution in the beakers is now poured back into a clean bottle and standardized against sodium oxalate. Weigh out several samples of 0.25–0.3 g. of a very pure grade and previously dried sodium oxalate and transfer each to 250 cc. Erlenmeyer flasks, add 150 cc. water and 4 cc. concentrated H_2SO_4, heat nearly to boiling and when dissolved run in $KMnO_4$ not faster than 10–15 cc. per minute, swirling the flask rapidly to mix the solutions; the last 1 cc. is added dropwise allowing the solution to decolorize completely before the next addition. The temperature of the solution must be kept above 60°C. and may be heated again if necessary. The addition of $KMnO_4$ is continued until a *faint*, permanent pink is obtained. The first titration may not be exact but will give a fair approximation of the amount necessary for the remaining samples of oxalate. 1 cc. of 0.1 N $KMnO_4$ is equivalent to 0.0067 g. sodium oxalate.

Decinormal Potassium Dichromate. $Cr^{vi} \rightarrow Cr^{iii}$ (4.9037 g. per liter) Dry about 6 g. of $K_2Cr_2O_7$ crystals in an oven for an hour and cool in a desiccator. Weigh out exactly 4.9037 g., place in a liter flask and dilute to exactly 1 liter. This solution is exactly decinormal and can be used for titrating in the standardization of thiosulfate solution. For use in Fe titration it should be checked against pure iron wire by weighing out accurately two samples of wire of 150–200 mg. each. These samples are dissolved separately in beakers with 20 cc. H_2O and 6 cc. HCl. A few particles of carbon may remain undissolved. The solutions are heated nearly to boiling and 2–3 drops of $SnCl_2$ solution are added to reduce any ferric salt formed by oxidation during solution. After cooling and diluting to about 50 cc., an excess of $HgCl_2$ is added (10 cc. of a saturated solution of $HgCl_2$) to reduce the excess $SnCl_2$. The $K_2Cr_2O_7$ solution is added from a burette until within 2 cc. of the quantity calculated from the amount of iron dissolved. The last amount of $K_2Cr_2O_7$ is added slowly and the end point determined using $K_3Fe(CN)_6$

as an external indicator (one small crystal of $K_3Fe(CN)_6$ in 30 cc H_2O). A blue color is obtained as long as ferrous iron is present. When no blue color is obtained after 30 seconds the end point is attained. Since the Fe wire is not absolutely pure, the weight of iron sample is multiplied by the percentage of iron in the wire. 0.005584 g. Fe is equivalent to 1 cc. 0.1 N solution.

Decinormal Sodium Thiosulfate. $2Na_2S_2O_3 \rightarrow Na_2S_4O_6$ (24.8192 g. $Na_2S_2O_3.5H_2O$ per liter) Do not dry the sodium thiosulfate in an oven as it can be obtained almost pure; weigh out 28.50 g. and dilute to exactly 1 liter. After mixing thoroughly the solution is allowed to stand two weeks. If free sulfur has separated, the clear liquid is siphoned off. The solution is standardized indirectly by titration with potassium dichromate (*see above*). Dissolve 5 g. KI and 4 g. $NaHCO_3$ in 300 cc. H_2O in a 500 cc. Erlenmeyer flask at room temperature and then add HCl slowly, swirling the flask, until there is no more evolution of CO_2 and then add about 10 cc. more acid; add 35 cc. 0.1 N $K_2Cr_2O_7$, mixing the solutions, rinse the sides of the flask with a few cc. of water, allowing it to form a layer over the solution without mixing; stopper the flask and allow to stand about 10 minutes. Then with thorough mixing run in thiosulfate until the solution is a light yellow, add a few drops of starch solution and continue with a slow addition of thiosulfate until the bright blue color has disappeared and only the pale green color of $CrCl_3$ remains.

Decinormal Iodine. $I_2 \rightarrow 2HI$ (12.6932 g. per liter) Dissolve about 13.5 g. pure sublimed iodine in a sulution of 24 g. KI in 200 cc. H_2O and dilute to 1 liter. The solution is standardized by adding the iodine to a known volume of standard thiosulfate with a few drops of starch solution for the indicator.

Decinormal Alkaline Arsenite $As^{iii} \rightarrow As^{v}$(4.9465 g. As_2O_3 per liter; equivalent to 0.0126932 g. I or 0.0035457 g. Cl per cc.) Dissolve 4.9465 g. pure sublimed As_2O_3 in a concentrated solution of 4 g. NaOH, add 100 cc. of a saturated $NaHCO_3$ solution and dilute to 1 liter. Do not warm the solution above 60° C. when dissolving the As_2O_3. Standardize against standard iodine solution with a starch indicator.

ACID DILUTION BY VOLUME

The volume of pure acid (or water) which must be added to 50 cm³ of water (or acid) to give solutions of specific gravity shown. Temperature 20°C. Taken from curves prepared by W. W. Stiles, based on experimental determinations. The values are approximate only.

Sulfuric Acid

Sp. gr.	Acid cm³
0.9982	0.0
1.01	0.2
1.02	0.5
1.03	0.9
1.04	1.3
1.05	1.7
1.06	2.2
1.07	2.7
1.08	3.2
1.09	3.7
1.10	4.3
1.11	4.9
1.12	5.5
1.13	6.2
1.14	6.9
1.15	7.6
1.16	8.3
1.17	9.0
1.18	9.7
1.19	10.5
1.20	11.3
1.21	12.1
1.22	12.9
1.23	13.7
1.24	14.5
1.25	15.3
1.26	16.1
1.27	16.9
1.28	17.8
1.29	18.7
1.30	19.6
1.31	20.6
1.32	21.6
1.33	22.7
1.34	23.8
1.35	25.0
1.36	26.2
1.37	27.4
1.38	28.6
1.39	29.8
1.40	31.1
1.41	32.5
1.42	33.9
1.43	35.4
1.44	36.8

Sulfuric Acid

Sp. gr.	Acid cm³
1.45	38.4
1.46	40.2
1.47	42.3
1.48	44.5
1.49	46.6
1.50	48.7
Sp. gr.	**Water cm³**
1.51	49.3
1.52	47.2
1.53	45.2
1.54	43.3
1.55	41.4
1.56	39.5
1.57	37.7
1.58	36.0
1.59	34.3
1.60	32.8
1.61	31.4
1.62	30.0
1.63	28.6
1.64	27.2
1.65	25.9
1.66	24.6
1.67	23.3
1.68	22.0
1.69	20.7
1.70	19.4
1.71	18.1
1.72	16.9
1.73	15.6
1.74	14.3
1.75	13.0
1.76	11.7
1.77	10.4
1.78	9.1
1.79	7.6
1.80	6.0
1.81	4.4
1.82	2.8
1.83	.5

Hydrochloric acid

Sp. gr.	Acid cm³
0.9982	0.0
1.000	0.4
1.005	1.4
1.010	2.7
1.015	4.1
1.020	5.6
1.025	7.1
1.030	8.6
1.035	10.2
1.040	11.8
1.045	13.8
1.050	15.9
1.055	18.4
1.060	21.1
1.065	24.
1.070	26.8
1.075	30.
1.080	33.7
1.085	37.9
1.090	42.2
1.095	47.0
1.100	47.8
Sp. gr.	**Water cm³**
1.105	42.2
1.110	37.6
1.115	33.7
1.120	30.0
1.125	26.4
1.130	23.2
1.135	20.0
1.140	17.2
1.145	14.8
1.150	12.4
1.155	10.
1.160	8.
1.165	5.9
1.170	3.9
1.175	2.1
1.180	0.6
1.185	0.0

Nitric acid

Sp. gr.	Acid cm³
0.9982	0.0
1.00	0.2
1.01	1.1
1.02	1.9
1.03	3.
1.04	4.1
1.05	5.2
1.06	6.4
1.07	7.7
1.08	9.1
1.09	10.6
1.10	12.
1.11	13.5
1.12	15.1
1.13	16.8
1.14	18.5
1.15	20.3
1.16	22.3
1.17	24.4
1.18	26.7
1.19	29.3
1.20	32.1
1.21	35.1
1.22	38.3
1.23	41.8
1.24	45.6
1.25	49.4
Sp. gr.	**Water cm³**
1.26	46.9
1.27	43.2
1.28	39.3
1.29	35.5
1.30	31.7
1.31	28.2
1.32	24.9
1.33	21.8
1.34	18.8
1.35	15.9
1.36	12.9
1.37	9.9
1.38	7.1
1.39	4.5
1.40	2.1
1.408	0.0

ORGANIC ANALYTICAL REAGENTS

Compiled by John H. Yoe

Determination	Reagent	Reference
Aluminum	Alizarin S	J. Am. Chem. Soc. **50,** 748 (1928)
	Ammonium salt of aurin tricarboxylic acid ("Aluminon")	" **49,** 2395 (1927)
	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Bull. soc. chim. Belg., **36,** 288 (1927)
	Hematoxylin	Ind. Eng. Chem. **16,** 233 (1924)
	8-Hydroxyquinoline	J. Am. Chem. Soc. **50,** 1900 (1928)
Antimony	Hexamethylenetetramine	Z. anal. Chem. **67,** 298 (1925)
	Phenylthiohydantoic acid	Compt. rend. **176,** 1221 (1923)
	Pyrogallol	Z. anal. Chem. **64,** 44 (1924)
Beryllium	Curcumin	J. Am. Chem. Soc. **50,** 393 (1928)
	8-Hydroxyquinoline	Bur. Standards J. Research **3,** 91 (1929)
	1, 2, 5, 8-Tetrahydroxyanthraquinone (Quinalizarin)	Siemens-Konzerns, Beryllium, p. 25 (1932)
Bismuth	Conchonine	Scott, p. 77
	Dimethylglyoxime	Z. anal. Chem. **72,** 11 (1927)
	8-Hydroxyquinoline	" **72,** 177 (1927)
	Pyrogallol	" **65,** 448 (1925)
Boron	Curcumin	Chem. News **87,** 27 (1903)
	Mannitol	Scott, p. 90
	Methyl alcohol	J. Am. Chem. Soc. **50,** 1385 (1928)
Cadmium	Allylthiourea	Helvetica Chim. Acta, **12,** 718 (1929)
	Ethylenediamine	Z. anal. Chem. **77,** 340 (1929)
	Hexamethylenetetramine alliodide	C. A., **24,** 311 (1930)
	Pyridine	Z. anal. Chem. **73,** 279 (1928)
Calcium	Alizarin	Biochem. J. 16, 494 (1922); Yoe, Vol. I, p. 139 (2)
	1-amino-2-naphthol-4-sulfonic acid	J. Biol. Chem. **81,** 1 (1929)
	Ammonium stearate	J. Biol. Chem. 29, 169 (1917); Yoe, Vol. II, p. 119 (3)
	Sodium sulforicinate	Biochem. Z. 137, 157 (1923); Yoe, Vol. II, p. 125 (3)
Chlorine	Oleic acid	J. Soc. Chem. Ind. **42,** 427A (1923)
	Sodium sulforicinate	Biochem. Z., **137,** 157 (1923); Yoe, Vol. II, p. 125 (3)
	Thymolphthalein	Ind. Eng. Chem. **19,** 112 (1927)
	o-Tolodine	Yoe, Vol. I, p. 157 (2)
Chromium	1, 8-Dihydroxynaphthalene-3, 6-Disulfonate	Ind. Eng. Chem. **5,** 298 (1913)
	s-Diphenylcarbazide	J. Am. Chem. Soc. **50,** 2363 (1928)
	Pyrogallol dimethyl ether	C. A. **4,** 3178 (1910)
Cobalt	Dimethylglyoxime	J. Am. Chem. Soc. **43,** 482 (1921)
	3, 5-Dimethylpyrazole	Ind. Eng. Chem., Anal. Ed. **2,** 38 (1930)
	Dinitrosoresorcinol	J. Am. Chem. Soc. **45,** 1439 (1923)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Cobalt (Cont.)....	α-Nitroso-β-naphthol	Chem. Zeit. **46,** 430 (1922)
	Nitroso-R-salt	J. Am. Chem. Soc. **43,** 746 (1921)
	Phenylthiohydantoic acid	" **44,** 2219 (1922)
Copper..........	Benzidine	Z. anal. Chem. **67,** 31 (1925)
	α-Benzionoxime (Cupron)	Ber. **56,** 2083 (1923)
	ρ-Dimethylamino-benzalrhodanine	J. Am. Chem. Soc. **52,** 2222 (1930)
	Dinitrosoresorcinol	J. Am. Chem. Soc. **47,** 1268 (1925)
	s-Diphenylcarbazide	Chem. Weekblad **21,** 20 (1924)
	Hydroquinone	Bull. soc chim. **31,** 1176 (1922)
	Isatin	Rec. trav. chim. 42, 199 (1923)
	α-Naphthol	Bull. soc. chim. 31, 1176 (1922)
	Phenolphthalin	Compt. rend. **173,** 1082 (1921)
	Phenylthiohydantoic acid	J. Am. Chem. Soc. **44,** 225 (1922)
	Potassium ethyl xanthate	Yoe, Vol. I, p. 184 (2)
	Pyridine	Z. anal. Chem. **67,** 27 (1925)
	Salicylic acid	Yoe, Vol. I, p. 183 (2)
	Sodium diethyldi-thiocarbamate	Analyst **54,** 650 (1929)
	o-Tolidine	Z. anal. Chem. **67,** 31 (1925)
Columbium......	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 109
Gold.............	Benzidine	Bull. Chim. Farm. **52,** 461 (1912)
	Formaldehyde	Bull. soc. chim. **31,** 717 (1922)
	m-Phenylenediamine sulfate	Chem. Zeit. **36,** 934 (1912)
	Phenylhydrazine	Ann. Chim. anal. **12,** 90 (1907)
	o-Tolidine	Analyst **44,** 94 (1919)
Hydrogen sulfide..	*p*-phenylenedi-methyldiamine sulfate	Yoe, Vol. I, p. 375 (2)
Iron..............	Acetylacetone	J. Am. Chem. Soc. **26,** 967 (1904)
	Alloxantin	Compt. rend. **180,** 519 (1925)
	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Ind. Eng. Chem. **3,** 629 (1911)
	Cysteine	Biochem. Z. **187,** 255 (1927)
	Dimethyl glyoxime	Z. anorg. Chemie **89,** 401 (1914)
	Dinitrosoresorcinol	J. Am. Chem. Soc. **47,** 1268 (1925)
	Diphenylamine	J. Am. Chem. Soc. **46,** 263 (1924)
	Hexamethylenetetramine	Bull. soc. chim. Rom. **2,** 89 (1921)
	Isonitrosoacetophenone	Ber. **60,** 527 (1927)
	7-Iodo-8-hydroxy-quinoline-5-sulfonic acid	J. Am. Chem. Soc. **54,** 4139 (1932)
	α-Nitroso-β-naphthol	Bull. soc. chim. **35,** 641 (1924)
	Salicylic acid	J. Chem. Soc. **93,** 93 (1908)
	Sulfosalicylic acid	Biochem. Z. **181,** 391 (1927)
	Thioglycollic acid	J. Am. Chem. Soc. **49,** 1916 (1927)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Lead	Ammonium thiocyanate and pyridine	Z. anal. Chem. **72,** 289 (1927)
	Aniline	Ind. Eng. Chem. 11, 1055 (1919); Yoe, Vol. I, p. 257 (2)
	s-Diphenylcarbazide	Yoe, Vol. I, p. 255 (2)
	Hematin	" 257 (2)
Magnesium	Clayton yellow	C. A., **23,** 1838 (1929)
	Dimethylamine	Z. anorg. Chem. **26,** 347 (1901)
	Hydroquinone	Yoe, Vol. I, p 264 (2)
	8-Hydroxyquinoline	Z. anal. Chem. **71,** 122 (1927)
	p-Nitrobenzene-azoresorcinol	J. Am. Chem. Soc. **51,** 1456 (1929)
	Oleic acid	Yoe, Vol. I, p. 270 (2)
Mercury	*p*-Dimethylamino-benzalrhodamine	J. Am. Chem. Soc. **52,** 2222 (1930)
	s-Diphenylcarbazide	Z. angew. Chem. **39,** 791 (1926)
Molybdenum	Ethyl ether	Blair, 7th Ed., p. 210 (4)
	Phenylhydrazine	Ber. **36,** 512 (1903)
	Potassium ethyl xanthate and chloroform	J. Am. Chem. Soc. **44,** 1462 (1922)
	Tannic acid	Chem. Eng. Mining Rev. **11,** 258 (1919)
Nickel	*α*-Benzil-dioxime	Analyst **38,** 316 (1913)
	Dicyandiamidine sulfate	Chem. Zeit **31,** 335, 911 (1907)
	Dimethylglyoxime	Chem. Weekblad. **21,** 358 (1924)
	Potassium dithiooxalate	J. Am. Chem. Soc. **54,** 1866 (1932)
Nitrate	Brucine	Yoe, Vol. I, p. 318 (2)
	Diphenylbenzidine	" 316 (2)
	Diphenyl-endo-anilo-hydro-triazole ("Nitron")	Fales, Inorg. Quant. Anal. p. 271 (1925)
	Phenoldisulfonic acid	Yoe, Vol. I, p. 313 (2)
	Pyrogallol	" 319
	Strychnine sulfate	" 320
Nitrite	Antipyrin	" 311
	Dimethylaniline	" 311
	Diphenylamine sulfate	" 654
	m-Phenylenediamine	" 310
	α-Naphthylamine hydrochloride	" 309
	Sulfanilic acid and *α*-naphthylamine	" 308
Osmium	Thiourea	Compt rend. **167,** 235 (1918)
Oxygen	Pyrogallol	Dennis, Gas Analysis, p. 174 (1929)
Phosphate	1, 2, 4-Aminonaphthosulfonic acid	Yoe, Vol. I, p. 348 (2)
	Hydroquinone	" pp. 346 and 353
Phosphorus	Hydrazine sulfate	" p. 341
Selenium	Codeine phosphate	Arch. Pharm. **252,** 161 (1914)
	Hydroquinone	Am. J. Sci. **15,** 253 (1928)
	Hydroxylamine hydrochloride	J. Am. Chem. Soc. **47,** 2456 (1925)
Silver	Chromotropic acid	Helvetica Chim. Acta **12,** 714 (1929)
	Dichlorofluorescein	J. Am Chem. Soc. **51,** 3273 (1929)
	p-Dimethylamino-benzalrhodanine	J. Am. Chem. Soc. **52,** 2222 (1930)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Silver (Cont.)	Methylamine	Mikrochemie **7,** 233 (1929)
Sulfur	*p*-Phenylenedimethyldiamine hydrochloride	Yoe, Vol. I, p. 373 (2)
Tellurium	Hydrazine hydrochloride	J. Am. Chem. Soc. **47,** 2456 (1925)
	Hydroquinone	Am. J. Sci. **15,** 253 (1928)
Tantalum	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 113 (5)
Thorium	Phenylarsonic acid	J. Am. Chem. Soc. **48,** 895 (1926)
Tin	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 113 (5)
Titanium	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 113; Z. anal. Chem. **83,** 345 (1931)
	5, 7-Dibromo-8-hydroxyquinoline	Z. anorg. Chem. **204,** 215 (1932)
	8-Hydroxyquinoline	Z. anal. Chem. **81,** 1 (1930)
	Tannic acid	Analyst **55,** 605 (1930)
	Thymol	Yoe, Vol. I, p. 381 (2)
Tungsten	Benzidine	Ber. **38,** 783 (1905)
	Cinchonine	Hillebrand and Lundell, p. 553 (5)
	Phenylhydrazine hydrochloride	Bull. soc. chim. Belg. **38,** 385 (1929)
	Uric acid	Ann. chim. anal. **9,** 371 (1904)
Uranium	Sodium salicylate	Chem. Zeit. **43,** 739 (1919)
Vanadium	Aniline	C. A. **24,** 567 (1930)
	Diphenylamine	Yoe, Vol. I, p. 715 (2)
	Diphenylbenzidine	Ind. Eng. Chem. **20,** 764 (1928)
	Safranine	Vol. Anal., Vol. II, p. 326 (6)
	Strychnine	Yoe, Vol. I, p. 393 (2)
Zinc	Diphenylamine	J. Am. Chem. Soc. **49,** 2214 (1927)
	Diphenylbenzidine	J. Am. Chem. Soc. **49,** 356 (1927)
	8-Hydroxyquinoline	Z. anal. Chem. **71,** 171 (1927)
	Pyridine	" **73,** 356 (1928)
	Resorcinol	Yoe, Vol. I, p. 396 (2)
	Urobilin	J. Ind. Hyg. **7,** 273 (1925)
Zirconium	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 109 (5)
	Phenylarsonic acid	J. Am. Chem. Soc. **48,** 895 (1926)

(1) Scott, Standard Methods of Analysis, 1927.
(2) Yoe, Photometric Chemical Analysis, Vol. I, Colorimetry, 1928.
(3) Yoe, Photometric Chemical Analysis, Vol. II, Nephelometry, 1929.
(4) Blair, Chemical Analysis of Iron.
(5) Hillebrand and Lundell, Applied Inorganic Analysis, 1929.
(6) Kolthoff and Furman, Volumetric Analysis, 1929.

VOLUMETRIC PRIMARY STANDARDS

Compiled by John H. Yoe

The 1933 International atomic weights were used in computing the equivalent weights.

Primary standard	Formula	$\frac{\text{Eq. wt.}}{\text{mol. wt.}}$	Equivalent weight
A. Acidimetry			
s-Diphenylguanidine	$NH{:}C[NHC_6H_5]_2$	1	211.13
Mercuric oxide	HgO	$\frac{1}{2}$	108.31
Potassium acid carbonate	$KHCO_3$	1	100.11
Potassium iodate	KIO_3	$\frac{1}{6}$	35.67
Sodium carbonate	Na_2CO_3	$\frac{1}{2}$	53.00
Sodium oxalate (1)	$Na_2C_2O_4$	$\frac{1}{2}$	67.00
Sodium tetraborate (borax)	$Na_2B_4O_7.10H_2O$	$\frac{1}{2}$	190.72
B. Alkalimetry			
Benzoic acid (1)	C_6H_5COOH	1	122.05
Hydrazine sulfate	$N_2H_4.H_2SO_4$	$\frac{1}{2}$	65.06
Oxalic acid (cryst.) (2)	$H_2C_2O_4.2H_2O$	$\frac{1}{2}$	63.02
Potassium acid oxalate	KHC_2O_4	1	128.11
Potassium acid phthalate (1)	$KHC_8H_4O_4$	1	204.14
Potassium acid tartrate	$KHC_4H_4O_6$	1	188.14
Potassium tetraoxalate	$KH_3(C_2O_4)_2.2H_2O$	$\frac{1}{3}$	84.72
Sodium tetraborate (borax)	$Na_2B_4O_7.10H_2O$	$\frac{1}{2}$	190.72
C. Oxidimetry			
Ferrous sulfate (3)	$FeSO_4.7H_2O$	1	278.01
Ferrous ammonium sulfate (3)	$FeSO_4.(NH_4)_2SO_4.6H_2O$	1	392.14
Iron wire (4)	Fe	1	55.84
Oxalic acid (cryst.) (2)	$H_2C_2O_4.2H_2O$	$\frac{1}{2}$	63.02
Potassium ferrocyanide	$K_4Fe(CN)_6.3H_2O$	1	422.34
Potassium iodate	KIO_3	$\frac{1}{2}$	107.01
Potassium iodide	KI	$\frac{1}{2}$	83.01
Silver	Ag	1	107.88
Sodium oxalate (1)	$Na_2C_2O_4$	$\frac{1}{2}$	67.00
D. Iodimetry			
Arsenous oxide (1)	As_2O_3	$\frac{1}{4}$	49.47
Copper	Cu	1	63.57
Hydrazine sulfate	$N_2H_4.H_2SO_4$	$\frac{1}{4}$	32.531
Iodine (resublimed)	I	1	126.92
Iodine cyanide	ICN	$\frac{1}{2}$	76.464
Oxalic acid (cryst.) (2)	$H_2C_2O_4.2H_2O$	$\frac{1}{2}$	63.02
Potassium bromate	$KBrO_3$	$\frac{1}{6}$	27.836
Potassium diiodate	$KH(IO_3)_2$	$\frac{1}{12}$	32.496
Potassium dichromate	$K_2Cr_2O_7$	$\frac{1}{6}$	49.037
Potassium ferricyanide	$K_3Fe(CN)_6$	1	329.19
Potassium iodate	KIO_3	$\frac{1}{6}$	35.670
Sodium thiosulfate	$Na_2S_2O_3.5H_2O$	1	248.19

VOLUMETRIC PRIMARY STANDARDS (Continued)

Primary standard	Formula	Eq. wt. / mol. wt.	Equivalent weight
E. Silver Nitrate			
Potassium bromide	KBr	1	119.02
Potassium chloride	KCl	1	74.56
Sodium chloride	NaCl	1	58.45
F. Alkali Thiocyanates			
Mercury	Hg	$\frac{1}{2}$	100.31
Mercuric oxide	HgO	$\frac{1}{2}$	108.31
Silver	Ag	1	107.88
Silver nitrate	$AgNO_3$	1	169.89

G. Miscellaneous

For the determination of substances that must pass through complicated reactions, it is best to standardize against a standard sample of the substance that has been carried through all steps of the analysis. The U. S. Bureau of Standards can supply at a nominal fee a large number of standard samples of irons and steels (representing a wide range in composition), iron ores, manganese ore, zinc ore, etc.

(1) May be obtained from the U. S. Bureau of Standards.
(2) Difficult to obtain with exactly two molecules of water but a valuable primary standard when carefully prepared.
(3) The pure salt is hard to obtain and to keep without slight oxidation or loss of water, hence other standards are recommended.
(4) Possesses many disadvantages and is not recommended.
(5) The last few drops of iodine are decolorized very slowly. Titrate till the pale yellow color persists at least two minutes. Starch retards the reaction and should be avoided.

TRUE CAPACITY OF GLASS VESSELS FROM THE WEIGHT OF THE CONTAINED WATER OR MERCURY WHEN WEIGHED IN AIR WITH BRASS WEIGHTS*

A glass vessel containing G grams of water at a temperature of t°C has, at the same temperature, a capacity $V = W_t \times G$ cubic centimeters. Similarly when filled with G grams of mercury at a temperature of t°C the capacity at the same temperature is given by $V = M_t \times G$ cubic centimeters.

A glass vessel containing G grams of water at a temperature of t°C has a capacity at a temperature of 18°C given by $V = W_{18°} \times G$ cubic centimeters. Similarly when filled with G grams of mercury at a temperature of t°C the capacity at a temperature of 18°C is given by $V = M_{18°} \times G$ cubic centimeters. The true volume at temperature of 25°C when the weighing is made at $t°$ is similarly obtained by use of the values under $W_{25°}$ and $M_{25°}$ for water and mercury respectively.

t°C.	W_t	M_t	$W_{18°}$	$M_{18°}$	$W_{25°}$	$M_{25°}$
0	1.001193	0.0735501	1.001643	0.0735832	1.001818	0.0735960
1	1.001133	0.0735636	1.001559	0.0735949	1.001734	0.0736077
2	1.001092	0.0735771	1.001492	0.0736066	1.001668	0.0736194
3	1.001068	0.0735907	1.001443	0.0736183	1.001618	0.0736311
4	1.001060	0.0736037	1.001410	0.0736294	1.001586	0.0736423
5	1.001068	0.0736172	1.001394	0.0736411	1.001569	0.0736540
6	1.001092	0.0736308	1.001392	0.0736529	1.001568	0.0736657
7	1.001131	0.0736492	1.001406	0.0736695	1.001581	0.0736824
8	1.001184	0.0736628	1.001435	0.0736812	1.001610	0.0736941
9	1.001252	0.0736763	1.001477	0.0736929	1.001652	0.0737058
10	1.001333	0.0736894	1.001534	0.0737042	1.001709	0.0737171
11	1.001428	0.0736975	1.001603	0.0737104	1.001779	0.0737233
12	1.001536	0.0737111	1.001686	0.0737222	1.001862	0.0737351
13	1.001657	0.0737241	1.001782	0.0737333	1.001957	0.0737463
14	1.001790	0.0737377	1.001890	0.0737451	1.002066	0.0737581
15	1.001935	0.0737513	1.002010	0.0737569	1.002186	0.0737698
16	1.002092	0.0737644	1.002143	0.0737681	1.002318	0.0737810
17	1.002261	0.0737780	1.002286	0.0737798	1.002462	0.0737927
18	1.002441	0.0737911	1.002441	0.0737911	1.002617	0.0738039
19	1.002633	0.0738047	1.002608	0.0738028	1.002783	0.0738157
20	1.002835	0.0738183	1.002785	0.0738146	1.002960	0.0738275
21	1.003047	0.0738314	1.002972	0.0738258	1.003148	0.0738398
22	1.003271	0.0738450	1.003170	0.0738376	1.003346	0.0738505
23	1.003504	0.0738581	1.003379	0.0738489	1.003554	0.0738618
24	1.003748	0.0738717	1.003597	0.0738607	1.003773	0.0738736
25	1.004001	0.0738848	1.003825	0.0738719	1.004001	0.0738848
26	1.004264	0.0738985	1.004063	0.0738837	1.004239	0.0738966
27	1.004537	0.0739116	1.004310	0.0738950	1.004486	0.0739079
28	1.004819	0.0739253	1.004567	0.0739068	1.004743	0.0739197
29	1.005110	0.0739384	1.004833	0.0739181	1.005009	0.0739310
30	1.005410	0.0739520	1.005109	0.0739299	1.005284	0.0739428

* Assuming 25×10^{-6} as the coefficient of cubic expansion for glass.

Reduction of Weighings to Vacuo

If the apparent mass of a body is m, its density d_m, the density of the weights d_w and the density of the air d_a the true mass in vacuo is,

$$M = m + md_a\left(\frac{1}{d_m} - \frac{1}{d_w}\right)$$

DECI-NORMAL SOLUTIONS OF SALTS AND OTHER REAGENTS

The weight in grams of the compound in 1 c.c. of the following deci-normal solutions is found by dividing the H equivalent in the last column by 1000.

Name	Formula	At. or mol. wt.	Hydrogen equivalent	One H equiv. in gms.
Acetic acid	$HC_2H_3O_2$	60.03	$HC_2H_3O_2$	6.003
Ammonia	NH_3	17.03	NH_3	1.703
Ammonium	NH_4	18.04	NH_4	1.804
Ammonium chloride	NH_4Cl	53.50	NH_4Cl	5.350
Ammonium sulfate	$(NH_4)_2SO_4$	132.14	$\frac{1}{2}(NH_4)_2SO_4$	6.607
Ammonium sulfocyanate	NH_4CNS	76.11	NH_4CNS	7.611
Barium	Ba	137.36	$\frac{1}{2}Ba$	6.868
Barium carbonate	$BaCO_3$	197.36	$\frac{1}{2}BaCO_3$	9.868
Barium chloride	$BaCl_2.2H_2O$	244.31	$\frac{1}{2}BaCl_2\ 2H_2O$	12.216
Barium hydroxide	$Ba(OH)_2$	171.38	$\frac{1}{2}Ba(OH)_2$	8.569
Barium oxide	BaO	153.36	$\frac{1}{2}BaO$	7.668
Bromine	Br	79.92	Br	7.992
Calcium	Ca	40.08	$\frac{1}{2}Ca$	2.004
Calcium carbonate	$CaCO_3$	100.08	$\frac{1}{2}CaCO_3$	5.004
Calcium chloride	$CaCl_2$	110.99	$\frac{1}{2}CaCl_2$	5.550
Calcium chloride	$CaCl_2.6H_2O$	219.09	$\frac{1}{2}CaCl_2.6H_2O$	10.954
Calcium hydroxide	$Ca(OH)_2$	74.10	$\frac{1}{2}Ca(OH)_2$	3.705
Calcium oxide	CaO	56.08	$\frac{1}{2}CaO$	2.804
Chlorine	Cl	35.46	Cl	3.546
Citric acid	$C_6H_8O_7.H_2O$	210.08	$\frac{1}{3}C_6H_8O_7.H_2O$	7.003
Cobalt	Co	58.94	$\frac{1}{2}Co$	2.948
Copper	Cu	63.57	$\frac{1}{2}Cu$	3.179
Copper Oxide	CuO	79.57	$\frac{1}{2}CuO$	3.979
Copper sulfate	$CuSO_4\ 5H_2O$	249.71	$\frac{1}{2}CuSO_4.5H_2O$	12.485
Cyanogen	CN	26.01	CN	2.601
Hydrochloric acid	HCl	36.47	HCl	3.647
Hydrocyanic acid	HCN	27.02	HCN	2.702
Iodine	I	126.93	I	12.693
Lactic acid	$C_3H_6O_3$	90.05	$C_3H_6O_3$	9.005
Malic acid	$C_4H_6O_5$	134.05	$\frac{1}{2}C_4H_6O_5$	6.702
Magnesium	Mg	24.32	$\frac{1}{2}Mg$	1.216
Magnesium carbonate	$MgCO_3$	84.32	$\frac{1}{2}MgCO_3$	4.216
Magnesium chloride	$MgCl_2$	95.23	$\frac{1}{2}MgCl_2$	4.762
Magnesium chloride	$MgCl_2\ 6H_2O$	203.33	$\frac{1}{2}MgCl_2.6H_2O$	10.167
Magnesium oxide	MgO	40.32	$\frac{1}{2}MgO$	2.016
Manganese	Mn	54.93	$\frac{1}{2}Mn$	2.747
Manganese sulfate	$MnSO_4$	150.99	$\frac{1}{2}MnSO_4$	7.550
Mercuric chloride	$HgCl_2$	271.52	$\frac{1}{2}HgCl_2$	13.576
Nickel	Ni	58.69	$\frac{1}{2}Ni$	2.935
Nitric acid	HNO_3	63.02	HNO_3	6.302
Nitrogen	N	14.01	N	1.401
Nitrogen pentoxide	N_2O_5	108.02	$\frac{1}{2}N_2O_5$	5.401
Oxalic acid	$H_2C_2O_4$	90.02	$\frac{1}{2}H_2C_2O_4$	4.501
Oxalic acid	$H_2C_2O_4.2H_2O$	126.05	$\frac{1}{2}H_2C_2O_4.2H_2O$	6.302
Oxalic anhydride	C_2O_3	72.00	$\frac{1}{2}C_2O_3$	3.600
Phosphoric acid	H_3PO_4	98.04	$\frac{1}{3}H_3PO_4$	3.268
Potassium	K	39.10	K	3.910
Potassium bicarbonate	$KHCO_3$	100.11	$KHCO_3$	10.011
Potassium carbonate	K_2CO_3	138.20	$\frac{1}{2}K_2CO_3$	6.910
Potassium chloride	KCl	74.56	KCl	7.456
Potassium cyanide	KCN	65.11	KCN	6.511
Potassium hydroxide	KOH	56.11	KOH	5.611
Potassium oxide	K_2O	94.20	$\frac{1}{2}K_2O$	4.710
Potassium permanganate for Co estimation	$KMnO_4$	158.03	$\frac{1}{6}KMnO_4$	2.634

DECI-NORMAL SOLUTIONS OF SALTS AND OTHER REAGENTS (Continued.)

Name	Formula	At. or mol. wt.	Hydrogen equivalent	One H equiv. in gms.
Potassium permanganate for Mn estimation	$KMnO_4$	158.03	$\frac{1}{5}KMnO_4$	5.268
Potassium tartrate	$K_2H_4C_4O_6$	226.23	$\frac{1}{2}K_2H_4C_4O_6$	11.312
Silver	Ag	107.88	Ag	10.788
Silver nitrate	$AgNO_3$	169.89	$AgNO_3$	16.989
Sodium	Na	23.00	Na	2.300
Sodium bicarbonate	$NaHCO_3$	84.00	$NaHCO_3$	8.400
Sodium carbonate	Na_2CO_3	105.99	$\frac{1}{2}Na_2CO_3$	5.300
Sodium chloride	NaCl	58.45	NaCl	5.845
Sodium hydroxide	NaOH	40.00	NaOH	4.000
Sodium oxide	Na_2O	61.99	$\frac{1}{2}Na_2O$	3.100
Sodium sulfide	Na_2S	78.05	$\frac{1}{2}Na_2S$	3.903
Succinic acid	$H_2C_4H_4O_4$	118.05	$\frac{1}{2}H_2C_4H_4O_4$	5.902
Sulfuric acid	H_2SO_4	98.08	$\frac{1}{2}H_2SO_4$	4.904
Sulfur trioxide	SO_3	80.06	$\frac{1}{2}SO_3$	4.003
Tartaric acid	$C_4H_6O_6$	150.05	$\frac{1}{2}C_4H_6O_6$	7.502
Zinc	Zn	65.38	$\frac{1}{2}Zn$	3.269
Zinc sulfate	$ZnSO_4.7H_2O$	287.55	$\frac{1}{2}ZnSO_4.7H_2O$	14.377

REDUCTIONS OF WEIGHINGS IN AIR TO VACUO

When the weight M in grams of a body is determined in air, a correction is necessary for the buoyancy of the air. The following table is computed for an air density of 0.0012. The corrected weight = M + kM /1000, values of k being found in the table.

Density of body weighed	Correction factor, k.		
	Pt Ir weights	Brass weights	Quartz or Al weights
.5	+2.34	+2.26	+1.95
.6	+1.94	+1.86	+1.55
.7	+1.66	+1.57	+1.26
.75	+1.55	+1.46	+1.15
.80	+1.44	+1.36	+1.05
.85	+1.36	+1.27	+0.96
.90	+1.28	+1.19	+ .88
.95	+1.21	+1.12	+ .81
1.00	+1.14	+1.06	+ .75
1.1	+1.04	+0.95	+ .64
1.2	+0.94	+ .86	+ .55
1.3	+ .87	+ .78	+ .47
1.4	+ .80	+ .71	+ .40
1.5	+ .75	+ .66	+ .35
1.6	+ .69	+ .61	+ .30
1.7	+ .65	+ .56	+ .25
1.8	+ .62	+ .52	+ .21
1.9	+ .58	+ .49	+ .18
2.0	+ .54	+ .46	+ .15
2.5	+ .43	+ .34	+ .03
3.0	+ .34	+ .26	— .05
4.0	+ .24	+ .16	— .15
6.0	+ .14	+ .06	— .25
8.0	+ .09	+ .01	— .30
10.0	+ .06	— .02	— .33
15.0	+ .03	— .06	— .37
20.0	+ .004	— .08	— .39
22.0	— .001	— .09	— .40

DECI-NORMAL SOLUTIONS OF OXIDATION AND REDUCTION REAGENTS

Name	Formula	At. or mol. wt.	Hydrogen equivalent	One H equiv. in gms.
Antimony	Sb	121.76	$\frac{1}{2}Sb$	6.089
Arsenic	As	74.93	$\frac{1}{2}As$	3.747
Arsenic trisulfide	As_2S_3	246.04	$\frac{1}{4}As_2S_3$	6.151
Arsenous oxide	As_2O_3	197.86	$\frac{1}{4}As_2O_3$	4.947
Barium peroxide	BaO_2	169.36	$\frac{1}{2}BaO_2$	8.468
Barium peroxide, hydrated	$BaO_2.8H_2O$	313.48	$\frac{1}{2}BaO_2.8H_2O$	15.674
Calcium	Ca	40.08	$\frac{1}{2}Ca$	2.004
Calcium carbonate	$CaCO_3$	100.08	$\frac{1}{2}CaCO_3$	5.004
Calcium hypochlorite	$Ca(ClO)_2$	142.99	$\frac{1}{4}Ca(ClO)_2$	3.574
Calcium oxide	CaO	56.08	$\frac{1}{2}CaO$	2.804
Chlorine	Cl	35.46	Cl	3.546
Chromium trioxide	CrO_3	100.01	$\frac{1}{3}CrO_3$	3.334
Ferrous ammonium sulfate	$FeSO_4(NH_4)_2SO_4.6H_2O$	392.13	$FeSO_4(NH_4)_2SO_4.6H_2O$	39.213
Hydroferrocyanic acid	$H_4Fe(CN)_6$	215.92	$H_4Fe(CN)_6$	21.592
Hydrogen peroxide	H_2O_2	34.02	$\frac{1}{2}H_2O_2$	1.701
Hydrogen sulfide	H_2S	34.08	$\frac{1}{2}H_2S$	1.704
Iodine	I	126.93	I	12.693
Iron	Fe	55.84	Fe	5.584
Iron oxide, ferrous	FeO	71.84	FeO	7.184
Iron oxide, ferric	Fe_2O_3	159.68	$\frac{1}{2}Fe_2O_3$	7.984
Lead peroxide	PbO_2	239.22	$\frac{1}{2}PbO_2$	11.961
Manganese peroxide	MnO_2	86.93	$\frac{1}{2}MnO_2$	4.347
Nitric acid	HNO_3	63.02	$\frac{1}{3}HNO_3$	2.101
Nitrogen trioxide	N_2O_3	76.02	$\frac{1}{4}N_2O_3$	1.800
Nitrogen pentoxide	N_2O_5	108.02	$\frac{1}{6}N_2O_5$	1.800
Oxalic acid	$C_2H_2O_4$	90.02	$\frac{1}{2}C_2H_2O_4$	4.501
Oxalic acid	$C_2H_2O_4.2H_2O$	126.05	$\frac{1}{2}C_2H_2O_4.2H_2O$	6.302
Oxygen	O	16.00	$\frac{1}{2}O$	0.800
Potassium bichromate	$K_2Cr_2O_7$	294.22	$\frac{1}{6}K_2Cr_2O_7$	4.904
Potassium chlorate	$KClO_3$	122.56	$\frac{1}{6}KClO_3$	2.043
Potassium chromate	K_2CrO_4	194.21	$\frac{1}{3}K_2CrO_4$	6.474
Potassium ferrocyanide	$K_4Fe(CN)_6$	368.29	$K_4Fe(CN)_6$	36.829
Potassium ferrocyanide	$K_4Fe(CN)_6.3H_2O$	422.33	$K_4Fe(CN)_6.3H_2O$	42.233
Potassium iodide	KI	166.03	KI	16.603
Potassium nitrate	KNO_3	101.11	$\frac{1}{3}KNO_3$	3.370
Potassium perchlorate	$KClO_4$	138.56	$\frac{1}{8}KClO_4$	1.732
Potassium permanganate	$KMnO_4$	158.03	$\frac{1}{5}KMnO_4$	3.161
Sodium chlorate	$NaClO_3$	106.45	$\frac{1}{6}NaClO_3$	1.774
Sodium nitrate	$NaNO_3$	85.01	$\frac{1}{3}NaNO_3$	2.834
Sodium thiosulfate	$Na_2S_2O_3.5H_2O$	248.19	$Na_2S_2O_3.5H_2O$	24.819
Stannous chloride	$SnCl_2$	189.61	$\frac{1}{2}SnCl_2$	9.481
Stannous oxide	SnO	134.70	$\frac{1}{2}SnO$	6.735
Sulfur dioxide	SO_2	64.06	$\frac{1}{2}SO_2$	3.203
Tin	Sn	118.70	$\frac{1}{2}Sn$	5.935

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS

Aluminum

(1) $Al_2(SO_4)_3 + 6KOH = 2Al(OH)_3 + 3K_2SO_4$

$$KOH = \frac{Al_2(SO_4)_3}{6} = \frac{Al_2O_3}{6} = \frac{Al}{3}$$

Antimony

(2) $SbCl_5 + 2KI = SbCl_3 + 2KCl + I_2$

$$I = \frac{Sb}{2} = \frac{Sb_2O_5}{4}$$

(3) $Sb_2O_3 + 2I_2 + 2H_2O = Sb_2O_5 + 4HI$

$$I = \frac{Sb_2O_3}{4} = \frac{Sb}{2}$$

(4) (a) $Sb_2S_3 + 6HCl = 2SbCl_3 + 3H_2S$
(b) $3H_2S + 3I_2 = 6HI + 3S$

$$I = \frac{H_2S}{2} = \frac{Sb_2S_3}{6} = \frac{Sb}{3}$$

(5) $5Sb_2(SO_4)_3 + 4KMnO_4 + 24H_2O = 10H_3SbO_4 + 2K_2SO_4 + 4MnSO_4 + 9H_2SO_4$

$$\frac{4KMnO_4}{20} = \frac{Sb_2(SO_4)_3}{4} = \frac{Sb_2O_3}{4} = \frac{Sb}{2}$$

Arsenic

(6) $As_2O_3 + 2H_2O + 2I_2 = As_2O_5 + 4HI$

$$I = \frac{As_2O_3}{4} = \frac{As}{2}$$

(7) $AsCl_3 + I_2 + 2HCl = AsCl_5 + 2HI$

$$I = \frac{AsCl_3}{2} = \frac{As}{2}$$

(8) As_2S_3 same as reaction 4

Boron

(9) (a) $Na_2B_4O_7 + 2HCl + 5H_2O = 2NaCl + 4H_3BO_3$
(b) $H_3BO_3 + NaOH = NaBO_2 + 2H_2O$

$$NaOH = H_3BO_3 = B$$

Cadmium

(10) $CdS + 2HCl + I_2 = CdCl_2 + 2HI + S$

$$I = \frac{CdS}{2} = \frac{Cd}{2} = \frac{S}{2}$$

Calcium

(11) $5CaC_2O_4 + 2KMnO_4 + 8H_2SO_4 = 5CaSO_4 + K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$

$$\frac{2KMnO_4}{10} = \frac{CaC_2O_4}{2} = \frac{CaCO_3}{2} = \frac{CaO}{2}$$

(12) $CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O$

$$HCl = \frac{CaCO_3}{2} = \frac{CaO}{2}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Carbon

(13) $Na_2CO_3 + H_2SO_4 = Na_2SO_4 + H_2O + CO_2$

$$\frac{H_2SO_4}{2} = \frac{Na_2CO_3}{2}$$

(14) $2NaHCO_3 + H_2SO_4 = Na_2SO_4 + 2H_2O + 2CO_2$

$$\frac{H_2SO_4}{2} = \frac{NaHCO_3}{1}$$

(15) $KHC_2O_4 + KOH = K_2C_2O_4 + H_2O$

$$KOH = KHC_2O_4$$

(16) $H_2C_2O_4.2H_2O + 2NaOH = Na_2C_2O_4 + 4H_2O$

$$NaOH = \frac{H_2C_2O_4.2H_2O}{2}$$

(17) $C_6H_5COOH + NaOH = C_6H_5COONa + H_2O$

$$NaOH = C_6H_5COOH$$

(18) $5Na_2C_2O_4 + 2KMnO_4 + 8H_2SO_4 = 5Na_2SO_4 + K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{Na_2C_2O_4}{2}$$

Chlorine

(19) $NaCl + AgNO_3 = AgCl + NaNO_3$

$$NaCl = Cl$$

(20) (a) $Cl + KI = KCl + I$

(b) $I_2 + 2Na_2S_2O_3 = Na_2S_4O_6 + 2NaI$

$$I = Cl$$

(21) $CaOCl_2 + 2HCl = CaCl_2 + H_2O + Cl_2$

$$I = Cl = \frac{CaOCl_2}{2}$$

Chromium

(22) $K_2Cr_2O_7 + 6FeCl_2 + 14HCl = 6FeCl_3 + 2KCl + 2CrCl_3 + 7H_2O$

$$Fe = \frac{K_2Cr_2O_7}{6} = \frac{Cr_2O_3}{6} = \frac{Cr}{3}$$

(23) $K_2Cr_2O_7 + 6KI + 7H_2SO_4 = 4K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3I_2$

$$I = \frac{K_2Cr_2O_7}{6} = \frac{Cr_2O_3}{6} = \frac{Cr}{3}$$

Copper (KMnO₄ Method)

(24) (a) $2CuSO_4 + 2KCNS + H_2SO_3 + H_2O = 2CuCNS + K_2SO_4 + 2H_2SO_4$

(b) $CuCNS + NaOH = NaCNS + CuOH$

(c) $5NaCNS + 6KMnO_4 + 4H_2SO_4 = 3K_2SO_4 + 6MnSO_4 + 5NaCN + 4H_2O$

$$\frac{6KMnO_4}{30} = \frac{NaCNS}{6} = \frac{CuSO_4}{6} = \frac{Cu}{6}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

(25) (Iodide Method)

$$2CuSO_4 + 4KI = 2CuI + 2K_2SO_4 + I_2$$
$$I = CuSO_4 = Cu$$

(26) (KCN Method)

(a) $2CuSO_4 + 2NH_4OH = (NH_4)_2SO_4 + Cu_2SO_4(OH)_2$

(b) $Cu_2SO_4(OH)_2 + 6NH_3 + (NH_4)_2SO_4 = 2Cu(NH_3)_4SO_4.H_2O$

(c) $2Cu(NH_3)_4SO_4.H_2O + 7KCN = K_3NH_4Cu_2(CN)_8 + NH_4CNO + 2K_2SO_4 + 6NH_3 + H_2O$

$$\frac{KCN}{2} = \frac{Cu(NH_3)_4SO_4.H_2O}{7} = \frac{CuSO_4}{7} = \frac{Cu}{7}$$

Iodine

(27) $I_2 + 2Na_2S_2O_3 = Na_2S_4O_6 + 2NaI$

$$I = Na_2S_2O_3$$

(28) $KIO_3 + 5KI + 6HCl = 6KCl + 3H_2O + 3I_2$

$$I = \frac{KIO_3}{6} = \frac{5KI}{6}$$

(29) $10KI + 2KMnO_4 + 8H_2SO_4 = 6K_2SO_4 + 2MnSO_4 + 8H_2O + 5I_2$

$$\frac{2KMnO_4}{10} = I$$

Iron

(30) $6FeCl_2 + K_2Cr_2O_7 + 14HCl = 6FeCl_3 + 2KCl + 2CrCl_3 + 7H_2O$

$$\frac{K_2Cr_2O_7}{6} = \frac{6FeCl_2}{6} = \frac{Fe_2O_3}{2} = \frac{Fe}{1}$$

(31) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{10FeSO_4}{10} = \frac{Fe_2O_3}{2} = \frac{Fe}{1}$$

(32) $2FeCl_3 + 2KI = 2KCl + 2FeCl_2 + I_2$

$$I = FeCl_3 = Fe = \frac{Fe_2O_3}{2}$$

Lead

(33) $2Pb(C_2H_3O_2)_2 + K_2Cr_2O_7 + H_2O = 2PbCrO_4 + 2KC_2H_3O_2 + 2HC_2H_3O_2$

$$\frac{2Pb}{4} = \frac{K_2Cr_2O_7}{4}$$ (as precipitating agent for lead)

(34) $2PbCrO_4 + 6KI + 16HCl = 2PbCl_2 + 6KCl + 2CrCl_3 + 8H_2O + 3I_2$

$$I = \frac{PbCrO_4}{3} = \frac{Pb}{3} = \frac{K_2Cr_2O_7}{6}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Manganese

(35) $MnO_2 + H_2SO_4 + H_2C_2O_4 = MnSO_4 + 2CO_2 + 2H_2O$

$$\frac{2KMnO_4}{10} = \frac{C_2H_2O_4}{2} = \frac{MnO_2}{2} = \frac{Mn}{2}$$

(36) (Bismuthate Method)

(a) $2Mn(NO_3)_2 + 5NaBiO_3 + 16HNO_3 = 5NaNO_3 + 5Bi(NO_3)_3 + 7H_2O + 2HMnO_4$

(b) $2HMnO_4 + 5Na_3AsO_3 + 4HNO_3 = 5Na_3AsO_4 + 2Mn(NO_3)_2 + 3H_2O$

$$\frac{2HMnO_4}{10} = \frac{Na_3AsO_3}{2} = \frac{Mn}{5}$$

(37) (Persulfate Method)

(a) $2Mn(NO_3)_2 + 5(NH_4)_2S_2O_8 + 8H_2O = 5(NH_4)_2SO_4 + 4HNO_3 + 5H_2SO_4 + 2HMnO_4$

(b) $2HMnO_4 + 10FeSO_4 + 7H_2SO_4 = 5Fe_2(SO_4)_3 + 2MnSO_4 + 8H_2O$

$$\frac{2HMnO_4}{10} = \frac{10FeSO_4}{10} = \frac{Mn}{5}$$

(38) (Volhard's Method)

$3MnSO_4 + 2KMnO_4 + 2H_2O = 5MnO_2 + K_2SO_4 + 2H_2SO_4$ *or*

$6MnSO_4 + 5ZnSO_4 + 4KMnO_4 + 14H_2O = 4KHSO_4 + 7H_2SO_4 + 5Zn(OH)_2.2MnO_2$

$$\frac{2KMnO_4}{10} = \frac{3MnSO_4}{10} = \frac{3Mn}{10}$$

(39) (Ford Williams Method)

$MnO_2 + 2FeSO_4 + 2H_2SO_4 = MnSO_4 + Fe_2(SO_4)_3 + 2H_2O$

$$\frac{2FeSO_4}{2} = \frac{MnO_2}{2} = \frac{Mn}{2}$$

Molybdenum

(40) (a) $2MoO_3 + 3Zn = Mo_2O_3 + 3ZnO$

(b) $5Mo_2O_3 + 6KMnO_4 + 9H_2SO_4 = 10MoO_3 + 3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{Mo_2O_3}{6} = \frac{MoO_3}{3} = \frac{Mo}{3}$$

Nickel (KCN Method)

(41) (a) $2NiSO_4 + 12NH_4OH = 2Ni(NH_3)_6SO_4 + 12H_2O$

(b) $Ni(NH_3)_6SO_4 + 4KCN = K_2Ni(CN)_4 + K_2SO_4 + 6NH_3$

$$\frac{4KCN}{8} = \frac{Ni(NH_3)_6SO_4}{8} = \frac{Ni}{8}$$

Oxygen

(42) $5H_2O_2 + 2KMnO_4 + 4H_2SO_4 = 2KHSO_4 + 2MnSO_4 + 8H_2O + 5O_2$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

$$\frac{2KMnO_4}{10} = \frac{H_2O_2}{2}$$

Phosphorus

(43) (a) $H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 = (NH_4)_3PO_4.12MoO_3 + 21NH_4NO_3 + 12H_2O$

(b) $2(NH_4)_3PO_4.12MoO_3 + 46NaOH + H_2O = 2(NH_4)_2HPO_4 + (NH_4)_2MoO_4 + 23Na_2MoO_4 + 23H_2O$

$$\frac{NaOH}{1} = \frac{2(NH_4)_3PO_4.12MoO_3}{46} = \frac{P_2O_5}{46} = \frac{P}{23}$$

(44) (a) $2(NH_4)_3PO_4.12MoO_3 + 46NH_4OH + H_2O = 24(NH_4)_2MoO_4 + 2(NH_4)_2HPO_4 + 23H_2O$

(b) $(NH_4)_2MoO_4 + H_2SO_4 = (NH_4)_2SO_4 + H_2MoO_4$

(c) $2MoO_3 + 3Zn + 3H_2SO_4 = 3ZnSO_4 + 3H_2O + Mo_2O_3$

(d) $5Mo_2O_3 + 6KMnO_4 + 9H_2SO_4 = 10MoO_3 + 3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{Mo_2O_3}{6} = \frac{(NH_4)_3PO_4.12MoO_3}{36} = \frac{P}{36} = \frac{P_2O_5}{72}$$

(45) (No ferric alum present)

(a-b-c) as in Reaction 44

(d) $12Mo_2O_3 + O = Mo_{24}O_{37}$

(e) $Mo_{24}O_{37} + 14KMnO_4 + 21H_2SO_4 = 24MoO_3 + 7K_2SO_4 + 14MnSO_4 + 21H_2O$

$$\frac{14KMnO_4}{70} = \frac{Mo_{24}O_{37}}{70} = \frac{(NH_4)_3PO_4.12MoO_3}{35} = \frac{P}{35} = \frac{P_2O_5}{70}$$

Sulfur

(46) $H_2S + I_2 = 2HI + S$

$$I = \frac{H_2S}{2} = \frac{S}{2}$$

(47) $H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O$

$$NaOH = \frac{Na_2SO_4}{2}$$

(48) $NaHSO_4 + NaOH = Na_2SO_4 + H_2O$

$NaOH = NaHSO_4$

(49) $Na_2SO_3 + I_2 + H_2O = Na_2SO_4 + 2HI$

$$I = \frac{Na_2SO_3}{2} = \frac{SO_2}{2} = \frac{S}{2}$$

(50) $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$

$I = Na_2S_2O_3$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Tin

(51) $SnCl_2 + I_2 + 2HCl = SnCl_4 + 2HI$

$$I = \frac{SnCl_2}{2} = \frac{Sn}{2}$$

Titanium

(52) (a) $Ti_2(SO_4)_3 + Fe_2(SO_4)_3 = 2Ti(SO_4)_2 + 2FeSO_4$

(b) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{Ti_2(SO_4)_3}{2} = \frac{Ti}{1}$$

Tungsten

(53) $WO_3 + 2NaOH = Na_2WO_4 + H_2O$

$$\frac{NaOH}{1} = \frac{WO_3}{2} = \frac{W}{2}$$

Uranium

(54) (a) $U_3O_8 + 4H_2SO_4 = 2UO_2SO_4 + U(SO_4)_2 + 4H_2O$

(b) $5U(SO_4)_2 + 2KMnO_4 + 2H_2O = 2KHSO_4 + 2MnSO_4 + H_2SO_4 + 5UO_2SO_4$

$$\frac{2KMnO_4}{10} = \frac{U(SO_4)_2}{2} = \frac{UO_2}{2} = \frac{U}{2}$$

(c) $U_3O_8 = 2UO_3 + UO_2$

$$\frac{2KMnO_4}{10} = \frac{U_3O_8}{2} = \frac{3U}{2}$$

Vanadium

(55) (a) $V_2O_5 + SO_2 \rightleftarrows V_2O_4 + SO_3$

(b) $5V_2O_4 + 2KMnO_4 + 3H_2SO_4 = 5V_2O_5 + K_2SO_4 + 2MnSO_4 + 3H_2O$

$$\frac{2KMnO_4}{10} = \frac{V_2O_4}{2} = \frac{V_2O_5}{2} = \frac{V}{1}$$

(56) (a) $V_2O_5 + 3Zn + 3H_2SO_4 = V_2O_2 + 3H_2O + 3ZnSO_4$

(b) $V_2O_2 + 3Fe_2O_3 = 6FeO + V_2O_5$

(c) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{V_2O_5}{6} = \frac{V}{3}$$

57) (a) As in Reaction 56

(b) $5V_2O_2 + 6KMnO_4 + 9H_2SO_4 = 5V_2O_5 + 3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{V_2O_5}{6} = \frac{V_2O_2}{6} = \frac{V}{3}$$

(58) $V_2O_5 + 2KI + 2HCl = V_2O_4 + 2KCl + H_2O + I_2$

$$I = \frac{V_2O_5}{2} = \frac{V}{1}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Zinc

(59) (a) $Fe_2(SO_4)_3 + Zn = ZnSO_4 + 2FeSO_4$

(b) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{Zn}{2}$$

(60) $3ZnCl_2 + 2K_4Fe(CN)_6 = K_2Zn_3(Fe(CN)_6)_2 + 6KCl$

$$\frac{K_4Fe(CN)_6}{3} = \frac{3ZnCl_2}{.6} = \frac{Zn}{2}$$

EFFICIENCY OF DRYING AGENTS

Compiled by John H. Yoe

A. Drying agents depending upon chemical action (absorption) for their efficiency:*

Substance	Weights of residual water vapor in dried air—mg per liter	Authority
P_2O_5	Much less than 1 mg in 40,000 liters	Morley
$Mg(ClO_4)_2$ anh	Unweighable in 210 liters	Willard and Smith
$Mg(ClO_4)_2.3H_2O$	Unweighable in 57 liters	Willard and Smith
BaO	....	Booth and McIntire
$CaSO_4.\frac{1}{2}H_2O$	....	Smith
KOH (fused)	0.002	Baxter and Starkweather
H_2SO_4	0.003	Baxter and Starkweather
MgO	0.008	Dover and Marden
NaOH (fused)	0.16	Baxter and Starkweather
$CaBr_2$	0.2	Baxter and Warren
CaO	0.2	Dover and Marden
B_2O_3	....	Walton and Rosenbaum
$Ba(ClO_4)_2$ anh	....	Smith
$CaCl_2$ (granular)	0.14 to 0.25	McPherson
$CaCl_2$ (fused)	0.36	Baxter and Starkweather
$ZnCl_2$	0.8	Baxter and Warren
$ZnBr_2$	1.1	Baxter and Warren
$CuSO_4$ anh	1.4	Dover and Marden

B. Drying agents depending upon physical action (adsorption) for their efficiency:*—Alumina (low temperature fired), asbestos, charcoal, clay and porcelain (low temperature fired), glass wool, kieselguhr, silica gel, refrigeration.

* It should be noted that the efficiency of some drying agents (*e. g.* $Al_2O_3.xH_2O$ and anhydrous $CaCl_2$, and probably also BaO, anhydrous $Mg(ClO_4)_2$, $Mg(ClO_4)_2.3H_2O$, anhydrous $Ba(ClO_4)_2$, and $CaSO_4.\frac{1}{2}H_2O$) depends upon both adsorption and absorption.

ONE HUNDRED COMPLETED CHEMICAL EQUATIONS

1. $H_2PtCl_6 + 2KCl = 2HCl + K_2PtCl_6$
2. K_2PtCl_6 + heat $= 2KCl + Pt + 2Cl_2$
3. $KHC_4H_4O_6 + NaOH = KNaC_4H_4O_6 + H_2O$
4. $Na_2O_2 + 2H_2O = 2NaOH + H_2O_2$
5. $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 = K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$
6. $2KI + H_2O_2 = 2KOH + I_2$
7. $2AuCl_3 + 3H_2O_2 + 6NaOH = 6NaCl + 6H_2O + 3O_2 + 2Au$
8. $MnCl_2 + 2KOH + H_2O_2 = 2KCl + H_2O + MnO.(OH)_2$, (brown)
9. $2NiCl_2 + 4KOH + H_2O_2 = 4KCl + 2Ni(OH)_3$ (black)
10. $2CoCl_2 + 4KOH + H_2O_2 = 4KCl + 2Co(OH)_3$ (black)
11. $MgCl_2 + Na_2HPO_4 + NH_3 = 2NaCl + MgNH_4PO_4$
12. $2BaCl_2 + K_2Cr_2O_7 + H_2O = 2BaCrO_4 + 2HCl + 2KCl$
13. $AlCl_3 + 3KOH = 3KCl + Al(OH)_3$
14. $Al(OH)_3 + 3KOH = 3H_2O + Al(OK)_3$
15. $2AlCl_3 + 3Na_2S_2O_3 + 3H_2O = 6NaCl + 3S + 3SO_2 + 2Al(OH)_3$
16. $2CrCl_3 + 3(NH_4)_2S + 6H_2O = 6NH_4Cl + 3H_2S + 2Cr(OH)_3$
17. $CrCl_3 + 8NaC_2H_3O_2 + 4H_2O + 3Cl = 6NaCl + 8HC_2H_3O_2 + Na_2CrO_4$
18. $2CrCl_3 + 3MnO_2 + 2H_2O = 3MnCl_2 + 2H_2CrO_4$
19. $K_2Cr_2O_7 + 2KOH = H_2O + 2K_2CrO_4$
20. $K_2Cr_2O_7 + 6FeSO_4 + 7H_2SO_4 = 7H_2O + K_2SO_4 + 3Fe_2(SO_4)_3 + Cr_2(SO_4)_3$
21. $K_2Cr_2O_7 + 6HI + 4H_2SO_4 = K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 6I$
22. $K_2Cr_2O_7 + 14HCl = 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2$
23. $FeCl_2 + 2KCN = 2KCl + Fe(CN)_2$
24. $Fe(CN)_2 + 4KCN = K_4[Fe(CN)_6]$
25. $FeCl_3 + 3NaC_2H_3O_2 = 3NaCl + Fe(C_2H_3O_2)_3$
26. $Fe(C_2H_3O_2)_3 + 2H_2O = 2HC_2H_3O_2 + Fe(OH)_2(C_2H_3O_2)$
27. $K_4[Fe(CN)_6] + 6H_2SO_4 + 6H_2O = 2K_2SO_4 + FeSO_4 + 3(NH_4)_2SO_4 + 6CO$
28. $2MnO_2 + 8HCl = 4H_2O + 2MnCl_2 + 2Cl_2$
29. $2MnSO_4 + 5PbO_2 + 6HNO_3 = 2PbSO_4 + 3Pb(NO_3)_2 + 2H_2O + 2HMnO_4$
30. $2HMnO_4 + 14HCl = 8H_2O + 2MnCl_2 + 5Cl_2$
31. $MnSO_4 + 2Na_2CO_3 + O_2 = 2CO_2 + Na_2SO_4 + Na_2MnO_4$
32. $2KMnO_4 + 10FeSO_4 + 8H_2SO_4 = K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$
33. $2KMnO_4 + 3MnSO_4 + 2H_2O = K_2SO_4 + 5MnO_2 + 2H_2SO_4$
34. $NiCl_2 + 6NH_3 = Ni(NH_3)_6Cl_2$
35. $NiCl_2 + 2KCN = 2KCl + Ni(CN)_2$
36. $Ni(CN)_2 + 2KCN = K_2Ni(CN)_4$
37. $CoCl_2 + 2KNO_2 = Co(NO_2)_2 + 2KCl$
38. $Co(NO_2)_2 + 2HNO_2 = H_2O + NO + Co(NO_2)_3$
39. $Co(NO_2)_3 + 3KNO_2 = K_3Co(NO_2)_6$
40. $3Zn + 8HNO_3 = 3Zn(NO_3)_2 + 4H_2O + 2NO$
41. $Zn + 2KOH = K_2ZnO_2 + H_2$
42. $Zn(OH)_2 + 2NH_4Cl + 4NH_3 = Zn(NH_3)_6Cl_2 + 2H_2O$
43. $ZnCl_2 + 2KCN = 2KCl + Zn(CN)_2$

44. $Zn(CN)_2 + 2KCN = K_2Zn(CN)_4$
45. $3Hg + 8HNO_3 = 3Hg(NO_3)_2 + 4H_2O + 2NO$
46. $HgCl_2 + 2NH_3 = NH_4Cl + HgNH_2Cl$
47. $3HgCl_2 + 2H_2S = 4HCl + Hg_3Cl_2S_2$ (white)
48. $Hg_3Cl_2S_2 + H_2S = 2HCl + 3HgS$
49. $3Hg(NO_3)_2 + 6FeSO_4 = 2Fe(NO_3)_3 + 2Fe_2(SO_4)_3 + 3Hg$
50. $2HgCl + 2NH_3 = NH_4Cl + HgNH_2Cl + Hg$
51. $Hg_2(NO_3)_2 + H_2S = 2HNO_3 + HgS + Hg$
52. $Hg_2(NO_3)_2 + 2KCN = 2KNO_3 + Hg(CN)_2 + Hg$
53. $Pb(NO_3)_2 + 2KOH = Pb(OH)_2 + 2KNO_3$
54. $Pb(OH)_2 + 2KOH = K_2PbO_2 + 2H_2O$
55. $2PbCl_2 + H_2S = 2HCl + PbCl_2.PbS$ (orange)
56. $PbCl_2.PbS + H_2S = 2PbS + 2HCl$
57. $3PbS + 8HNO_3 = 3Pb(NO_3)_2 + 4H_2O + 2NO + 3S$
58. $BiCl_3 + H_2O = 2HCl + BiOCl$
59. $SnCl_2 + 2KOH = 2KCl + Sn(OH)_2$ (white ppt.)
60. $Sn(OH)_2 + 2KOH = K_2SnO_2 + 2H_2O$ (soluble)
61. $2BiCl_3 + 6KOH = 2Bi(OH)_3 + 6KCl$
62. $2Bi(OH)_3 + 3K_2SnO_2 = 3H_2O + 3K_2SnO_3 + Bi_2$ (black)
63. $3Cu + 8HNO_3 = 4H_2O + 3Cu(NO_3)_2 + 2NO$
64. $Cu + H_2SO_4 = H_2O + SO_2 + CuO$
65. $CuO + H_2SO_4 = CuSO_4 + H_2O$
66. $2CuSO_4 + 2NH_4OH = (NH_4)_2SO_4 + Cu_2SO_4 . (OH)_2$
67. $Cu_2SO_4(OH)_2 + (NH_4)_2SO_4 + 6NH_3 = 2[Cu(NH_3)_4]$ $(SO_4) . H_2O$ (soluble, blue)
68. $2Cu(NH_3)_4SO_4 . H_2O + 9KCN = Cu_2(CN)_8NH_4 . K_5 + 2K_2SO_4 + 6NH_3 + NH_4CNO + H_2O$
69. $Cd(NO_3)_2 + 2KCN = 2KNO_3 + Cd(CN)_2$
70. $Cd(CN)_2 + 2KCN = K_2Cd(CN)_4$
71. $K_2Cd(CN)_4 + H_2S = 2KCN + 2HCN + CdS$
72. $H_3AsO_4 + H_2S = H_2O + S + H_3AsO_3$
73. $2H_3AsO_3 + 3H_2S = 6H_2O + As_2S_3$
74. $As_2S_3 + 3(NH_4)_2S = 2(NH_4)_3AsS_3$
75. $2(NH_4)_3AsS_3 + 6HCl = 6NH_4Cl + As_2S_3 + 3H_2S$
76. $As_2S_5 + 3(NH_4)_2S = 2(NH_4)_3AsS_4$.
77. $2(NH_4)_3AsS_4 + 6HCl = As_2S_5 + 3H_2S + 6NH_4Cl$. Antimony reactions same as arsenic
78. $3Sn + 4HNO_3 + H_2O = 3H_2SnO_3 + 4NO$
79. $SnCl_2 + H_2S = SnS + 2HCl$
80. $SnS + (NH_4)_2S_2 = (NH_4)_2SnS_3$
81. $(NH_4)_2SnS_3 + 2HCl = 2NH_4Cl + H_2S + SnS_2$
82. $SnCl_4 + 2H_2S = SnS_2 + 4HCl$
83. $SnS_2 + (NH_4)_2S = (NH_4)_2SnS_3$
84. $SnO_2 + 2KCN = 2KCNO + Sn$ (fusion)
85. $2Au + 2HNO_3 + 6HCl = 4H_2O + 2NO + 2AuCl_3$
86. $2AgNO_3 + 2KOH = 2KNO_3 + H_2O + Ag_2O$
87. $Ag_2O + 2NH_4OH = 2(AgNH_3)OH + H_2O$
88. $AgCl + 2NH_4OH = Ag(NH_3)_2Cl + 2H_2O$
89. $AgCl + 2KCN = KAg(CN)_2 + KCl$
90. $6NH_4OH + 2NH_3 + 3Cl_2 = 6H_2O + 6NH_4Cl + N_2$
91. $6NaOH + 3Cl_2 = 5NaCl + NaClO_3 + 3H_2O$
92. $H_2SO_4 + 2HI = H_2O + H_2SO_3 + I_2$

93. $H_2SO_4 + 8HI = 4H_2O + H_2S + 4I_2$
94. $2Na_2S_2O_3 + I_2 = 2NaI + Na_2S_4O_6$
95. $H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 = (NH_4)_3PO_4.12MoO_3 + 21(NH_4)NO_3 + 12H_2O$
96. $(NH_4)_3PO_4.12MoO_3 + 24NH_4OH = (NH_4)_3PO_4 + 12(NH_4)_2MoO_4 + 12H_2O$
97. $6FeSO_4 + 3H_2SO_4 + 2HNO_3 = 3Fe_2(SO_4)_3 + 4H_2O + 2NO$
98. $Fe(NO_3)_2 + NO = Fe(NO_3)_2NO$
99. $KClO_3 + 3H_2SO_4 + 6FeSO_4 = 3Fe_2(SO_4)_3 + 3H_2O + KCl$
100. $Na_2SiO_3 + 2NH_4Cl + 2H_2O = 2NaCl + 2NH_4OH + H_2SiO_3$

A METHOD OF BALANCING EQUATIONS FOR OXIDATION-REDUCTION REACTIONS

On the left-hand side of the equation write the formulae for all the compounds entering into the reaction. On the right-hand side write the formulae for all the compounds formed in the reaction.

Determine the L. C. M. (least common multiple) of the numbers representing the changes in valence per molecule of the oxidizing and reducing agents.

The quotient obtained in dividing the L. C. M. by the number representing the valence change per molecule is the number of molecules of that compound required, or formed.

The reaction between $FeSO_4$, $KMnO_4$, and H_2SO_4 serves to illustrate. Following the rule as given above we write, $KMnO_4 + FeSO_4 + H_2SO_4 \longrightarrow K_2SO_4 + MnSO_4 + Fe_2(SO_4)_3 + H_2O$.

The valence change of manganese is five, that of iron is two per molecule of $Fe_2(SO_4)_3$. The L. C. M. of these two numbers is ten.

The quotient obtained by dividing the L. C. M. by the valence change of manganese is two. Therefore two molecules of $KMnO_4$ are required. The quotient obtained by dividing the L. C. M. by the valence change of iron per molecule of $Fe_2(SO_4)_3$ is five. Five molecules of $Fe_2(SO_4)_3$ are formed. Ten molecules of $FeSO_4$ are needed. From the two molecules of $KMnO_4$ used one molecule of K_2SO_4 is formed, as well as two molecules of $MnSO_4$.

Eighteen sulfate radicals are used in forming the salts; ten of these radicals are supplied by the $FeSO_4$ used, the other eight must be supplied by the free acid. The sixteen hydrogens form eight molecules of water.

The complete equation is, therefore,

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O.$$

PROBLEMS

THE METHOD OF SOLVING CHEMICAL PROBLEMS

(From Talbot's Quantitative Analysis, by permission.)

Detailed solutions of a few typical problems are given below. The student should study these carefully, and assure himself that they are fully understood.

1. A "chemical factor" expresses the ratio between a specific quantity of a chemical compound and the *equivalent* quantity of some other body. For example, if it is wished to determine the weight of sulfur which corresponds to a specific weight of barium sulfate, the latter is multiplied by the factor, or ratio, represented by the fraction $\frac{S}{BaSO_4}$, or $\frac{32.07}{233.50} = 0.1373$. It may also be expressed by the proportion $\overset{233.5}{BaSO_4} : \overset{32.07}{S} = \text{wt. } BaSO_4 : x$, from which it is plain that $x = \frac{32.07}{233.50} \cdot \text{wt. } BaSO_4$.

Again, if the weight of FeO in Fe_2O_3 is desired, the factor becomes $\frac{2\ FeO}{Fe_2O_3} = \frac{144.04}{160.04} = 0.9000$. Similarly, the factor for the conversion of KCl to K_2O is $\frac{K_2O}{2\ KCl} = \frac{94.22}{149.12} = 0.6320$. The logarithmic equivalents of these values are called log factors.

In the calculation of these factors, the atomic or molecular relations of the two substances must be kept clearly in mind; thus, it is plainly *incorrect* to express the ratio of ferrous to ferric oxide by the fraction $\frac{FeO}{Fe_2O_3}$, since each molecule of the higher oxide must correspond to two molecules of the lower. Carelessness in this respect is one of the most frequent sources of error.

2. To calculate the volume of a reagent required for a specific operation, it is necessary to know the exact reaction which is to be brought about, and, as with the calculation of factors, to keep in mind the molecular relations between the reagent and the substance reacted upon. For example, to estimate the weight of barium chloride necessary to precipitate the sulfur from 0.1 gram of pure pyrite (FeS_2), the proportion should stand $\overset{488.70}{2BaCl_2.2\ H_2O} : \overset{120.16}{FeS_2} = x : 0.1$, where x represents the weight

of the chloride required. Each of the two atoms of sulfur will form a molecule of sulfuric acid upon oxidation, which, in turn, will require a molecule of the barium chloride for precipitation. To determine the quantity of the barium chloride required, it is necessary to include in its molecular weight the water of crystallization, since this is inseparable from the chloride when it is weighed. This applies equally to other similar instances.

If the strength of an acid is expressed in percentage by weight, due regard must be paid to its specific gravity. For example, hydrochloric acid (sp. gr. 1.12) contains 23.8 per cent HCl by weight; *i.e.*, 0.2666 gram.

3. No rules for universal application to "indirect gravimetric analyses" can be laid down. A single example will be explained.

Given a mixture of KCl + NaCl weighing 0.15 gram, which contains 53 per cent chlorine, to calculate the weight of KCl and NaCl in the mixture.

The weight of chlorine in the mixture is (0.15 × 0.53) or 0.0795 gram. Assuming that this chlorine was all in combination with potassium, the corresponding weight of KCl would be 0.1672 gram (Cl : KCl = 0.0795 : 0.1672). This is an excess of 0.0172 gram over the actual weight of the mixture, and it is plain that this difference is occasioned by the replacement of certain of the molecules of potassium chloride, weighing 74.56 units, by molecules of sodium chloride weighing 58.50 units. To express this, let it be supposed that the mixture is made up of n molecules KCl and n' molecules NaCl; then it may be said that $n\ \overset{74.56}{\mathrm{KCl}} + n'\ \overset{58.50}{\mathrm{NaCl}} = 0.15$ gram, and $n\ \overset{74.56}{\mathrm{KCl}} + n'\ \overset{74.56}{\mathrm{KCl}} = 0.1672$ gram, then by subtracting the first equation from the second it is shown that $n'\ (\overset{74.56}{\mathrm{KCl}} - \overset{58.50}{\mathrm{NaCl}}) = 0.0172$ gram. That is, the difference in weight is equal to n' times the difference in the molecular weights of the two chlorides. The actual weight of NaCl present (x) is equal to $58.50n'$, or, since $n' = \frac{0.0172}{74.56 - 58.50}$, $x = 58.50\left(\frac{0.0172}{74.56 - 58.50}\right)$. This may be expressed in the form $(74.56 - 58.50) : 58.50 = 0.0172 : x$, from which $x = 0.0626$. The weight of NaCl subtracted from that of the mixture gives the weight of KCl.

The weights of the chlorides may also be calculated algebraically by solving the equations $x + y = 0.15$ and $\frac{35.45}{74.56}x + \frac{35.45}{58.50}y = 0.0795$, where x is the weight of KCl and y is the weight of NaCl in the mixture.

4. It is sometimes desirable to weigh out such a quantity of substance for analysis, that the number of cubic centimeters of standard solution entering into the reaction shall represent directly the percentage of the desired constituent. This may be

readily done, by considering the relation of the solution to a normal solution and the atomic or molecular weight of the desired component. For example, suppose it is desired to calculate such a weight for K_2CO_3 in pearl ash, when a half-normal acid solution is used. Since half-normal acid and alkali solutions are equivalent, and since by definition the half-normal K_2CO_3 solution contains 34.55 grams per liter, each cubic centimeter of the acid solution must be equivalent to 0.03455 gram K_2CO_3. Hence, 100 cc. would neutralize 3.455 grams pure K_2CO_3 and this becomes the desired weight of the pearl ash. Similarly the required weight of limonite where the iron (Fe) is to be determined by means of a deci-normal $K_2Cr_2O_7$ solution is 0.5602 gram.

5. One of the most frequently recurring cases in volumetric analysis is that in which it is wished to express the value of a specific solution in terms of some substance other than that against which it has been standardized as for instance, the value of a permanganate solution which has been standardized against oxalic acid, in terms of iron. Although such problems apparently vary widely, there are common principles which can be applied to them all. These are stated below, and the student should assure himself that they are fully understood.

Suppose, for example, it is desired to find the iron value (Fe) of a permanganate solution, of which 1 cc. is equivalent to 0.006302 gram $C_2H_2O_4 . 2H_2O$.

From a comparison of the reactions it is seen that 10 molecules of ferrous sulfate and 5 molecules of oxalic acid each react with the same amount (2 molecules) of the permanganate. These two quantities being, then, equivalent to the same third quantity, must be equivalent to each other; in other words, 10 molecules of ferrous sulfate and 5 molecules of oxalic acid have the same reducing power. But, as stated above, the value is desired in terms of metallic iron (Fe), not $FeSO_4$, but as it is plain that $10FeSO_4$ are equivalent to 10Fe, it is proper to make the proportion

$$\overset{560.2}{10\ \mathrm{Fe}} : \overset{630.25}{5C_2H_2O_4 . 2\ H_2O} = x : 0.006302$$

in which $x = 0.005602$ gram. Here, again, as in example 2, it is necessary to include the water of crystallization in the molecular weight of the oxalic acid, as it is weighed with it.

The same conclusion is arrived at, if we consider the relation of the solution to the normal. As given, it is deci-normal and must, therefore, be equivalent to a deci-normal solution of iron. From the equations cited, it is seen that $10FeSO_4$, unite with 5O, therefore each molecule is equivalent to 1 hydrogen atom in reducing power. The normal solution must, then, contain 1 gram-molecule of ferrous sulfate, or 56.02 grams Fe, and each cubic centimeter of the deci-normal solution would contain 0.005602 gram, the value obtained above.

Again, suppose the value of the same permanganate solution were desired in terms of molybdenum (Mo), the reactions with permanganate being

$5Mo_{12}O_{19} + 17Mn_2O_7 = 60MoO_3 + 34MnO$, and
$5C_2H_2O_4.2H_2O + Mn_2O_7 = 2MnO + 10CO_2 + 15H_2O$.
(Mn_2O_7 is the anhydride of $HMnO_4$.)

It is plain that in these equations as they stand, the molecular quantities of oxidizing agent are not equal. They can be made so by simply multiplying the second equation by 17, and they then become,

$5Mo_{12}O_{19} + 17Mn_2O_7 = 34MnO + 60MoO_3$, and
$85C_2H_2O_4.2H_2O + 17Mn_2O_7 = 34MnO + 170\ CO_2 + 255\ H_2O$.

It is now possible to reason in the same way as before, and to conclude that 85 molecules of the oxalic acid have the same reducing power as 5 molecules of the oxide $Mo_{12}O_{19}$, or 60 atoms of molybdenum. Accordingly,

$$\overset{5758.8}{60Mo} : \overset{10714.25}{85C_2H_2O_4.2H_2O} :: x : 0.006302$$

in which x 0.003387 gram.

Since $5Mo_{12}O_{19}$ unite with 85O, a normal solution of the former as a reducing agent, would contain 1/170 of the 5 gram-molecules or 33.87 grams Mo, and the deci-normal solution 3.387 grams per liter. This agrees with the values already obtained.

6. It is sometimes necessary to calculate the value of solutions according to the principles just explained, when several successive reactions are involved. Such problems may be solved by a series of proportions, but it is usually possible, after stating these to eliminate the common factors and solve but a single one.

For example, suppose it is desired to express the value of a permanganate solution, of which 1 cc. = 0.008 gram iron (Fe), in terms of calcium oxide (CaO). The reactions involved in the volumetric determination of calcium are the following; $CaCl_2 + (NH_4)_2C_2O_4 = CaC_2O_4 + 2NH_4Cl$; $CaC_2O_4 + H_2SO_4 + 2H_2O = CaSO_4 + C_2H_2O_4.2H_2O$; $5C_2H_2O_4.2H_2O + 2KMnO_4 + 3H_2SO_4 = K_2SO_4 + MnSO_4 + 10CO_2 + 18H_2O$.

From the considerations stated under 5, the following proportions may be made.

$$10Fe : 5C_2H_2O_4.2H_2O = 0.008 : x$$
$$5C_2H_2O_4.2H_2O : 5CaC_2O_4 = x : y$$
$$5CaC_2O_4 : 5CaO = y : x$$

Canceling the common factors, there remains simply

$$\overset{560.2}{10Fe} : \overset{280.4}{5\ CaO} = 0.008 : z$$

Similarly, from the reactions, the equivalent of the iodine liberated may be calculated in terms of MnO_2 as follows: Supposing the weight of iodine to be 0.5 gram then

$$2I : 2KI = 0.5 : x$$
$$2KI : 2Cl = x : y$$
$$2Cl : 2HCl = y : z$$
$$2HCl : MnO_2 = z : w$$

Canceling the common factors, there remains

$$2I : MnO_2 = 0.5 : w$$

SOLUBILITY CHART

SOLUBILITY

Abbreviations: W, soluble in water; A, insoluble in water but soluble in acids; w, sparingly
I, insoluble in both water and acids; d, decomposes in water. * Certain salts occur in two

No.		Al	NH_4	Sb	Ba	Bi	Cd	Ca
1	Acetates —($C_2H_3O_2$)	W $Al(-)_3$	W $NH_4(-)$	....	W $Ba(-)_2$	W $Bi(-)_3$	W $Cd(-)_2$	W $Ca(-)_2$
2	Arsenate —(AsO_4)	a $Al(-)$	W $(NH_4)_3(-)$	A $Sb(-)$	w $Ba_3(-)_2$	A $Bi(-)$	A $Cd_3(-)_2$	w $Ca_3(-)_2$
3	Arsenite —(AsO_3)	....	W NH_4AsO_2	A $Sb(-)$	....	....	....	w $Ca_3(-)_2$
4	Benzoate —($C_7H_5O_2$)	....	W $NH_4(-)$	....	W $Ba(-)_2$	A $Bi(-)_3$	W $Cd(-)_2$	W $Ca(-)_2$
5	Bromide	W $AlBr_3$	W NH_4Br	d $SbBr_3$	W $BaBr_2$	d $BiBr_3$	W $CdBr_2$	W $CaBr_2$
6	Carbonate	....	W $(NH_4)_2CO_3$	....	w $BaCO_3$	....	A $CdCO_3$	w $CaCO_3$
7	Chlorate —(ClO_3)	W $Al(-)_3$	W $NH_4(-)$	....	W $Ba(-)_2$	W $Bi(-)_3$	W $Cd(-)_2$	W $Ca(-)_2$
8	Chloride	W $AlCl_3$	W NH_4Cl	W $SbCl_3$	W $BaCl_2$	d $BiCl_3$	W $CdCl_2$	W $CaCl_2$
9	Chromate —(CrO_4)	....	W $(NH_4)_2(-)$	....	A $Ba(-)$	....	A $Cd(-)$	W $Ca(-)$
10	Citrate —($C_6H_5O_7$)	W $Al(-)$	W $(NH_4)_3(-)$	....	w $Ba_3(-)_2$	A $Bi(-)$	A $Cd_3(-)_2$	w $Ca_3(-)_2$
11	Cyanide	....	W NH_4CN	....	W $Ba(CN)_2$	w $Bi(CN)_3$	W $Cd(CN)_2$	W $Ca(CN)_2$
12	Ferricy'de —($Fe(CN)_6$)	......	W $(NH_4)_3(-)$	....	w $Ba_3(-)_2$	....	A $Cd_3(-)_2$	W $Ca_3(-)_2$
13	Ferrocy'de —($Fe(CN)_6$)	w $Al_4(-)_3$	W $(NH_4)_4(-)$	....	W $Ba_2(-)$	....	A $Cd_2(-)$	W $Ca_2(-)$
14	Fluoride	W AlF_3	W NH_4F	W SbF_3	w BaF_2	W BiF_3	W CdF_2	w CaF_2
15	Formate —(CHO_2)	W $Al(-)_3$	W $NH_4(-)$	....	W $Ba(-)_2$	W $Bi(-)_3$	W $Cd(-)_2$	W $Ca(-)_2$
16	Hydroxide	A $Al(OH)_3$	W NH_4OH	....	W $Ba(OH)_2$	A $Bi(OH)_3$	A $Cd(OH)_2$	W $Ca(OH)_2$
17	Iodide	W AlI_3	W NH_4I	d SbI_3	W BaI_2	A BiI_3	W CdI_2	W CaI_2
18	Nitrate	W $Al(NO_3)_3$	W NH_4NO_3	....	W $Ba(NO_3)_2$	d $Bi(NO_3)_3$	W $Cd(NO_3)_2$	W $Ca(NO_3)_2$
19	Oxalate —(C_2O_4)	A $Al_2(-)_3$	W $(NH_4)_2(-)$	....	w $Ba(-)$	A $Bi_2(-)_3$	w $Cd(-)$	A $Ca(-)$
20	Oxide	a Al_2O_3	....	w Sb_2O_3	W BaO	A Bi_2O_3	A CdO	w CaO
21	Phosphate	A $AlPO_4$	W $NH_4H_2PO_4$	....	A $Ba_3(PO_4)_2$	A $BiPO_4$	A $Cd_3(PO_4)_2$	w $Ca_3(PO_4)_2$
22	Silicate, —(SiO_3)	I $Al_2(-)_3$	....	....	W $Ba(-)$	....	A $Cd(-)$	w $Ca(-)$
23	Sulfate	W $Al_2(SO_4)_3$	W $(NH_4)_2SO_4$	A $Sb_2(SO_4)_3$	a $BaSO_4$	d $Bi_2(SO_4)_3$	W $CdSO_4$	w $CaSO_4$
24	Sulfide	d Al_2S_3	W $(NH_4)_2S$	A Sb_2S_3	d BaS	A Bi_2S_3	A CdS	w CaS
25	Tartrate —($C_4H_4O_6$)	w $Al_2(-)_3$	W $(NH_4)_2(-)$	W $Sb_2(-)_3$	w $Ba(-)$	A $Bi_2(-)_3$	A $Cd(-)$	w $Ca(-)$
26	Thiocy'te	....	W NH_4CNS	....	W $Ba(CNS)_2$	....	.. ....	W $Ca(CNS)_2$

CHART

soluble in water but soluble in acids; a, insoluble in water and only sparingly soluble in acids; modifications.

No.	Cr	Co	Cu	Au′	Au‴	H	Fe″	Fe‴
1	W $Cr(-)_3$	W $Co(-)_2$	W $Cu(-)_2$	....	....	W $C_2H_4O_2$	W $Fe(-)_2$	W $Fe_2(-)_6$
2	....	A $Co_3(-)_2$	A $Cu_3(-)_2$	....	....	W H_3AsO_4	A $Fe_3(-)_2$	A $Fe(-)$
3	....	A $Co_3H_6(-)_4$	A $CuH(-)$	....	....	....	....	....
4	....	W $Co(-)_2$	W $Cu(-)_2$	....	....	W $C_7H_6O_2$	W $Fe(-)_2$	A $Fe_2(-)_6$
5	W(I)* $CrBr_3$	W $CoBr_2$	W $CuBr_2$	w $AuBr$	W $AuBr_3$	W HBr	W $FeBr_2$	W $FeBr_3$
6	W $CrCO_3$	A $CoCO_3$	....	....	....	....	w $FeCO_3$	....
7	....	W $Co(-)_2$	W $Cu(-)_2$	....	....	W $HClO_3$	W $Fe(-)_2$	W $Fe(-)_3$
8	I $CrCl_3$	W $CoCl_2$	W $CuCl_2$	w $AuCl$	W $AuCl_3$	W HCl	W $FeCl_2$	W $FeCl_3$
9	....	A $Co(-)$	....	....	....	....	....	A $Fe_2(-)_3$
10	....	w $Co_3(-)_2$	....	....	....	W $C_6H_8O_7$	....	W $Fe(-)$
11	A $Cr(CN)_2$	A $Co(CN)_2$	A $Cu(CN)_2$	w $AuCN$	W $Au(CN)_3$	W HCN	a $Fe(CN)_2$	....
12	....	I $Co_3(-)_2$	I $Cu_3(-)_2$	....	....	W $H_3(-)$	I $Fe_3(-)_2$	....
13	....	I $Co_2(-)$	I $Cu_2(-)$	....	....	W $H_4(-)$	I $Fe_2(-)$	a $Fe_4(-)_3$
14	W(a)* CrF_3	W CoF_2	w CuF_2	....	....	W HF	w FeF_2	w FeF_3
15	....	W $Co(-)_2$	W $Cu(-)_2$	....	....	W CH_2O_2	W $Fe(-)_2$	W $Fe(-)_3$
16	A $Cr(OH)_3$	A $Co(OH)_2$	A $Cu(OH)_2$	W $AuOH$	A $Au(OH)_3$	....	A $Fe(OH)_2$	A $Fe(OH)_3$
17	W CrI_2	W CoI_2	a CuI	a AuI	a AuI_3	W HI	W FeI_2	W FeI_3
18	W $Cr(NO_3)_3$	W $Co(NO_3)_2$	W $Cu(NO_3)_2$	....	....	W HNO_3	W $Fe(NO_3)_2$	W $Fe(NO_3)_3$
19	W $Cr(-)$	A $Co(-)$	A $Cu(-)$	....	....	W $C_2H_2O_4$	A $Fe(-)$	W $Fe_2(-)_3$
20	a Cr_2O_3	A CoO	A CuO	A Au_2O	A Au_2O_3	W H_2O_2	A FeO	A Fe_2O_3
21	w $Cr_2(PO_4)_2$	A $Co_3(PO_4)_2$	A $Cu_3(PO_4)_2$	....	....	W H_3PO_4	A $Fe_3(PO_4)_2$	w $FePO_4$
22	....	A Co_2SiO_4	A $Cu(-)$	....	....	I H_2SiO_3	....	....
23	W(I)* $Cr_2(SO_4)_3$	W $CoSO_4$	W $CuSO_4$	....	....	W H_2SO_4	W $FeSO_4$	w $Fe_2(SO_4)_3$
24	d Cr_2S_3	A CoS	A CuS	I Au_2S	I Au_2S_3	W H_2S	A FeS	d Fe_2S_3
25	....	w $Co(-)$	w $Cu(-)$	....	....	W $C_4H_6O_6$	w $Fe(-)$	W $Fe_2(-)_3$
26	....	W $Co(CNS)_2$	d $CuCNS$	....	....	W $CNSH$	W $Fe(CNS)_2$	W $Fe(CNS)_3$

No.		Pb	Mg	Mn	Hg′	Hg″	Ni	K
1	Acetate $-(C_2H_3O_2)$	W $Pb(-)_2$	W $Mg(-)_2$	W $Mn(-)_2$	w $Hg(-)$	W $Hg(-)_2$	W $Ni(-)_2$	W $K(-)$
2	Arsenate $-(AsO_4)$	A $PbH(-)$	A $Mg_3(-)$	w $MnH(-)$	A $Hg_3(-)$	w $Hg_3(-)_2$	A $Ni_3(-)_2$	W $K_3(-)$
3	Arsenite $-(AsO_3)$	....	W $Mg_3(-)_2$	A $Mn_3H_6(-)_4$	A $Hg_3(-)$	A $Hg_3(-)$	A $Ni_3H_6(-)_4$	W K_3AsO_3
4	Benzoate $-(C_7H_5O_2)$	w $Pb(-)_2$	W $Mg(-)_2$	W $Mn(-)_2$	A $Hg_2(-)_2$	w $Hg(-)_2$	w $Ni(-)_2$	W $K(-)$
5	Bromide	W $PbBr_2$	W $MgBr_2$	W $MnBr_2$	A $HgBr$	W $HgBr_2$	W $NiBr_2$	W KBr
6	Carbonate	A $PbCO_3$	w $MgCO_3$	w $MnCO_3$	A Hg_2CO_3	....	w $NiCO_3$	W K_2CO_3
7	Chlorate $-(ClO_3)$	W $Pb(-)_2$	W $Mg(-)_2$	W $Mn(-)_2$	W $Hg(-)$	W $Hg(-)_2$	W $Ni(-)_2$	W $K(-)$
8	Chloride	W $PbCl_2$	W $MgCl_2$	W $MnCl_2$	a $HgCl$	W $HgCl_2$	W $NiCl_2$	W KCl
9	Chromate $-(CrO_4)$	A $Pb(-)$	W $Mg(-)$	....	w $Hg_2(-)$	w $Hg(-)$	A $Ni(-)$	W $K_2(-)$
10	Citrate $-(C_6H_5O_7)$	W $Pb_3(-)_2$	W $Mg_3(-)_2$	w $MnH(-)$	w $Hg_3(-)$	....	W $Ni_3(-)_2$	W $K_3(-)$
11	Cyanide	w $Pb(CN)_2$	W $Mg(CN)_2$	....	A $HgCN$	W $Hg(CN)_2$	a $Ni(CN)_2$	W KCN
12	Ferricy'de $-Fe(CN)_6$	w $Pb_3(-)_2$	W $Mg_3(-)_2$	....	......	A $Hg_3(-)_2$	I $Ni_3(-)_2$	W $K_3(-)$
13	Ferrocy'de $-Fe(CN)_6$	a $Pb_2(-)$	W $Mg_2(-)$	A $Mn_2(-)$	......	I $Hg_2(-)$	I $Ni_2(-)$	W $K_4(-)$
14	Fluoride	w PbF_2	w MgF_2	A MnF_2	d HgF	d HgF_2	w NiF_2	W KF
15	Formate $-(CHO_2)$	W $Pb(-)_2$	W $Mg(-)_2$	W $Mn(-)_2$	w $Hg(-)$	W $Hg(-)_2$	W $Ni(-)_2$	W $K(-)$
16	Hydroxide	w $Pb(OH)_2$	A $Mg(OH)_2$	A $Mn(OH)_2$		A $Hg(OH)_2$	w $Ni(OH)_2$	W KOH
17	Iodide	w PbI_2	W MgI_2	W MnI_2	A HgI	w HgI_2	W NiI_2	W KI
18	Nitrate	W $Pb(NO_3)_2$	W $Mg(NO_3)_2$	W $Mn(NO_3)_2$	W $HgNO_3$	W $Hg(NO_3)_2$	W $Ni(NO_3)_2$	W KNO_3
19	Oxalate $-(C_2O_4)$	A $Pb(-)$	w $Mg(-)$	w $Mn(-)$	a $Hg_2(-)$	A $Hg(-)$	A $Ni(-)$	W $K_2(-)$
20	Oxide	w PbO	A MgO	A MnO	A Hg_2O	w HgO	A NiO	W K_2O
21	Phosphate	A $Pb_3(PO_4)_2$	w $Mg_3(PO_4)_2$	w $Mn_3(PO_4)_2$	A Hg_3PO_4	A $Hg_3(PO_4)_2$	A $Ni_3(PO_4)_2$	W K_3PO_4
22	Silicate $-(SiO_3)$	A $Pb(-)$	A $Mg(-)$	I $Mn(-)$	......	......	....	W $K_2(-)$
23	Sulfate	w $PbSO_4$	W $MgSO_4$	W $MnSO_4$	w Hg_2SO_4	d $HgSO_4$	W $NiSO_4$	W K_2SO_4
24	Sulfide	A PbS	d MgS	A MnS	I Hg_2S	I HgS	A NiS	W K_2S
25	Tartrate $-(C_4H_4O_6)$	A $Pb(-)$	w $Mg(-)$	w $Mn(-)$	I $Hg_2(-)$	......	A $Ni(-)$	W $K_2(-)$
26	Thiocy'te	w $Pb(CNS)_2$	W $Mg(CNS)_2$	W $Mn(CNS)_2$	A $HgCNS$	w $Hg(CNS)_2$		W $KCNS$

CHART Continued

No.	Ag	Na	Sn''''	Sn''	Sr	Zn	Pt
1	w $Ag(-)$	W $Na(-)$	W $Sn(-)_4$	d $Sn(-)_2$	W $Sr(-)_2$	W $Zn(-)_2$	....
2	A $Ag_3(-)$	W $Na_3(-)$	....	....	w $SrH(-)$	A $Zn_3(-)_2$	....
3	A $Ag_3(-)$	W $Na_2H(-)$	....	A $Sn_3(-)_2$	w $Sr_3(-)_2$	....	....
4	w $Ag(-)$	W $Na(-)$	....	....	....	W $Zn(-)_2$	....
5	a $AgBr$	W $NaBr$	W $SnBr_4$	W $SnBr_2$	W $SrBr_2$	W $ZnBr_2$	w $PtBr_4$
6	A Ag_2CO_3	W Na_2CO_3	....	....	w $SrCO_3$	w $ZnCO_3$	....
7	W $Ag(-)$	W $Na(-)$	....	W $Sn(-)_2$	W $Sr(-)_2$	W $Zn(-)_2$	....
8	a $AgCl$	W $NaCl$	W $SnCl_4$	W $SnCl_2$	W $SrCl_2$	W $ZnCl_2$	W $PtCl_4$
9	w $Ag_2(-)$	W $Na_2(-)$	W $Sn(-)_2$	A $Sn(-)$	w $Sr(-)$	w $Zn(-)$	....
10	w $Ag_3(-)$	W $Na_3(-)$	....	....	A $SrH(-)$	w $Zn_3(-)_2$	....
11	a $AgCN$	W $NaCN$	....	....	W $Sr(CN)_2$	A $Zn(CN)_2$	I $Pt(CN)_2$
12	I $Ag_3(-)$	W $Na_3(-)$	....	A $Sn_3(-)_2$	W $Sr_3(-)_2$	A $Zn_3(-)_2$	....
13	I $Ag_4(-)$	W $Na_4(-)$	....	a $Sn_2(-)$	W $Sr_2(-)$	I $Zn_2(-)$	....
14	W AgF	W NaF	W SnF_4	W SnF_2	w SrF_2	w ZnF_2	W PtF_4
15	W $Ag(-)$	W $Na(-)$	....	....	W $Sr(-)_2$	W $Zn(-)_2$	....
16	....	W $NaOH$	w $Sn(OH)_4$	A $Sn(OH)_2$	W $Sr(OH)_2$	A $Zn(OH)_2$	A $Pt(OH)_4$
17	I AgI	W NaI	d SnI_4	W SnI_2	W SrI_2	W ZnI_2	I PtI_2
18	W $AgNO_3$	W $NaNO_3$	....	d $Sn(NO_3)_2$	W $Sr(NO_3)_2$	W $Zn(NO_3)_2$	W $Pt(NO_3)_4$
19	a $Ag_2(-)$	W $Na_2(-)$	....	A $Sn(-)$	w $Sr(-)$	A $Zn(-)$	....
20	w Ag_2O	d Na_2O	A SnO_2	A SnO	W SrO	w ZnO	A PtO
21	A Ag_3PO_4	W Na_3PO_4	....	A $Sn_3(PO_4)_2$	A $Sr_3(PO_4)_2$	A $Zn_3(PO_4)_2$	....
22	....	W $Na_2(-)$	....	....	A $Sr(-)$	A $Zn(-)$	....
23	w Ag_2SO_4	W Na_2SO_4	W $Sn(SO_4)_2$	W $SnSO_4$	w $SrSO_4$	W $ZnSO_4$	W $Pt(SO_4)_2$
24	A Ag_2S	W Na_2S	A SnS_2	A SnS	W SrS	A ZnS	I PtS
25	w $Ag_2(-)$	W $Na_2(-)$	....	W $Sn(-)$	w $Sr(-)$	w $Zn(-)$	....
26	I $AgCNS$	W $NaCNS$	....	....	W $Sr(CNS)_2$	W $Zn(CNS)_2$	....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER

The table shows the number of grams of the anhydrous substance indicated in the first column which can be dissolved in 100 grams of water at the temperature in degrees Centigrade given at the top. When the formula is preceded by a * the solubility is stated in grams of anhydrous substance in 100 grams of saturated solution; when preceded by ** the solubility is stated in grams of anhydrous substance in 100 c.c. of the saturated solution. The column headed with S. P. shows the solid phase hydrated form in equilibrium with the saturated solution.

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
Ag_3AsO_3				1.15×10^{-3}								
Ag_3AsO_4				8.5×10^{-4}								
AgBr				8.4×10^{-6}								
$AgC_2H_3O_2$		0.72	0.88	1.04	1.21	1.41	1.64	1.89	2.18	2.52		
AgCl			8.9×10^{-5}	1.5×10^{-4}			5.23×10^{-4}					2.1×10^{-3}
AgCN				2.2×10^{-5}								
Ag_2CO_3				3.2×10^{-3}								5×10^{-2}
Ag_2CrO_4		1.4×10^{-3}			3.6×10^{-3}		5.3×10^{-3}		8×10^{-3}			
$Ag_3Fe(CN)_6$				6.6×10^{-5}								
AgI					3×10^{-7}			3×10^{-6}				
$AgIO_3$			3×10^{-3}	4×10^{-3}				1.9×10^{-2}				
$AgNO_2$		1.55×10^{-1}	2.20×10^{-1}	3.40×10^{-1}	5×10^{-1}	7.15×10^{-1}	9.95×10^{-1}	13.63×10^{-1}				
$AgNO_3$		122	170	222	300	376	455	525		669		952
Ag_2S				1.4×10^{-5}								
*Ag_2SO_4		5.7×10^{-1}	6.9×10^{-1}	7.9×10^{-1}	8.8×10^{-1}	9.7×10^{-1}	10.7×10^{-1}	11.4×10^{-1}	12.1×10^{-1}	12.8×10^{-1}	13.4×10^{-1}	13.9×10^{-1}
*$AlCl_3$			$41.13^{15°}$									
*$Al_2(SO_4)_3$	$18H_2O$	23.8	25.1	26.7	28.8	31.4	34.3	37.2	39.8	42.2	44.7	47.1
*As_2O_5		37.3	38.3	39.7	41	41.6		42.2		42.9		43.4
As_2S_3				5.17×10^{-5}	at 18°							
B_2O_3		1.1	1.5	2.2		4.0		6.2		9.5		15.7
$BaBr_2$		98	101	104	109	114	118	123	128	135		149
*$Ba(BrO_3)_2$		2.85×10^{-1}	4.39×10^{-1}	6.52×10^{-1}	9.5×10^{-1}	13.1×10^{-1}	17.2×10^{-1}	22.71×10^{-1}	29.22×10^{-1}	35.21×10^{-1}	42.6×10^{-1}	54×10^{-1}
$Ba(C_2H_3O_2)_2$	$3H_2O$	59	63	71								
$Ba(C_2H_3O_2)_2$	$1H_2O$				75	79	77	74	74			75
$BaCl_2$		31.6	33.3	35.7	38.2	40.7	43.6	46.4	49.4	52.4		58.8
*$Ba(ClO_3)_2$		16.90	21.23	25.26	29.43	33.16		40.05		45.90		51.2

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
*$Ba(ClO_4)_2$		67.3		74.3		78.2		81		83.2		84.0
$BaCO_3$		1.6×10^{-3} at 8°; 2.2×10^{-3} at 18°; 2.4×10^{-3} at 24.2°										
*BaC_2O_4		5.8×10^{-3}	8.2×10^{-3}		17×10^{-3}							
$BaCrO_4$		2×10^{-4}	2.8×10^{-4}	3.7×10^{-4}	4.6×10^{-4}							
BaI_2	$6H_2O$	170.2	185.7	203.1	219.6							
BaI_2	$2H_2O$					231.9		247.3		261.0		271.7
*$Ba(IO_3)_2$		8×10^{-3}	1.4×10^{-2}	2.2×10^{-2}	3.1×10^{-2}	4.1×10^{-2}	5.6×10^{-2}	7.4×10^{-2}	9.3×10^{-2}	11.5×10^{-2}	14.1×10^{-2}	19.7×10^{-2}
$BaMoO_4$			5.8×10^{-3} at 23°									
*$Ba(NO_2)_2$	$1H_2O$			40.3						67.3		75
$Ba(NO_3)_2$		5.0	7.0	9.2	11.6	14.2	17.1	20.3		27.0		34.2
$Ba(OH)_2$		1.67	2.48	3.89	5.59	8.22	13.12	20.94		101.40		
$BaSO_4$		1.15×10^{-4}	2.0×10^{-4}	2.4×10^{-4}	2.85×10^{-4}							
$BeKF_3$				2.0								5.2
$BeNaF_3$				1.4								2.8
$BeSO_4$	$6H_2O$				52		60.67					
$BeSO_4$	$4H_2O$				43.78	46.74			62		83	100
$BeSO_4$	$2H_2O$									84.76	98	110
Br_2		4.22	3.4	3.20	3.13							
Bi_2S_3			1.8×10^{-5} at 18°									
$CaBr_2$	$6H_2O$	125	132	143								
$CaBr_2$	$4H_2O$					68.1		73.5		74.7		
$Ca(C_2H_3O_2)_2$	$2H_2O$	37.4	36.0	34.7	33.8	33.2		32.7		33.5		
$Ca(C_2H_3O_2)_2$	H_2O										31.1	29.7
$CaCl_2$	$6H_2O$	59.5	65.0	74.5	102							
$CaCl_2$	$2H_2O$							136.8	141.7	147.0	152.7	159
CaC_2O_4		6.7×10^{-4} at 13°; 6.8×10^{-4} at 25°; 9.5×10^{-4} at 50°; 14.0×10^{-4} at 95°										
CaF_2		1.6×10^{-3} at 18°; 1.7×10^{-3} at 26°										
$Ca(HCO_3)_2$		16.15		16.60		17.05		17.50		17.95		18.40
*CaI_2		64.6	66.0	67.6	69	70.8		74		78		81
*$Ca(IO_3)_2$	$6H_2O$	0.10	0.17		0.42	0.61	0.89	1.36				
*$Ca(IO_3)_2$	$1H_2O$					0.52	0.59	0.65		0.79		0.94

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
*$Ca(NO_2)_2$	$4H_2O$	38.3		43.4								
*$Ca(NO_2)_2$	$2H_2O$							57	60.3		71	
*$Ca(NO_3)_2$	$4H_2O$	50.50	53.55	56.39	60.41	66.21						
*$Ca(NO_3)_2$	$3H_2O$					70.37	73.79					
*$Ca(NO_3)_2$										78.2		78.43
$Ca(OH)_2$		1.85×10^{-1}	1.76×10^{-1}	1.65×10^{-1}	1.53×10^{-1}	1.41×10^{-1}	1.28×10^{-1}	1.16×10^{-1}	1.06×10^{-1}	9.4×10^{-2}	8.5×10^{-2}	7.7×10^{-2}
$CaSO_4$		1.759×10^{-1}	1.928×10^{-1}		2.09×10^{-1}		2.097×10^{-1}	2.047×10^{-1}	1.974×10^{-1}			1.619×10^{-1}
*$CdBr_2$		37.92			56.90	60.65		61.10		62.29		
*$CdCl_2$	$4H_2O$	49.39	55.58									
*$CdCl_2$	$2\frac{1}{2}H_2O$	47.37			56.91							
*$CdCl_2$	H_2O		57.47	57.35		57.51		57.71		58.41		59.52
$Cd(CN)_2$			$1.7^{15°}$									
CdI_2		79.8	83.2	86.2	89.7	93.8	97.4					127.6
$Cd(OH)_2$			2.6×10^{-4}	at 25°								
CdS			9×10^{-7}	at 18°								
*$Ce_2(SO_4)_3$	$9H_2O$	17.35		9.16	6.36		4.465	3.73				
*$Ce_2(SO_4)_3$	$8H_2O$	15.95		8.69		5.613		3.88				
*$Ce_2(SO_4)_3$	$5H_2O$							3.145		1.19		0.46
*$Ce_2(SO_4)_3$	$4H_2O$					5.71	3.31	2.3		1.0		0.42
Cl_2 760mm.		1.46	0.980	0.716	0.562	0.451	0.386	0.324	0.274	0.219	0.125	0
CO 760mm.		4.4×10^{-8}	3.5×10^{-3}	2.8×10^{-3}	2.4×10^{-3}	2.1×10^{-3}	1.8×10^{-3}	1.5×10^{-3}	1.3×10^{-3}	1.0×10^{-3}	6×10^{-4}	0
CO_2 760mm.		0.3346	0.2318	0.1688	0.1257	0.0973	0.0761	0.0576				
*$CoCl_2$	$6H_2O$	29.5	31.5	33.5	35.5							
*$CoCl_2$	H_2O					41.0	47.0	47.5		49.5		51.0
*CoI_2		58.0	61.5	65.2	70.0	75.0	79.0			80.0		
*$Co(NO_3)_2$	$6H_2O$	45.66		50		55.9						
*$Co(NO_3)_2$	$3H_2O$							62	64.89	68	77	
CoS		3.79×10^{-4}	at 18°									
$CoSO_4$		25.55	30.55	36.21	42.26	48.85	55.2	60.4	65.7	70		83
*CrO_3		62.24				63.50	64.55				68.5	67.4
CsCl		161.4	174.7	186.5	197.3	208.0	218.5	229.7	239.5	250.0	260.1	270.5

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$CsClO_3$	...	2.46	3.8	6.2	9.5	13.8	10.4	26.2	34.7	45.0	58.0	79.0
$CsClO_4$	...	0.8	1.0	1.6	2.6	4.0	5.4	7.3	9.8	14.4	20.5	30.0
CsF	$1\frac{1}{2}H_2O$	...	...	$366.6^{18°}$	...	...	...	...	...	...	...	...
$CsIO_3$	...	...	...	$2.6^{24°}$	...	...	...	...	...	...	...	...
$CsIO_4$	...	...	...	$2.15^{15°}$	...	...	...	...	...	...	...	...
$CsNO_3$	...	9.33	14.9	23.0	33.9	47.2	64.4	83.8	107.0	134.0	163.0	197.0
*CsOH	...	...	...	$79.41^{15°}$	...	...	...	...	...	...	...	...
Cs_2SO_4	...	167.1	173.1	178.7	184.1	189.9	194.9	199.9	205.0	210.3	214.9	220.3
CuCl	...	...	...	$1.52^{25°}$	...	...	...	...	...	...	...	...
*$CuCl_2$	...	41.4	42.45	43.5	44.55	45.6	46.65	47.7	...	49.8	...	51.9
CuI_2	...	...	...	1.107	...	...	...	...	...	...	...	...
*$Cu(NO_3)_2$	$6H_2O$	45	48.79	55.58	...	...	...	...	...	...	...	...
*$Cu(NO_3)_2$	$3H_2O$	...	...	...	...	61.51	...	64.17	...	67.51	...	...
CuS	...	...	3.3×10^{-5}	at 18°	...	...	...	...	...	...	...	...
$CuSO_4$	...	14.3	17.4	20.7	25	28.5	33.3	40	...	55	...	75.4
*$FeBr_2$	...	50.5	...	53.5	55.0	56.2	...	59.0	...	61.5	...	64.0
*$FeCl_2$	$4H_2O$	...	39.2	...	42.2	43.6	45.2	47.0	...	50.0	...	...
*$FeCl_2$	H_2O	...	...	...	...	...	...	...	...	...	51.3	51.4
$FeCl_3$	...	74.4	81.9	91.8	...	...	315.1	...	...	525.8	...	535.7
*$Fe(NO_3)_2$	$6H_2O$	41.53	...	45.6	...	...	...	62.5	...	...	...	...
FeS	...	6.16×10^{-4}	at 18°	...	...	...	...	...	...	...	...	...
$FeSO_4$	$7H_2O$	15.65	20.51	26.5	32.9	40.2	48.6	...	...	...	...	...
$FeSO_4$	H_2O	...	...	...	...	...	...	...	50.9	43.6	37.3	...
*H_3BO_3	...	2.59	3.45	4.8	6.30	8.02	10.35	12.90	15.70	19.11	23.30	28.7
HBr 760mm.	...	221.2	210.3	198	...	...	171.5	...	...	...	...	130
HCl 760mm.	...	82.3	...	...	67.3	63.3	59.6	56.1	...	...	...	...
*H_2SeO_3	...	47.4	55	62.5	70.2	77.5	79.2	79.3	79.3	79.3	79.4	...
H_2SeO_4	H_2O	81	...	85	...	...	...	...	...	...	...	...
H_2SeO_4	...	...	...	...	93	94.5	96.5	100	...	...	...	...
*H_6TeO_6	$6H_2O$	13.92	26.21	...	...	...	...	...	...	...	...	...
*H_2TeO_4	$2H_2O$	...	25.29	...	33.36	36.38	...	43.67	...	51.55	...	60.84

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
HgBr	......	......	3.9×10^{-6}	at 25°	......	......	......	......	......	......	......	......
$HgBr_2$	......	......	......	0.5	......	......	......	......	......	......	......	25
*HgCl	......	1.4×10^{-4}	......	2×10^{-4}	7×10^{-4}	......	......	......	......	......	......	......
*$HgCl_2$	......	3.5	4.6	6.1	7.7	9.3	......	14	......	23.1	......	38
$Hg(CN)_2$	......		$9.3^{13.5°}$;	$53.85^{101.1°}$	......	......	......	......	......	......	......	......
HgI	......	......	2×10^{-8}	at 25°	......	......	......	......	......	......	......	......
HgI_2	......	......	5.91×10^{-3}	at 25°	......	......	......	......	......	......	......	......
I_2	......	......	......	2.9×10^{-2}	4.0×10^{-2}	5.6×10^{-2}	7.8×10^{-2}	......	......	......	......	......
KBr	......	53.5	59.5	65.2	70.6	75.5	80.2	85.5	90.0	95.0	99.2	104.0
$KBrO_3$	......	3.1	4.8	6.9	9.5	13.2	17.5	22.7	......	34.0	......	50.0
$KC_2H_3O_2$	$1\frac{1}{2}H_2O$	216.7	233.9	255.6	283.8	323.3						
$KC_2H_3O_2$	$\frac{1}{2}H_2O$	......	......	......	......	......	337.3	350	364.8	380.1	396.3	......
KCl	......	27.6	31.0	34.0	37.0	40.0	42.6	45.5	48.3	51.1	54.0	56.7
$KClO_3$	......	3.3	5	7.4	10.5	14	19.3	24.5	......	38.5	......	57
$KClO_4$	......	0.75	1.05	1.80	2.6	4.4	6.5	9	11.8	14.8	18	21.8
*KCNS	......	63.9	......	68.5	......	......	......	......	......	......	......	......
*K_2CO_3	$2H_2O$	51.3	52	52.5	53.2	53.9	51.8	55.9	57.1	58.3	59.6	60.9
K_2CrO_4	......	58.2	60.0	61.7	63.4	65.2	66.8	68.6	70.4	72.1	73.9	75.6
$K_2Cr_2O_7$	......	5	7	12	20	26	34	43	52	61	70	80
*$KHC_4H_4O_6$	......	0.32	0.40	0.53	0.9	1.3	1.8	2.4	......	4.4	......	6.5
*$KHCO_3$	......	18.3	21.7	24.9	28.1	31.2	......	57.5	......	......	......	......
$KHSO_4$	......	36.3	......	51.4	......	67.3	......	......	......	......	......	121.6
KI	......	127.5	136	144	152	160	168	176	184	192	200	208
KIO_3	......	4.73	......	8.13	11.73	12.8	......	18.5	......	21.8	......	32.2
$KMnO_4$	......	2.83	4.4	6.4	9.0	12.56	16.89	22.2	......	......	......	......
*KNO_2	......	73.6	......	74.9	......	77	......	......	......	......	......	80.5
KNO_3	......	13.3	20.9	31.6	45.8	63.9	85.5	110.0	138	169	202	246
KOH	$2H_2O$	97	103	112	126							
KOH	H_2O	......	......	......	......	......	140	......	......	......	......	178
K_2PtCl_6	......	0.74	0.90	1.12	1.41	1.76	2.17	2.64	3.19	3.79	4.45	5.18
K_2SO_4	......	7.35	9.22	11.11	12.97	14.76	16.50	18.17	19.75	21.4	22.8	24.1

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
**$K_2S_2O_8$	....	1.62	2.60	4.49	7.19	9.89	....	....	....	....	....	....
$K_2SO_4.Al_2(SO_4)_3$	$24H_2O$	3.0	4.0	5.9	8.39	11.70	17.00	24.75	40.0	71.0	109.0	....
$La_2(SO_4)_3$	....	3	....	....	1.9	....	1.5	....	....	....	....	0.69
LiBr	H_2O	....	....	....	....	....	214	224	....	245	....	266
LiBr	$2H_2O$	143	166	177	191	205	....	....	....	....	....	....
LiCl	....	67	72	78.5	84.5	90.5	97	103	....	115	....	127.5
Li_2CO_3	....	1.54	1.43	1.33	1.25	1.17	1.08	1.01	....	0.85	....	0.72
LiI	$3H_2O$	151	157	165	171	179	187	202	230	....	....	....
LiI	H_2O	....	....	....	....	....	....	....	....	435	....	481
*$LiNO_3$	$3H_2O$	34.8	37.9	....	57	....	....	....	....	....	....	....
*$LiNO_3$	$1\frac{1}{2}H_2O$	....	....	....	....	....	61	63.6	....	....	....	....
*$LiNO_3$	....	....	....	....	....	....	....	....	66	....	....	....
LiOH	....	12.7	12.7	12.8	12.9	13	13.3	13.8	....	15.3	....	17.5
*Li_2SO_4	....	26.1	25.9	25.5	25.1	24.7	24.5	24.2	....	23.5	....	23
$MgBr_2$	$6H_2O$	91.0	94.5	96.5	99.2	101.6	104.1	107.5	....	113.7	....	120.2
$MgCl_2$	$6H_2O$	52.8	53.5	54.5	....	57.5	....	61.0	....	66.0	....	73.0
*MgI_2	$8H_2O$	54.7	....	58.3	....	63.4	....	....	....	....	....	....
*$Mg(NO_3)_2$	$6H_2O$	....	....	....	....	....	....	....	....	....	65	....
$Mg(OH)_2$	....	9×10^{-4} at 18°		....	....	....	....	....	....	....	....	....
*$MgSO_4$	$7H_2O$	....	23.6	26.2	29	31.3	....	....	....	....	....	....
*$MgSO_4$	$6H_2O$	29	29.7	30.8	31.2	....	33.5	35.5	37.3	39.1	40.8	42.5
*$MgSO_4$	H_2O	....	....	....	....	....	....	....	....	38.6	....	40.6
*$MnBr_2$	$4H_2O$	56.0	57.6	59.5	61.1	62.8	64.5	66.3	68.0	....	....	....
*$MnBr_2$	$2H_2O$	....	....	....	....	....	....	....	....	69.2	69.3	69.5
$MnCl_2$	$4H_2O$	63.4	68.1	73.9	80.71	88.59	98.15	....	....	....	....	....
$MnCl_2$	$2H_2O$	....	....	....	....	....	....	108.6	110.6	112.7	114.1	115.3
*$Mn(NO_3)_2$	$6H_2O$	50.49	54.1	58.8	....	....	....	....	....	....	....	....
*$Mn(NO_3)_2$	$3H_2O$	....	....	....	67.38	....	....	....	....	....	....	....
MnS	....	....	6.23×10^{-4} at 18°		....	....	....	....	....	....	....	....
$MnSO_4$	$7H_2O$	53.23	60.01	....	....	....	....	....	....	....	....	....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$MnSO_4$	$5H_2O$	...	59.5	62.9	67.76	...	...	...	...	...	...	...
$MnSO_4$	$4H_2O$	...	...	64.5	66.44	68.8	72.6	...	...	...	...	...
$MnSO_4$	H_2O	...	...	...	...	...	58.17	55.0	52.0	48.0	42.5	34.0
MoO_3	...	...	...	0.138	0.264	0.476	0.687	1.206	2.055	2.106	...	...
N_2O	...	...	0.1705	0.1211	...	...	...	...	...	...	...	...
NH_4Br	...	60.6	68	75.5	83.2	91.1	99.2	107.8	116.8	126	135.6	145.6
*NH_4CNS	...	54.5	59	63	67.5	...	...	...	...	...	...	...
*$(NH_4)_2C_2O_4$	...	2.1	3	4.2	5.6	7.4	9.3	...	...	...	...	...
$(NH_4)_2Cd(SO_4)_2$	...	...	...	72.3^{25°	...	...	...	...	...	...	...	...
NH_4Cl	...	29.4	33.3	37.2	41.4	45.8	50.4	55.2	60.2	65.6	71.3	77.3
**NH_4ClO_4	...	11.56	...	20.85	...	30.58	...	39.05	...	48.19	...	57.01
$(NH_4)_2CoSO_4$	...	6.0	9.5	13.0	17.0	22.0	27.0	33.5	40.0	49.0	...	...
*$(NH_4)_2CrO_4$	...	...	...	...	28.8	...	...	...	...	...	...	...
*$(NH_4)_2Cr_2O_7$	...	...	...	...	32.05	...	...	...	...	...	...	...
$(NH_4)_2Cr_2(SO_4)_4$	...	...	...	10.78^{25°	...	...	...	...	...	...	...	...
$(NH_4)_2Fe(SO_4)_2$	...	12.5	17.2	...	...	33.0	40	...	52	...	...	...
$(NH_4)_2Fe_2(SO_4)_4$	...	...	...	44.15^{25°	...	...	...	...	...	...	...	...
NH_4HCO_3	...	11.9	15.8	21	27	...	...	...	...	...	...	...
$NH_4H_2PO_3$	...	171	$190^{14.5^\circ}$	260^{31°	...	...	...	...	...	...	...	...
$(NH_4)_2HPO_4$	...	...	131^{15°	...	...	...	...	...	...	...	...	...
NH_4I	...	154.2	163.2	172.3	181.4	190.5	199.6	208.9	218.7	228.8	...	250.3
*NH_4LiSO_4	...	...	35.58	...	35.87	...	36.00	...	36.18	...	...	...
NH_4MgPO_4	...	0.023	...	0.052	...	0.036	0.030	0.040	0.016	0.019	...	...
NH_4MnPO_4	...	...	...	0	...	0	...	0	0.005	0.007	...	...
NH_4NO_3	...	118.3	...	192	241.8	297.0	344.0	421.0	499.0	580.0	740.0	871.0
$(NH_4)_2PtCl_6$	...	...	0.7	...	...	...	...	...	...	...	...	1.25
$(NH_4)_2SO_4$	...	70.6	73.0	75.4	78.0	81.0	...	88.0	...	95.3	...	103.3

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$(NH_4)_2SO_4.Al_2(SO_4)_3$	$24H_2O$	2.10	4.99	7.74	10.94	14.88	20.10	26.70	....	....	....	....
$(NH_4)_2S_2O_8$	....	58.2	....	....	....	....	....	....	....	....	....	....
*$(NH_4)_3SbS_4$	....	41.6	....	47.7	54.5	....	....	....	....	....	....	....
$(NH_4)_2SeO_4$	....	....	$1.22^{12°}$	....	....	....	....	....	....	....	....	....
NH_4VO_3	....	....	....	4.8	8.4	13.2	17.8	....	30.5	....	....	....
NO 760mm.	....	9.84×10^{-3}	7.57×10^{-3}	6.18×10^{-3}	5.17×10^{-3}	4.40×10^{-3}	3.76×10^{-3}	3.24×10^{-3}	2.67×10^{-3}	1.99×10^{-3}	1.14×10^{-3}	0
N_2O 760mm.	....	....	0.171	0.121	....	....	....	....	....	....	....	....
*$NaBr$	$2H_2O$	44.3	....	47.5	49.4	51.4	53.7	....	....	....	....	....
*$NaBr$	....	....	....	....	....	....	....	....	....	54.2	....	54.8
$Na_2B_4O_7$	$10H_2O$	1.3	1.6	2.7	3.9	....	10.5	20.3	....	....	....	....
$Na_2B_4O_7$	$5H_2O$	....	....	....	....	....	....	....	24.4	31.5	41	52.5
$NaBrO_3$	....	27.5	....	34.5	....	50.2	....	62.5	....	75.7	....	90.9
$NaC_2H_3O_2$	$3H_2O$	36.3	40.8	46.5	54.5	65.5	83	139	....	....	....	....
$NaC_2H_3O_2$	....	119	121	123.5	126	129.5	134	139.5	146	153	161	170
$Na_2C_2O_4$	....	....	....	3.7	....	....	....	....	....	....	....	6.33
$NaCl$	....	35.7	35.8	36.0	36.3	36.6	37.0	37.3	37.8	38.4	39.0	39.8
$NaClO_3$	....	79	89	101	113	126	140	155	172	189	....	230
Na_2CO_3	$10H_2O$	7	12.5	21.5	38.8	....	....	....	....	....	....	....
Na_2CO_3	H_2O	....	....	....	50.5	48.5	....	46.4	....	45.8	....	45.5
*Na_2CrO_4	$10H_2O$	24.07	33.41	47	....	....	....	....	....	....	....	....
*Na_2CrO_4	$4H_2O$	....	....	....	47	48.97	51	53.4	....	....	....	....
*Na_2CrO_4	....	....	....	....	....	....	....	....	55.15	55.53	....	55.74
*$Na_2Cr_2O_7$	$2H_2O$	61.98	....	64	....	....	71	....	76	79	....	....
$Na_2Cr_2O_7$	....	....	....	....	....	....	....	....	....	....	....	81
$Na_4Fe(CN)_6$	....	....	....	17.9	....	30	....	....	....	59	....	63
$NaHCO_3$	....	6.9	8.15	9.6	11.1	12.7	14.45	16.4	....	....	....	....
NaH_2PO_4	$2H_2O$	57.9	60.9	85.2	106.5	138.2	....	....	....	....	....	....
NaH_2PO_4	H_2O	....	....	....	....	....	158.6	....	....	....	....	....
NaH_2PO_4	....	....	....	....	....	....	....	179.3	190.3	207.3	225.3	246.6
Na_2HAsO_4	....	7.3	15.5	26.5	37	47	....	65	....	85	....	....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
Na_2HPO_4	$12H_2O$	1.67	3.6	7.7	20.8							
Na_2HPO_4	$7H_2O$					51.8						
Na_2HPO_4	$2H_2O$						80.2	82.9	88.1	92.4	102.9	
Na_2HPO_4												102.2
NaI									294	296		302
NaI	$2H_2O$	158.7	168.6	178.7	190.3	205.0	227.8	256.8				
$NaIO_3$		2.5		9		15		21		27		34
*$NaNO_2$		41.9	43.8	45.8	47.8	49.6	51			57		62
$NaNO_3$		73	80	88	96	104	114	124		148		180
NaOH	$4H_2O$	42										
NaOH	$3\frac{1}{2}H_2O$		51.5									
NaOH	H_2O			109	119	129	145	174				
NaOH											313	347
Na_3PO_4	$12H_2O$	1.5	4.1	11	20	31	43	55		81		108
$Na_4P_2O_7$	$10H_2O$	3.16	3.95	6.23	9.95	13.50	17.45	21.83		30.04		40.26
*Na_2S	$9H_2O$		13.36	15.8	18.4	22.2						
*Na_2S	$5\frac{1}{2}H_2O$						28.48	29.92	31.38	33.95	37.20	
*Na_2S	$6H_2O$						26.7	28.1	30.22	32.95	36.42	
Na_2SO_3	$7H_2O$	13.9	20	26.9	36							
Na_2SO_3						28.0	28.2	28.8		28.3		
Na_2SO_4	$10H_2O$	5.0	9.0	19.4	40.8							
Na_2SO_4	$7H_2O$	19.5	30	44								
Na_2SO_4						48.8	46.7	45.3		43.7		42.5
$Na_2S_2O_3$		52.5	61.0	70.0	84.7	102.6	169.7	206.7		248.8	254.2	266.0
*Na_2SeO_4	$10H_2O$	11.74			44.05							
*Na_2SeO_4							44.49					42.14
$NaVO_3$	$2H_2O$					30.2		68.4				
$NaVO_3$						26.23		32.97	36.9			
*Na_2WO_4	$10H_2O$	36.54										
*Na_2WO_4	$2H_2O$	41.73		42						47.7		49.3
$Nd_2(SO_4)_3$		9.5			5		3.7			2.7		

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
*$NiBr_2$	....	53	55	56.7	58	59.1	60	60.4	....	60.6	....	60.8
$NiCO_3$	....	....	$9.25\times$	10^{-3} at 25°	....	....	....	....	....	....	....	....
*$NiCl_2$		35	37.3	39.1	40.8	42.3	43.9	45.1	46	....	....	46.7
*NiI_2	....	55.4	57.5	59.7	61.7	63.5	64.7	64.8	65	65.2	65.3	....
*$Ni(NO_3)_2$	$6H_2O$	44.32	....	49.06	....	55	....	....	....	....	....	....
*$Ni(NO_3)_2$	$3H_2O$	....	....	....	....	....	....	61.99	63.95	....	70.16	....
NiS	....	....	$3.6\times$	10^{-4} at 18°	....	....	....	....	....	....	....	....
$NiSO_4$	$7H_2O$	27.22	32	....	42.46	....	....	....	....	....	....	....
$NiSO_4$	$6H_2O$			....	....	....	50.15	51.89	50.44	63.17	....	76.7
O_3	....	3.9×10^{-3}	2.9×10^{-3}	2.1×10^{-3}	7×10^{-4}	4×10^{-4}	1×10^{-4}	0	....	....	....	....
$PbBr_2$	....	0.455	....	0.85	1.15	1.53	1.94	2.36	....	3.34	....	4.75
$Pb(C_2H_3O_2)_2$		....	....	$55.04^{25°}$	....	....	....	....	....	....	....	....
$PbCO_3$		....	....	1.1×10^{-4}	....	....	....	....	....	....	....	....
$PbCl_2$		0.6728	....	0.99	1.20	1.45	1.70	1.98	....	2.62	....	3.34
$PbCrO_4$	....	....	....	7×10^{-6}	....	....	....	....	....	....	....	....
PbF_2	....	....	0.06	0.064	0.068	....	....	....	....	....	....	....
PbI_2	....	0.0442		0.068	0.090	0.125	0.164	0.197	....	0.302	....	0.436
$Pb(NO_3)_2$	....	38.8	48.3	56.5	66	75	85	95	....	115	....	138.8
PbS	....			8.6×10^{-6}	at 18°	....	....	....	....	....	....	....
$PbSO_4$	....	0.0028	0.0035	0.0041	0.0049	0.0056	....	....	....	....	....	....
RbCl	....	77	81.4	91.1	97.6	103.5	109.3	115.5	121.4	127.2	133.1	138.9
$RbClO_3$	....	2.11	....	5.4	8	....	15.98	....	....	....	....	62.8
$RbClO_4$	....	0.5	0.6	1.0	1.5	2.3	3.5	4.85	6.72	9.2	12.7	18
$RbNO_3$		19.5	33.0	53.3	81.3	116.7	155.6	200	251	309	375	452
Rb_2SO_4	....	36.4	42.6	48.2	53.5	58.5	63.1	67.4	71.4	75.0	78.7	81.8
SO_2 760mm.		22.83	16.21	11.29	7.81	5.41	4.5	....	....	....	....	....
$SbCl_3$	....	601.6		931.5	[illegible]	1368.0	1917.0	4531.0	....	∞	....	....
SbF_3	....	384.7		444.7	563.6	....	....	....	....	....	....	....
Sb_2S_3	....	....	$1.75\times$	10^{-4} at 18°	....	....	....	....	....	....	....	....
$SnCl_2$	....	83.9	$269.8^{15°}$		....	....	....	....	....	....	....	....
SnI_2	....	....	....	1.0	1.2	1.4	1.7	2.1	2.5	3.0	3.4	4.0

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$SnSO_4$				19								18
$SrBr_2$		85.2	93	102.4	111.9	123.2	135.8	150		181.8		222.5
$Sr(C_2H_3O_2)_2$	$4H_2O$	36.9	43.61									
$Sr(C_2H_3O_2)_2$	$\frac{1}{2}H_2O$		42.95	41.6	39.5		37.35		36.24	36.10	36.24	36.4
SrC_2O_4		0.0033	0.0044	0.0046	0.0057							
$SrCl_2$	$6H_2O$	43.5	47.7	52.9	58.7	65.3	72.4	81.8				
$SrCl_2$	$2H_2O$								85.9	90.5		100.8
SrI_2	$6H_2O$	165.3		177.8		191.5		217.5		270.4		
SrI_2	$2H_2O$										365.2	383.1
•$Sr(NO_2)_2$	H_2O	34.5		39			45.6	49.3			56.6	58.1
$Sr(NO_3)_2$	$4H_2O$	40.1		70.5								
$Sr(NO_3)_2$					88.6	90.1		93.8	96	98	100	
$SrSO_4$		0.0113		0.0114	0.0114							
$Th(SO_4)_2$	$9H_2O$	0.74	0.98	1.38	1.995	2.998	5.22					
$Th(SO_4)_2$	$8H_2O$	1.0	1.25	1.62								
$Th(SO_4)_2$	$6H_2O$	1.50		1.90	2.45			6.04				
$Th(SO_4)_2$	$4H_2O$					4.04	2.54	1.63	1.09			
$Th(SeO_4)_2$		0.498										
$TlBr$		0.024	0.029	0.042								
$TlBrO_3$				0.346		0.736						
$TlCl$		0.21	0.25	0.33	0.42	0.52	0.63	0.8		1.2		1.8
$TlClO_3$		2		3.92			12.67			36.65		57.31
$TlClO_4$		6	8.04		19.72		39.62		65.32	81.49		166.6
TlI			0.0036	0.006	0.008	0.015		0.035		0.070		0.120
$TlIO_3$				0.058								
$TlNO_3$		3.91	6.22	9.55	14.3	20.9	30.4	46.2	69.5	111.0	200.0	414.0
$TlOH$		25.44			39.9	49.5		73.8		106	126.1	148.3
Tl_2S				0.022								
Tl_2SO_4		2.70	3.70	4.87	6.16		9.21	10.92	12.74	14.61	16.53	18.45
Tl_2SeO_4			2.13	2.8								
•$UO_2(NO_2)_2$	$6H_2O$	49.5	52	55.7			67					

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$Yb_2(SO_4)_3$		44.2		38.4		21.0		10.4	7.22	6.92	5.83	4.67
*$ZnBr_2$	$2H_2O$	79.55		81.7	84.08							
*$ZnBr_2$						85.53		86.08		86.57		87.05
*$Zn(ClO_3)_2$	$6H_2O$	59.19	60.4									
*$Zn(ClO_3)_2$	$4H_2O$			66.7	67.66	69.06	73.2					
*ZnI_2	$2H_2O$	81.16	82.06	82.9								
*ZnI_2		81.11				81.66		82.37		83.05		83.62
*$Zn(NO_3)_2$	$6H_2O$	48.66		54.2								
*$Zn(NO_3)_2$	$3H_2O$					67.42						
$ZnSO_4$	$7H_2O$	41.9	47	54.4								
$ZnSO_4$	$6H_2O$					41.2	43.5					
$ZnSO_4$										46.4	45.5	44.7

SOLUBILITY OF

α, the absorption coefficient, is the volume of gas when reduced to 0° and 760 mm., absorbed by one volume of water when the pressure of the gas itself, without the aqueous tension, amounts to 760 mm.

q is the weight of gas in grams dissolved in 100 grams of water when the total pressure (i.e., the sum of the partial pressure of the gas plus the aqueous tension at the given temperature) is 760 mm.

Temp. °C	Nitrogen*		Oxygen		Hydrogen		Carbon Dioxide	
	α	q	α	q	α	q	α	q
0	0.02354	0.002942	0.04889	0.006945	0.02148	0.0001922	1.713	0.3346
1	0.02297	0.002869	0.04758	0.006756	0.02126	0.0001901	1.646	0.3213
2	0.02241	0.002798	0.04633	0.006574	0.02105	0.0001881	1.584	0.3091
3	0.02187	0.002730	0.04512	0.006400	0.02084	0.0001862	1.527	0.2978
4	0.02135	0.002663	0.04397	0.006232	0.02064	0.0001843	1.473	0.2871
5	0.02086	0.002600	0.04287	0.006072	0.02044	0.0001824	1.424	0.2774
6	0.02037	0.002537	0.04180	0.005918	0.02025	0.0001806	1.377	0.2681
7	0.01990	0.002477	0.04080	0.005773	0.02007	0.0001789	1.331	0.2589
8	0.01945	0.002419	0.03983	0.005632	0.01989	0.0001772	1.282	0.2492
9	0.01902	0.002365	0.03891	0.005498	0.01972	0.0001756	1.237	0.2403
10	0.01861	0.002312	0.03802	0.005368	0.01955	0.0001740	1.194	0.2318
11	0.01823	0.002263	0.03718	0.005246	0.01940	0.0001725	1.154	0.2239
12	0.01786	0.002216	0.03637	0.005128	0.01925	0.0001710	1.117	0.2165
13	0.01750	0.002170	0.03559	0.005014	0.01911	0.0001696	1.083	0.2098
14	0.01717	0.002126	0.03486	0.004906	0.01897	0.0001682	1.050	0.2032
15	0.01685	0.002085	0.03415	0.004802	0.01883	0.0001668	1.019	0.1970
16	0.01654	0.002045	0.03348	0.004703	0.01869	0.0001654	0.985	0.1903
17	0.01625	0.002006	0.03283	0.004606	0.01856	0.0001641	0.956	0.1845
18	0.01597	0.001970	0.03220	0.004514	0.01844	0.0001628	0.928	0.1789
19	0.01570	0.001935	0.03161	0.004426	0.01831	0.0001616	0.902	0.1737
20	0.01545	0.001901	0.03102	0.004339	0.01819	0.0001603	0.878	0.1688
21	0.01522	0.001869	0.03044	0.004252	0.01805	0.0001588	0.854	0.1640
22	0.01498	0.001838	0.02988	0.004169	0.01792	0.0001575	0.829	0.1590
23	0.01475	0.001809	0.02934	0.004087	0.01779	0.0001561	0.804	0.1540
24	0.01454	0.001780	0.02881	0.004007	0.01766	0.0001548	0.781	0.1493
25	0.01434	0.001751	0.02831	0.003931	0.01754	0.0001535	0.759	0.1449
26	0.01413	0.001724	0.02783	0.003857	0.01742	0.0001522	0.738	0.1406
27	0.01394	0.001698	0.02736	0.003787	0.01731	0.0001509	0.718	0.1366
28	0.01376	0.001672	0.02691	0.003718	0.01720	0.0001496	0.699	0.1327
29	0.01358	0.001647	0.02649	0.003651	0.01709	0.0001484	0.682	0.1292
30	0.01342	0.001624	0.02608	0.003588	0.01699	0.0001474	0.665	0.1257
35	0.01256	0.001501	0.02440	0.003315	0.01666	0.0001425	0.592	0.1105
40	0.01184	0.001391	0.02306	0.003082	0.01644	0.0001384	0.530	0.0973
45	0.01130	0.001300	0.02187	0.002858	0.01624	0.0001341	0.479	0.0860
50	0.01088	0.001216	0.02090	0.002657	0.01608	0.0001287	0.436	0.0761
60	0.01023	0.001052	0.01946	0.002274	0.01600	0.0001178	0.359	0.0576
70	0.00977	0.000851	0.01833	0.001856	0.0160	0.000102	—	—
80	0.00958	0.000660	0.01761	0.001381	0.0160	0.000079	—	—
90	0.0095	0.00038	0.0172	0.00079	0.0160	0.000046	—	—
100	0.0095	0.00000	0.0170	0.00000	0.0160	0.000000	—	—

* Atmospheric Nitrogen 98.815% Vol. N_2 + 1.185% Vol. A

GASES IN WATER

l is the volume of gas in c.c. dissolved by one volume of water when the total pressure (i.e., the sum of the partial pressure of the gas plus the aqueous tension at the given temperature) is 760 mm.

	Carbon Monoxide		Hydrogen Sulfide		Sulfur Dioxide		Nitric Oxide		Air**	
t	α	q	α	q	l	q	α	q	cc/1000cc	% O_2 in dissolved air
0	0.03537	0.004397	4.670	0.7066	79.789	22.83	0.07381	0.009833	29.18	34.91
1	0.03455	0.004293	4.522	0.6839	77.210	22.09	0.07184	0.009564	28.42	34.87
2	0.03375	0.004191	4.379	0.6619	74.691	21.37	0.06993	0.009305	27.69	34.82
3	0.03297	0.004092	4.241	0.6407	72.230	20.66	0.06809	0.009057	26.99	34.78
4	0.03222	0.003996	4.107	0.6201	69.828	19.98	0.06632	0.008816	26.32	34.74
5	0.03149	0.003903	3.977	0.6001	67.485	19.31	0.06461	0.008584	25.68	34.69
6	0.03078	0.003813	3.852	0.5809	65.200	18.65	0.06298	0.008361	25.06	34.65
7	0.03009	0.003725	3.732	0.5624	62.973	18.02	0.06140	0.008147	24.47	34.60
8	0.02942	0.003640	3.616	0.5446	60.805	17.40	0.05990	0.007943	23.90	34.56
9	0.02878	0.003559	3.505	0.5276	58.697	16.80	0.05846	0.007747	23.36	34.52
10	0.02816	0.003479	3.399	0.5112	56.647	16.21	0.05709	0.007560	22.84	34.47
11	0.02757	0.003405	3.300	0.4960	54.655	15.64	0.05587	0.007393	22.34	34.43
12	0.02701	0.003332	3.206	0.4814	52.723	15.09	0.05470	0.007233	21.87	34.38
13	0.02646	0.003261	3.115	0.4674	50.849	14.56	0.05357	0.007078	21.41	34.34
14	0.02595	0.003194	3.028	0.4540	49.033	14.04	0.05250	0.006930	20.97	34.30
15	0.02543	0.003130	2.945	0.4411	47.276	13.54	0.05147	0.006788	20.55	34.25
16	0.02494	0.003066	2.865	0.4287	45.578	13.05	0.05049	0.006652	20.14	34.21
17	0.02448	0.003007	2.789	0.4169	43.939	12.59	0.04956	0.006524	19.75	34.17
18	0.02402	0.002947	2.717	0.4056	42.360	12.14	0.04868	0.006400	19.38	34.12
19	0.02360	0.002891	2.647	0.3948	40.838	11.70	0.04785	0.006283	19.02	34.08
20	0.02319	0.002838	2.582	0.3846	39.374	11.28	0.04706	0.006173	18.68	34.03
21	0.02281	0.002789	2.517	0.3745	37.970	10.88	0.04625	0.006059	18.34	33.99
22	0.02244	0.002739	2.456	0.3648	36.617	10.50	0.04545	0.005947	18.01	33.95
23	0.02208	0.002691	2.396	0.3554	35.302	10.12	0.04469	0.005838	17.69	33.90
24	0.02174	0.002646	2.338	0.3463	34.026	9.76	0.04395	0.005733	17.38	33.86
25	0.02142	0.002603	2.282	0.3375	32.786	9.41	0.04323	0.005630	17.08	33.82
26	0.02110	0.002560	2.229	0.3290	31.584	9.06	0.04254	0.005530	16.79	33.77
27	0.02080	0.002519	2.177	0.3208	30.422	8.73	0.04188	0.005435	16.50	33.73
28	0.02051	0.002479	2.128	0.3130	29.314	8.42	0.04124	0.005342	16.21	33.68
29	0.02024	0.002442	2.081	0.3055	28.210	8.10	0.04063	0.005252	15.92	33.64
30	0.01998	0.002405	2.037	0.2983	27.161	7.80	0.04004	0.005165	15.64	33.60
35	0.01877	0.002231	1.831	0.2648	22.489	6.47	0.03734	0.004757		
40	0.01775	0.002075	1.660	0.2361	18.766	5.41	0.03507	0.004394		
45	0.01690	0.001933	1.516	0.2110	—	—	0.03311	0.004059		
50	0.01615	0.001797	1.392	0.1883	—	—	0.03152	0.003758		
60	0.01488	0.001522	1.190	0.1480	—	—	0.02954	0.003237		
70	0.01440	0.001276	1.022	0.1101	—	—	0.02810	0.002668		
80	0.01430	0.000980	0.917	0.0765	—	—	0.02700	0.001984		
90	0.0142	0.00057	0.84	0.041	—	—	0.0265	0.00113		
100	0.0141	0.00000	0.81	0.000	—	—	0.0263	0.00000		

** Cubic centimeters of air (free from CO_2 and NH_3) dissd. in 1000 c.c. H_2O with barometer at 760 mm. (total pressure).

SOLUBILITY OF AMMONIA IN WATER

Press. NH_3,mm	0°C		20°C		40°C	
	g/g	cm^3/cm^3	g/g	cm^3/cm^3	g/g	cm^3/cm^3
700	.....	....	0.497	652.9	.....	......
800	.....	....	0.544	714.6	0.329	429.6
900	0.997	1312	0.588	772.4	.....	......
1000	1.094	1440	0.629	826.2	0.386	504.0
1100	1.192	1569	0.669	878.8	.....	......
1200	1.288	1695	0.707	928.8	0.433	565.4
1300	1.388	1827	0.745	978.7	.....	......
1400	1.488	1958	0.781	1025.9	0.472	616.3
1500	1.588	2090	0.815	1070.6	.....	......
1600	1.688	2221	0.847	1112.6	0.508	663.3
1700	1.778	2340	0.877	1152.1	.....	......
1800	1.847	2431	0.906	1190.1	0.543	709.0
1900	.....	....	0.934	1226.9	.....	......
2000	.....	....	0.959	1259.7	0.577	753.4
2100	.....	....	0.984	1292.6	.....	......
2200	.....	....	1.007	1322.8	0.611	797.8
2300	.....	....	1.029	1351.7	.....	......
2400	.....	....	1.052	1381.8	0.644	840.9
2500	.....	....	1.074	1410.8	.....	......
2600	.....	....	1.096	1439.6	0.676	882.7
2700	.....	....	1.117	1467.3	.....	......
2800	.....	....	1.140	1497.4	0.706	921.7
2900	.....	....	1.162	1526.4	.....	......
3000	.....	....	1.185	1556.6	0.732	955.8
3100	.....	....	1.207	1585.5	.....	......
3200	.....	....	1.230	1615.7	0.758	989.8
3300	.....	....	.....	......	.....	......
3400	.....	....	.....	......	0.784	1023.7

SOLUBILITY OF VARIOUS GASES

HENRY'S LAW CONSTANT, K

$K = p/x$ where p is the partial pressure of the gas in mm and x the mole fraction of the gas in solution.

Gas	Value of K at t°C						
	t = 0°	10°	20°	30°	40°	50°	60°
	$\times 10^{-7}$	$\times 10^{-7}$	$\times 10^{-7}$	$\times 10^{-7}$	$\times 10^{-7}$	$\times 10^{-7}$	$\times 10^{-7}$
Argon	1.635	2.089	2.511	2.895	3.265	3.632	.....
Helium	9.78	9.54	9.50	9.39	9.19	8.73	.....
Krypton	0.945	1.170	1.510	1.850	2.182	2.471	2.649
Neon	8.67	7.69	6.76	5.71	4.37	2.94	.....
Ozone	0.1475	0.1884	0.2856	0.4548	0.9110	2.085	∞
Radon	0.1855	0.2805	0.397	0.526	0.663	0.792	0.894
Xenon	......	......	......	0.9629	1.176	.....	.....
Acetylene	0.0547	0.0727	0.0917	0.111	......	.....	.....
Ethane	0.9547	1.4386	1.9978	2.5976	3.218	3.794	4.289
Ethylene	0.419	0.584	0.774	0.962	......	.....	.....
Methane	1.6994	2.2575	2.8531	3.408	3.946	4.385	4.757

INDICATORS

R. T. Thomson's table, showing the hydrogen atoms replaced by NaOH or KOH when a compound neutral to the indicator is formed. The blank spaces indicate that the end-reaction is obscure.

(From Cohn's Indicators and Test-papers, John Wiley and Sons, publishers, by permission.)

Acid	Formula	Methyl-orange Cold	Phenolphthalein		Litmus	
			Cold	Boiling	Cold	Boiling
Sulphuric	H_2SO_4	2	2	2	2	2
Hydrochloric	HCl	1	1	1	1	1
Nitric	HNO_3	1	1	1	1	1
Thiosulphuric	$H_2S_2O_3$	2	2	2	2	2
Carbonic	H_2CO_3	0	1 dilute	0	..	0
Sulphurous	H_2SO_3	1	2	..	..	..
Hydrosulphuric	H_2S	0	1 dilute	0	..	0
Phosphoric	H_3PO_4	1	2	..	..	..
Arsenic	H_3AsO_4	1	2	..	..	..
Arsenous	H_3AsO_3	4	..	..	0	0
Nitrous	HNO_2	indicator destroyed	1	..	1	..
Silicic	H_4SiO_4	0	..	..	0	0
Boric	H_3BO_3	0	..	..	..	..
Chromic	H_2CrO_4	1	2	2	..	..
Oxalic	$H_2C_2O_4$	..	2	2	2	2
Acetic	$HC_2H_3O_2$	..	1	..	1 nearly	..
Butyric	$HC_4H_7O_2$	..	1	..	1 nearly	..
Succinic	$H_2C_4H_4O_4$	..	2	..	2 nearly	..
Lactic	$HC_3H_5O_3$	..	1	..	1	..
Tartaric	$H_2C_4H_4O_6$	..	2	..	2	..
Citric	$H_3C_6H_5O_7$	..	3	..	..	.

TABLE OF INDICATORS

Due to hydrolysis of the salt formed, the composition of a weak acid solution titrated against a strong base is basic (when equivalent amounts of acid and base are present) and of a weak base against a strong acid is acid. A truly neutral titrated solution has the same concentration of hydrogen ions $[H^+]$ and hydroxyl ions $[OH^-]$ as water. Water has a concentration of $[H^+]$ ion of 10^{-7} and of $[OH^-]$ ion of 10^{-7} at 25°C. As an index of the acid intensity the expression pH is employed and is equal to the logarithm of the reciprocal of the hydrogen ion concentration; i. e., $pH = \log \frac{1}{[H^+]}$ per liter. From this it follows that the pH of a neutral solution is the same as that of water; viz., 7; an acid solution has a pH less than 7 and a basic solution has a pH greater than 7. Those indicators in the table below with a * are the Sörensen selected indicators; those with a # are the Clark and Lubs selected indicators; those with the ## are Cohen's supplement to the Clark and Lubs selection; those with the *E* are the Eastman indicators.

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Mauveine	....	0.1–2.9 *	
α-Naphtholbenzein	....	0–1 E 8–9 E	
Methyl Red (para)	....	0–2 E	
Methyl Violet	....	0–2 E 0.1–3.1 *	
Iodeosin	Tetraiodofluorescein	0.3–0 E 4–5 E	
Benzoyl Auramine	....	0.1–1 E	
Quinaldine Red	....	1.2 E	
Diphenylamino-azo-benzene	....	1.2–2.1 *	
Tropeolin 00	Orange IV; diphenylamino azo-p-benzene sulfonic acid	1.4–2.6 * 1–3 E	
Metanil Yellow	Diphenylamino-azo-m-benzene sulfonic acid	1.2–2.3 *E	
Meta Cresol Purple	....	1.2–2.8 ## 7.4–9.0 ##	
Thymol Blue	Thymolsulfonphthalein	1.2–2.8 # 8.0–9.6	
Benzylaniline-azo-benzene sulfonic acid	....	1.9–3.3 *	
Ethyl Orange	Diethylaniline orange; sodium (or ammonium) diethylaniline-azo-benzene sulfonate	2–4 E	
Benzopurpurin 4B	....	2–4 E	
Benzylaniline-azo-benzene		2.3–3.3 *	
Red Cabbage Extract	Wild cabbage; sea cabbage; *Brassica oleracea*	2.4–4.5	Walbum
m-Chloro-diethyl aniline-azo-p-benzene sulfonic acid	....	2.6–4.0 *	
p-Dimethylamino-azo-benzene	Butter yellow; benzene-azo-dimethylaniline	2.9–4.0 * 3–4 E	
Congo Red	Sodium tetrazodiphenyl-naphthionate	3–5 E	Prideaux
2, 5-Dinitrohydro-quinone	....	3–9	Henderson and Forbes
Bromophenol Blue	Tetrabromophenolsulfon-phthalein	3.0–3.6 #E	
Methyl Orange[1]	Tropeolin D; orange III; Helianthine; Lunge's Indicator	2.9–4.0 E 3.1–4.4 *	
α-Naphthylamino-azo-p-benzene sulfonic acid	....	3.5–5.7 *	
α-Naphthylamino-azo-benzene	....	3.7–5.0 *	
Brom Cresol Green	....	3.8–5.4##	
p-Sulfo-o-methoxy-benzene-azo-di-methyl-α-napthy-lamine	....	4.0–4.6 E	
Iodeosin	*See iodeosin above*	4–5 E 0.3–0 E	

[1] Methyl Orange may be used in the presence of carbon dioxide or hydrogen sulfide.

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Dinitrohydroquinone Acetate	....	4–5 9–10 } E	
Sodium Alizarinsulfonate	....	4–5 5–6 } E	
Dichlorofluorescein	....	4–6 E	Hottinger
Lacmosol	....	4.4–5.5	
Methyl Red	....	4.4–6.0 ‡ 4.2–6.3 E	
Lacmoid	....	4.4–6.2	Sörensen
Tetrabromo-m-cresol-sulfonphthalein	....	4.5–5.5 E	
Azolitmin (Litmus)	....	4.5–8.3	Sörensen
Cochineal	Dried female insect, *Coccus cacti* Lin.; carminic acid	4.7–6.2	Sörensen
Chlor Phenol Red	....	4.8–6.4 ‡‡	
Propyl Red	....	4.8–6.4 E	Lubs and Clark
Hematoxylin	From logwood, *Haematoxylon campechia* L.	5–6 E	
p-Nitrophenol	....	5.0–7.0 * 5–6 E	
Sodium Alizarinsulfonate	....	4–5 5–6 E	
Brom Phenol Red	....	5.2–6.8 ‡‡	
Bromocresol Purple	Dibromo-o-cresolsulfonphthalein	5.2–6.8 ‡E	
Alizarin	Roots of madder; *Rubia tinctorum*, Lin. Dihydroxyanthraquinone; Schaal's Indicator.	5.5–6.8 10.1–12.1 }	Sörensen
Dinitrobenzoyleneurea	....	7–8 E 6–8	Bogart and Scatchard
Bromothymol Blue	Dibromothymolsulfonphthalein	6.0–7.6 ‡E	
Anisolesulfonphthalein	....	6–8 E	
Curcumin	Turmeric Yellow; curcummin; roots of *Curcuma longa* L.	6.8 E	
Brilliant Yellow	....	6–8 E	
Neutral Red	Toluylene Red	6.8–8.0 *E	
Phenol Red	Phenolsulfonphthalein	6.8–8.4 ‡E	
Rosolic acid	Aurin; aurin red; corallin; p-rosolic acid	6.9–8.0 *E	
Cyanin	Quinoline Blue; diamylcyanine iodide	7–8	Prideaux
β-Naphtholphthalein	....	7.2–8.6	Sörensen and Palitzsch
Cresol Red	o-Cresolsulfonphthalein	7–9 E 7.2–8.8 ‡E	
Meta Cresol Purple	....	7.4–9.0 1.2–2.8 } ‡‡	
Tropeolin 000	Orange I; Orange B; sodium-naphthol-azo-benzene sulfonate; von Muller's indicator	7.6–8.9 *	

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Thymol Blue........	*See thymol blue above*.......	8.0–9.6, 1.2–2.8 #E	
α-Naphtholbenzein..	....	8.9 E	
Cresolphthalein.....	o-Cresolphthalein	8.2–9.8 # 8–10 E	
Phenolphthalein[2]....	Dihydroxyphthalophenone; Luck's indicator	8.3–10 *E	
Dinitrohydroquinone Acetate	....	9–10 E	
Alizarin Yellow R...	Sodium p-nitrobenzene-azo-salicylate	9–10 E	
Tetranitrophenolsulfonphthalein	....	9–10 E	
Thymolphthalein.....	....	9.3–10.5 * 10–11 E	
Alizarin Yellow G....	p-nitrobenzene-azo-salicylic acid	10.1–12.1 *	
Alizarin Blue S......	....	11–13	Prideaux
Poirrier's Blue.......	....	11–13	Prideaux
Tropeolin 0..........	Resorcine-azo-benzene-sulfonic acid	11.1–12.7 *E	
Sodium Indigodisulfonate............	....	12–14 E	
1,3,5-Trinitrobenzene	....	14–14.3 E	

[2] Phenolphthalein may be used in the presence of weak acids.

PREPARATION OF CLARK AND LUBS INDICATOR SOLUTIONS

To prepare a 0.04% indicator reagent, 0.1 gram of the dry indicator is mixed in a mortar with the number of cubic centimeters of 0.01 *N* sodium hydroxide as given in the table below and the mixture diluted to 250 cc with water. Such solutions give satisfactory results when five drops of indicator are added to 10 cc of the solution to be tested.

Indicator	0.01 *N* NaOH cc	Indicator	0.01 *N* NaOH cc
Brom cresol green	14.3	Chlor phenol red	23.6
Brom cresol purple	18.5	Cresol red	26.2
Brom phenol blue	14.9	Meta cresol purple	26.2
Brom phenol red	19.5	Phenol red	28.2
Brom thymol blue	16.0	Thymol blue	21.5

CONVERSION FACTORS—pH TO E. M. F.

When the half-cell:

KCl (saturated)|KCl (0.1*N*), HgCl (s)|Hg is used as a standard of reference and it is assumed, arbitrarily that in the cell:

$$\underset{A}{\text{Pt, } H_2 \text{ (1 atmosphere)}}|\text{H}^+ \text{ (unknown activity)}\underset{B}{|}\text{KCl (saturated)}\underset{C}{|}\text{KCl (0.1}N\text{), HgCl (s)}\underset{D}{|}\text{Hg}$$

the potential difference at **B** remains constant with variations of "H (unknown activity)" and that the sum of the potential differences at **B, C** and **D** is Σ as follows: (cf. Clark: *Determination of Hydrogen Ions*, 3d Ed., 1928).

t°C	18	20	25	30
Potential difference (Σ) volts	0.3380	0.3379	0.3376	0.3371

t°C	35	38	40
Potential difference (Σ) volts	0.3365	0.3361	0.3358

then,

$$pH = \frac{\text{E. M. F.} - \Sigma}{0.00019832 \times T}$$ where T is the absolute temperature.

CALOMEL ELECTRODE

The voltage of the calomel electrode at 25°C. is for the half-cell:

$$Hg|HgCl, (N)\ KCl|| = +0.2822$$
$$Hg|HgCl, (0.1N\ KCl)|| = +0.3376$$
$$Hg|HgCl, (saturated)\ KCl|| = +0.2458$$

From this the relation of the E. M. F. and pH (of a cell composed of a hydrogen electrode and one of the calomel electrodes) is given by:

$$pH = \frac{E.\ M.\ F. - \Sigma}{0.0591} \text{ (at 25°C.)}$$

QUINHYDRONE ELECTRODE

The normal electrode potential (E_h) of the quinhydrone electrode referred to the normal hydrogen electrode at t°C. is given by the expression:

$$E_h = 0.7177 - 0.00074t$$

McILVAINE'S STANDARD BUFFER SOLUTIONS

Stock solution A: 0.1 molar citric acid ($C_6H_8O_7$) solution.
Stock solution B: 0.2 molar disodium phosphate (Na_2HPO_4) solution.

pH	Soln. A cc	Soln. B cc	pH	Soln. A cc	Soln. B cc
2.2	19.60	0.40	5.2	9.28	10.72
2.4	18.76	1.24	5.4	8.85	11.15
2.6	17.82	2.18	5.6	8.40	11.60
2.8	16.83	3.17	5.8	7.91	12.09
3.0	15.89	4.11	6.0	7.37	12.63
3.2	15.06	4.94	6.2	6.78	13.22
3.4	14.30	5.70	6.4	6.15	13.85
3.6	13.56	6.44	6.6	5.45	14.55
3.8	12.90	7.10	6.8	4.55	15.45
4.0	12.29	7.71	7.0	3.53	16.47
4.2	11.72	8.28	7.2	2.61	17.39
4.4	11.18	8.82	7.4	1.83	18.17
4.6	10.65	9.35	7.6	1.27	18.73
4.8	10.14	9.86	7.8	0.85	19.15
5.0	9.70	10.30	8.0	0.55	19.45

pH VALUES FOR POTENTIOMETER READINGS

Harold V. Gaskill

The following table presents pH values for various potentiometer readings using the quinhydrone half-cell and saturated calomel half-cell at 25°C. The argument is potential in millivolts and the table entries are in terms of pH. The table was constructed upon the following formula:

$$\text{pH} = \frac{0.4538 - E_q}{0.0591}$$

in which E_q is the observed potential in volts.[1]

The temperature factor is 0.77 millivolts per degree, to be added above 25°C and subtracted below 25°C.

Polarity is reversed above 7.68 pH.

Milli-volts	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	7.6785	7.6768	7.6751	7.6734	7.6717	7.6700	7.6683	7.6667	7.6650	7.6633
1	7.6616	7.6599	7.6582	7.6565	7.6548	7.6531	7.6514	7.6497	7.6480	7.6464
2	7.6447	7.6430	7.6413	7.6396	7.6379	7.6362	7.6345	7.6328	7.6311	7.6294
3	7.6277	7.6260	7.6244	7.6227	7.6210	7.6193	7.6176	7.6159	7.6142	7.6125
4	7.6108	7.6091	7.6074	7.6057	7.6040	7.6024	7.6007	7.5990	7.5973	7.5956
5	7.5939	7.5922	7.5905	7.5888	7.5871	7.5854	7.5837	7.5821	7.5804	7.5787
6	7.5770	7.5753	7.5736	7.5719	7.5702	7.5685	7.5668	7.5651	7.5634	7.5617
7	7.5601	7.5584	7.5567	7.5550	7.5533	7.5516	7.5499	7.5482	7.5465	7.5448
8	7.5431	7.5414	7.5398	7.5381	7.5364	7.5347	7.5330	7.5313	7.5296	7.5279
9	7.5262	7.5245	7.5228	7.5211	7.5194	7.5178	7.5161	7.5144	7.5127	7.5110
10	7.5093	7.5076	7.5059	7.5042	7.5025	7.5008	7.4991	7.4975	7.4958	7.4941
11	7.4924	7.4907	7.4890	7.4873	7.4856	7.4839	7.4822	7.4805	7.4788	7.4771
12	7.4755	7.4738	7.4721	7.4704	7.4687	7.4671	7.4653	7.4636	7.4619	7.4602
13	7.4585	7.4568	7.4551	7.4535	7.4518	7.4501	7.4484	7.4467	7.4450	7.4433
14	7.4416	7.4399	7.4382	7.4365	7.4348	7.4332	7.4315	7.4298	7.4281	7.4264
15	7.4247	7.4230	7.4213	7.4196	7.4179	7.4162	7.4145	7.4128	7.4112	7.4095
16	7.4078	7.4061	7.4044	7.4027	7.4010	7.3993	7.3976	7.3959	7.3942	7.3925
17	7.3909	7.3892	7.3875	7.3858	7.3841	7.3824	7.3807	7.3790	7.3773	7.3756
18	7.3739	7.3722	7.3705	7.3689	7.3672	7.3655	7.3638	7.3621	7.3604	7.3587
19	7.3570	7.3553	7.3536	7.3519	7.3502	7.3486	7.3469	7.3452	7.3435	7.3418
20	7.3401	7.3384	7.3367	7.3350	7.3333	7.3316	7.3299	7.3282	7.3266	7.3249
21	7.3232	7.3215	7.3198	7.3181	7.3164	7.3147	7.3130	7.3113	7.3096	7.3079
22	7.3062	7.3046	7.3029	7.3012	7.2995	7.2978	7.2961	7.2944	7.2927	7.2910
23	7.2893	7.2876	7.2859	7.2843	7.2826	7.2809	7.2792	7.2775	7.2758	7.2741
24	7.2724	7.2707	7.2690	7.2673	7.2656	7.2639	7.2623	7.2606	7.2589	7.2572
25	7.2565	7.2538	7.2521	7.2504	7.2487	7.2470	7.2453	7.2436	7.2420	7.2403
26	7.2386	7.2369	7.2352	7.2335	7.2318	7.2301	7.2284	7.2267	7.2250	7.2233
27	7.2216	7.2200	7.2183	7.2166	7.2149	7.2132	7.2115	7.2098	7.2081	7.2064
28	7.2047	7.2030	7.2013	7.1997	7.1980	7.1963	7.1946	7.1929	7.1912	7.1895
29	7.1878	7.1861	7.1844	7.1827	7.1810	7.1793	7.1777	7.1760	7.1743	7.1726
30	7.1709	7.1692	7.1675	7.1658	7.1641	7.1624	7.1607	7.1590	7.1573	7.1557
31	7.1540	7.1523	7.1506	7.1489	7.1472	7.1455	7.1438	7.1421	7.1404	7.1387
32	7.1370	7.1354	7.1337	7.1320	7.1303	7.1286	7.1269	7.1252	7.1235	7.1218
33	7.1201	7.1184	7.1167	7.1150	7.1134	7.1117	7.1100	7.1083	7.1066	7.1049
34	7.1032	7.1015	7.0998	7.0981	7.0964	7.0947	7.0931	7.0914	7.0897	7.0880

[1] From formula number 1, p. 405, Clark, W. M., The determination of hydrogen ions, Baltimore, 1928; and, Baver, L. D., Soil Science, 1926, **21**, 3, 167–180.

pH VALUES FOR POTENTIOMETER READINGS
(Continued)

Milli-volts	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
35	7.0863	7.0846	7.0829	7.0812	7.0795	7.0778	7.0761	7.0744	7.0727	7.0711
36	7.0694	7.0677	7.0660	7.0643	7.0626	7.0609	7.0592	7.0575	7.0558	7.0541
37	7.0524	7.0508	7.0491	7.0474	7.0457	7.0440	7.0423	7.0406	7.0389	7.0372
38	7.0355	7.0338	7.0321	7.0304	7.0288	7.0271	7.0254	7.0237	7.0220	7.0203
39	7.0186	7.0169	7.0152	7.0135	7.0118	7.0101	7.0084	7.0068	7.0051	7.0034
40	7.0017	7.0000	6.9983	6.9966	6.9949	6.9932	6.9915	6.9898	6.9881	6.9865
41	6.9848	6.9831	6.9814	6.9797	6.9780	6.9763	6.9746	6.9729	6.9712	6.9695
42	6.9678	6.9661	6.9645	6.9628	6.9611	6.9594	6.9577	6.9560	6.9543	6.9526
43	6.9509	6.9492	6.9475	6.9458	6.9442	6.9425	6.9408	6.9391	6.9374	6.9357
44	6.9340	6.9323	6.9306	6.9289	6.9272	6.9255	6.9238	6.9222	6.9205	6.9188
45	6.9171	6.9154	6.9137	6.9120	6.9103	6.9086	6.9069	6.9052	6.9035	6.9019
46	6.9002	6.8985	6.8968	6.8951	6.8934	6.8917	6.8900	6.8883	6.8866	6.8849
47	6.8832	6.8815	6.8799	6.8782	6.8765	6.8748	6.8731	6.8714	6.8697	6.8680
48	6.8663	6.8646	6.8629	6.8612	6.8595	6.8579	6.8562	6.8545	6.8528	6.8511
49	6.8494	6.8477	6.8460	6.8443	6.8426	6.8409	6.8392	6.8376	6.8359	6.8342
50	6.8325	6.8308	6.8291	6.8274	6.8257	6.8240	6.8223	6.8206	6.8189	6.8172
51	6.8156	6.8139	6.8122	6.8105	6.8088	6.8071	6.8054	6.8037	6.8020	6.8003
52	6.7986	6.7969	6.7953	6.7936	6.7919	6.7902	6.7885	6.7868	6.7851	6.7834
53	6.7817	6.7800	6.7783	6.7766	6.7749	6.7733	6.7716	6.7699	6.7682	6.7665
54	6.7648	6.7631	6.7614	6.7597	6.7580	6.7563	6.7546	6.7530	6.7513	6.7496
55	6.7479	6.7462	6.7445	6.7428	6.7411	6.7394	6.7377	6.7360	6.7343	6.7326
56	6.7310	6.7293	6.7276	6.7259	6.7242	6.7225	6.7208	6.7191	6.7174	6.7157
57	6.7140	6.7123	6.7106	6.7090	6.7073	6.7056	6.7039	6.7022	6.7005	6.6988
58	6.6971	6.6954	6.6937	6.6920	6.6903	6.6887	6.6870	6.6853	6.6836	6.6819
59	6.6802	6.6785	6.6768	6.6751	6.6734	6.6717	6.6700	6.6683	6.6667	6.6650
60	6.6633	6.6616	6.6599	6.6582	6.6565	6.6548	6.6531	6.6514	6.6497	6.6480
61	6.6464	6.6447	6.6430	6.6413	6.6396	6.6379	6.6362	6.6345	6.6328	6.6311
62	6.6294	6.6277	6.6260	6.6244	6.6227	6.6210	6.6193	6.6176	6.6159	6.6142
63	6.6125	6.6108	6.6091	6.6074	6.6057	6.6040	6.6024	6.6007	6.5990	6.5973
64	6.5956	6.5939	6.5922	6.5905	6.5888	6.5871	6.5854	6.5837	6.5821	6.5804
65	6.5787	6.5770	6.5753	6.5736	6.5719	6.5702	6.5685	6.5668	6.5651	6.5634
66	6.5617	6.5601	6.5584	6.5567	6.5550	6.5533	6.5516	6.5499	6.5482	6.5465
67	6.5448	6.5431	6.5414	6.5398	6.5381	6.5364	6.5347	6.5330	6.5313	6.5296
68	6.5279	6.5262	6.5245	6.5228	6.5211	6.5194	6.5178	6.5161	6.5144	6.5127
69	6.5110	6.5093	6.5076	6.5059	6.5042	6.5025	6.5008	6.4991	6.4975	6.4958
70	6.4941	6.4924	6.4907	6.4890	6.4873	6.4856	6.4839	6.4822	6.4805	6.4788
71	6.4771	6.4755	6.4738	6.4721	6.4704	6.4687	6.4670	6.4653	6.4636	6.4619
72	6.4602	6.4585	6.4568	6.4551	6.4535	6.4518	6.4501	6.4484	6.4467	6.4450
73	6.4433	6.4416	6.4399	6.4382	6.4365	6.4348	6.4332	6.4315	6.4298	6.4281
74	6.4264	6.4247	6.4230	6.4213	6.4196	6.4179	6.4162	6.4145	6.4128	6.4112
75	6.4095	6.4078	6.4061	6.4044	6.4027	6.4010	6.3993	6.3976	6.3959	6.3942
76	6.3925	6.3909	6.3892	6.3875	6.3858	6.3841	6.3824	6.3807	6.3790	6.3773
77	6.3756	6.3739	6.3722	6.3705	6.3689	6.3672	6.3655	6.3638	6.3621	6.3604
78	6.3587	6.3570	6.3553	6.3536	6.3519	6.3502	6.3486	6.3469	6.3452	6.3435
79	6.3418	6.3401	6.3384	6.3367	6.3350	6.3333	6.3316	6.3299	6.3282	6.3266
80	6.3249	6.3232	6.3215	6.3198	6.3181	6.3164	6.3147	6.3130	6.3113	6.3096
81	6.3079	6.3062	6.3046	6.3029	6.3012	6.2995	6.2978	6.2961	6.2944	6.2927
82	6.2910	6.2893	6.2876	6.2859	6.2843	6.2826	6.2809	6.2792	6.2775	6.2758
83	6.2741	6.2724	6.2707	6.2690	6.2673	6.2656	6.2639	6.2623	6.2606	6.2589
84	6.2572	6.2555	6 2538	6.2521	6.2504	6.2487	6.2470	6.2453	6.2436	6.2420

pH VALUES FOR POTENTIOMETER READINGS
(Continued)

Millivolts	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
85	6.2403	6.2386	6.2369	6.2352	6.2335	6.2318	6.2301	6.2284	6.2267	6.2250
86	6.2233	6.2216	6.2200	6.2183	6.2166	6.2149	6.2132	6.2115	6.2098	6.2081
87	6.2064	6.2047	6.2030	6.2013	6.1997	6.1980	6.1963	6.1946	6.1929	6.1912
88	6.1895	6.1878	6.1861	6.1844	6.1827	6.1810	6.1793	6.1777	6.1760	6.1743
89	6.1726	6.1709	6.1692	6.1675	6.1658	6.1641	6.1624	6.1607	6.1590	6.1573
90	6.1557	6.1540	6.1523	6.1506	6.1489	6.1472	6.1455	6.1438	6.1421	6.1404
91	6.1387	6.1370	6.1354	6.1337	6.1320	6.1303	6.1286	6.1269	6.1252	6.1235
92	6.1218	6.1201	6.1184	6.1167	6.1150	6.1134	6.1117	6.1100	6.1083	6.1066
93	6.1049	6.1032	6.1015	6.0998	6.0981	6.0964	6.0947	6.0931	6.0914	6.0897
94	6.0880	6.0863	6.0846	6.0829	6.0812	6.0795	6.0778	6.0761	6.0744	6.0727
95	6.0711	6.0694	6.0677	6.0660	6.0643	6.0626	6.0609	6.0592	6.0575	6.0558
96	6.0541	6.0524	6.0508	6.0491	6.0474	6.0457	6.0440	6.0423	6.0406	6.0389
97	6.0372	6.0355	6.0338	6.0321	6.0304	6.0288	6.0271	6.0254	6.0237	6.0220
98	6.0203	6.0186	6.0169	6.0152	6.0135	6.0118	6.0101	6.0084	6.0068	6.0051
99	6.0034	6.0017	6.0000	5.9983	5.9966	5.9949	5.9932	5.9915	5.9898	5.9881
100	5.9865	5.9848	5.9831	5.9814	5.9797	5.9780	5.9763	5.9746	5.9729	5.9712
101	5.9695	5.9678	5.9661	5.9645	5.9628	5.9611	5.9594	5.9577	5.9560	5.9543
102	5.9526	5.9509	5.9492	5.9475	5.9458	5.9442	5.9425	5.9408	5.9391	5.9374
103	5.9357	5.9340	5.9323	5.9306	5.9289	5.9272	5.9255	5.9238	5.9222	5.9205
104	5.9188	5.9171	5.9154	5.9137	5.9120	5.9103	5.9086	5.9069	5.9052	5.9035
105	5.9019	5.9002	5.8985	5.8968	5.8951	5.8934	5.8917	5.8900	5.8883	5.8866
106	5.8849	5.8832	5.8815	5.8799	5.8782	5.8765	5.8748	5.8731	5.8714	5.8697
107	5.8680	5.8663	5.8646	5.8629	5.8612	5.8595	5.8579	5.8562	5.8545	5.8528
108	5.8511	5.8494	5.8477	5.8460	5.8443	5.8426	5.8409	5.8392	5.8376	5.8359
109	5.8342	5.8325	5.8308	5.8291	5.8274	5.8257	5.8240	5.8223	5.8206	5.8189
110	5.8172	5.8156	5.8139	5.8122	5.8105	5.8088	5.8071	5.8054	5.8037	5.8020
111	5.8003	5.7986	5.7969	5.7953	5.7936	5.7919	5.7902	5.7885	5.7868	5.7851
112	5.7834	5.7817	5.7800	5.7783	5.7766	5.7749	5.7733	5.7716	5.7699	5.7682
113	5.7665	5.7648	5.7631	5.7614	5.7597	5.7580	5.7563	5.7546	5.7530	5.7513
114	5.7496	5.7479	5.7462	5.7445	5.7428	5.7411	5.7394	5.7377	5.7360	5.7343
115	5.7326	5.7310	5.7293	5.7276	5.7259	5.7242	5.7225	5.7208	5.7191	5.7174
116	5.7157	5.7140	5.7123	5.7106	5.7090	5.7073	5.7056	5.7039	5.7022	5.7005
117	5.6988	5.6971	5.6954	5.6937	5.6920	5.6903	5.6887	5.6870	5.6853	5.6836
118	5.6819	5.6802	5.6785	5.6768	5.6751	5.6734	5.6717	5.6700	5.6683	5.6667
119	5.6650	5.6633	5.6616	5.6599	5.6582	5.6565	5.6548	5.6531	5.6514	5.6497
120	5.6480	5.6464	5.6447	5.6430	5.6413	5.6396	5.6379	5.6362	5.6345	5.6328
121	5.6311	5.6294	5.6277	5.6260	5.6244	5.6227	5.6210	5.6193	5.6176	5.6159
122	5.6142	5.6125	5.6108	5.6091	5.6074	5.6057	5.6040	5.6024	5.6007	5.5990
123	5.5973	5.5956	5.5939	5.5922	5.5905	5.5888	5.5871	5.5854	5.5837	5.5821
124	5.5804	5.5787	5.5770	5.5753	5.5736	5.5719	5.5702	5.5685	5.5668	5.5651
125	5.5634	5.5617	5.5601	5.5584	5.5567	5.5550	5.5533	5.5516	5.5499	5.5482
126	5.5465	5.5448	5.5431	5.5414	5.5398	5.5381	5.5364	5.5347	5.5330	5.5313
127	5.5296	5.5279	5.5262	5.5245	5.5228	5.5211	5.5194	5.5178	5.5161	5.5144
128	5.5127	5.5110	5.5093	5.5076	5.5059	5.5042	5.5025	5.5008	5.4991	5.4975
129	5.4958	5.4941	5.4924	5.4907	5.4890	5.4873	5.4856	5.4839	5.4822	5.4805
130	5.4788	5.4771	5.4755	5.4738	5.4721	5.4704	5.4687	5.4670	5.4653	5.4636
131	5.4619	5.4602	5.4585	5.4568	5.4551	5.4535	5.4518	5.4501	5.4484	5.4467
132	5.4450	5.4433	5.4416	5.4399	5.4382	5.4365	5.4348	5.4332	5.4315	5.4298
133	5.4281	5.4264	5.4247	5.4230	5.4213	5.4196	5.4179	5.4162	5.4145	5.4128
134	5.4112	5.4095	5.4078	5.4061	5.4044	5.4027	5.4010	5.3993	5.3976	5.3959

pH VALUES FOR POTENTIOMETER READINGS (Continued)

Milli-volts	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
135	5.3942	5.3925	5.3909	5.3892	5.3875	5.3858	5.3841	5.3824	5.3807	5.3790
136	5.3773	5.3756	5.3739	5.3722	5.3705	5.3689	5.3672	5.3655	5.3638	5.3621
137	5.3604	5.3587	5.3570	5.3553	5.3536	5.3519	5.3502	5.3486	5.3469	5.3452
138	5.3435	5.3418	5.3401	5.3384	5.3367	5.3350	5.3333	5.3316	5.3299	5.3282
139	5.3266	5.3249	5.3232	5.3215	5.3198	5.3181	5.3164	5.3147	5.3130	5.3113
140	5.3096	5.3079	5.3062	5.3046	5.3029	5.3012	5.2995	5.2978	5.2961	5.2944
141	5.2927	5.2910	5.2893	5.2876	5.2859	5.2843	5.2826	5.2809	5.2792	5.2775
142	5.2758	5.2741	5.2724	5.2707	5.2690	5.2673	5.2656	5.2639	5.2623	5.2606
143	5.2589	5.2572	5.2555	5.2538	5.2521	5.2504	5.2487	5.2470	5.2453	5.2436
144	5.2420	5.2403	5.2386	5.2369	5.2352	5.2335	5.2318	5.2301	5.2284	5.2267
145	5.2250	5.2233	5.2216	5.2200	5.2183	5.2166	5.2149	5.2132	5.2115	5.2098
146	5.2081	5.2064	5.2047	5.2030	5.2013	5.1997	5.1980	5.1963	5.1946	5.1929
147	5.1912	5.1895	5.1878	5.1861	5.1844	5.1827	5.1810	5.1793	5.1777	5.1760
148	5.1743	5.1726	5.1709	5.1692	5.1675	5.1658	5.1641	5.1624	5.1607	5.1590
149	5.1573	5.1557	5.1540	5.1523	5.1506	5.1489	5.1472	5.1455	5.1438	5.1421
150	5.1404	5.1387	5.1370	5.1354	5.1337	5.1320	5.1303	5.1286	5.1269	5.1252
151	5.1235	5.1218	5.1201	5.1184	5.1167	5.1150	5.1134	5.1117	5.1100	5.1083
152	5.1066	5.1049	5.1032	5.1015	5.0998	5.0981	5.0964	5.0947	5.0931	5.0914
153	5.0897	5.0880	5.0863	5.0846	5.0829	5.0812	5.0795	5.0778	5.0761	5.0744
154	5.0727	5.0711	5.0694	5.0677	5.0660	5.0643	5.0626	5.0609	5.0592	5.0575
155	5.0558	5.0541	5.0524	5.0508	5.0491	5.0474	5.0457	5.0440	5.0423	5.0406
156	5.0389	5.0372	5.0355	5.0338	5.0321	5.0304	5.0288	5.0271	5.0254	5.0237
157	5.0220	5.0203	5.0186	5.0169	5.0152	5.0135	5.0118	5.0101	5.0084	5.0068
158	5.0051	5.0034	5.0017	5.0000	4.9983	4.9966	4.9949	4.9932	4.9915	4.9898
159	4.9881	4.9865	4.9848	4.9831	4.9814	4.9797	4.9780	4.9763	4.9746	4.9729
160	4.9712	4.9695	4.9678	4.9661	4.9645	4.9628	4.9611	4.9594	4.9577	4.9560
161	4.9543	4.9526	4.9509	4.9492	4.9475	4.9458	4.9442	4.9425	4.9408	4.9391
162	4.9374	4.9357	4.9340	4.9323	4.9306	4.9289	4.9272	4.9255	4.9238	4.9222
163	4.9205	4.9188	4.9171	4.9154	4.9137	4.9120	4.9103	4.9086	4.9069	4.9052
164	4.9035	4.9019	4.9002	4.8985	4.8968	4.8951	4.8934	4.8917	4.8900	4.8883
165	4.8866	4.8849	4.8832	4.8815	4.8799	4.8782	4.8765	4.8748	4.8731	4.8714
166	4.8697	4.8680	4.8663	4.8646	4.8629	4.8612	4.8595	4.8579	4.8562	4.8545
167	4.8528	4.8511	4.8494	4.8477	4.8460	4.8443	4.8426	4.8409	4.8392	4.8376
168	4.8359	4.8342	4.8325	4.8308	4.8291	4.8274	4.8257	4.8240	4.8223	4.8206
169	4.8189	4.8172	4.8156	4.8139	4.8122	4.8105	4.8088	4.8071	4.8054	4.8037
170	4.8020	4.8003	4.7986	4.7969	4.7953	4.7936	4.7919	4.7902	4.7885	4.7868
171	4.7851	4.7834	4.7817	4.7800	4.7783	4.7766	4.7749	4.7733	4.7716	4.7699
172	4.7682	4.7665	4.7648	4.7631	4.7614	4.7597	4.7580	4.7563	4.7546	4.7530
173	4.7513	4.7496	4.7479	4.7462	4.7445	4.7428	4.7411	4.7394	4.7377	4.7360
174	4.7343	4.7326	4.7310	4.7293	4.7276	4.7259	4.7242	4.7225	4.7208	4.7191
175	4.7174	4.7157	4.7140	4.7123	4.7106	4.7090	4.7073	4.7056	4.7039	4.7022
176	4.7005	4.6988	4.6971	4.6954	4.6937	4.6920	4.6903	4.6887	4.6870	4.6853
177	4.6836	4.6819	4.6802	4.6785	4.6768	4.6751	4.6734	4.6717	4.6700	4.6683
178	4.6667	4.6650	4.6633	4.6616	4.6599	4.6582	4.6565	4.6548	4.6531	4.6514
179	4.6497	4.6480	4.6464	4.6447	4.6430	4.6413	4.6396	4.6379	4.6362	4.6345
180	4.6328	4.6311	4.6294	4.6277	4.6260	4.6244	4.6227	4.6210	4.6193	4.6176
181	4.6159	4.6142	4.6125	4.6108	4.6091	4.6074	4.6057	4.6040	4.6024	4.6007
182	4.5990	4.5973	4.5956	4.5939	4.5922	4.5905	4.5888	4.5871	4.5854	4.5837
183	4.5821	4.5804	4.5787	4.5770	4.5753	4.5736	4.5719	4.5702	4.5685	4.5668
184	4.5651	4.5634	4.5617	4.5601	4.5584	4.5567	4.5550	4.5533	4.5516	4.5499

pH VALUES FOR POTENTIOMETER READINGS (Continued)

Millivolts	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
185	4.5482	4.5465	4.5448	4.5431	4.5414	4.5398	4.5381	4.5364	4.5347	4.5330
186	4.5313	4.5296	4.5279	4.5262	4.5245	4.5228	4.5211	4.5194	4.5178	4.5161
187	4.5144	4.5127	4.5110	4.5093	4.5076	4.5059	4.5042	4.5025	4.5008	4.4991
188	4.4975	4.4958	4.4941	4.4924	4.4907	4.4890	4.4873	4.4856	4.4839	4.4822
189	4.4805	4.4788	4.4771	4.4755	4.4738	4.4721	4.4704	4.4687	4.4670	4.4653
190	4.4636	4.4619	4.4602	4.4585	4.4568	4.4551	4.4535	4.4518	4.4501	4.4484
191	4.4467	4.4450	4.4433	4.4416	4.4399	4.4382	4.4365	4.4348	4.4332	4.4315
192	4.4298	4.4281	4.4264	4.4247	4.4230	4.4213	4.4196	4.4179	4.4162	4.4145
193	4.4128	4.4112	4.4095	4.4078	4.4061	4.4044	4.4027	4.4010	4.3993	4.3976
194	4.3959	4.3942	4.3925	4.3909	4.3892	4.3875	4.3858	4.3841	4.3824	4.3807
195	4.3790	4.3773	4.3756	4.3739	4.3722	4.3705	4.3689	4.3672	4.3655	4.3638
196	4.3621	4.3604	4.3587	4.3570	4.3553	4.3536	4.3519	4.3502	4.3486	4.3469
197	4.3452	4.3435	4.3418	4.3401	4.3384	4.3367	4.3350	4.3333	4.3316	4.3299
198	4.3282	4.3266	4.3249	4.3232	4.3215	4.3198	4.3181	4.3164	4.3147	4.3130
199	4.3113	4.3096	4.3079	4.3062	4.3046	4.3029	4.3012	4.2995	4.2978	4.2961

POLARITY REVERSED

0	7.6785	7.6802	7.6819	7.6836	7.6853	7.6870	7.6887	7.6903	7.6920	7.6937
1	7.6954	7.6971	7.6988	7.7005	7.7022	7.7039	7.7056	7.7073	7.7090	7.7106
2	7.7123	7.7140	7.7157	7.7174	7.7191	7.7208	7.7225	7.7242	7.7259	7.7276
3	7.7293	7.7310	7.7326	7.7343	7.7360	7.7377	7.7394	7.7411	7.7428	7.7445
4	7.7462	7.7479	7.7496	7.7513	7.7530	7.7546	7.7563	7.7580	7.7597	7.7614
5	7.7631	7.7648	7.7665	7.7682	7.7699	7.7716	7.7733	7.7749	7.7763	7.7783
6	7.7800	7.7817	7.7834	7.7851	7.7868	7.7885	7.7902	7.7919	7.7936	7.7953
7	7.7969	7.7986	7.8003	7.8020	7.8037	7.8054	7.8071	7.8088	7.8105	7.8122
8	7.8139	7.8156	7.8172	7.8189	7.8206	7.8223	7.8240	7.8257	7.8274	7.8291
9	7.8308	7.8325	7.8342	7.8359	7.8376	7.8392	7.8409	7.8426	7.8443	7.8460
10	7.8477	7.8494	7.8511	7.8528	7.8545	7.8562	7.8579	7.8595	7.8612	7.8629
11	7.8646	7.8663	7.8680	7.8697	7.8714	7.8731	7.8748	7.8765	7.8782	7.8799
12	7.8815	7.8832	7.8849	7.8866	7.8883	7.8900	7.8917	7.8934	7.8951	7.8968
13	7.8985	7.9002	7.9019	7.9035	7.9052	7.9069	7.9086	7.9103	7.9120	7.9137
14	7.9154	7.9171	7.9188	7.9205	7.9222	7.9238	7.9255	7.9272	7.9289	7.9306
15	7.9323	7.9340	7.9357	7.9374	7.9391	7.9408	7.9425	7.9442	7.9458	7.9475
16	7.9492	7.9509	7.9526	7.9543	7.9560	7.9577	7.9594	7.9611	7.9628	7.9645
17	7.9661	7.9678	7.9695	7.9712	7.9729	7.9746	7.9763	7.9780	7.9797	7.9814
18	7.9831	7.9848	7.9865	7.9881	7.9898	7.9915	7.9932	7.9949	7.9966	7.9983
19	8.0000	8.0017	8.0034	8.0051	8.0068	8.0084	8.0101	8.0118	8.0135	8.0152
20	8.0169	8.0186	8.0203	8.0220	8.0237	8.0254	8.0271	8.0288	8.0304	8.0321
21	8.0338	8.0355	8.0372	8.0389	8.0406	8.0423	8.0440	8.0457	8.0474	8.0491
22	8.0508	8.0524	8.0541	8.0558	8.0575	8.0592	8.0609	8.0626	8.0643	8.0660
23	8.0677	8.0694	8.0711	8.0727	8.0744	8.0761	8.0778	8.0795	8.0812	8.0829
24	8.0846	8.0862	8.0880	8.0897	8.0914	8.0931	8.0947	8.0964	8.0981	8.0998
25	8.1015	8.1032	8.1049	8.1066	8.1083	8.1100	8.1117	8.1134	8.1150	8.1167
26	8.1184	8.1201	8.1218	8.1235	8.1252	8.1269	8.1286	8.1303	8.1320	8.1337
27	8.1354	8.1370	8.1387	8.1404	8.1421	8.1438	8.1455	8.1472	8.1489	8.1506
28	8.1523	8.1540	8.1557	8.1573	8.1590	8.1607	8.1624	8.1641	8.1658	8.1675
29	8.1692	8.1709	8.1726	8.1743	8.1760	8.1777	8.1793	8.1810	8.1827	8.1844

STANDARD OXIDATION-REDUCTION POTENTIALS

Values, in Volts, Referred to the Hydrogen-Hydrogen Ion Couple as Zero, are for Unit Activities and Temperature of 25° C.

(From Latimer and Hildebrand, Reference Book of Inorganic Chemistry, The Macmillan Co., Publishers, by permission.)

Reaction	E_0	Reaction	E_0
$Li = Li^{+} + E^{-}$	+2.957	$H_2 = 2H^{+} + 2E^{-}$	0.000
$Rb = Rb^{+} + E^{-}$	+2.924	$2OH^{-} + NO_2^{-} = NO_3^{-} + H_2O + 2E^{-}$	0.0
$K = K^{+} + E^{-}$	+2.922	$HCN + H_2O = HCNO + 2H^{+} + 2E^{-}$	0.0
$Sr = Sr^{++} + 2E^{-}$	+2.92	$Sb + 3H_2O = H_3SbO_3 + 3H^{+} + 3E^{-}$	ca 0.0
$Ba = Ba^{++} + 2E^{-}$	+2.90	$W + 3H_2O = WO_3 + 6H^{+} + 6E^{-}$	ca 0.0
$Ca = Ca^{++} + 2E^{-}$	+2.87	$WO^{+++} + 2H_2O = WO_3 + 4H^{+} + E^{-}$	ca 0.0
$Na = Na^{+} + E^{-}$	+2.712	$Ti^{+++} + H_2O = TiO^{++} + 2H^{+} + E^{-}$	−0.04
$Mg = Mg^{++} + 2E^{-}$	+2.40	$Hg + 2OH^{-} = HgO + H_2O + 2E^{-}$	−0.099
$Al = Al^{+++} + 3E^{-}$	+1.7	$Ag + Br^{-} = AgBr + E^{-}$	−0.10
$Be = Be^{++} + 2E^{-}$	+1.69	$2Hg + 2Br^{-} = Hg_2Br_2 + 2E^{-}$	−0.13
$U = U^{+4} + 4E^{-}$	+1.4	$Sn^{++} = Sn^{++++} + 2E^{-}$	−0.13
$Mn = Mn^{++} + 2E^{-}$	+1.1	$H_2O + H_2SO_3 = SO_4^{--} + 4H^{+} + 2E^{-}$	−0.14
$CN^{-} + 2OH^{-} = CNO^{-} + H_2O + 2E^{-}$	+0.97	$Cu^{+} = Cu^{++} + E^{-}$	−0.17
$Fe + 2OH^{-} = Fe(OH)_2 + 2E^{-}$	+0.86	$H_2S = S + 2H^{+} + 2E^{-}$	−0.17
$\frac{1}{2}H_2 + OH^{-} = H_2O + E^{-}$	+0.828	$Bi = Bi^{+++} + 3E^{-}$	−0.2
$Tl + I^{-} = TlI + E^{-}$	+0.77	$2Ta + 5H_2O = Ta_2O_5 + 10H^{+} + 10E^{-}$	ca −0.2
$Hg + HS^{-} + OH^{-} = HgS + H_2O + 2E^{-}$	+0.77	$Pt + 4Cl^{-} = PtCl_4^{--} + 2E^{-}$	ca −0.2
$Zn = Zn^{++} + 2E^{-}$	+0.758	$Ag + Cl^{-} = AgCl + E^{-}$	−0.223
$Zn + 3OH^{-} = HZnO_2^{-} + H_2O + 2E^{-}$	+0.72	$As + 3H_2O = H_3AsO_3 + 3H^{+} + 3E^{-}$	−0.24
$H_2Te = Te + 2H^{+} + 2E^{-}$	ca +0.7	$Mo + 3H_2O = MoO_3 + 6H^{+} + 6E^{-}$	−0.25
$Fe(OH)_2 + OH^{-} = Fe(OH)_3 + E^{-}$	+0.65	$2Hg + 2Cl^{-} = Hg_2Cl_2 + 2E^{-}$	−0.270
$Cr = Cr^{++} + 2E^{-}$	+0.6	$PbO + 2OH^{-} = PbO_2 + H_2O + 2E^{-}$	−0.3
$Pb + 2OH^{-} = PbO + H_2O + 2E^{-}$	+0.58	$V + H_2O = VO^{++} + 2H^{+} + 4E^{-}$	−0.3
$S^{--} = S + 2E^{-}$	+0.51	$Cu = Cu^{++} + 2E^{-}$	−0.344
$H_2Se = Se + 2H^{+} + 2E^{-}$	ca +0.5	$V^{+++} + H_2O = VO^{++} + 2H^{+} + E^{-}$	−0.4
$Ga = Ga^{+++} + 3E^{-}$	+0.5	$4OH^{-} = O_2 + 2H_2O + 4E^{-}$	−0.40
$Ag + 2CN^{-} = Ag(CN)_2^{-} + E^{-}$	+0.5	$PtCl_4^{--} + 2Cl^{-} = PtCl_6^{--} + 2E^{-}$	ca −0.40
$Fe = Fe^{++} + 2E^{-}$	+0.44	$U^{+4} + 2H_2O = UO_2^{++} + 4H^{+} + 2E^{-}$	−0.41
$Cr^{++} = Cr^{+++} + E^{-}$	+0.4	$S + 3H_2O = H_2SO_3 + 4H^{+} + 4E^{-}$	−0.47
$H_2 = 2H^{+}(10^{-7}M) + 2E^{-}$	+0.414	$Fe(CN)_6^{----} = Fe(CN)_6^{---} + E^{-}$	−0.49
$Cd = Cd^{++} + 2E^{-}$	+0.397	$H_3AsO_3 + H_2O = H_3AsO_4 + 2H^{+} + 2E^{-}$	−0.49
$In = In^{+++} + 3E^{-}$	+0.38	$Ni(OH)_2 + 2OH^{-} = NiO_2 \cdot 2H_2O + 2E^{-}$	−0.49
$Ti^{++} = Ti^{+++} + E^{-}$	+0.37	$2Ag + CO_3^{--} = Ag_2CO_3 + 2E^{-}$	−0.50
$2Cu + 2OH^{-} = Cu_2O + H_2O + 2E^{-}$	+0.34	$MoO^{+++} + 2H_2O = MoO_3 + 4H^{+} + E^{-}$	−0.5
$Tl = Tl^{+} + E^{-}$	+0.336	$Cu = Cu^{+} + E^{-}$	−0.51
$Pb + SO_4^{--} = PbSO_4 + 2E^{-}$	+0.31	$2I^{-} = I_2 + 2E^{-}$	−0.535
$P + 4H_2O = H_3PO_4 + 5H^{+} + 5E^{-}$	+0.3	$3I^{-} = I_3^{-} + 2E^{-}$	−0.54
$Co(CN)_6^{----} = Co(CN)_6^{---} + E^{-}$	+0.3	$Hg_2Cl_2 + 2Cl^{-} = 2HgCl_2 + 2E^{-}$	−0.63
$Co = Co^{++} + 2E^{-}$	+0.29	$MnO_4^{--} = MnO_4^{-} + E^{-}$	−0.66
$Ni = Ni^{++} + 2E^{-}$	+0.22	$H_2O_2 = O_2 + 2H^{+} + 2E^{-}$	−0.68
$V^{++} = V^{+++} + E^{-}$	+0.2	$Ag + BrO_3^{-} = AgBrO_3 + E^{-}$	−0.68
$Cu + I^{-} = CuI + E^{-}$	+0.17	$C_6H_4(OH)_2 = C_6H_4O_2$ (quinone) $+ 2H^{+} + 2E^{-}$	−0.70
$Ag + I^{-} = AgI + E^{-}$	+0.15	$MnO_2 + 4OH^{-} = MnO_4^{--} + 2H_2O + 2E^{-}$	−0.71
$Cu_2O + 2OH^{-} = 2CuO + H_2O + 2E^{-}$	+0.15	$Fe^{++} = Fe^{+++} + E^{-}$	−0.74
$Sn = Sn^{++} + 2E^{-}$	+0.13	$Se + 3H_2O = H_2SeO_3 + 4H^{+} + 4E^{-}$	−0.74
$Pb = Pb^{++} + 2E^{-}$	+0.12		
$9OH^{-} + NH_3 = NO_3^{-} + 6H_2O + 8E^{-}$	+0.12		
$2Hg + 2I^{-} = Hg_2I_2 + 2E^{-}$	+0.04		
$2Ag + H_2S = Ag_2S + 2H^{+} + 2E^{-}$	+0.036		
$Cu + H_2S = CuS + 2H^{+} + 2E^{-}$	+0.02		

STANDARD OXIDATION-REDUCTION POTENTIALS
(Continued)

Reaction	E_0	Reaction	E_0
$H_3SbO_3+H_2O=H_3SbO_4+2H^++2E^-$	−0.75	$Mn^{++}+2H_2O=MnO_2+4H^++2E^-$	−1.33
$2Hg=Hg_2^{++}+2E^-$	−0.798	$Cl^-+4H_2O=ClO_4^-+8H^++8E^-$	−1.35
$Ag=Ag^++E^-$	−0.799	$2Cl^-=Cl_2+2E^-$	−1.359
$CuI=Cu^{++}+I^-+E^-$	−0.85	$2Au+3H_2O=Au_2O_3+6H^++6E^-$	−1.362
$Hg=Hg^{++}+2E^-$	−0.86	$I^-+4H_2O=IO_4^-+8H^++8E^-$	−1.4
$2H_2O+NH_4^+=HNO_2+7H^++6E^-$	−0.86	$Br^-+3H_2O=BrO_3^-+6H^++6E^-$	−1.42
$3OH^-=HO_2^-+H_2O+2E^-$	−0.87	$Pb^{++}+2H_2O=PbO_2+4H^++2E^-$	−1.44
$CoO+2OH^-=CoO_2+H_2O+2E^-$	−0.9	$Cl^-+3H_2O=ClO_3^-+6H^++6E^-$	−1.45
$Hg_2^{++}=2Hg^{++}+2E^-$	−0.92	$Cl^-+H_2O=HClO+H^++2E^-$	−1.50
$Cl^-+2OH^-=ClO^-+H_2O+2E^-$	−0.94	$Mn^{++}=Mn^{+++}+E^-$	ca −1.5
$NO+2H_2O=NO_3^-+4H^++3E^-$	−0.94	$Au=Au^++E^-$	ca −1.5
$HNO_2+H_2O=NO_3^-+3H^++2E^-$	−0.95	$2SO_4^{--}+2H^+=H_2S_2O_8+2E^-$	ca −1.5
$NO+H_2O=HNO_2+H^++E^-$	−0.98	$Ce^{+++}+2H_2O=CeO_2+4H^++E^-$	−1.5
$I^-+H_2O=HIO+H^++2E^-$	−0.99	$Mn^{++}+4H_2O=MnO_4^-+8H^++5E^-$	−1.52
$OsO_2Cl_4^{--}+2H_2O=OsO_4+4H^++4Cl^-+2E^-$	ca −1.0	$MnO_2+2H_2O=MnO_4^-+4H^++3E^-$	−1.63
$2Br^-=Br_2+2E^-$	−1.065	$Fe^{+++}+4H_2O=FeO_4^{--}+8H^++3E^-$	ca −1.7
$I^-+3H_2O=IO_3^-+6H^++6E^-$	−1.09	$Bi^{+++}+6H_2O=HBiO_3+5H^++2E^-$	ca −1.7
$VO^{++}+2H_2O=HVO_3+3H^++E^-$	−1.1	$PbSO_4+2H_2O=PbO_2+4H^++SO_4^{--}+2E^-$	−1.7
$Tl^+=Tl^{+++}+2E^-$	−1.2	$2H_2O=H_2O_2+2H^++2E^-$	−1.78
$H_2SeO_3+H_2O=H_2SeO_4+2H^++2E^-$	ca −1.2	$Co^{++}=Co^{+++}+E^-$	−1.8
$2H_2O=O_2+4H^++4E^-$	−1.23	$Ni^{++}+4H_2O=NiO_2\cdot 2H_2O+4H^++2E^-$	−1.8
$PdCl_4^{--}+2Cl^-=PdCl_6^{--}+2E^-$	−1.3	$O_2+H_2O=O_3+2H^++2E^-$	−1.9
$Cr^{+++}+4H_2O=HCrO_4^-+7H^++3E^-$	−1.3	$2F^-=F_2+2E^-$	−2.8
$Br^-+H_2O=HBrO+H^++2E^-$	−1.33		

SOLUBILITY OF CANE SUGAR IN WATER

Grams of sugar in 100 grams of water, temperature in degrees Centigrade.

	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$C_{12}H_{22}O_{11}$	179.2	190.5	203.9	219.5	238.1	260.4	287.3	320.5	362.1	415.7	487.2

The values below give the per cent by weight of sugar in the final solution:

Temp., °C.	Per cent sugar	Temp., °C.	Per cent sugar	Temp., °C.	Per cent sugar
0	64.18	35	69.55	70	76.22
5	64.87	40	70.42	75	77.27
10	65.58	45	71.32	80	78.36
15	66.53	50	72.25	85	79.46
20	67.09	55	73.20	90	80.61
25	67.89	60	74.18	95	81.77
30	68.80	65	75.88	100	82.97

DEGREE OF IONIZATION

In Normal Solution at 18° Unless Indicated

Acids

Nitric acid	0.82
Hydrochloric acid	0.784
Sulfuric acid	0.510
Hydrofluoric acid	0.070
* Oxalic acid	0.500
* Tartaric acid	0.082
Acetic acid	0.004
* Carbonic acid	0.0017
* Hydrogen sulfide	0.0007
* Boric acid	0.0001
* Hydrocyanic acid	0.0001
† Permanganic acid	0.933
† Hydriodic acid	0.901
† Hydrobromic acid	0.899
† Perchloric acid	0.880
† Chloric acid	0.878
† Hydrochloric acid	0.876
† Phosphoric acid	0.170

* In o.1 M. solution; primary ionization.
† In N/2 solution, at 25°.

Bases

Potassium hydroxide	0.77
Sodium hydroxide	0.73
Barium hydroxide	0.69
Lithium hydroxide	0.63
Ammonium hydroxide	0.004
Tetramethyl ammonium hydroxide	0.96
‡ Strontium hydroxide	0.93
‡ Barium hydroxide	0.92
‡ Calcium hydroxide	0.90

‡ In N/64 solution, at 25°.

Salts

Approximate degree of ionization for active salts in N/10 solution:

Type R^+R^- (e.g. KCl)	0.86
Type $R^{++}(R^-)_2$ (e.g. $BaCl_2$)	0.72
Type $(R^+)_2R^{--}$ (e.g. K_2SO_4)	0.72
Type $R^{++}R^{--}$ (e.g. $BaSO_4$)	0.45

SOLUBILITY PRODUCT

The solubility product (or ion product constant) is the product of the concentrations of the ions in the saturated solution of a difficultly soluble salt. The concentrations are expressed as moles per liter of solution. The number of cations (or anions) resulting from the dissociation of one molecule of the salt, appears in the formula for calculations of the solubility product as the exponent of the concentration of the cation (or anion).

If two solutions, each containing one of the ions of a difficultly soluble salt, are mixed, no precipitation takes place unless the product of the ion concentrations in the mixture is greater than the solubility product.

In a solution containing two salts which yield a common ion the ratio of solubilities of the two salts is the ratio of the solubility products.

Substance	Solubility product at temperature noted	Substance	Solubility product at temperature noted
Aluminum hydroxide	4×10^{-13} (15°)	Calcium oxalate, $CaC_2O_4.H_2O$	1.78×10^{-9} (18°)
Aluminum hydroxide	1.1×10^{-15} (18°)	Calcium oxalate, $CaC_2O_4.H_2O$	2.57×10^{-9} (25°)
Aluminum hydroxide	3.7×10^{-15} (25°)	Calcium sulfate	6.1×10^{-5} (10°)
Barium carbonate	7×10^{-9} (16°)	Calcium tartrate, $CaC_4H_4O_6.2H_2O$	0.77×10^{-6} (18°)
Barium carbonate	8.1×10^{-9} (25°)	Cobalt sulfide	3×10^{-26} (18°)
Barium chromate	1.6×10^{-10} (18°)	Cupric iodate	1.4×10^{-7} (25°)
Barium chromate	2.4×10^{-10} (28°)	Cupric oxalate	2.87×10^{-8} (25°)
Barium fluoride	1.6×10^{-6} (9.5°)	Cupric sulfide	8.5×10^{-45} (18°)
Barium fluoride	1.7×10^{-6} (18°)	Cuprous bromide	4.15×10^{-8} (18–20°)
Barium fluoride	1.73×10^{-6} (25.8°)	Cuprous chloride	1.02×10^{-6} (18–20°)
Barium iodate, $Ba(IO_3)_2.2H_2O$	8.4×10^{-11} (10°)	Cuprous iodide	5.06×10^{-12} (18–20°)
Barium iodate, $Ba(IO_3)_2.2H_2O$	6.5×10^{-10} (25°)	Cuprous sulfide	2×10^{-47} (16–18°)
Barium oxalate, $BaC_2O_4.3\frac{1}{2}H_2O$	1.62×10^{-7} (18°)	Cuprous thiocyanate	1.6×10^{-11} (18°)
Barium oxalate, $BaC_2O_4.2H_2O$	1.2×10^{-7} (18°)	Ferric hydroxide	1.1×10^{-36} (18°)
Barium oxalate, $BaC_2O_4.\frac{1}{2}H_2O$	2.18×10^{-7} (18°)	Ferrous hydroxide	1.64×10^{-14} (18°)
Barium sulfate	0.87×10^{-10} (18°)	Ferrous oxalate	2.1×10^{-7} (25°)
Barium sulfate	1.08×10^{-10} (25°)	Ferrous sulfide	3.7×10^{-19} (18°)
Barium sulfate	1.98×10^{-10} (50°)	Lead carbonate	3.3×10^{-14} (18°)
Cadmium oxalate $CdC_2O_4.3H_2O$	1.53×10^{-8} (18°)	Lead chromate	1.77×10^{-14} (18°)
Cadmium sulfide	3.6×10^{-29} (18°)	Lead fluoride	2.7×10^{-8} (9°)
Calcium carbonate (calcite)	0.99×10^{-8} (15°)	Lead fluoride	3.2×10^{-8} (18°)
Calcium carbonate (calcite)	0.87×10^{-8} (25°)	Lead fluoride	3.7×10^{-8} (26.6°)
Calcium fluoride	3.4×10^{-11} (18°)	Lead iodate	5.3×10^{-14} (9.2°)
Calcium fluoride	3.95×10^{-11} (26°)	Lead iodate	1.2×10^{-13} (18°)
Calcium iodate, $Ca(IO_3)_2.6H_2O$	22.2×10^{-8} (10°)	Lead iodate	2.6×10^{-13} (25.8°)
Calcium iodate, $Ca(IO_3)_2.6H_2O$	64.4×10^{-8} (18°)	Lead iodide	7.47×10^{-9} (15°)
		Lead iodide	1.39×10^{-8} (25°)
		Lead oxalate	2.74×10^{-11} (18°)
		Lead sulfate	1.06×10^{-8} (18°)
		Lead sulfide	3.4×10^{-28} (18°)
		Lithium carbonate	1.7×10^{-3} (25°)
		Magnesium ammonium phosphate	2.5×10^{-13} (25°)

SOLUBILITY PRODUCT (Continued)

Substance	Solubility product at temperature noted
Magnesium carbonate	2.6×10^{-5} (12°)
Magnesium fluoride	7.1×10^{-9} (18°)
Magnesium fluoride	6.4×10^{-9} (27°)
Magnesium hydroxide	1.2×10^{-11} (18°)
Magnesium oxalate	8.57×10^{-5} (18°)
Manganese hydroxide	4×10^{-14} (18°)
Manganese sulfide	1.4×10^{-15} (18°)
Mercuric sulfide	4×10^{-53} to 2×20^{-49} (18°)
Mercurous bromide	1.3×10^{-21} (25°)
Mercurous chloride	2×10^{-18} (25°)
Mercurous iodide	1.2×10^{-28} (25°)
Nickel sulfide	1.4×10^{-24} (18°)
Potassium acid tartrate $[K^+][HC_4H_4O_6^-]$	3.8×10^{-4} (18°)
Silver bromate	3.97×10^{-5} (20°)
Silver bromate	5.77×10^{-5} (25°)
Silver bromide	4.1×10^{-13} (18°)
Silver bromide	7.7×10^{-13} (25°)
Silver carbonate	6.15×10^{-12} (25°)
Silver chloride	0.21×10^{-10} (4.7°)
Silver chloride	0.37×10^{-10} (9.7°)
Silver chloride	1.56×10^{-10} (25°)
Silver chloride	13.2×10^{-10} (50°)
Silver chloride	21.5×10^{-10} (100°)
Silver chromate	1.2×10^{-12} (14.8°)
Silver chromate	9×10^{-12} (25°)
Silver cyanide $[Ag^+][Ag(CN)_2^-]$	2.2×10^{-12} (20°)
Silver dichromate	2×10^{-7} (25°)
Silver hydroxide	1.52×10^{-8} (20°)
Silver iodate	0.92×10^{-8} (9.4°)
Silver iodide	0.32×10^{-16} (13°)
Silver iodide	1.5×10^{-16} (25°)
Silver sulfide	1.6×10^{-49} (18°)
Silver thiocyanate	0.49×10^{-12} (18°)
Silver thiocyanate	1.16×10^{-12} (25°)
Strontium carbonate	1.6×10^{-9} (25°)
Strontium fluoride	2.8×10^{-9} (18°)
Strontium oxalate	5.61×10^{-8} (18°)
Strontium sulfate	2.77×10^{-7} (2.9°)
Strontium sulfate	3.81×10^{-7} (17.4°)
Zinc hydroxide	1.8×10^{-14} (18–20°)
Zinc oxalate, $ZnC_2O_4.2H_2O$	1.35×10^{-9} (18°)
Zinc sulfide	1.2×10^{-23} (18°)

TABLE FOR TRANSFORMING EXPRESSION OF RESULTS OF WATER ANALYSIS

Compiled by Dr. R. E. Brewer. (Based on Equivalents of $CaCO_3$)

	Parts per 1,000,000	Parts per 100,000	mg per l	g per l	Grains pe U. S. gal.	Grains per Eng. gal.	English or Clark degrees	French degrees	German degrees
p.p.m.	1	0.10	1.0	0.001	0.0583*	0.07	0.07	0.10	0.056
mg / l	1	0.10	1.0	0.001	0.0583	0.07	0.07	0.10	0.056
p./100,000	10	1.00	10.0	0.010	0.583	0.70	0.70	1.00	0.560
French degrees	10	1.00	10.0	0.010	0.583	0.70	0.70	1.00	0.560
g / l	1000	100.0	1000.0	1.000	58.300	70.00	70.00	100.00	56.000
Gr. /U. S. gal.	17.1	1.71	17.1	0.0171	1.000	1.2	1.2	1.71	0.958
Gr. /Eng. gal.	14.3	1.43	14.3	0.0143	0.829	1.00	1.00	1.43	0.80
Clark degrees	14.3	1.43	14.3	0.0143	0.829	1.00	1.00	1.43	0.80
German degrees	17.8	1.78	17.8	0.0178	1.044	1.24	1.24	1.78	1.00

*Variously reported.

DISSOCIATION CONSTANTS OF ACIDS

Acid	Formula	Constant for the first hydrogen	Temp. °C.	Constant for the second hydrogen	Temp. °C.
Acetic	$C_2H_4O_2$	1.86×10^{-5}	25		
α-Alanine	$C_3H_7O_2N$	9×10^{-10}	25		
Arsenic	H_3AsO_4	5×10^{-3}	25	4×10^{-5}	25
				6×10^{-10} (3H)	25
Arsenious	$HAsO_2$	6×10^{-10}	25		
Barbituric	$C_4H_4O_3N$	1.05×10^{-4}	25		
Benzoic	$C_7H_6O_2$	6.6×10^{-5}	25		
Boric	H_3BO_3	6.4×10^{-10}	25		
Bromacetic	$C_2H_3O_2Br$	1.38×10^{-3}	25		
α-Brompropionic	$C_3H_5O_2Br$	1.08×10^{-3}	25		
β-Brompropionic	$C_3H_5O_2Br$	9.8×10^{-5}	25		
Butyric	$C_4H_8O_2$	1.48×10^{-5}	25		
Carbonic	H_2CO_3	3×10^{-7}	18	6×10^{-11}	25
Chloracetic	$C_2H_3O_2Cl$	1.55×10^{-3}	25		
α-Chlorpropionic	$C_3H_5O_2Cl$	1.47×10^{-3}	25		
β-Chlorpropionic	$C_3H_5O_2Cl$	8.59×10^{-5}	25		
Citric	$C_6H_8O_7$	8×10^{-4}	25		
Dichloracetic	$C_2H_2O_2Cl_2$	5×10^{-2}	25		
Formic	CH_2O_2	2.14×10^{-4}	25		
Fumaric	$C_4H_4O_4$	1×10^{-3}	25	3×10^{-5}	25
Hippuric	$C_9H_9O_3N$	2.3×10^{-4}	25		
Hydrocyanic	CHN	7.2×10^{-10}	25		
Hydroquinone	$C_6H_6O_2$	1.1×10^{-10}	18		
Hydrosulfuric	H_2S	9.1×10^{-8}	18	1.2×10^{-15}	
Hydrazoic	HN_3	1.9×10^{-5}	25		
Hypochlorous	$HOCl$	3.7×10^{-8}	17		
Iodic	HIO_3	1.9×10^{-1}	25		
Isobutyric	$C_4H_8O_2$	1.5×10^{-5}	25		
Isovaleric	$C_5H_{10}O_2$	1.7×10^{-5}	25		
Lactic	$C_3H_6O_3$	1.38×10^{-4}	25		
Maleic	$C_4H_4O_4$	1.5×10^{-2}	25	2.6×10^{-7}	25
Malic	$C_4H_6O_5$	4×10^{-4}	25	9×10^{-6}	25
Malonic	$C_3H_4O_4$	1.61×10^{-3}	25	2.1×10^{-6}	25
Mandelic	$C_8H_8O_3$	4.29×10^{-4}	25		
α-Naphthoic	$C_{11}H_8O_2$	2×10^{-4}	25		
β-Naphthoic	$C_{11}H_8O_2$	6.8×10^{-5}	25		
Nicotinic	$C_6H_5O_2N$	1.4×10^{-5}	25		
Nitrous	HNO_2	4×10^{-4}	18		
Oxalic	$H_2C_2O_4$	3.8×10^{-2}	25	4.9×10^{-5}	25
Periodic	HIO_4	2.3×10^{-2}	25		
Phenol	C_6H_6O	1.3×10^{-10}	25		
Phosphoric	H_3PO_4	1.1×10^{-2}	18	2×10^{-7}	18
				3.6×10^{-13} (3H)	18
Phosphorous	H_3PO_3	5×10^{-2}	25	2×10^{-5}	25
Phthalic	$C_8H_6O_4$	1.26×10^{-3}	25	3.1×10^{-6}	25
Picolinic	$C_6H_5O_2N$	3×10^{-6}	25		
Picric	$C_6H_3O_7N_3$	1.6×10^{-1}	18		
Propionic	$C_3H_6O_2$	1.4×10^{-5}	25		
Pyromucic	$C_5H_4O_3$	7.1×10^{-4}	25		
Pyrophosphoric	$H_4P_2O_7$	1.4×10^{-1}	18	1.1×10^{-2}	18
				2.9×10^{-7} (3H)	18
				3.6×10^{-9} (4H)	18
Pyrotartaric	$C_5H_8O_4$	8.7×10^{-5}	25		
Salicylic	$C_7H_6O_3$	1.06×10^{-3}	25	1×10^{-13}	20
Selenious	H_2SeO_3	3×10^{-3}	25	5×10^{-8}	25
Succinic	$C_4H_6O_4$	6.6×10^{-5}	25	2.8×10^{-6}	25
Sulfanilic	$C_6H_7O_3NS$	6.2×10^{-4}			
Sulfuric	H_2SO_4	....	......	2×10^{-2}	18

DISSOCIATION CONSTANTS OF ACIDS (Continued)

Acid	Formula	Constant for the first hydrogen	Temp. °C.	Constant for the second hydrogen	Temp. °C.
Sulfurous	H_2SO_3	1.7×10^{-2}	25	5×10^{-6}	25
Tartaric	$C_4H_6O_6$	1.1×10^{-3}	25	6.9×10^{-5}	25
Telluric	H_2TeO_4	6×10^{-7}	25	4×10^{-11}	25
Tellurous	H_2TeO_3	3×10^{-3}	25	2×10^{-8}	25
Trichloracetic	$C_2HO_2Cl_3$	2×10^{-1}	18		
Uric	$C_5H_4O_3N_4$	1.5×10^{-6}	25		
Valeric	$C_5H_{10}O_2$	1.6×10^{-5}	25		

COMPOSITION OF AMINO ACIDS

Compiled by H. B. Vickery

The following table gives the molecular weight, empirical formula and percentage composition of the amino acids resulting from the hydrolysis of proteins.

Amino acid	Empirical formula	Molecular weight	Percentage composition			
			Carbon	Hydrogen	Oxygen	Nitrogen
α-Alanine	$C_3H_7O_2N$	89.06	40.42	7.92	35.93	15.73
Arginine	$C_6H_{14}O_2N_4$	174.14	41.35	8.10	18.37	32.18
Aspartic acid	$C_4H_7O_4N$	133.06	36.07	5.30	48.10	10.53
Cystine[1]	$C_6H_{12}O_4N_2S_2$	240.23	29.97	5.03	26.64	11.66
Glutamic acid	$C_5H_9O_4N$	147.08	40.79	6.17	43.51	9.52
Glycine	$C_2H_5O_2N$	75.05	31.98	6.71	42.64	18.66
Histidine	$C_6H_9O_2N_3$	155.09	46.42	5.85	20.63	27.10
Hydroxyglutamic acid	$C_5H_9O_5N$	163.08	36.79	5.56	49.06	8.59
Hydroxyproline	$C_5H_9O_3N$	131.08	45.77	6.92	36.62	10.69
Iodogorgoic acid[2]	$C_9H_9O_3NI_2$	432.91	24.95	2.10	11.09	3.24
Isoleucine	$C_6H_{13}O_2N$	131.11	54.92	9.99	24.41	10.68
Leucine	$C_6H_{13}O_2N$	131.11	54.92	9.99	24.41	10.68
Lysine	$C_6H_{14}O_2N_2$	146.13	49.27	9.66	21.90	19.17
Methionine[3]	$C_5H_{11}O_2NS$	149.15	40.23	7.43	21.46	9.39
Norleucine	$C_6H_{13}O_2N$	131.11	54.92	9.99	24.41	10.68
Phenylalanine	$C_9H_{11}O_2N$	165.09	65.42	6.72	19.38	8.49
Proline	$C_5H_9O_2N$	115.08	52.14	7.88	27.81	12.17
Serine	$C_3H_7O_3N$	105.06	34.27	6.72	45.69	13.33
Thyroxine[4]	$C_{15}H_{11}O_4NI_4$	776.77	23.17	1.43	8.24	1.80
Tryptophane	$C_{11}H_{12}O_2N_2$	204.11	64.67	5.93	15.68	13.73
Tyrosine	$C_9H_{11}O_3N$	181.09	59.64	6.12	26.51	7.74
Valine	$C_5H_{11}O_2N$	117.09	51.24	9.47	27.33	11.96

[1] 26.69 per cent sulfur.
[2] 58.64 per cent iodine.
[3] 21.49 per cent sulfur.
[4] 65.36 per cent iodine.

PROPERTIES OF THE AMINO ACIDS

Compiled by M. S. Dunn

Dissociation Constants and pH Values at the Isoelectric Points of the Amino Acids at 25°

Interpretation of Data in the Tables

Electrometric titration data and ionic concentration values were used in calculating the classical constants, K_a and K_b. In the few instances where ionic activities were used in place of concentrations the constants varied inappreciably from the values listed.

pH values at the isoelectric points were calculated from the general expression,

$$pI = p\sqrt{\frac{\Sigma K_a}{\Sigma K_b} \times K_w},$$

which may be used in its simplified form, $pI = \frac{1}{2}(pK_a + pK_w - pK_b)$, in the following cases: monoamino monocarboxylic acids; monoamino dicarboxylic acids, where the second acid constant may be neglected; and diamino monocarboxylic acids, where the second base constant may be neglected.

No K_b values for amino acids in formaldehyde solution are listed since they are practically the same as those in water.

Amino acid	Aqueous solution				16 % formaldehyde	
	K_a	K_b	pI	Ref. no.	K_a	Ref. no.
α-Alanine	2.1×10^{-10}	2.2×10^{-12}	6.0	1	4.0×10^{-7}	12
Arginine	3.3×10^{-13}	1.1×10^{-5} 1.1×10^{-12}	10.8	2		
Aspartic acid	2.2×10^{-4} 2.5×10^{-10}	7.5×10^{-13}	2.8	3	1.6×10^{-4} 1.4×10^{-7}	12
Cystine	3.3×10^{-8} 9.6×10^{-10}	5.0×10^{-13} 1.5×10^{-13}	4.6	4		
Glutamic acid	5.6×10^{-5} 2.2×10^{-10}	1.6×10^{-12}	3.2	3	6.3×10^{-5} 1.6×10^{-7}	12
Glycine	2.5×10^{-10}	2.2×10^{-12}	6.0	1	4.0×10^{-6}	12
Histidine	6.7×10^{-10}	1.0×10^{-8} 6.6×10^{-13}	7.6	6		
β-Hydroxyglutamic acid	5.8×10^{-5} 2.8×10^{-10}	2.1×10^{-12}	3.3	7		
Hydroxyproline	1.9×10^{-10}	8.3×10^{-13}	5.8	7		
Iodogorgoic acid	3.3×10^{-7} 1.5×10^{-8}	1.3×10^{-12}	4.3	5		
Isoleucine	2.1×10^{-10}	2.3×10^{-12}	6.0	7		
Leucine	2.5×10^{-10}	2.2×10^{-12}	6.0	8		
Lysine	3×10^{-11}	8.9×10^{-6} 1×10^{-12}	9.7	2		
Methionine	6.2×10^{-10}	1.9×10^{-12}	5.7	11		
Norleucine	1.7×10^{-10}	2.5×10^{-12}	6.1	7		
Phenylalanine	7.5×10^{-10}	4×10^{-13}	5.4	9	1.3×10^{-6}	12
Proline	2.5×10^{-11}	1×10^{-12}	6.3	10		
Serine	7.1×10^{-10}	1.6×10^{-12}	5.7	7		
Thyroxine						
Tryptophane	4.1×10^{-10}	2.2×10^{-12}	5.9	9		
Tyrosine	7×10^{-10} 7×10^{-11}	1.7×10^{-12}	5.7	9	6.0×10^{-7} $< 1.0 \times 10^{-9}$	12
Valine	2.3×10^{-10}	2.0×10^{-12}	6.0	9		

Dissociation Constants and pH Values at the Isoelectric Points of the Amino Acids at 25° (Continued)

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Specific Rotations of the Amino Acids in Aqueous and Hydrochloric Acid Solutions

Amino acid	Solvent	Temp. °C.	$[\alpha]_D$	Ref. No.
d-Alanine	aq.	22	+2.7	1
	5.6 % HCl	15	+14.7	2
l-Alanine	aq.		−2.5	3
	2 N HCl	20	+14.5	4
d-Arginine	aq.	20	+12.9	5
	8 N HCl	20	+26.5	6
l-Arginine	no data			
d-Aspartic acid	10 % HCl		−28.0	7
l-Aspartic acid	aq.	25	+5.9	8
	3 N HCl		+26.5	9
d-Cystine	HCl	20	+221	10
l-Cystine	1 N HCl	20	−223.6	11
d-Glutamic acid	aq.	25	+12.6	8
	20 % HCl	20	+31.9	12
l-Glutamic acid	aq.	20	−12.9	13
	20 % HCl	20	−30.1	9
d-Histidine	aq.	20	+40.2	14
	HCl	20	−7.9	15
l-Histidine	aq.	20	−39.7	14
	1 N HCl	18	+9.6	16
d-β-Hydroxyglutamic acid	aq.		+0.8	17
	20 % HCl		+16.3	17
l-β-Hydroxyglutamic acid	no data			
d-Hydroxyproline(a)	aq.	20	+75.2	18
l-Hydroxyproline(a)	aq.	20	−81.0	45
	1 N HCl	20	−59.5	19
d-Hydroxyproline(b)	aq.	18	+58.6	18
l-Hydroxyproline(b)	aq.	18	−58.1	18
d-Iodogorgoic acid	4 % HCl	20	+2.9	20
l-Iodogorgoic acid	4 % HCl	19	−2.9	21
d-Isoleucine	aq.	20	+11.3	22
	20 % HCl	20	+41.3	23
l-Isoleucine	aq.	20	−11.4	23
	20 % HCl	20	−40.9	22
d-Isoleucine(allo)	aq.	20	−14.4	24
	20 % HCl	20	−38.0	25

Specific Rotations of the Amino Acids in Aqueous and Hydrochloric Acid Solutions (Continued)

Amino acid	Solvent	Temp. °C.	$[\alpha]_D$	Ref. No
l-Isoleucine(allo)	aq.	20	+14.0	25
	20 % HCl	20	+38.1	25
d-Leucine	aq.	20	+10.3	26
	20 % HCl	20	−17.5	27
l-Leucine	aq.	20	−10.8	28
	20 % HCl	20	+18.6	29
d-Lysine	aq.	20	+14.6	30
	8 N HCl		+15.5	19
l-Lysine	no data			
d-Methionine	no data			
l-Methionine	aq.	20	−7.3	31
d-Norleucine	aq.	20	+6.5	32
	20 % HCl	20	+23.1	33
l-Norleucine	aq.	20	−4.5	34
	20 % HCl	17	−23.0	33
d-Phenylalanine	aq.	20	+35.1	35
	18 % HCl	20	+7.1	36
l-Phenylalanine	aq.	20	−35.3	35
d-Proline	aq.	20	+81.9	37
l-Proline	aq.	20	−84.9	38
	20 % HCl	20	−54.5	38
d-Serine	aq.	20	+6.9	39
	1 N HCl	20	−14.3	39
l-Serine	aq.	20	−6.8	39
	1 N HCl	25	+14.4	39
d-Thyroxine	no data			
l-Thyroxine	no data			
d-Tryptophane	aq.	25	+32.4	40
l-Tryptophane	aq.	20	−32.1	40
	1 N HCl	20	+1.3	41
d-Tyrosine	21 % HCl	20	+11.6	42
l-Tyrosine	21 % HCl	20	−13.2	42
d-Valine	aq.	20	+6.4	43
	20 % HCl	20	+28.8	43
l-Valine	aq.	20	−6.1	28
	20 % HCl	20	−31.2	28

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Specific Rotations of the Amino Acids in Aqueous and Hydrochloric Acid Solutions (Continued)

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Solubilities of the Amino Acids in Grams per 100 Grams of Water

Amino acid	Temperature in °C.				
	0°	25°	50°	75°	100°
dl-Alanine	12.11(1)	16.58(1)	23.48(1)	32.18(1)	43.2(1)
d-Alanine	12.73(2)	16.65(2)	21.79(2)	28.51(2)	37.30(2)
dl-Aspartic acid	0.32(1)	0.82(1)	2.10(1)	4.79(1)	9.94(1)
l-Aspartic acid	0.22(1)	0.54(1)	1.25(1)	2.71(1)	4.88(1)
dl-Cystine		0.006(11)			
d-Cystine		0.011(11)			
l-Cystine	0.005(3)	0.011(3)	0.024(3)	0.052(3)	0.114(3)
meso-Cystine		0.006(11)			
dl-Glutamic acid	0.83(1)	2.64(1)	8.16(1)	19.9(1)	decomposes
d-Glutamic acid	0.34(1)	0.89(1)	2.23(1)	5.34(1)	decomposes
Glycine	14.31(1)	25.31(1)	40.15(1)	57.49(1)	75.2(1)
l-Hydroxyproline(b)	*ca.* 25.0(12)				
dl-Iodogorgoic acid	0.02(2)	0.06(2)	0.19(2)	0.56(2)	1.70(2)
l-Iodogorgoic acid		*ca.* 0.29(15) at 20°			
dl-Isoleucine	1.75(1)	2.19(1)	3.02(1)	4.83(1)	9.04(1)
d-Isoleucine	3.79(3)	4.12(3)	4.82(3)	6.08(3)	8.25(3)
d-Isoleucine(allo)		*ca.* 2.9(8) at 20°			
dl-Leucine	0.80(2)	0.99(2)	1.41(2)	2.28(2)	4.21(2)
d-Leucine		2.02(7) at 19°			
l-Leucine	2.27(2)	2.43(2)	2.89(2)	3.82(2)	5.64(2)
dl-Methionine	1.82(3)	3.38(3)	6.07(3)	10.52(3)	17.60(3)
dl-Norleucine	0.91(1)	1.18(1)	1.80(1)	2.88(1)	4.70(1)
d-Norleucine		*ca.* 1.5(10)			
l-Norleucine		*ca.* 1.6(9) at 19°			

Solubilities of the Amino Acids in Grams per 100 Grams of Water (Continued)

Amino acid	Temperature in °C.				
	0°	25°	50°	75°	100°
dl-Phenylalanine	1.01(1)	1.42(1)	2.20(1)	3.70(1)	6.53(1)
d-Phenylalanine		*ca.* 2.83(13) at 16°			
l-Phenylalanine	1.98(3)	2.96(3)	4.43(3)	6.62(3)	9.90(3)
dl-Serine	2.20(3)	5.02(3)	10.34(3)	19.21(3)	32.24(3)
d-Serine		*ca.* 25–30(4) at 22°			
l-Serine		*ca.* 25–30(4) at 20°			
l-Tryptophane	0.82(3)	1.14(3)	1.71(3)	2.80(3)	4.99(3)
dl-Tyrosine		*ca.* 0.04(14) at 20°			0.65(14)
l-Tyrosine	0.022(1)	0.048(1)	0.110(1)	0.238(1)	0.492(1)
dl-Valine	7.01(1)	7.44(1)	9.42(1)	13.31(1)	20.0(1)
d-Valine		*ca.* 9.1(5) at 16.5°			
l-Valine		*ca.* 5.3(6) at 20°			

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Solubilities of the Amino Acids in Grams per 100 Grams of Water-Alcohol Mixtures

Amino acid	Per cent ethyl alcohol	Temp. °C.	Grams amino acid per 100 grams of solvent	Ref. no.
dl-Alanine	5	25	14.37	2
	10	25	12.41	2
	20	25	8.48	2
	25	25	7.09	1
	25	45	11.6	1
	25	65	15.9	1
	40	25	3.89	2
	50	25	2.52	1
	50	45	4.25	1
	50	65	6.68	1
	60	25	1.57	2
	75	25	0.57	1
	75	45	0.95	1
	75	65	1.49	1
	80	25	0.37	2
	90	25	0.084	3

Solubilities of the Amino Acids in Grams per 100 Grams of Water-Alcohol Mixtures (Continued)

Amino acid	Per cent ethyl alcohol	Temp. °C.	Grams amino acid per 100 grams of solvent	Ref. no.
dl-Aspartic acid	25	0	0.071	1
	25	25	0.27	1
	25	45	0.68	1
	25	65	1.53	1
	50	0	0.027	1
	50	25	0.10	1
	50	45	0.26	1
	50	65	0.59	1
	75	0	0.012	1
	75	25	0.032	1
	75	45	0.062	1
	75	65	0.13	1
-Glutamic acid	25	0	0.086	1
	25	25	0.29	1
	25	45	0.81	1
	32	15	0.33	4
	50	0	0.039	1
	50	25	0.13	1
	50	45	0.38	1
	75	0	0.017	1
	75	25	0.038	1
	75	45	0.089	1
	80	15	0.067	4
	100	25	0.0032	1
	100	25	0.0068	5
	100	45	0.0064	1
Glycine	25	25	8.72	1
	25	45	15.0	1
	25	65	24.5	1
	50	25	2.47	1
	50	45	4.63	1
	50	65	8.04	1
	75	25	0.45	1
	75	45	0.76	1
	75	65	1.23	1
	90	25	0.043	3
l + Isoleucine	80	20	0.47	7
	80	78–80	1.16	7
	100	20	0.083	7
	100	78–80	0.12	7
l-Isoleucine(allo)	80	20	0.82	7
	80	78–80	2.02	7
	100	20	0.12	7
	100	78–80	0.18	7
dl-Leucine	25	25	0.49	1
	25	45	0.85	1
	25	65	1.45	1
	50	25	0.32	1
	50	45	0.63	1
	75	25	0.18	1
	75	65	0.58	1
	90	25	0.13	3
l-Leucine	99	17	0.072	9

Solubilities of the Amino Acids in Grams per 100 Grams of Water-Alcohol Mixtures (Continued)

Amino acid	Per cent ethyl alcohol	Temp. °C.	Grams amino acid per 100 grams of solvent	Ref. no.
dl-Norleucine	25	25	0.63	1
	25	45	1.12	1
	25	65	2.02	1
	50	25	0.45	1
	50	45	0.92	1
	50	65	1.76	1
	75	25	0.27	1
	75	45	0.52	1
	75	65	0.95	1
l-Proline	100	19	1.55	6
dl-Serine	25	25	1.54	1
	25	45	3.15	1
	50	25	0.46	1
	50	45	0.99	1
	75	45	0.19	1
l-Tyrosine	95	17	0.01	8
dl-Valine	25	0	2.11	1
	25	25	3.31	1
	25	45	5.10	1
	25	65	7.44	1
	50	0	0.77	1
	50	25	1.27	1
	50	45	2.74	1
	50	65	4.56	1
	75	0	0.27	1
	75	25	0.57	1
	75	45	1.00	1
	75	65	1.65	1
	100	0	0.014	1

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DISSOCIATION CONSTANTS OF BASES

Name	Formula	Constant for first OH	Temp. °C.	Constant for second OH	Temp. °C.
Acetamide	C_2H_5ON	3.1×10^{-15}	25		
Acetanilide	C_8H_9ON	4.1×10^{-14}	40		
α-Alanine	$C_3H_7O_2N$	5.1×10^{-12}	25		
o-Aminobenzoic	$C_7H_7O_2N$	1.4×10^{-12}	25		
Ammonium Hydroxide	NH_4OH	1.8×10^{-5}	25		
Aniline	C_6H_7N	4.6×10^{-10}	25		
Arsenious Oxide	As_2O_3	1×10^{-14}	25		
Beryllium Hydroxide	$Be(OH)_2$	....	.....	5×10^{-11}	25
Brucine	$C_{23}H_{26}O_4N_2$	7.2×10^{-4}	25	2.5×10^{-11}	25
Butylamine (sec.)	$C_4H_{11}N$	4.4×10^{-4}	25		
Caffeine	$C_8H_{10}O_2N_4$	4.1×10^{-14}	40		
Cinchonine	$C_{19}H_{22}ON_2$	1.6×10^{-7}	15	3.3×10^{-10}	15
Cocaine	$C_{17}H_{21}O_4N$	4×10^{-7}	25		
Diethylbenzylamine	$C_{11}H_{17}N$	3.6×10^{-5}	25		
Diethylamine	$C_4H_{11}N$	1.26×10^{-3}	25		
Diisoamylamine	$C_{10}H_{23}N$	9.6×10^{-4}	25		
Diisobutylamine	$C_8H_{19}N$	4.8×10^{-4}	25		
Dimethylamine	C_2H_7N	7.4×10^{-4}	25		
Dimethylbenzylamine	$C_9H_{13}N$	1.05×10^{-5}	25		
Dipropylamine	$C_6H_{15}N$	1.02×10^{-3}	25		
Ethylamine	C_2H_7N	5.6×10^{-4}	25		
Ethylenediamine	$C_2H_8N_2$	8.5×10^{-5}	25		
Hydrazine	$N_2H_4.H_2O$	3×10^{-6}	25		
Isoamylamine	$C_5H_{13}N$	5×10^{-4}	25		
Isobutylamine	$C_4H_{11}N$	3.1×10^{-4}	25		
Isopropylamine	C_3H_9N	5.3×10^{-4}	25		
Lead Hydroxide	$Pb(OH)_2$	....	.....	3×10^{-8}	25
Methylamine	CH_5N	5×10^{-4}	25		
Methyldiethylamine	$C_5H_{13}N$	2.7×10^{-4}	25		
α-Naphthylamine	$C_{10}H_9N$	9.9×10^{-11}	25		
β-Naphthylamine	$C_{10}H_9N$	2×10^{-10}	25		
o-Phenylenediamine	$C_6H_8N_2$	3.3×10^{-10}	25		
Phenylhydrazine	$C_6H_8N_2$	1.6×10^{-9}	40		
Piperidine	$C_5H_{11}N$	1.6×10^{-3}	25		
Propylamine (norm.)	C_3H_9N	4.7×10^{-4}	25		
Pyridine	C_5H_5N	2.3×10^{-9}	25		
Quinine	$C_{20}H_{24}O_2N_2$	2.2×10^{-7}	15	3.3×10^{-10}	15
Quinoline	C_9H_7N	1×10^{-9}	25		
Semicarbazide	CH_5ON_3	2.7×10^{-11}	40		
Silver Hydroxide	$AgOH$	1.1×10^{-4}	25		
Strychnine	$C_{21}H_{22}O_4N_2$	1×10^{-7}	15	6×10^{-11}	15
Tetramethylenediamine	$C_4H_{12}N_2$	5.1×10^{-4}	25		
Thiourea	CH_4N_2S	1.1×10^{-15}	25		
m-Toluidine	C_7H_9N	5.5×10^{-10}	25		
o-Toluidine	C_7H_9N	3.3×10^{-10}	25		
p-Toluidine	C_7H_9N	2×10^{-9}	25		
Triethylamine	$C_6H_{15}N$	6.4×10^{-4}	25		
Triisobutylamine	$C_{12}H_{27}N$	2.6×10^{-4}	25		
Trimethylamine	C_3H_9N	7.4×10^{-5}	25		
Trimethylenediamine	$C_3H_{10}N_2$	3.5×10^{-4}	25		
Tripropylamine	$C_9H_{21}N$	5.5×10^{-4}	25		
Urea	CH_4ON_2	1.5×10^{-14}	25		
Zinc Hydroxide	$Zn(OH)_2$	....	.....	1.5×10^{-9}	25

ELECTROMOTIVE FORCE SERIES OF ELEMENTS

Compiled by Giles B. Cooke
Standard Electrode Potentials at 25°C

Element	Ion	Electrode reaction	Electrode potential
Li	Li^+	$Li = Li^+ + e$	+2.9595
Rb	Rb^+	$Rb = Rb^+ + e$	2.9259
K	K^+	$K = K^+ + e$	2.9241
*Sr	Sr^{++}	$\frac{1}{2}Sr = \frac{1}{2}Sr^{++} + e$	2.92
*Ba	Ba^{++}	$\frac{1}{2}Ba = \frac{1}{2}Ba^{++} + e$	2.90
*Ca	Ca^{++}	$\frac{1}{2}Ca = \frac{1}{2}Ca^{++} + e$	2.87
Na	Na^+	$Na = Na^+ + e$	2.7146
*Mg	Mg^{++}	$\frac{1}{2}Mg = \frac{1}{2}Mg^{++} + e$	2.40
*Al	Al^{+++}	$\frac{1}{3}Al = \frac{1}{3}Al^{+++} + e$	1.70
*Be	Be^{++}	$\frac{1}{2}Be = \frac{1}{2}Be^{++} + e$	1.69
*U	U^{++++}	$\frac{1}{4}U = \frac{1}{4}U^{++++} + e$	1.40
*Mn	Mn^{++}	$\frac{1}{2}Mn = \frac{1}{2}Mn^{++} + e$	1.10
*Te	$Te^=$	$\frac{1}{2}Te^= = \frac{1}{2}Te + e$	0.827
Zn	Zn^{++}	$\frac{1}{2}Zn = \frac{1}{2}Zn^{++} + e$	0.7618
Cr	Cr^{++}	$\frac{1}{2}Cr = \frac{1}{2}Cr^{++} + e$	0.557
*S	$S^=$	$\frac{1}{2}S^= = \frac{1}{2}S + e$	0.51
*Ga	Ga^{+++}	$\frac{1}{3}Ga = \frac{1}{3}Ga^{+++} + e$	0.50
Fe	Fe^{++}	$\frac{1}{2}Fe = \frac{1}{2}Fe^{++} + e$	0.441
*Cd	Cd^{++}	$\frac{1}{2}Cd = \frac{1}{2}Cd^{++} + e$	0.401
*In	In^{+++}	$\frac{1}{3}In = \frac{1}{3}In^{+++} + e$	0.336
*Tl	Tl^+	$Tl = Tl^+ + e$	0.330
Co	Co^{++}	$\frac{1}{2}Co = \frac{1}{2}Co^{++} + e$	0.278
Ni	Ni^{++}	$\frac{1}{2}Ni = \frac{1}{2}Ni^{++} + e$	0.231
Sn	Sn^{++}	$\frac{1}{2}Sn = \frac{1}{2}Sn^{++} + e$	0.136
Pb	Pb^{++}	$\frac{1}{2}Pb = \frac{1}{2}Pb^{++} + e$	0.122
*Fe	Fe^{+++}	$\frac{1}{3}Fe = \frac{1}{3}Fe^{+++} + e$	0.045
H_2	H^+	$\frac{1}{2}H_2 = H^+ + e$	0.0000
*Sb	Sb^{+++}	$\frac{1}{3}Sb = \frac{1}{3}Sb^{+++} + e$	−0.10
*Bi	Bi^{+++}	$\frac{1}{3}Bi = \frac{1}{3}Bi^{+++} + e$	−0.226
*As	As^{+++}	$\frac{1}{3}As = \frac{1}{3}As^{+++} + e$	−0.30
Cu	Cu^{++}	$\frac{1}{2}Cu = \frac{1}{2}Cu^{++} + e$	−0.344
*O_2	OH^-	$OH^- = \frac{1}{4}O_2 + \frac{1}{2}H_2O + e$	−0.397
Po (18°C)	Po^{++++}	$\frac{1}{4}Po = \frac{1}{4}Po^{++++} + e$	−0.40
Cu	Cu^+	$Cu = Cu^+ + e$	−0.470
I_2	I^-	$I^- = \frac{1}{2}I_2 + e$	−0.5345
*Te	Te^{++++}	$\frac{1}{4}Te = \frac{1}{4}Te^{++++} + e$	−0.558
Ag	Ag^+	$Ag = Ag^+ + e$	−0.7978
Hg	Hg^{++}	$2Hg = Hg_2^{++} + 2e$	−0.7986
*Pb	Pb^{++++}	$\frac{1}{4}Pb = \frac{1}{4}Pb^{++++} + e$	−0.80
*Pd	Pd^{++}	$\frac{1}{2}Pd = \frac{1}{2}Pd^{++} + e$	−0.820
*Pt	Pt^{++++}	$\frac{1}{4}Pt = \frac{1}{4}Pt^{++++} + e$	−0.863
Br_2	Br^-	$Br^- = \frac{1}{2}Br_2 + e$	−1.0648
Cl_2	Cl^-	$Cl^- = \frac{1}{2}Cl_2 + e$	−1.3583
*Au	Au^{+++}	$\frac{1}{3}Au = \frac{1}{3}Au^{+++} + e$	−1.360
*Au	Au^+	$Au = Au^+ + e$	−1.50
*F_2	F^-	$F^- = \frac{1}{2}F_2 + e$	−1.90

* These values are doubtful but they indicate the relative activity of the elements and are therefore included.

1. **Action of Metals on Salts.**—Any metal will replace any other metal *below* it in the series thus:

$$Mg + FeSO_4 \rightarrow MgSO_4 + Fe$$
$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$
$$Sn + 2AgNO_3 \rightarrow Sn(NO_3)_2 + 2Ag$$
$$Cu + Hg(NO_3)_2 \rightarrow Cu(NO_3)_2 + Hg$$

This is the fundamental principle of the Daniell Cell. The voltage of such a cell depends upon the difference between the electrode potentials of the metals employed. Thus the Zn-Cu couple gives a greater E.F.M. than the Zn-Pb couple or the Fe-Cu couple.

ELECTROMOTIVE FORCE SERIES OF ELEMENTS (Continued)

2. **Action of Metals on Acids.**—Metals *above* H_2 react with HCl and dilute H_2SO_4, replacing the H_2

$$Zn + \text{dil. } H_2SO_4 \rightarrow ZnSO_4 + H_2$$
$$Sn + 2HCl \rightarrow SnCl_2 + H_2$$
$$Cu + \text{dil. } H_2SO_4 \rightarrow \text{no reaction}$$

Metals above Pt react with HNO_3 and *hot conc.* H_2SO_4

$$2Ag + 2 \text{ conc. } H_2SO_4 \rightarrow Ag_2SO_4 + SO_2 + 2H_2O$$
$$3Zn + 8 \text{ conc. } HNO_3 \rightarrow 3Zn(NO_3)_2 + 2NO + 4H_2O$$
$$3Cu + 8 \text{ dil. } HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$$

The acid first oxidizes the metal and the reaction may be explained as follows:

Some of the acid takes on water and ionizes thus:

$$2HNO_3 + 4H_2O \rightleftarrows 10OH^- + 2N^{+++++}$$

Nitrogen gains 3 electrons and copper loses 2 electrons:

$$2(N^{+++++} + 3e) + 3(Cu - 2e) \rightarrow 3Cu^{++} + 2N^{++}$$

Some of the acid ionizes as follows:

$$6HNO_3 \leftrightarrows 6H^+ + 6NO_3^-$$
$$3Cu^{++} + 6NO_3^- \rightarrow 3Cu(NO_3)_2$$
$$10OH^- + 6H^+ + 2N^{++} \rightarrow 2NO + 8H_2O$$

added $\quad 3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

3. **In Regard to Ease of Reduction of Oxides.**—The metallic oxides down to and including Mn can not be completely reduced to the metal state, even in a current of hydrogen. The oxides of Cd and succeeding metals are easily reduced, and far down the list, the oxides of silver, platinum, mercury, and gold are reduced (decomposed into metal and oxygen) even by heat alone.

4. **In Regard to Ease of Rusting. (Oxidation in the Air.)**—The alkali and alkaline-earth metals rust very rapidly and with considerable evolution of heat. All the metals down to copper rust with comparative ease. The metals below copper do not rust. Assuming the electrolytic theory of the process of rusting to be true, these facts are just about what might have been predicted.

5. **In Regard to the Occurrence of the Metals in the Free State in Nature.**—Natural waters are frequently dilute solutions of carbonic, nitric, humic, etc., acids. As such they contain displaceable hydrogen. Metals *above* hydrogen in the E.M.F. series scarcely, if ever, occur in the free state in nature, but are practically without exception found in the combined state, as sulfides, carbonates, etc. Metals *below* hydrogen are frequently found in the free state in nature. Thus gold is found in the form of nuggets of metallic gold. However, metals below hydrogen are also found in the combined state, as cinnabar, HgS, etc.

6. **In Regard to Action of the Metals on Water.**—The alkali and alkaline-earths metal displace hydrogen from water, even in the cold, and with evolution of much heat. Mg and succeeding metals will displace hydrogen from steam. Metals at the bottom of the list will not displace hydrogen from steam.

7. **In Regard to the Solubility and Stability of Hydroxides.**—The alkali metal oxides have great avidity for water, forming hydroxides. The alkaline-earth metal oxides react with less readiness, forming hydroxides. MgO reacts slowly and incompletely with water, forming the hydroxide. All the other metallic oxides and hydroxides are insoluble in water and have no perceptible reaction therewith. When a solution of NaOH acts on solutions of salts of the metals, the alkali metal salts are not precipitated. The alkaline-earth metal salts are not precipitated unless in very concentrated solution. All the other metal solutions are acted upon, with precipitation of hydroxides, except in the case of copper which first gives copper hydroxide (blue), and which, on warming, changes to copper oxide (black). Also in the case of arsenic, no precipitate falls, sodium arsenite being formed. In the case of the last metals in the series, the *oxide* is precipitated, instead of the hydroxide, thus NaOH acting on salts of Sb, Hg, Ag, Pd, Pt, and Au, causes a precipitation of the *oxides* of these metals. Bismuth, as an exception, gives a normal hydroxide.

ELECTROMOTIVE FORCE SERIES OF ELEMENTS (Continued)

8. **In Regard to Carbonates.**—The alkali metals form normal stable, soluble carbonates, not easily decomposed on heating. The alkaline-earth metals form normal carbonates, which are insoluble in water, and which decompose upon heating, leaving the oxide, carbon dioxide being evolved. When sodium carbonate solution acts on solutions of all the other metals, as a rule, a basic carbonate is precipitated, being insoluble in water, and decomposed by heat into oxide and carbon dioxide. If the solution is cold, Ag, Hg, Cd, Fe, and Mn give normal carbonates. If the solution is warm, Sb, Hg, Ag, Pd, Pt, and Au give a precipitate of the *oxide*, instead of the carbonate, thus showing the instability of the carbonates of the lowest metals in the series.

9. **In Regard to Nitrates.**—The nitrates of the alkali metals decompose when strongly heated forming the *nitrite* and oxygen. The nitrates of the heavy metals, down to and including copper, decompose when heated forming the oxide of the metal, oxygen and nitrogen dioxide. Mercury nitrate when heated yields mercury, oxygen and nitrogen dioxide.

REDUCTION VALUES FOR GLUCOSE IN BLOOD

Amounts of Glucose Corresponding to Titration Values when 0.1 c.c. Blood is Used in the Method of Hagedorn and Jensen. Biochem. Zeit. 135, 46; 137, 92 (1923).

Milligrams of Glucose in 0.1 c.c. of Blood

c.c. of 0.005N $Na_2S_2O_3$	Hundredths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0.0	0.385	0.382	0.379	0.376	0.373	0.370	0.367	0.364	0.361	0.358
0.1	0.355	0.352	0.350	0.348	0.345	0.343	0.341	0.338	0.336	0.333
0.2	0.331	0.329	0.327	0.325	0.323	0.321	0.318	0.316	0.314	0.312
0.3	0.310	0.308	0.306	0.304	0.302	0.300	0.298	0.296	0.294	0.292
0.4	0.290	0.288	0.286	0.284	0.282	0.280	0.278	0.276	0.274	0.272
0.5	0.270	0.268	0.266	0.264	0.262	0.260	0.259	0.257	0.255	0.253
0.6	0.251	0.249	0.247	0.245	0.243	0.241	0.240	0.238	0.236	0.234
0.7	0.232	0.230	0.228	0.226	0.224	0.222	0.221	0.219	0.217	0.215
0.8	0.213	0.211	0.209	0.208	0.206	0.204	0.202	0.200	0.199	0.197
0.9	0.195	0.193	0.191	0.190	0.188	0.186	0.184	0.182	0.181	0.179
1.0	0.177	0.175	0.173	0.172	0.170	0.168	0.166	0.164	0.163	0.161
1.1	0.159	0.157	0.155	0.154	0.152	0.150	0.148	0.146	0.145	0.143
1.2	0.141	0.139	0.138	0.136	0.134	0.132	0.131	0.129	0.127	0.125
1.3	0.124	0.122	0.120	0.119	0.117	0.115	0.113	0.111	0.110	0.108
1.4	0.106	0.104	0.102	0.101	0.099	0.097	0.095	0.093	0.092	0.090
1.5	0.088	0.086	0.084	0.083	0.081	0.079	0.077	0.075	0.074	0.072
1.6	0.070	0.068	0.066	0.065	0.063	0.061	0.059	0.057	0.056	0.054
1.7	0.052	0.050	0.048	0.047	0.045	0.043	0.041	0.039	0.038	0.036
1.8	0.034	0.032	0.031	0.029	0.027	0.025	0.024	0.022	0.020	0.019
1.9	0.017	0.015	0.014	0.012	0.010	0.008	0.007	0.005	0.003	0.002

Procedure

Into a test tube (15 × 150 mm.) pipette 1 c.c. 0.1 normal NaOH and 5 c.c. 0.45% zinc sulfate solution; 0.1 c.c. of blood from a capillary pipette is added being washed out with the mixture in the test tube; heat for 3 minutes in a boiling water bath; filter through cotton into a test tube (30 × 90 mm.) and wash the filter with two 3 c.c. portions of water. Add 2 c.c. of alkaline ferricyanide solution (1.65 g potassium ferricyanide, 10.6 g anhydrous sodium carbonate in 1000 c.c. of water) and heat in a boiling water bath for 15 minutes; cool and add 3 c.c. of the iodide-sulfate solution (5 g potassium iodide, 10 g zinc sulfate, 50 g sodium chloride and sufficient water to make 200 c.c.) and 2 c.c. of 3% acetic acid solution. Titrate with 0.005 normal sodium thiosulfate using starch indicator. The method is based upon the reduction of alkaline ferricyanide by glucose and the subsequent titration of the excess unreduced ferricyanide according to the following equation: $2H_3Fe(CN)_6 + 2HI = 2H_4Fe(CN)_6 + I_2$

Amounts of Glucose Corresponding to Titration Values when 5 c.c. of 1:10 Blood Filtrate and 5 c.c. of Copper Reagent (Modified*) are Heated in a Water Bath for 15 Minutes. M. Somogyi, Jour. Biol. Chem. 70, 599 (1926).

Milligrams of Glucose in 100 c.c. of Blood

c.c. of 0.005N $Na_2S_2O_3$	Tenths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0			21	23	26	29	31	34	36	39
1	41	44	46	49	51	53	56	58	61	63
2	65	68	70	72	75	77	80	82	84	86
3	89	92	94	97	99	101	103	106	108	110
4	113	115	117	119	121	124	126	128	130	132
5	135	137	139	141	143	146	148	150	152	154
6	157	159	161	163	165	168	170	172	174	176
7	179	181	183	185	187	190	192	194	196	199
8	201	203	205	207	210	212	214	216	218	221
9	223	225	227	230	232	234	237	239	241	243
10	245	248	250	252	254	256	259	261	263	265
11	267	270	272	274	276	279	281	283	285	288
12	290	292	294	296	299	301	303	305	308	310
13	312	314	316	318	321	323	326	328	330	332
14	334	337	339	341	343	345	347	350	352	354
15	356	359	361	363	365	367	370	372	374	376
16	378	381	383	386	388	390	392	394	396	398
17	400	–	–	–	–	–	–	–	–	–

To 5 c.c. of the copper reagent in a test tube (250 × 25 mm) are added 5 c.c. of the sugar solution containing between 0.1 and 2.0 mg of glucose; mix; heat for 15 minutes in a boiling water bath; cool to 35°C; with mixing add 1 c.c. of 5N H_2SO_4 and 2 minutes later titrate with 0.005 normal $Na_2S_2O_3$. A blank titration using 5 c.c. of water in place of the blood is run at the same time.

Amounts of Glucose Corresponding to Titration Values when 2 c.c. of 1:15 Blood Filtrate and 2 c.c. of Copper Reagent (Modified*) are Heated in a Water Bath for 15 Minutes. M. Somogyi, Jour. Biol. Chem. 70, 599 (1926).

Milligrams of Glucose in 100 c.c. of Blood

c.c. of 0.005N $Na_2S_2O_3$	Tenths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0	–	–	42	53	63	74	83	91	100	108
1	117	125	134	142	150	159	168	176	185	193
2	202	210	219	227	236	245	253	262	270	279
3	288	296	305	313	322	330	339	347	355	364
4	373	381	390	399	407	416	424	433	441	450
5	458	–	–	–	–	–	–	–	–	–

To 2 c.c. of 0.0667 normal H_2SO_4 in a test tube add 0.2 c.c. of blood, rinsing the pipette several times with the liquid in the test tube; add exactly 0.2 c.c. of 2.5% sodium tungstate solution; centrifugate; fasten a small tuft of absorbent cotton over the end of a 2 c.c. pipette and with this pipette remove 2 c.c. of the blood filtrate in the test tube and deliver it into a 16 × 150 mm. test tube; add exactly 2 c.c. of the sugar-copper reagent; mix; heat in a boiling water bath for 15 minutes; cool to 35°C.; add 1 c.c. 2 normal H_2SO_4 and titrate with 0.005 normal $Na_2S_2O_3$. A blank using 0.2 c.c. of water in place of the blood is run at the same time.

* Modified tartrate-carbonate copper reagent. — Copper sulfate (crystalline) 6.5 g; rochelle salt 12 g; sodium carbonate (anhydrous) 20 g; potassium iodide 10 g; potassium iodate 0.8 g; potassium oxalate 18 g; sodium bicarbonate 25 g; water sufficient to make one liter of solution.

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

(Munson and Walker, Jour. Amer. Chem. Soc. 28, 663 (1906.)

Add exactly 25 c.c. of Fehling Solution A and 25 c.c. of Fehling Solution B (see under *Special Solutions and Reagents*) to 50 c.c. of reducing sugar solution (if a smaller volume of sugar solution is used, add sufficient water to make the final solution 100 c.c.); heat the solution at such a rate that boiling begins in four minutes and continue boiling for exactly 2 minutes, keeping the beaker covered with a watch glass; filter immediately on a Gooch crucible using suction; wash thoroughly with water at 60°C., then with 10 c c. of alcohol and finally with 10 c.c. of ether; dry for 30 minutes in an oven at 100°C., cool in a desiccator and weigh as cuprous oxide.

(Expressed in Milligrams)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
10	4.0	4.5	3.8	5.9	50	21.3	22.3	30.1	37.6
11	4.5	5.0	4.5	6.7	51	21.7	22.8	30.7	38.4
12	4.9	5.4	5.1	7.5	52	22.2	23.2	31.4	39.2
13	5.3	5.8	5.8	8.3	53	22.6	23.7	32.1	40.0
14	5.7	6.3	6.4	9.1	54	23.0	24.1	32.7	40.8
15	6.2	6.7	7.1	9.9	55	23.5	24.6	33.4	41.6
16	6.6	7.2	7.8	10.6	56	23.9	25.0	34.0	42.4
17	7.0	7.6	8.4	11.4	57	24.3	25.5	34.7	43.2
18	7.5	8.1	9.1	12.2	58	24.8	25.9	35.4	44.0
19	7.9	8.5	9.7	13.0	59	25.2	26.4	36.0	44.8
20	8.3	8.9	10.4	13.8	60	25.6	26.8	36.7	45.6
21	8.7	9.4	11.0	14.6	61	26.1	27.3	37.3	46.3
22	9.2	9.8	11.7	15.4	62	26.5	27.7	38.0	47.1
23	9.6	10.3	12.3	16.2	63	27.0	28.2	38.6	47.9
24	10.0	10.7	13.0	17.0	64	27.4	28.6	39.3	48.7
25	10.5	11.2	13.7	17.8	65	27.8	29.1	40.0	49.5
26	10.9	11.6	14.3	18.6	66	28.3	29.5	40.6	50.3
27	11.3	12.0	15.0	19.4	67	28.7	30.0	41.3	51.1
28	11.8	12.5	15.6	20.2	68	29.2	30.4	41.9	51.9
29	12.2	12.9	16.3	21.0	69	29.6	30.9	42.6	52.7
30	12.6	13.4	16.9	21.8	70	30.0	31.3	43.3	53.5
31	13.1	13.8	17.6	22.6	71	30.5	31.8	43.9	54.3
32	13.5	14.3	18.3	23.3	72	30.9	32.3	44.6	55.1
33	13.9	14.7	18.9	24.1	73	31.4	32.7	45.2	55.9
34	14.3	15.2	19.6	24.9	74	31.8	33.2	45.9	56.7
35	14.8	15.6	20.2	25.7	75	32.2	33.6	46.6	57.5
36	15.2	16.1	20.9	26.5	76	32.7	34.1	47.2	58.2
37	15.6	16.5	21.5	27.3	77	33.1	34.5	47.9	59.0
38	16.1	16.9	22.2	28.1	78	33.6	35.0	48.5	59.8
39	16.5	17.4	22.8	28.9	79	34.0	35.4	49.2	60.6
40	16.9	17.8	23.5	29.7	80	34.4	35.9	49.9	61.4
41	17.4	18.3	24.2	30.5	81	34.9	36.3	50.5	62.2
42	17.8	18.7	24.8	31.3	82	35.3	36.8	51.2	63.0
43	18.2	19.2	25.5	32.1	83	35.8	37.3	51.8	63.8
44	18.7	19.6	26.1	32.9	84	36.2	37.7	52.5	64.6
45	19.1	20.1	26.8	33.7	85	36.7	38.2	53.1	65.4
46	19.6	20.5	27.4	34.4	86	37.1	38.6	53.8	66.2
47	20.0	21.0	28.1	35.2	87	37.5	39.1	54.5	67.0
48	20.4	21.4	28.7	36.0	88	38.0	39.5	55.1	67.8
49	20.9	21.9	29.4	36.8	89	38.4	40.0	55.8	68.5

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
90	38.9	40.4	56.4	69.3	140	61.3	63.6	89.5	109.0
91	39.3	40.9	57.1	70.1	141	61.8	64.0	90.2	109.8
92	39.8	41.4	57.8	70.9	142	62.2	64.5	90.8	110.5
93	40.2	41.8	58.4	71.7	143	62.7	65.0	91.5	111.3
94	40.6	42.3	59.1	72.5	144	63.1	65.4	92.2	112.1
95	41.1	42.7	59.7	73.3	145	63.6	65.9	92.8	112.9
96	41.5	43.2	60.4	74.1	146	64.0	66.4	93.5	113.7
97	42.0	43.7	61.1	74.9	147	64.5	66.9	94.2	114.5
98	42.4	44.1	61.7	75.7	148	65.0	67.3	94.8	115.3
99	42.9	44.6	62.4	76.5	149	65.4	67.8	95.5	116.1
100	43.3	45.0	63.0	77.3	150	65.9	68.3	96.1	116.9
101	43.8	45.5	63.7	78.1	151	66.3	68.7	96.8	117.7
102	44.2	46.0	64.4	78.8	152	66.8	69.2	97.5	118.5
103	44.7	46.4	65.0	79.6	153	67.2	69.7	98.1	119.3
104	45.1	46.9	65.7	80.4	154	67.7	70.1	98.8	120.0
105	45.5	47.3	66.4	81.2	155	68.2	70.6	99.5	120.8
106	46.0	47.8	67.0	82.0	156	68.6	71.1	100.1	121.6
107	46.4	48.3	67.7	82.8	157	69.1	71.6	100.8	122.4
108	46.9	48.7	68.3	83.6	158	69.5	72.0	101.5	123.2
109	47.3	49.2	69.0	84.4	159	70.0	72.5	102.1	124.0
110	47.8	49.6	69.7	85.2	160	70.4	73.0	102.8	124.8
111	48.2	50.1	70.3	86.0	161	70.9	73.4	103.4	125.6
112	48.7	50.6	71.0	86.8	162	71.4	73.9	104.1	126.4
113	49.1	51.0	71.6	87.6	163	71.8	74.4	104.8	127.2
114	49.6	51.5	72.3	88.4	164	72.3	74.9	105.4	128.0
115	50.0	51.9	73.0	89.2	165	72.8	75.3	106.1	128.8
116	50.5	52.4	73.6	90.0	166	73.2	75.8	106.8	129.6
117	50.9	52.9	74.3	90.7	167	73.7	76.3	107.4	130.3
118	51.4	53.3	75.0	91.5	168	74.1	76.8	108.1	131.1
119	51.8	53.8	75.6	92.3	169	74.6	77.2	108.8	131.9
120	52.3	54.3	76.3	93.1	170	75.1	77.7	109.4	132.7
121	52.7	54.7	76.9	93.9	171	75.5	78.2	110.1	133.5
122	53.2	55.2	77.6	94.7	172	76.0	78.7	110.8	134.3
123	53.6	55.7	78.3	95.5	173	76.4	79.1	111.4	135.1
124	54.1	56.1	78.9	96.3	174	76.9	79.6	112.1	135.9
125	54.5	56.6	79.6	97.1	175	77.4	80.1	112.8	136.7
126	55.0	57.0	80.3	97.9	176	77.8	80.6	113.4	137.5
127	55.4	57.5	80.9	98.7	177	78.3	81.0	114.1	138.3
128	55.9	58.0	81.6	99.4	178	78.8	81.5	114.8	139.1
129	56.3	58.4	82.2	100.2	179	79.2	82.0	115.4	139.8
130	56.8	58.9	82.9	101.0	180	79.7	82.5	116.1	140.6
131	57.2	59.4	83.6	101.8	181	80.1	82.9	116.7	141.4
132	57.7	59.8	84.2	102.6	182	80.6	83.4	117.4	142.2
133	58.1	60.3	84.9	103.4	183	81.1	83.9	118.1	143.0
134	58.6	60.8	85.5	104.2	184	81.5	84.4	118.7	143.8
135	59.0	61.2	86.2	105.0	185	82.0	84.9	119.4	144.6
136	59.5	61.7	86.9	105.8	186	82.5	85.3	120.1	145.4
137	60.0	62.2	87.5	106.6	187	82.9	85.8	120.7	146.2
138	60.4	62.6	88.2	107.4	188	83.4	86.3	121.4	147.0
139	60.9	63.1	88.9	108.2	189	83.9	86.8	122.1	147.8

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
190	84.3	87.2	122.7	148.6	240	108.0	111.5	156.1	188.1
191	84.8	87.7	123.4	149.3	241	108.4	112.0	156.7	188.9
192	85.3	88.2	124.1	150.1	242	108.9	112.5	157.4	189.7
193	85.7	88.7	124.7	150.9	243	109.4	113.0	158.1	190.5
194	86.2	89.2	125.4	151.7	244	109.9	113.5	158.7	191.3
195	86.7	89.6	126.1	152.5	245	110.4	114.0	159.4	192.1
196	87.1	90.1	126.7	153.3	246	110.8	114.5	160.1	192.9
197	87.6	90.6	127.4	154.1	247	111.3	115.0	160.7	193.6
198	88.1	91.1	128.1	154.9	248	111.8	115.4	161.4	194.4
199	88.5	91.6	128.7	155.7	249	112.3	115.9	162.1	195.2
200	89.0	92.0	129.4	156.5	250	112.8	116.4	162.7	196.0
201	89.5	92.5	130.0	157.3	251	113.2	116.9	163.4	196.8
202	89.9	93.0	130.7	158.1	252	113.7	117.4	164.1	197.6
203	90.4	93.5	131.4	158.8	253	114.2	117.9	164.7	198.4
204	90.9	94.0	132.0	159.6	254	114.7	118.4	165.4	199.2
205	91.4	94.5	132.7	160.4	255	115.2	118.9	166.1	200.0
206	91.8	94.9	133.4	161.2	256	115.7	119.4	166.8	200.8
207	92.3	95.4	134.0	162.0	257	116.1	119.9	167.4	201.6
208	92.8	95.9	134.7	162.8	258	116.6	120.4	168.1	202.3
209	93.2	96.4	135.4	163.6	259	117.1	120.9	168.8	203.1
210	93.7	96.9	136.0	164.4	260	117.6	121.4	169.4	203.9
211	94.2	97.4	136.7	165.2	261	118.1	121.9	170.1	204.7
212	94.6	97.8	137.4	166.0	262	118.6	122.4	170.8	205.5
213	95.1	98.3	138.0	166.8	263	119.0	122.9	171.4	206.3
214	95.6	98.8	138.7	167.5	264	119.5	123.4	172.1	207.1
215	96.1	99.3	139.4	168.3	265	120.0	123.9	172.8	207.9
216	96.5	99.8	140.0	169.1	266	120.5	124.4	173.5	208.7
217	97.0	100.3	140.7	169.9	267	121.0	124.9	174.1	209.5
218	97.5	100.8	141.4	170.7	268	121.5	125.4	174.8	210.3
219	98.0	101.2	142.0	171.5	269	122.0	125.9	175.5	211.0
220	98.4	101.7	142.7	172.3	270	122.5	126.4	176.1	211.8
221	98.9	102.2	143.4	173.1	271	122.9	126.9	176.8	212.6
222	99.4	102.7	144.0	173.9	272	123.4	127.4	177.5	213.4
223	99.9	103.2	144.7	174.7	273	123.9	127.9	178.1	214.2
224	100.3	103.7	145.4	175.5	274	124.4	128.4	178.8	215.0
225	100.8	104.2	146.0	176.2	275	124.9	128.9	179.5	215.8
226	101.3	104.6	146.7	177.0	276	125.4	129.4	180.2	216.6
227	101.8	105.1	147.4	177.8	277	125.9	129.9	180.8	217.4
228	102.2	105.6	148.0	178.6	278	126.4	130.4	181.5	218.2
229	102.7	106.1	148.7	179.4	279	126.9	130.9	182.2	218.9
230	103.2	106.6	149.4	180.2	280	127.3	131.4	182.8	219.7
231	103.7	107.1	150.0	181.0	281	127.8	131.9	183.5	220.5
232	104.1	107.6	150.7	181.8	282	128.3	132.4	184.2	221.3
233	104.6	108.1	151.4	182.6	283	128.8	132.9	184.8	222.1
234	105.1	108.6	152.0	183.4	284	129.3	133.4	185.5	222.9
235	105.6	109.1	152.7	184.2	285	129.8	133.9	186.2	223.7
236	106.0	109.5	153.4	184.9	286	130.3	134.4	186.9	224.5
237	106.5	110.0	154.0	185.7	287	130.8	134.9	187.5	225.3
238	107.0	110.5	154.7	186.5	288	131.3	135.4	188.2	226.1
239	107.5	111.0	155.4	187.3	289	131.8	135.9	188.9	226.9

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
290	132.3	136.4	189.5	227.6	340	157.3	162.0	223.2	267.1
291	132.7	136.9	190.2	228.4	341	157.8	162.5	223.8	267.9
292	133.2	137.4	190.9	229.2	342	158.3	163.1	224.5	268.7
293	133.7	137.9	191.5	230.0	343	158.8	163.6	225.2	269.5
294	134.2	138.4	192.2	230.8	344	159.3	164.1	225.9	270.3
295	134.7	138.9	192.9	231.6	345	159.8	164.6	226.5	271.1
296	135.2	139.4	193.6	232.4	346	160.3	165.1	227.2	271.9
297	135.7	140.0	194.2	233.2	347	160.8	165.7	227.9	272.7
298	136.2	140.5	194.9	234.0	348	161.4	166.2	228.5	273.5
299	136.7	141.0	195.6	234.8	349	161.9	166.7	229.2	274.3
300	137.2	141.5	196.2	235.5	350	162.4	167.2	229.9	275.0
301	137.7	142.0	196.9	236.3	351	162.9	167.7	230.6	275.8
302	138.2	142.5	197.6	237.1	352	163.4	168.3	231.2	276.6
303	138.7	143.0	198.3	237.9	353	163.9	168.8	231.9	277.4
304	139.2	143.5	198.9	238.7	354	164.4	169.3	232.6	278.2
305	139.7	144.0	199.6	239.5	355	164.9	169.8	233.3	279.0
306	140.2	144.5	200.3	240.3	356	165.4	170.4	233.9	279.8
307	140.7	145.0	201.0	241.1	357	166.0	170.9	234.6	280.6
308	141.2	145.5	201.6	241.9	358	166.5	171.4	235.3	281.4
309	141.7	146.1	202.3	242.7	359	167.0	171.9	236.0	282.2
310	142.2	146.6	203.0	243.5	360	167.5	172.5	236.7	282.9
311	142.7	147.1	203.6	244.2	361	168.0	173.0	237.3	283.7
312	143.2	147.6	204.3	245.0	362	168.5	173.5	238.0	284.5
313	143.7	148.1	205.0	245.8	363	169.0	174.0	238.7	285.3
314	144.2	148.6	205.7	246.6	364	169.6	174.6	239.4	286.1
315	144.7	149.1	206.3	247.4	365	170.1	175.1	240.0	286.9
316	145.2	149.6	207.0	248.2	366	170.6	175.6	240.7	287.7
317	145.7	150.1	207.7	249.0	367	171.1	176.1	241.4	288.5
318	146.2	150.7	208.4	249.8	368	171.6	176.7	242.1	289.3
319	146.7	151.2	209.0	250.6	369	172.1	177.2	242.7	290.0
320	147.2	151.7	209.7	251.3	370	172.7	177.7	243.4	290.8
321	147.7	152.2	210.4	252.1	371	173.2	178.3	244.1	291.6
322	148.2	152.7	211.0	252.9	372	173.7	178.8	244.8	292.4
323	148.7	153.2	211.7	253.7	373	174.2	179.3	245.4	293.2
324	149.2	153.7	212.4	254.5	374	174.7	179.8	246.1	294.0
325	149.7	154.3	213.1	255.3	375	175.3	180.4	246.8	294.8
326	150.2	154.8	213.7	256.1	376	175.8	180.9	247.5	295.6
327	150.7	155.3	214.4	256.9	377	176.3	181.4	248.1	296.4
328	151.2	155.8	215.1	257.7	378	176.8	182.0	248.8	297.2
329	151.7	156.3	215.8	258.5	379	177.3	182.5	249.5	297.9
330	152.2	156.8	216.4	259.3	380	177.9	183.0	250.2	298.7
331	152.7	157.3	217.1	260.0	381	178.4	183.6	250.8	299.5
332	153.2	157.9	217.8	260.8	382	178.9	184.1	251.5	300.3
333	153.7	158.4	218.4	261.6	383	179.4	184.6	252.2	301.1
334	154.2	158.9	219.1	262.4	384	180.0	185.2	252.9	301.9
335	154.7	159.4	219.8	263.2	385	180.5	185.7	253.6	302.7
336	155.2	159.9	220.5	264.0	386	181.0	186.2	254.2	303.5
337	155.8	160.5	221.1	264.8	387	181.5	186.8	254.9	304.2
338	156.3	161.0	221.8	265.6	388	182.0	187.3	255.6	305.0
339	156.8	161.5	222.5	266.4	389	182.6	187.8	256.3	305.8

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
390	183.1	188.4	256.9	306.6	440	209.8	215.5	290.9	346.1
391	183.6	188.9	257.6	307.4	441	210.3	216.1	291.5	346.8
392	184.1	189.4	258.3	308.2	442	210.9	216.6	292.2	347.6
393	184.7	190.0	259.0	309.0	443	211.4	217.2	292.9	348.4
394	185.2	190.5	259.6	309.8	444	212.0	217.8	293.6	349.2
395	185.7	191.0	260.3	310.6	445	212.5	218.3	294.2	350.0
396	186.2	191.6	261.0	311.4	446	213.1	218.9	294.9	350.8
397	186.8	192.1	261.7	312.1	447	213.6	219.4	295.6	351.6
398	187.3	192.7	262.3	312.9	448	214.1	220.0	296.3	352.4
399	187.8	193.2	263.0	313.7	449	214.7	220.5	297.0	353.2
400	188.4	193.7	263.7	314.5	450	215.2	221.1	297.6	353.9
401	188.9	194.3	264.4	315.3	451	215.8	221.6	298.3	354.7
402	189.4	194.8	265.0	316.1	452	216.3	222.2	299.0	355.5
403	189.9	195.4	265.7	316.9	453	216.9	222.8	299.7	356.3
404	190.5	195.9	266.4	317.7	454	217.4	223.3	300.4	357.1
405	191.0	196.4	267.1	318.5	455	218.0	223.9	301.1	357.9
406	191.5	197.0	267.8	319.2	456	218.5	224.4	301.7	358.7
407	192.1	197.5	268.4	320.0	457	219.1	225.0	302.4	359.5
408	192.6	198.1	269.1	320.8	458	219.6	225.5	303.1	360.3
409	193.1	198.6	269.8	321.6	459	220.2	226.1	303.8	361.0
410	193.7	199.1	270.5	322.4	460	220.7	226.7	304.5	361.8
411	194.2	199.7	271.2	323.2	461	221.3	227.2	305.1	362.6
412	194.7	200.2	271.8	324.0	462	221.8	227.8	305.8	363.4
413	195.2	200.8	272.5	324.8	463	222.4	228.3	306.5	364.2
414	195.8	201.3	273.2	325.6	464	222.9	228.9	307.2	365.0
415	196.3	201.8	273.9	326.3	465	223.5	229.5	307.9	365.8
416	196.8	202.4	274.6	327.1	466	224.0	230.0	308.6	366.6
417	197.4	202.9	275.2	327.9	467	224.6	230.6	309.2	367.3
418	197.9	203.5	275.9	328.7	468	225.1	231.2	309.9	368.1
419	198.4	204.0	276.6	329.5	469	225.7	231.7	310.6	368.9
420	199.0	204.6	277.3	330.3	470	226.2	232.3	311.3	369.7
421	199.5	205.1	277.9	331.1	471	226.8	232.8	312.0	370.5
422	200.1	205.7	278.6	331.9	472	227.4	233.4	312.6	371.3
423	200.6	206.2	279.3	332.7	473	227.9	234.0	313.3	372.1
424	201.1	206.7	280.0	333.4	474	228.5	234.5	314.0	372.9
425	201.7	207.3	280.7	334.2	475	229.0	235.1	314.7	373.7
426	202.2	207.8	281.3	335.0	476	229.6	235.7	315.4	374.4
427	202.8	208.4	282.0	335.8	477	230.1	236.2	316.1	375.2
428	203.3	208.9	282.7	336.6	478	230.7	236.8	316.7	376.0
429	203.8	209.5	283.4	337.4	479	231.3	237.4	317.4	376.8
430	204.4	210.0	284.1	338.2	480	231.8	237.9	318.1	377.6
431	204.9	210.6	284.7	339.0	481	232.4	238.5	318.8	378.4
432	205.5	211.1	285.4	339.7	482	232.9	239.1	319.5	379.2
433	206.0	211.7	286.1	340.5	483	233.5	239.6	320.1	380.0
434	206.5	212.2	286.8	341.3	484	234.1	240.2	320.8	380.7
435	207.1	212.8	287.5	342.1	485	234.6	240.8	321.5	381.5
436	207.6	213.3	288.1	342.9	486	235.2	241.4	322.2	382.3
437	208.2	213.9	288.8	343.7	487	235.7	241.9	322.9	383.1
438	208.7	214.4	289.5	344.5	488	236.3	242.5	323.6	383.9
439	209.2	215.0	290.2	345.3	489	236.9	243.1	324.2	384.7
					490	237.4	243.6	324.5	385.5

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Computed from the International atomic weights of 1933 by Eric A. Arnold and Howard E. Thompson.

To facilitate the use of the table the group of substances weighed given under each element as well as the substances sought under each substance weighed are arranged in the alphabetical order of their formulae.

Weighed	Sought	Factor	Logarithm
Aluminum $Al = 26.97$			—10
Al	Al_2O_3	1.8899	10.27643
	$AlPO_4$	4.5231	10.65544
Al_4C_3	Al_2O_3	1.4170	10.15137
$AlCl_3$	Al_2O_3	0.38225	9.58235
AlF_3	CaF_2	1.3948	10.14451
Al_2O_3	Al	0.52913	9.72357
	Al_4C_3	0.70571	9.84863
	$AlCl_3$	2.6161	10.41765
	$AlPO_4$	2.3934	10.37901
	$Al_2(SO_4)_3$	3.3561	10.52583
	$Al_2(SO_4)_3.18H_2O$	6.5372	10.81539
	$K_2SO_4.Al_2(SO_4)_3.24H_2O$	9.3070	10.96881
	$(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$	8.8938	10.94909
$AlPO_4$	Al	0.22108	9.34456
	Al_2O_3	0.41782	9.62099
	P_2O_5	0.58218	9.76506
$Al_2(SO_4)_3$	Al_2O_3	0.29797	9.47417
$Al_2(SO_4)_3.18H_2O$	Al_2O_3	0.15297	9.18461
CaF_2	AlF_3	0.71696	9.85549
$K_2SO_4.Al_2(SO_4)_3.24H_2O$	Al_2O_3	0.10745	9.03119
$(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$	Al_2O_3	0.11244	9.05091
P_2O_5	$AlPO_4$	1.7177	10.23494
Ammonium: $NH_4 = 18.0392$			
Ag	NH_4Br	0.90800	9.95809
	NH_4Cl	0.49589	9.69538
	NH_4I	1.3437	10.12830
$AgBr$	NH_4Br	0.52160	9.71734
$AgCl$	NH_4Cl	0.37322	9.57196
AgI	NH_4I	0.61737	9.79055
$BaSO_4$	$(NH_4)_2SO_4$	0.56610	9.75289
Br	NH_4Br	1.2257	10.08839
Cl	NH_4	0.50877	9.70652
	NH_4Cl	1.5088	10.17862
HCl	NH_4Cl	1.4671	10.16645
I	NH_4I	1.1421	10.05772
$MgNH_4PO_4.6H_2O$	NH_3	0.069382	8.84125

Weighed	Sought	Factor	Logarithm
Ammonium:			—10
$MgNH_4PO_4.6H_2O$	NH_4	0.073487	8.86621
	$(NH_4)_2O$	0.10608	9.02562
N	NH_3	1.2158	10.08487
	NH_4	1.2878	10.10984
	NH_4Cl	3.8190	10.58195
	NH_4NO_3	5.7144	10.75697
	$(NH_4)_2O$	1.8589	10.26925
	$(NH_4)_2SO_4$	4.7165	10.67362
NH_3	$MgNH_4PO_4.6H_2O$	14.413	11.15875
	N	0.82248	9.9151
	NH_4	1.0592	10.0249
	NH_4Cl	3.1410	10.49707
	$(NH_4)_2CO_3$	2.8206	10.45035
	NH_4HCO_3	4.6413	10.66664
	NH_4NO_3	4.7000	10.67210
	$(NH_4)_2O$	1.5289	10.18438
	NH_4OH	2.0578	10.31340
	$(NH_4)_2PtCl_6$	13.036	11.11515
	$(NH_4)_2SO_4$	3.8793	10.58875
	N_2O_5	3.1711	10.50121
	Pt	5.7315	10.75827
	SO_3	2.3504	10.37114
NH_4	Cl	1.9656	10.29348
	$MgNH_4PO_4.6H_2O$	13.608	11.13379
	N	0.77653	9.89016
	NH_3	0.94413	9.97503
	NH_4Cl	2.9656	10.47211
	$(NH_4)_2PtCl_6$	12.308	11.09018
	Pt	5.4113	10.73330
NH_4Br	Ag	1.1013	10.04191
	$AgBr$	1.9172	10.28266
	Br	0.81584	9.91161
NH_4Cl	Ag	2.0166	10.30462
	$AgCl$	2.6794	10.42804
	Cl	0.66280	9.82138
	HCl	0.68163	9.83355
	N	0.26185	9.41805
	NH_3	0.31837	9.50293
	NH_4	0.33721	9.52789
	$(NH_4)_2O$	0.48675	9.68730
	NH_4OH	0.65513	9.81633
	$(NH_4)_2PtCl_6$	4.1503	10.61808
	Pt	1.8247	10.26119
$(NH_4)_2CO_3$	NH_3	0.35453	9.54965
NH_4HCO_3	NH_3	0.21546	9.33336

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Ammonium:			−10
NH_4I	Ag	0.74420	9.87169
	AgI	1.6198	10.20945
	I	0.87556	9.94228
NH_4NO_3	NH_3	0.21277	9.32790
	$(NH_4)_2PtCl_6$	2.7737	10.44306
	N_2O_5	0.67470	9.82911
	Pt	1.2195	10.08617
$(NH_4)_2O$	$MgNH_4PO_4 \cdot 6H_2O$	9.4270	10.97438
	NH_4Cl	2.0544	10.31270
	N	0.53796	9.73075
	NH_3	0.65407	9.81562
	$(NH_4)_2PtCl_6$	8.5266	10.93077
	N_2O_5	2.0741	10.31683
	Pt	3.7488	10.57389
NH_4OH	N	0.39969	9.60173
	NH_3	0.48596	9.68660
	NH_4	0.51471	9.71157
	NH_4Cl	1.5264	10.18367
	$(NH_4)_2PtCl_6$	6.3351	10.80175
	Pt	2.7853	10.44487
$(NH_4)_2PtCl_6$	NH_3	0.076709	8.88485
	NH_4	0.081248	8.90982
	NH_4Cl	0.24095	9.38192
	NH_4NO_3	0.36053	9.55694
	$(NH_4)_2O$	0.11728	9.06923
	NH_4OH	0.15785	9.19825
	$(NH_4)_2SO_4$	0.29758	9.47360
$(NH_4)_2SO_4$	$BaSO_4$	1.7665	10.24711
	H_2SO_4	0.74222	9.87053
	N	0.21202	9.32638
	NH_3	0.25778	9.41125
	$(NH_4)_2PtCl_6$	3.3605	10.52640
	Pt	1.4775	10.16952
	SO_3	0.60588	9.78239
N_2O_5	NH_3	0.31535	9.49879
	NH_4NO_3	1.4821	10.17089
	$(NH_4)_2O$	0.48214	9.68317
Pt	NH_3	0.17448	9.24173
	NH_4	0.18480	9.26670
	NH_4Cl	0.54803	9.73881
	NH_4NO_3	0.82003	9.91383
	$(NH_4)_2O$	0.26675	9.42611
	NH_4OH	0.35903	9.55513
	$(NH_4)_2SO_4$	0.67683	9.83048
SO_3	NH_3	0.42547	9.62886
	$(NH_4)_2SO_4$	1.6505	10.21761
Antimony Sb = 121.76			
$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	Sb	0.36466	9.56189
	Sb_2O_3	0.43654	9.64002
Antimony			−10
$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	Sb_2O_4	0.46050	9.66323
	Sb_2S_3	0.50869	9.70645
Sb	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.7423	10.43811
	Sb_2O_3	1.1971	10.07813
	Sb_2O_4	1.2628	10.10134
	Sb_2O_5	1.3285	10.12337
	Sb_2S_3	1.3950	10.14456
	Sb_2S_5	1.6583	10.21965
Sb_2O_3	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.2907	10.35998
	Sb	0.83535	9.92187
	Sb_2O_4	1.0549	10.02321
	Sb_2O_5	1.1098	10.04523
	Sb_2S_3	1.1653	10.06643
	Sb_2S_5	1.3852	10.14152
Sb_2O_4	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.1716	10.33677
	Sb	0.79188	9.89866
	Sb_2O_3	0.94797	9.97679
	Sb_2O_5	1.0520	10.02203
	Sb_2S_3	1.1046	10.04322
	Sb_2S_5	1.3132	10.11831
Sb_2O_5	Sb	0.75272	9.87663
	Sb_2O_3	0.90109	9.95477
	Sb_2O_4	0.95054	9.97797
	Sb_2S_5	1.2482	10.09629
Sb_2S_3	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	1.9659	10.29355
	Sb	0.71687	9.85544
	Sb_2O_3	0.85817	9.93357
	Sb_2O_4	0.90527	9.95678
	Sb_2O_5	0.95237	9.97881
Sb_2S_5	Sb	0.60304	9.78035
	Sb_2O_3	0.72191	9.85848
	Sb_2O_4	0.76153	9.88169
	Sb_2O_5	0.80115	9.90371
Arsenic: As = 74.93			
As	As_2O_3	1.3203	10.12067
	As_2O_5	1.5338	10.18578
	As_2S_3	1.6418	10.21532
	As_2S_5	2.0697	10.31590
	$BaSO_4$	4.6728	10.66957
	$Mg_2As_2O_7$	2.0719	10.31638
	$MgNH_4AsO_4\frac{1}{2}H_2O$	2.5397	10.40478
As_2O_3	As	0.75740	9.87933
	As_2O_5	1.1617	10.06511
	As_2S_3	1.2435	10.09465
	As_2S_5	1.5676	10.19523
	$BaSO_4$	3.5392	10.54890
	$Mg_2As_2O_7$	1.5693	10.19570

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Arsenic:			—10
As_2O_3	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.9236	10.28410
As_2O_5	As	0.65196	9.81422
	As_2O_3	0.86078	9.93489
	As_2S_3	1.0704	10.02954
	As_2S_5	1.3493	10.13012
	$BaSO_4$	3.0465	10.48380
	$Mg_2As_2O_7$	1.3508	10.13060
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.6558	10.21900
AsO_3	$BaSO_4$	2.8482	10.45457
	$Mg_2As_2O_7$	1.2629	10.10137
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.5480	10.18977
AsO_4	$BaSO_4$	2.5202	10.40143
	$Mg_2As_2O_7$	1.1175	10.04824
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.3697	10.13664
As_2S_3	As	0.60909	9.78468
	As_2O_3	0.80418	9.90535
	As_2O_5	0.93424	9.97046
	As_2S_5	1.2606	10.10058
	$Mg_2As_2O_7$	1.2620	10.10106
As_2S_5	As	0.48317	9.68410
	As_2O_3	0.63793	9.80477
	As_2O_5	0.74110	9.86988
	As_2S_3	0.79327	9.89942
$BaSO_4$*	As	0.21401	9.33043
	As_2O_3	0.28255	9.45110
	As_2O_5	0.32825	9.51620
	AsO_3	0.35110	9.54543
	AsO_4	0.39680	9.59857
$Mg_2As_2O_7$	As	0.48264	9.68362
	As_2O_3	0.63723	9.80430
	As_2O_5	0.74029	9.86940
	AsO_3	0.79182	9.89863
	AsO_4	0.89488	9.95176
	As_2S_3	0.79240	9.89894
$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	As	0.39375	9.59522
	As_2O_3	0.51987	9.71590
	As_2O_5	0.60395	9.78100
	AsO_3	0.64599	9.81023
	AsO_4	0.73007	9.86336
Barium: Ba = 137.36			
Ba	$BaCO_3$	1.4368	10.15740
	$BaCrO_4$	1.8446	10.26589
	$BaSiF_6$	2.0342	10.30840
	$BaSO_4$	1.6993	10.23028
$BaCl_2$	$BaCO_3$	0.94760	9.97662

Weighed	Sought	Factor	Logarithm
Barium:			—10
$BaCl_2$	$BaCrO_4$	1.2165	10.08512
	$BaSO_4$	1.1207	10.04950
$BaCl_2 \cdot 2H_2O$	$BaSO_4$	0.95544	9.98021
$BaCO_3$	Ba	0.69599	9.84260
	$BaCl_2$	1.0553	10.02338
	$BaCrO_4$	1.2838	10.10850
	$Ba(HCO_3)_2$	1.3142	10.11867
	BaO	0.77706	9.89045
	$BaSO_4$	1.1827	10.07285
	CO_2	0.22294	9.34818
$BaCrO_4$	Ba	0.54213	9.73411
	$BaCl_2$	0.82201	9.91487
	$BaCO_3$	0.77894	9.89150
	BaO	0.60528	9.78196
BaF_2	$BaSiF_6$	1.5934	10.20233
$Ba(HCO_3)_2$	$BaCO_3$	0.76090	9.88133
$Ba(NO_3)_2$	$BaSO_4$	0.89304	9.95087
BaO	$BaCO_3$	1.2869	10.10955
	$BaCrO_4$	1.6521	10.21804
	$BaSiF_6$	1.8220	10.26055
	$BaSO_4$	1.5220	10.18243
	CO_2	0.28691	9.45774
BaO_2	$BaSO_4$	1.3783	10.13933
BaS	$BaSO_4$	1.3778	10.13917
$BaSiF_6$	Ba	0.49159	9.69160
	BaF_2	0.62759	9.79767
	BaO	0.54885	9.73945
$BaSO_4$	Ba	0.58847	9.76972
	$BaCl_2$	0.89227	9.95056
	$BaCl_2 \cdot 2H_2O$	1.0466	10.01979
	$BaCO_3$	0.84552	9.92712
	$Ba(NO_3)_2$	1.1198	10.04913
	BaO	0.65701	9.81757
	BaO_2	0.72556	9.86067
	BaS	0.72582	9.86083
CO_2	BaO	3.4855	10.54226
	$BaCO_3$	4.4855	10.65181
Beryllium: (Glucinum) Be = 9.02			
BeO	Be	0.36051	9.55692
	$BeCl_2$	3.1948	10.50444
	$BeSO_4 \cdot 4H_2O$	7.0800	10.85004
Be	BeO	2.7738	10.44308
$BeCl_2$	BeO	0.31301	9.49556
$BeSO_4 \cdot 4H_2O$	BeO	0.14124	9.14996
Bismuth: Bi = 209.00			
Bi	Bi_2O_3	1.1148	10.04721
	$BiAsO_4$	1.6647	10.22135
	BiOCl	1.2462	10.09559

* See also under sulfur.

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Bismuth:			—10
Bi	Bi_2S_3	1.2301	10.08994
$BiAsO_4$	Bi	0.60070	9.77865
	Bi_2O_3	0.66967	9.82586
$Bi(NO_3)_3.5H_2O$	Bi_2O_3	0.48031	9.68152
	BiOCl	0.53691	9.72990
Bi_2O_3	Bi	0.89700	9.95279
	$BiAsO_4$	1.4933	10.17414
	BiOCl	1.1178	10.04838
	$Bi(NO_3)_3.5H_2O$	2.0820	10.31848
	$BiONO_3$	1.2318	10.09054
	Bi_2S_3	1.1034	10.04273
BiOCl	Bi	0.80244	9.90441
	$Bi(NO_3)_3.5H_2O$	1.8625	10.27010
	Bi_2O_3	0.89458	9.95162
	$BiONO_3$	1.1019	10.04216
$BiONO_3$	Bi_2O_3	0.81182	9.90946
	BiOCl	0.90749	9.95784
Bi_2S_3	Bi	0.81295	9.91006
	Bi_2O_3	0.90630	9.95727
Boron: B=10.82			
B	B_2O_3	3.2181	10.50760
	KBF_4	11.638	11.06587
B_2O_3	B	0.31074	9.49240
	BO_2	1.2298	10.08982
	BO_3	1.6893	10.22770
	B_4O_7	1.1149	10.04723
	H_3BO_3	1.7761	10.24946
	KBF_4	3.6163	10.55827
	$Na_2B_4O_7.10H_2O$	2.7386	10.43753
BO_2	B_2O_3	0.81317	9.91018
BO_3	B_2O_3	0.59198	9.77230
B_4O_7	B_2O_3	0.89696	9.95277
H_3BO_3	B_2O_3	0.56304	9.75054
	KBF_4	2.0361	10.30880
KBF_4	B	0.085928	8.93413
	B_2O_3	0.27652	9.44173
	H_3BO_3	0.49113	9.69120
	$Na_2B_4O_7.10H_2O$	0.75729	9.87926
$Na_2B_4O_7$ $10H_2O$	B_2O_3	0.36515	9.56247
	KBF_4	1.3205	10.12074
Bromine: Br=79.916			
Ag	Br	0.74079	9.86969
	BrO_3	1.1857	10.07398
	HBr	0.75013	9.87514
AgBr	Br	0.42555	9.62895
	BrO_3	0.68114	9.83324
	HBr	0.43091	9.63439
AgCl	Br	0.55754	9.74628

Weighed	Sought	Factor	Logarithm
Bromine:			—10
Br	Ag	1.3499	10.13031
	AgBr	2.3499	10.37105
	AgCl	1.7936	10.25372
	O	1.0011	9.00046
BrO_3	Ag	0.84337	9.92602
	AgBr	1.4681	10.16676
HBr	Ag	1.3331	10.12486
	AgBr	2.3207	10.36561
O	Br	9.9895	10.99954
Cadmium: Cd=112.41			
Cd	$CdCl_2$	1.6309	10.21241
	$Cd(NO_3)_2$	2.1032	10.32289
	CdO	1.1423	10.05779
	CdS	1.2852	10.10897
	$CdSO_4$	1.8546	10.26824
$CdCl_2$	Cd	0.61318	9.78759
	CdO	0.70045	9.84538
	CdS	0.78806	9.89656
	$CdSO_4$	1.1372	10.05582
$Cd(NO_3)_2$	Cd	0.47546	9.67711
	CdO	0.54313	9.73490
	CdS	0.61106	9.78608
	$CdSO_4$	0.88176	9.94535
CdO	Cd	0.87540	9.94221
	$CdCl_2$	1.4276	10.15462
	$Cd(NO_3)_2$	1.8412	10.26510
	CdS	1.1251	10.05118
	$CdSO_4$	1.6235	10.21044
CdS	Cd	0.77809	9.89103
	$CdCl_2$	1.2689	10.10344
	$Cd(NO_3)_2$	1.6365	10.21392
	CdO	0.88884	9.94882
	$CdSO_4$	1.4430	10.15927
$CdSO_4$	Cd	0.53921	9.73176
	$CdCl_2$	0.87938	9.94418
	$Cd(NO_3)_2$	1.1341	10.05465
	CdO	0.61596	9.78956
	CdS	0.69300	9.84073
Caesium: Cs=132.81			
AgCl	CsCl	1.1739	10.06964
Cl	Cs	3.7457	10.57353
	CsCl	4.7457	10.67630
Cs	Cl	0.26698	9.42647
	CsCl	1.2670	10.10277
	Cs_2CO_3	1.2259	10.08845
	Cs_2O	1.0602	10.02540
	Cs_2PtCl_6	2.5359	10.40414
	Cs_2SO_4	1.3616	10.13406
CsCl	AgCl	0.85184	9.93036
	Cl	0.21072	9.32370
	Cs	0.78928	9.89723
	Cs_2O	0.83682	9.92263
	Cs_2PtCl_6	2.0016	10.30137

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Caesium:			—10
$CsCl$	Cs_2SO_4	1.0747	10.03130
Cs_2CO_3	Cs	0.81574	9.91155
	Cs_2PtCl_6	2.0686	10.31569
	Cs_2SO_4	1.1107	10.04561
Cs_2O	Cs	0.94319	9.97460
	$CsCl$	1.1950	10.07737
	Cs_2SO_4	1.2843	10.10866
	Cs_2PtCl_6	2.3918	10.37873
	SO_3	0.28428	9.45375
Cs_2PtCl_6	Cs	0.39433	9.59586
	$CsCl$	0.49961	9.69863
	Cs_2CO_3	0.48341	9.68431
	Cs_2O	0.41809	9.62127
Cs_2SO_4	Cs	0.73441	9.86594
	$CsCl$	0.93047	9.96870
	Cs_2CO_3	0.90030	9.95439
	Cs_2O	0.77864	9.89134
SO_3	Cs_2O	3.5176	10.54625
Calcium: Ca = 40.08			
$BaSO_4$	CaS	0.30906	9.49004
	$CaSO_4$	0.58324	9.76585
	$CaSO_4.2H_2O$	0.73760	9.86782
Ca	$CaCl_2$	2.7693	10.44237
	$CaCO_3$	2.4970	10.39742
	CaF_2	1.9481	10.28961
	CaO	1.3992	10.14588
	$CaSO_4$	3.3967	10.53106
	Cl	1.7693	10.24780
$Ca_3(AsO_4)_2$	$Mg_2As_2O_7$	0.77996	9.89207
$CaCl_2$	Ca	0.36110	9.55763
	$CaCO_3$	0.90167	9.99505
	CaO	0.50525	9.70351
	$CaSO_4$	1.2266	10.08869
	Cl	0.63890	9.80543
$CaCO_3$	Ca	0.40048	9.60258
	$CaCl_2$	1.1091	10.04495
	$Ca(HCO_3)_2$	1.6197	10.20942
	CaO	0.56035	9.74846
	$CaSO_4$	1.3603	10.13364
	$CaSO_4.2H_2O$	1.7203	10.23561
	CO_2	0.43965	9.64311
	HCl	0.72871	9.86256
CaF_2	Ca	0.51332	9.71039
	$CaSO_4$	1.7436	10.24145
$Ca(HCO_3)_2$	$CaCO_3$	0.61741	9.79058
	CaO	0.34597	9.53904
$Ca(NO_3)_2$	N_2O_5	0.65825	9.81839
CaO	Ca	0.71469	9.85412
	$CaCl_2$	1.9792	10.29649
	$CaCO_3$	1.7846	10.25154
	CaF_2	1.3923	10.14373
	$Ca(HCO_3)_2$	2.8904	10.46096
Calcium:			—10
CaO	$Ca_3(PO_4)_2$	1.8443	10.26582
	$CaSO_4$	2.4276	10.38518
	$CaSO_4.2H_2O$	3.0701	10.48715
	Cl	1.2645	10.10192
	CO_2	0.78459	9.89464
	MgO	0.71897	9.85671
	SO_3	1.4276	10.15461
$Ca_3(PO_4)_2$	CaO	0.54222	9.73418
	$CaSO_4$	1.3163	10.11935
	$Mg_2P_2O_7$	0.71767	9.85593
	$(NH_4)_3PO_4.12MoO_3$	12.100	11.08277
	P_2O_5	0.45778	9.66066
CaS	$BaSO_4$	3.2357	10.50996
$CaSO_4$	$BaSO_4$	1.7146	10.23415
	Ca	0.29440	9.46894
	$CaCl_2$	0.81529	9.91131
	$CaCO_3$	0.73513	9.86636
	CaF_2	0.57353	9.75855
	CaO	0.41193	9.61482
	$Ca_3(PO_4)_2$	0.75971	9.88065
	SO_3	0.58807	9.76943
$CaSO_4.2H_2O$	$BaSO_4$	1.3557	10.13218
	$CaCO_3$	0.58128	9.76439
	CaO	0.32572	9.51285
	SO_3	0.46500	9.66746
$CaWO_4$	WO_3	0.80533	9.90597
Cl	Ca	0.56519	9.75220
	$CaCl_2$	1.5652	10.19457
	CaO	0.79082	9.89808
CO_2	CaO	1.2745	10.10536
	$CaCO_3$	2.2745	10.35689
HCl	$CaCO_3$	1.3723	10.13744
$Mg_2As_2O_7$	$Ca_3(AsO_4)_2$	1.2821	10.10793
MgO	CaO	1.3909	10.14329
$Mg_2P_2O_7$	$Ca_3(PO_4)_2$	1.3934	10.14407
$(NH_4)_3PO_4.12MoO_3$	$Ca_3(PO_4)_2$	0.082647	8.91723
N_2O_5	$Ca(NO_3)_2$	1.5192	10.18161
P_2O_5	$Ca_3(PO_4)_2$	2.1845	10.33934
SO_3	CaO	0.70047	9.84539
	$CaSO_4$	1.7005	10.23057
	$CaSO_4.2H_2O$	2.1505	10.33254
WO_3	$CaWO_4$	1.2417	10.09403
Carbon: C = 12.00			
Ag	CN	0.24108	9.38217
	HCN	0.25042	9.39868
	KCN	0.60352	9.78069
$AgCN$	CN	0.19425	9.28837
	HCN	0.20178	9.30488

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Carbon:			—10
AgCN	KCN	0.48629	9.68689
AgCNS	CNS	0.34992	9.54396
$BaCO_3$	C	0.060803	8.78392
	CO_2	0.22294	9.34819
	CO_3	0.30401	9.48289
BaO	CO_2	0.28691	9.45774
	CO_2, bicarbonate	0.57381	9.75877
$BaSO_4$	CNS	0.24877	9.39580
C	$BaCO_3$	16.447	11.21608
	CO_2	3.6667	10.56427
$CaCO_3$	CO_2	0.43965	9.64311
$Ca(HCO_3)_2$	CO_2	0.54289	9.73471
CN	AgCN	5.1480	10.71163
	Ag	4.1480	10.61783
CNS	AgCNS	2.8578	10.45604
	CuCNS	2.0948	10.32113
	$BaSO_4$	4.0198	10.60420
CaO	CO_2	0.78459	9.89464
	CO_2, bicarbonate	1.5692	10.19567
CO_2	$BaCO_3$	4.4855	10.65181
	$Ba(HCO_3)_2$	2.9474	10.46945
	BaO	3.4855	10.54226
	C	0.27273	9.43573
	$CaCO_3$	2.2745	10.35689
	$Ca(HCO_3)_2$	1.8420	10.26529
	CaO	1.2745	10.10536
	CO_3	1.3636	10.13470
	Cs_2CO_3	7.4005	10.86926
	$CsHCO_3$	4.4050	10.64394
	$FeCO_3$	2.6327	10.42041
	$Fe(HCO_3)_2$	2.0211	10.30558
	K_2CO_3	3.1409	10.49706
	$KHCO_3$	2.2752	10.35702
	K_2O	2.1409	10.33060
	Li_2CO_3	1.6791	10.22507
	$LiHCO_3$	1.5443	10.18872
	Li_2O	0.67909	9.83193
	$MgCO_3$	1.9164	10.28248
	$Mg(HCO_3)_2$	1.6629	10.22087
	MgO	0.91636	9.96207
	$MnCO_3$	2.6120	10.41698
	$Mn(HCO_3)_2$	2.0107	10.30336
	MnO	1.6120	10.20738
	Na_2CO_3	2.4090	10.38183
	$NaHCO_3$	1.9092	10.28085
	Na_2O	1.4090	10.14890
	$(NH_4)_2CO_3$	2.1836	10.33917
	NH_4HCO_3	1.7965	10.25443
	$PbCO_3$	6.0732	10.78342
	Rb_2CO_3	5.2473	10.71993
	$RbHCO_3$	3.3284	10.52223
	Rb_2O	4.2473	10.62811
	$SrCO_3$	3.3552	10.52572
Carbon:			—10
CO_2	$Sr(HCO_3)_2$	2.3823	10.37700
	SrO	2.3552	10.37203
CO_3	$BaCO_3$	3.2893	10.51711
	CO_2	0.73333	9.86530
Cs_2CO_3	CO_2	0.13513	9.13074
$CsHCO_3$	CO_2	0.22702	9.35606
CuCNS	CNS	0.47738	9.67887
$FeCO_3$	CO_2	0.37983	9.57959
$Fe(HCO_3)_2$	CO_2	0.49478	9.69442
HCN	Ag	3.9932	10.60132
	AgCN	4.9559	10.69512
KCN	Ag	1.6569	10.21931
	AgCN	2.0564	10.31311
K_2CO_3	CO_2	0.31838	9.50294
$KHCO_3$	CO_2	0.43953	9.64298
K_2O	CO_2	0.46709	9.66940
Li_2CO_3	CO_2	0.59556	9.77493
$LiHCO_3$	CO_2	0.64756	9.81128
Li_2O	CO_2	1.4726	10.16807
$MgCO_3$	CO_2	0.52182	9.71752
$Mg(HCO_3)_2$	CO_2	0.60136	9.77913
MgO	CO_2	1.0913	10.03793
$MnCO_3$	CO_2	0.38284	9.58302
$Mn(HCO_3)_2$	CO_2	0.49733	9.69664
MnO	CO_2	0.62033	9.79262
Na_2CO_3	CO_2	0.41512	9.61817
$NaHCO_3$	CO_2	0.52378	9.71915
Na_2O	CO_2	0.70975	9.85110
$(NH_4)_2CO_3$	CO_2	0.45796	9.66083
NH_4HCO_3	CO_2	0.55663	9.74557
$PbCO_3$	CO_2	0.16466	9.21658
Rb_2CO_3	CO_2	0.10958	9.28007
$RbHCO_3$	CO_2	0.30045	9.47777
Rb_2O	CO_2	0.23545	9.37189
$SrCO_3$	CO_2	0.29804	9.47428
$Sr(HCO_3)_2$	CO_2	0.41976	9.62300
SrO	CO_2	0.42459	9.62797
Cerium: Ce = 140.13			
Ce	$Ce_2(C_2O_4)_3 \cdot 3H_2O$	2.1348	10.32936
	$Ce(NO_3)_4$	2.7700	10.44248
	$Ce(NO_3)_4 \cdot (NH_4NO_3)_2 \cdot H_2O$	4.0411	10.60649
	CeO_2	1.2284	10.08933
	Ce_2O_3	1.1713	10.06866
	$Ce_2(SO_4)_3$	2.0283	10.30712

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Cerium:			—10
$Ce_2(C_2O_4)_3.3H_2O$	$Ce_2(SO_4)_3$	0.95008	9.97776
	Ce	0.46842	9.67064
$Ce(NO_3)_4$	Ce	0.36101	9.55752
	Ce_2O_3	0.42284	9.62617
	CeO_2	0.44345	9.64684
$Ce(NO_3)_4.(NH_4NO_3)_2.H_2O$	Ce	0.24746	9.39351
	Ce_2O_3	0.28984	9.46216
	CeO_2	0.30397	9.48283
CeO_2	Ce	0.81409	9.91067
	$Ce(NO_3)_4$	2.2551	10.35316
	$Ce(NO_3)_4.(NH_4NO_3)_2.H_2O$	3.2898	10.51717
	Ce_2O_3	0.95352	9.97933
Ce_2O_3	Ce	0.85377	9.93134
	$Ce(NO_3)_4$	2.3650	10.37383
	$Ce(NO_3)_4.(NH_4NO_3)_2.H_2O$	3.4501	10.53784
	CeO_2	1.0487	10.02067
	$Ce_2(SO_4)_3$	1.7317	10.23847
$Ce_2(SO_4)_3$	Ce	0.49303	9.69288
	Ce_2O_3	0.67748	9.76153
	$Ce_2(C_2O_4)_3.3H_2O$	1.0525	10.02224
Chlorine: Cl = 35.457			
Ag	Cl	0.32867	9.51676
	HCl	0.33801	9.52893
AgCl	Cl	0.24737	9.39334
	ClO_3	0.58224	9.76510
	ClO_4	0.69387	9.84128
	HCl	0.25440	9.40552
$BaCrO_4$	Cl	0.27988	9.44698
Ca	Cl	1.7693	10.24780
Cl	Ag	3.0426	10.48324
	AgCl	4.0426	10.60666
	$BaCrO_4$	3.5729	10.55302
	Ca	0.56519	9.75220
	HCl	1.0284	10.01217
	K	1.1027	10.04247
	KCl	2.1027	10.32279
	Li	0.19573	9.29166
	Mg	0.34295	9.53523
	$MgCl_2$	1.3430	10.12806
	MnO_2	1.2259	10.08844
	Na	0.64859	9.81197
	NaCl	1.6486	10.21711
	NH_4	0.50876	9.70652
	$PbCrO_4$	4.5581	10.65878

Weighed	Sought	Factor	Logarithm
Chlorine:			—10
ClO_3	AgCl	1.7175	10.23490
	KCl	0.89336	9.95103
	NaCl	0.70041	9.84535
ClO_4	AgCl	1.4412	10.15872
	KCl	0.74964	9.87485
	NaCl	0.58773	9.76918
HCl	Ag	2.9585	10.47107
	AgCl	3.9308	10.59448
	NH_4Cl	1.4671	10.16645
	$(NH_4)_2SO_4$	1.8119	10.25813
K	Cl	0.90683	9.95753
KCl	Cl	0.47557	9.67721
	ClO_3	1.1194	10.04897
	ClO_4	1.3340	10.12515
Li	Cl	5.1091	10.70834
Mg	Cl	2.9159	10.46477
$MgCl_2$	Cl	0.74463	9.87194
MnO_2	Cl	0.81576	9.91156
Na	Cl	1.5418	10.18803
NaCl	Cl	0.60658	9.78289
	ClO_3	1.4277	10.15465
	ClO_4	1.7015	10.23082
NH_4	Cl	1.9656	10.29348
NH_4Cl	HCl	0.68163	9.83355
$(NH_4)_2SO_4$	HCl	0.55192	9.74187
$PbCrO_4$	Cl	0.21939	9.34122
Chromium: Cr = 52.01			
$BaCrO_4$	Cr	0.20527	9.31233
	Cr_2O_3	0.30000	9.47712
	CrO_3	0.39472	9.59629
	CrO_4	0.45787	9.66074
	$Cr_2(SO_4)_3.18H_2O$	1.4139	10.15042
Cr	$BaCrO_4$	4.8716	10.68767
	Cr_2O_3	1.4614	10.16478
	$PbCrO_4$	6.2148	10.79342
Cr_2O_3	$BaCrO_4$	3.3334	10.52288
	Cr	0.68425	9.83522
	CrO_3	1.3157	10.11917
	CrO_4	1.5262	10.18362
	$PbCrO_4$	4.2525	10.62864
CrO_3	$BaCrO_4$	2.5334	10.40371
	Cr_2O_3	0.76002	9.88083
	K_2CrO_4	1.9419	10.28823
	$K_2Cr_2O_7$	1.4710	10.16760
	$PbCrO_4$	3.2320	10.50947
CrO_4	$BaCrO_4$	2.1840	10.33926
	$PbCrO_4$	2.7862	10.44502
$Cr_2(SO_4)_3.18H_2O$	$BaCrO_4$	0.70726	9.84958
	$PbCrO_4$	0.90227	9.95534
K_2CrO_4	CrO_3	0.51496	9.71177
	$PbCrO_4$	1.6643	10.22124

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Chromium:			—10
$K_2Cr_2O_7$	CrO_3	0.67983	9.83240
	$PbCrO_4$	2.1972	10.34187
$PbCrO_4$	Cr	0.16091	9.20658
	Cr_2O_3	0.23516	9.37136
	CrO_3	0.30941	9.49053
	CrO_4	0.35891	9.55498
	$Cr_2(SO_4)_3.18H_2O$	1.1083	10.04466
	K_2CrO_4	0.60084	9.77876
	$K_2Cr_2O_7$	0.45512	9.65813
Cobalt: Co = 58.94			
Co	$Co(NO_3)_2.6H_2O$	4.9381	10.69356
	$Co(NO_2)_3.(KNO_2)_3$	7.6737	10.88500
	CoO	1.2715	10.10430
	Co_3O_4	1.3620	10.13416
	$CoSO_4$	2.6298	10.41992
	$CoSO_4.7H_2O$	4.7694	10.67846
	$(CoSO_4)_2.(K_2SO_4)_3$	7.0646	10.84909
$Co(NO_3)_2.6H_2O$	Co	0.20251	9.30644
$Co(NO_2)_3.(KNO_2)_3$	Co	0.13032	9.11500
	CoO	0.16569	9.21930
CoO	Co	0.78650	9.89570
	$Co(NO_2)_3.(KNO_2)_3$	6.0353	10.78070
	Co_3O_4	1.0712	10.02986
	$CoSO_4$	2.0683	10.31562
	$(CoSO_4)_2.(K_2SO_4)_3$	5.5563	10.74479
Co_3O_4	Co	0.73424	9.86584
	CoO	0.93356	9.97014
$CoSO_4$	Co	0.38026	9.58008
	CoO	0.48348	9.68438
$CoSO_4.7H_2O$	Co	0.20967	9.32154
	CoO	0.26659	9.42584
$(CoSO_4)_2.(K_2SO_4)_3$	Co	0.14155	9.15091
	CoO	0.17998	9.25521
Columbium: (niobium) Cb = 93.3			
Cb_2O_5	Cb	0.69992	9.84505
Cb	Cb_2O_5	1.4287	10.15495

Weighed	Sought	Factor	Logarithm
Copper: Cu = 63.57			—10
Cu	$Cu_2C_2H_3O_2(AsO_2)_3$	3.9874	10.60069
	CuCNS	1.9134	10.28182
	CuO	1.2517	10.09750
	Cu_2O	1.1258	10.05148
	Cu_2S	1.2522	10.09766
	$CuSO_4.5H_2O$	3.9281	10.59418
$Cu_2C_2H_3O_2(AsO_2)_3$	Cu	0.25079	9.39931
	$Mg_2As_2O_7$	0.91872	9.96318
CuCNS	Cu	0.52262	9.71818
	CuO	0.65415	9.81568
CuO	Cu	0.79892	9.90250
	CuCNS	1.5287	10.18432
	Cu_2S	1.0004	10.00016
	$CuSO_4.5H_2O$	3.1382	10.49668
Cu_2O	Cu	0.88822	9.94852
	Cu_2S	1.1122	10.04618
$CuSO_4$ $5H_2O$	Cu	0.25458	9.40582
	CuO	0.31865	9.50332
	Cu_2S	0.31877	9.50348
Cu_2S	Cu	0.79862	9.90234
	CuO	0.99962	9.99984
	Cu_2O	0.89912	9.95382
	$CuSO_4.5H_2O$	3.1370	10.49652
$Mg_2As_2O_7$	$Cu_2C_2H_3O_2(AsO_2)_3$	1.0885	10.03682
Erbium: Er = 167.64			
Er_2O_3	Er	0.87477	9.94189
Er	Er_2O_3	1.1432	10.05811
Fluorine: F = 19.00			
BaF_2	$BaSiF_6$	1.5934	10.20233
$BaSiF_6$	BaF_2	0.62759	9.79767
	F	0.40799	9.61065
	HF	0.42963	9.63309
	H_2SiF_6	0.51562	9.71233
	SiF_4	0.37241	9.57103
	SiF_6	0.50841	9.70621
CaF_2	F	0.48668	9.68724
	HF	0.51249	9.70969
	H_2SiF_6	0.61508	9.78893
	SiF_6	0.60647	9.78281
$CaSO_4$	F	0.27912	9.44580
	HF	0.29393	9.46824
F	$BaSiF_6$	2.4511	10.38935
	CaF_2	2.0547	10.31276
	$CaSO_4$	3.5826	10.55420

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
			—10
Fluorine:			
F	H_2SiF_6	1.2638	10.10169
	K_2SiF_6	1.9321	10.28603
HF	$BaSiF_6$	2.3276	10.36691
	CaF_2	1.9512	10.29031
	$CaSO_4$	3.4022	10.53176
	K_2SiF_6	1.8348	10.26359
2HF	H_2SiF_6	3.6005	10.55636
6HF	H_2SiF_6	1.2002	10.07924
H_2SiF_6	$BaSiF_6$	1.9394	10.28767
	CaF_2	1.6258	10.21107
	F	0.79125	9.89831
	2HF	0.27774	9.44364
	6HF	0.83322	9.92076
	K_2SiF_6	1.5288	10.18435
	SiF_4	0.72226	9.85869
	SiF_6	0.98601	9.99388
KF	K_2SiF_6	1.8955	10.27773
K_2SiF_6	F	0.51757	9.71397
	HF	0.54502	9.73641
	H_2SiF_6	0.65412	9.81565
	KF	0.52756	9.72227
	SiF_6	0.64497	9.80954
SiF_4	$BaSiF_6$	2.6852	10.42897
	H_2SiF_6	1.3845	10.14131
SiF_6	$BaSiF_6$	1.9669	10.29379
	CaF_2	1.6489	10.21719
	H_2SiF_6	1.0142	10.00612
	K_2SiF_6	1.5505	10.19046
Gallium: Ga = 69.72			
Ga_2O_3	Ga	0.74392	9.87153
Ga_2S_3	Ga	0.59180	9.77218
Ga	Ga_2O_3	1.3442	10.12847
	Ga_2S_3	1.6898	10.22782
Germanium: Ge = 72.60			
GeO_2	Ge	0.69407	9.84140
K_2GeF_6	Ge	0.27417	9.43802
Ge	GeO_2	1.4408	10.15860
	K_2GeF_6	3.6474	10.56198
Gold: Au = 197.2			
Au	$AuCl_3$	1.5394	10.18735
	$HAuCl_4.4H_2O$	2.0897	10.32009
	$KAu(CN)_4.H_2O$	1.8172	10.25940
$AuCl_3$	Au	0.64960	9.81265
$HAuCl_4.4H_2O$	Au	0.47853	9.67991
$KAu(CN)_4.H_2O$	Au	0.55030	9.74060

Weighed	Sought	Factor	Logarithm
			—10
Hydrogen: H = 1.0078			
H	O	7.9381	10.89972
	H_2O	8.9381	10.95124
H_2O	H	0.11188	9.04876
O	H	0.12598	9.10028
HCNS	AgCNS	2.8091	10.44856
	CuCNS	2.0590	10.31366
	$BaSO_4$	3.9512	10.59673
AgCNS	HCNS	0.35599	9.55144
CuCNS	HCNS	0.48567	9.68634
$BaSO_4$	HCNS	0.25309	9.40327
Indium: In = 114.8			
In	In_2O_3	1.2091	10.08245
	In_2S_3	1.4189	10.15195
In_2O_3	In	0.82709	9.91755
In_2S_3	In	0.70477	9.84805
Iodine: I = 126.92			
Ag	HI	1.1858	10.07402
	I	1.1765	10.07059
AgCl	I	0.88547	9.94717
AgI	HI	0.54484	9.73627
	I	0.54055	9.73283
	IO_3	0.74497	9.87214
	IO_4	0.81312	9.91015
	I_2O_5	0.71090	9.85181
	I_2O_7	0.77905	9.89156
HI	Ag	0.84329	9.92598
	AgI	1.83541	10.26373
	Pd	0.41703	9.62017
	PdI_2	1.40915	10.14896
	TlI	2.58982	10.41327
I	Ag	0.84998	9.92941
	AgCl	1.12935	10.05283
	AgI	1.84998	10.26717
	Pd	0.42034	9.62360
	PdI_2	1.4203	10.15239
	TlI	2.6104	10.41670
IO_3	AgI	1.3423	10.12786
	PdI_2	1.0306	10.01308
	TlI	1.8941	10.27739
IO_4	AgI	1.2298	10.08985
	PdI_2	0.94422	9.97507
	TlI	1.7353	10.23938
I_2O_5	AgI	1.4067	10.14819
	PdI_2	1.0800	10.03341
	TlI	1.9848	10.29773
I_2O_7	AgI	1.2836	10.10844
	PdI_2	0.98551	9.99366
	TlI	1.8112	10.25797
Pd	HI	2.3979	10.37983
	I	2.3790	10.37640
PdI_2	HI	0.70965	9.85104

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Iodine:			—10
PdI_2	I	0.70406	9.84761
	IO_3	0.97032	9.98692
	IO_4	1.0591	10.02493
	I_2O_5	0.92594	9.96658
	I_2O_7	1.0147	10.00634
TlI	HI	0.38613	9.58673
	I	0.38309	9.58330
	IO_3	0.52796	9.72260
	IO_4	0.57626	9.76062
	I_2O_5	0.50382	9.70227
	I_2O_7	0.55211	9.74203
Iron: Fe = 55.84			
Ag	$Fe_7(CN)_{18}$, prussian blue	0.44238	9.64579
CN	$Fe_7(CN)_{18}$	1.8350	10.26363
CO_2	FeO	1.6327	10.21291
	$FeCO_3$	2.6327	10.42041
	$Fe(HCO_3)_2$	2.0211	10.30558
Fe	$Fe(HCO_3)_2$	3.1851	10.50312
	FeO	1.2865	10.10942
	Fe_2O_3	1.4298	10.15528
	$FePO_4$	2.7016	10.43163
	FeS	1.5741	10.19704
	$FeSO_4$	2.7203	10.43461
	$FeSO_4.7H_2O$	4.9787	10.69711
	$FeSO_4.(NH_4)_2.SO_4.6H_2O$	7.0224	10.84649
$FeAsO_4$	$Mg_2As_2O_7$	0.79709	9.90151
$FeCl_3$	Fe_2O_3	0.49220	9.69214
$Fe_7(CN)_{18}$ prussian blue	Ag	2.2605	10.35421
	CN	0.54497	9.73637
$FeCO_3$	CO_2	0.37983	9.57959
	FeO	0.62017	9.79251
	Fe_2O_3	0.68923	9.83836
$Fe(HCO_3)_2$	CO_2	0.49478	9.69442
	Fe	0.31396	9.49688
	FeO	0.40392	9.60630
	Fe_2O_3	0.44890	9.65215
FeO	CO_2	0.61247	9.78709
	Fe	0.77728	9.89058
	$FeCO_3$	1.6125	10.20749
	$Fe(HCO_3)_2$	2.4757	10.39370
	Fe_2O_3	1.1114	10.04585
	$FePO_4$	2.0999	10.32221
	FeS	1.2236	10.08762
	SO_3	1.1144	10.04705
Fe_3O_4	Fe_2O_3	1.0346	10.01475
Iron:			—10
Fe_2O_3	Fe	0.69940	9.84472
	$FeCl_3$	2.0317	10.30786
	$FeCO_3$	1.4509	10.16164
	$Fe(HCO_3)_2$	2.2277	10.34785
	$Fe(HCO_3)_3$	2.9918	10.47593
	FeO	0.89980	9.95415
	Fe_3O_4	0.96660	9.98525
	$FePO_4$	1.8895	10.27635
	FeS	1.1010	10.04177
	$FeSO_4$	1.9026	10.27934
	$FeSO_4.7H_2O$	3.4821	10.54184
	$FeSO_4.(NH_4)_2.SO_4.6H_2O$	4.9115	10.69121
	$Fe_2(SO_4)_3$	2.5041	10.39866
$FePO_4$	Fe	0.37014	9.56837
	FeO	0.47620	9.67779
	Fe_2O_3	0.52923	9.72365
FeS	Fe	0.63527	9.80296
	FeO	0.81729	9.91238
	Fe_2O_3	0.90830	9.95823
$FeSO_4$	Fe	0.36761	9.56539
	Fe_2O_3	0.52561	9.72066
	SO_3	0.52706	9.72186
$FeSO_4.7H_2O$	Fe	0.20086	9.30289
	Fe_2O_3	0.28718	9.45816
$FeSO_4.(NH_4)_2.SO_4.6H_2O$	Fe	0.14240	9.15351
	Fe_2O_3	0.20360	9.30879
$Fe_2(SO_4)_3$	Fe_2O_3	0.39934	9.60134
$Mg_2As_2O_7$	$FeAsO_4$	1.2546	10.09849
SO_3	FeO	0.89733	9.95295
	$FeSO_4$	1.8973	10.27814
Lanthanum: La = 138.92			
La	La_2O_3	1.1728	10.06921
La_2O_3	La	0.85269	9.93079
Lead: Pb = 207.22			
$BaSO_4$	$PbSO_4$	1.2993	10.11371
Pb	$PbCl_2$	1.3422	10.12782
	$PbCO_3$	1.2895	10.11044
	$(PbCO_3)_2.Pb(OH)_2$	1.2477	10.09613
	$PbCrO_4$	1.5598	10.19308
	$Pb(OH)_2$	1.1642	10.06601
	PbO	1.0772	10.03230
	PbO_2	1.1544	10.06237
	PbS	1.1547	10.06247
	$PbSO_4$	1.4636	10.16541

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Lead:			−10
$PbCl_2$	Pb	0.74504	9.87218
	PbO	0.80256	9.90448
$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	$PbCrO_4$	0.85214	9.93051
	$PbSO_4$	0.79955	9.90285
$PbCO_3$	Pb	0.77547	9.88956
	PbO	0.83534	9.92186
	$PbSO_4$	1.1349	10.05497
$(PbCO_3)_2 Pb(OH)_2$	Pb	0.80144	9.90387
	$PbCrO_4$	1.2501	10.09695
	$PbSO_4$	1.1730	10.06928
$PbCrO_4$	Pb	0.64109	9.80692
	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	1.1735	10.06949
	$(PbCO_3)_2 \cdot Pb(OH)_2$	0.79992	10.90305
	PbO	0.69059	9.83922
	Pb_3O_4	0.70709	9.84948
	$PbSO_4$	0.93828	9.97233
$Pb(NO_3)_2$	PbO	0.67390	9.82860
	PbO_2	0.72220	9.85866
	$PbSO_4$	0.91560	9.96171
PbO	Pb	0.92832	9.96770
	$PbCl_2$	1.2460	10.09552
	$PbCO_3$	1.1971	10.07814
	$PbCrO_4$	1.4480	10.16078
	$Pb(NO_3)_2$	1.4839	10.17140
	PbO_2	1.0717	10.03006
	PbS	1.0719	10.03017
	$PbSO_4$	1.3587	10.13311
PbO_2	Pb	0.86623	9.93763
	$Pb(NO_3)_2$	1.3847	10.14134
	PbO	0.93312	9.96994
	$PbSO_4$	1.2678	10.10305
Pb_3O_4	$PbCrO_4$	1.4142	10.15052
	$PbSO_4$	1.3270	10.12286
$Pb(OH)_2$	Pb	0.85899	9.93399
PbS	Pb	0.86601	9.93753
	PbO	0.93288	9.96983
	$PbSO_4$	1.2675	10.10294
$PbSO_4$	$BaSO_4$	0.76965	9.88629
	Pb	0.68326	9.83459
	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	1.2507	10.09715
	$PbCO_3$	0.88110	9.94503
	$(PbCO_3)_2 Pb(OH)_2$	0.85254	9.93072
	$PbCrO_4$	1.0658	10.02767
	$Pb(NO_3)_2$	1.0922	10.03829
	PbO	0.73602	9.86689
	PbO_2	0.78878	9.89695
	Pb_3O_4	0.75361	9.87714
	PbS	0.78897	9.89706

Weighed	Sought	Factor	Logarithm
Lithium:			−10
Li = 6.940			
CO_2	Li_2CO_3	1.6791	10.22507
	$LiHCO_3$	1.5443	10.18872
	Li_2O	0.67909	9.83193
Li	LiCl	6.1091	10.78598
	Li_2CO_3	5.3228	10.72614
	Li_2O	2.1527	10.33299
	Li_3PO_4	5.5639	10.74538
	Li_2SO_4	7.9207	10.89877
LiCl	Li	0.16369	9.21402
	Li_2CO_3	0.87129	9.94016
	Li_2O	0.35238	9.54702
	Li_3PO_4	0.91076	9.95940
	Li_2SO_4	1.2966	10.11279
Li_2CO_3	CO_2	0.59556	9.77493
	Li	0.18787	9.27386
	LiCl	1.1477	10.05984
	$LiHCO_3$	1.8394	10.26468
	Li_2O	0.40444	9.60685
	Li_3PO_4	1.0453	10.01924
$LiHCO_3$	CO_2	0.64755	9.81128
	Li_2CO_3	0.54365	9.73532
	Li_2O	0.21987	9.34218
	Li_3PO_4	0.56828	9.75456
Li_2O	CO_2	1.4726	10.16807
	Li	0.46452	9.66701
	LiCl	2.8378	10.45298
	Li_2CO_3	2.4726	10.39315
	$LiHCO_3$	4.5480	10.65782
	Li_3PO_4	2.5846	10.41239
	Li_2SO_4	3.6794	10.56578
	SO_3	2.6794	10.42804
Li_3PO_4	Li	0.17973	9.25462
	LiCl	1.0980	10.04060
	Li_2CO_3	0.95666	9.98076
	$LiHCO_3$	1.7597	10.24544
	Li_2O	0.38691	9.58761
	Li_2SO_4	1.4236	10.15339
	$Li_2SO_4 \cdot H_2O$	1.6569	10.21929
Li_2SO_4	Li	0.12625	9.10123
	LiCl	0.77128	9.88721
	Li_2O	0.27178	9.43422
	Li_3PO_4	0.70244	9.84661
	SO_3	0.72822	9.86226
$Li_2SO_4 \cdot H_2O$	Li_3PO_4	0.60354	9.78071
SO_3	Li_2O	0.37322	9.57197
	Li_2SO_4	1.3732	10.13774
Magnesium:			
Mg = 24.32			
$BaSO_4$	$MgSO_4$	0.51572	9.71242
	$MgSO_4 \cdot 7H_2O$	1.0560	10.0236[illegible]
Br	Mg	0.15216	9.18230

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Magnesium:			—10
Br	$MgBr_2$	1.1522	10.06151
	$MgBr_2.6H_2O$	1.8285	10.26208
Cl	Mg	0.34295	9.53523
	$MgCl_2$	1.3430	10.12806
	$MgCl_2.6H_2O$	2.8672	10.45746
CO_2	$MgCO_3$	1.9164	10.28248
	MgO	0.91636	9.96207
I	Mg	0.095808	8.98140
	MgI_2	1.0958	10.03973
Mg	Br	6.5720	10.81770
	Cl	2.9159	10.46477
	I	10.438	11.01860
	$MgCO_3$	3.4671	10.53997
	MgO	1.6579	10.21956
	$Mg_2P_2O_7$	4.5781	10.66069
	$MgSO_4$	4.9498	10.69459
$MgBr_2$	Br	0.86794	9.93849
$MgBr_2.6H_2O$	Br	0.54691	9.73792
$MgCl_2$	Cl	0.74463	9.87194
	$Mg_2P_2O_7$	1.1691	10.06786
$MgCl_2.6H_2O$	Cl	0.34877	9.54254
	$Mg_2P_2O_7$	0.54759	9.73845
$MgCl.KCl.6H_2O$	$Mg_2P_2O_7$	0.40067	9.60279
$MgCO_3$	CO_2	0.52182	9.71752
	Mg	0.28843	9.46003
	$Mg(HCO_3)_2$	1.7355	10.23942
	MgO	0.47818	9.67959
	$Mg_2P_2O_7$	1.3204	10.12072
$Mg(HCO_3)_2$	$MgCO_3$	0.57621	9.76058
	MgO	0.27553	9.44017
	$Mg_2P_2O_7$	0.76085	9.88130
MgI_2	I	0.91257	9.96027
MgO	CO_2	1.0913	10.03793
	Mg	0.60318	9.78044
	$MgCO_3$	2.0913	10.32041
	$Mg(HCO_3)_2$	3.6294	10.55983
	$Mg_2P_2O_7$	2.7614	10.44113
	$MgSO_4$	2.9856	10.47503
	SO_3	1.9856	10.29790
$Mg_2P_2O_7$	Mg	0.21843	9.33931
	$MgCl_2$	0.85534	9.93214
	$MgCl_2.6H_2O$	1.8262	10.26155
	$MgCl_2.KCl.6H_2O$	2.4958	10.39721
	$MgCO_3$	0.75732	9.87928
	$Mg(HCO_3)_2$	1.3143	10.11870
	MgO	0.36213	9.55887
	$MgSO_4$	1.0812	10.03390
	$MgSO_4.7H_2O$	2.2138	10.34515
$MgSO_4$	$BaSO_4$	1.9390	10.28758
Magnesium:			—10
$MgSO_4$	Mg	0.20203	9.30541
	MgO	0.33494	9.52497
	$Mg_2P_2O_7$	0.92490	9.96610
	SO_3	0.66506	9.82286
$MgSO_4.7H_2O$	$BaSO_4$	0.94698	9.97634
	$Mg_2P_2O_7$	0.45170	9.65485
	SO_3	0.32480	9.51162
SO_3	MgO	0.50362	9.70210
	$MgSO_4$	1.5036	10.17714
	$MgSO_4.7H_2O$	3.0788	10.48838
Manganese: Mn = 54.93			
$BaSO_4$	$MnSO_4$	0.64686	9.81081
CO_2	$MnCO_3$	2.6120	10.41698
	MnO	1.6120	10.20738
Mn	$MnCO_3$	2.0923	10.32062
	MnO	1.2913	10.11102
	Mn_2O_3	1.4369	10.15743
	Mn_3O_4	1.3884	10.14251
	$Mn_2P_2O_7$	2.5842	10.41233
$MnCO_3$	CO_2	0.38284	9.58302
	Mn	0.47794	9.67938
	MnS	0.75690	9.87904
	$MnSO_4$	1.3138	10.11851
	$Mn(HCO_3)_2$	1.5396	10.18741
	MnO	0.61716	9.79040
	Mn_3O_4	0.66356	9.82188
	$Mn_2P_2O_7$	1.2351	10.09170
$Mn(HCO_3)_2$	$MnCO_3$	0.64952	9.81259
	MnO	0.40086	9.60299
	Mn_3O_4	0.43100	9.63448
MnO	CO_2	0.62033	9.79262
	Mn	0.77443	9.88898
	$MnCO_3$	1.6203	10.20960
	$Mn(HCO_3)_2$	2.4947	10.39701
	Mn_2O_3	1.1128	10.04641
	Mn_3O_4	1.0752	10.03149
	$Mn_2P_2O_7$	2.0013	10.30131
	MnS	1.2264	10.08864
	$MnSO_4$	2.1287	10.32812
	SO_3	1.1287	10.05259
Mn_2O_3	Mn	0.69593	9.84257
	MnO	0.89864	9.95359
	Mn_3O_4	0.96621	9.98507
Mn_3O_4	Mn	0.72027	9.85749
	$MnCO_3$	1.5070	10.17812
	$Mn(HCO_3)_2$	2.3202	10.36552
	MnO	0.93007	9.96851
	Mn_2O_3	1.0350	10.01493
	MnO_2	1.1399	10.05685

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
			—10
Manganese:			
Mn_3O_4	$MnSO_4$	1.9799	10.29663
MnO_2	$Mn_2P_2O_7$	1.6329	10.21297
	Mn_3O_4	0.87730	9.94315
$Mn_2P_2O_7$	Mn	0.38697	9.58767
	$MnCO_3$	0.80965	9.90830
	MnO	0.49968	9.69869
	MnO_2	0.61240	9.78703
	$MnSO_4$	1.0637	10.02681
MnS	Mn	0.63145	9.80034
	$MnCO_3$	1.3212	10.12096
	MnO	0.81538	9.91136
	$MnSO_4$	1.7357	10.23948
$MnSO_4$	$BaSO_4$	1.5459	10.18919
	MnO	0.46977	9.67188
	Mn_3O_4	0.50509	9.70337
	$Mn_2P_2O_7$	0.94013	9.97319
	MnS	0.57613	9.76052
	Mn	0.36380	9.56086
	SO_3	0.53023	9.72447
SO_3	MnO	0.88596	9.94741
	$MnSO_4$	1.8860	10.27553
Mercury: Hg= 200.61			
Hg	HgCl	1.1767	10.07068
	$HgCl_2$	1.3535	10.13146
	HgO	1.0798	10.03333
	HgS	1.1598	10.06439
HgCl	Hg	0.84980	9.92932
	$HgCl_2$	1.1502	10.06077
	$HgNO_3$	1.1125	10.04629
	Hg_2O	0.88369	9.94630
	HgO	0.91758	9.96264
	HgS	0.98561	9.99371
$HgCl_2$	Hg	0.73883	9.86854
	HgCl	0.86942	9.93923
	HgS	0.85690	9.93293
$Hg(CN)_2$	HgS	0.92101	9.96426
$HgNO_3$	HgCl	0.89890	9.95371
	HgS	0.88596	9.94742
$Hg(NO_3)_2$	HgS	0.71673	9.85536
$Hg(NO_3)_2.H_2O$	HgS	0.67905	9.83190
Hg_2O	HgCl	1.1316	10.05370
	HgS	1.1153	10.04741
HgO	Hg	0.92613	9.96667
	HgCl	1.0898	10.03736
	HgS	1.0741	10.03106
HgS	HgCl	1.0146	10.00629
	$HgCl_2$	1.1670	10.06707
	$Hg(CN)_2$	1.0858	10.03574
	$HgNO_3$	1.1287	10.05258
	$Hg(NO_3)_2$	1.3952	10.14464
Mercury:			
HgS	$Hg(NO_3)_2.H_2O$	1.4727	10.16810
	Hg_2O	0.89659	9.95259
	HgO	0.93098	9.96894
	Hg	0.86221	9.93561
	$HgSO_4$	1.2751	10.10553
$HgSO_4$	HgS	0.78427	9.89447
Molybdenum: Mo= 96.0			
Mo	MoO_3	1.5000	10.17609
	MoS_3	2.0019	10.30144
	$PbMoO_4$	3.8252	10.58266
MoO_3	Mo	0.66667	9.82391
	MoS_3	1.3346	10.12535
	$(NH_4)_2MoO_4$	1.3617	10.13407
	$(NH_4)_3PO_4.12MoO_3$	1.0863	10.03595
	$PbMoO_3$	2.5501	10.40656
MoS_3	Mo	0.49953	9.69856
	MoO_3	0.74930	9.87465
	$(NH_4)_2MoO_4$	1.0203	10.0087
$(NH_4)_2MoO_4$	MoO_3	0.73440	9.86593
	MoS_3	0.98012	9.99128
	$(NH_4)_3PO_4.12MoO_3$	0.79778	9.90189
	$PbMoO_4$	1.8728	10.27250
$(NH_4)_3PO_4.12MoO_3$	MoO_3	0.92055	9.96405
	$(NH_4)_2MoO_4$	1.2535	10.09811
$PbMoO_4$	Mo	0.26142	9.41734
	MoO_3	0.39214	9.59344
	$(NH_4)_2MoO_4$	0.53395	9.72750
Neodymium: Nd= 144.27			
Nd	Nd_2O_3	1.1664	10.06683
Nd_2O_3	Nd	0.85737	9.93317
Nickel: Ni= 58.69			
Ni	$Ni(C_4H_7N_2O_2)_2$ Ni-glyoxime	4.9213	10.69208
	$Ni(NO_3)_2.6H_2O$	4.9548	10.69503
	NiO	1.2726	10.10470
	$NiSO_4$	2.6367	10.42107
	$NiSO_4.7H_2O$	4.7855	10.67992

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Nickel:			−10
$Ni(C_4H_7N_2O_2)_2$ (Ni-glyoxime)	Ni	0.20320	9.30792
	NiO	0.25859	9.41262
$Ni(NO_3)_2.6H_2O$	Ni	0.20182	9.30497
	NiO	0.25684	9.40967
	$NiSO_4$	0.53215	9.72604
NiO	Ni	0.78578	9.89530
	$Ni(C_4H_7N_2O_2)_2$ Ni-glyoxime	3.8671	10.58738
	$Ni(NO_3)_2.6H_2O$	3.8934	10.59033
	$NiSO_4$	2.0719	10.31637
	$NiSO_4.7H_2O$	3.7603	10.57523
$NiSO_4$	Ni	0.37926	9.57893
	$Ni(NO_3)_2.6H_2O$	1.8792	10.27396
	NiO	0.48265	9.68363
	$NiSO_4.7H_2O$	1.8149	10.25886
$NiSO_4.7H_2O$	Ni	0.20897	9.32008
	NiO	0.26593	9.42477
	$NiSO_4$	0.55099	9.74114
Nitrogen: N=14 008			
$AgNO_2$	HNO_2	0.30552	9.48504
	N_2O_3	0.24698	9.39267
HNO_2	$AgNO_2$	3.2731	10.51496
HNO_3	N	0.22229	9.34693
	NH_3	0.27027	9.43180
	NH_4Cl	0.84893	9.92887
	$(NH_4)_2PtCl_6$	3.5233	10.54695
	NO	0.47620	9.67779
	Pt	1.5491	10.19007
	SO_3	0.63524	9.80294
KNO_3	N_2O_5	0.53416	9.72767
N	HNO_3	4.4986	10.65307
	$NaNO_3$	6.0683	10.78307
	NH_3	1.2158	10.08487
	NH_4Cl	3.8190	10.58195
	$(NH_4)_2PtCl_6$	15.850	11.20003
	$(NH_4)_2SO_4$	4.7165	10.67362
	NO_2	3.2844	10.51646
	N_2O_3	2.7133	10.43350
	NO_3	4.4266	10.64607
	N_2O_5	3.8555	10.58608
	Pt	6.9685	10.84314
	SO_3	2.8577	10.45601
$NaNO_3$	N	0.16479	9.21693
	N_2O_5	0.63535	9.80301
NO	HNO_3	2.1000	10.32221
Nitrogen:			−10
NO	NO_2	1.5332	10.18560
	N_2O_3	1.2666	10.10264
	NO_3	2.0664	10.31521
	N_2O_5	1.7998	10.25522
N_2O_3	$AgNO_2$	4.0488	10.60733
	N	0.36855	9.56650
	NO	0.78952	9.89736
N_2O_5	KNO_3	1.8721	10.27233
	N	0.25937	9.41392
	$NaNO_3$	1.5739	10.19699
	NH_3	0.31535	9.49879
	NH_4Cl	0.99052	9.99586
	$(NH_4)_2PtCl_6$	4.1110	10.61394
	$(NH_4)_2SO_4$	1.2233	10.08754
	NO	0.55562	9.74478
	Pt	1.8074	10.25706
	SO_3	0.74119	9.86993
NO_2	N	0.30447	9.48354
	NO	0.65223	9.81440
NO_3	N	0.22591	9.35393
	NH_3	0.27466	9.43880
	NH_4Cl	0.86273	9.93588
	NO	0.48394	9.68479
	Pt	1.5742	10.19707
NH_3	HNO_3	3.70000	10.56820
	N	0.82248	9.91513
	N_2O_5	3.1711	10.50121
	NO_3	3.6408	10.56120
NH_4Cl	HNO_3	1.1779	10.07113
	NO_3	1.1591	10.06412
	N_2O_5	1.0096	10.00414
	N	0.26185	9.41805
$(NH_4)_2PtCl_6$	HNO_3	0.28382	9.45305
	N	0.063092	8.79997
	N_2O_5	0.24325	9.38606
	NO_3	0.27928	9.44605
$(NH_4)_2SO_4$	N	0.21202	9.32638
	N_2O_5	0.81745	9.91246
Pt	HNO_3	0.64555	9.80993
	N	0.14350	9.15686
	NO_3	0.63523	9.80293
	N_2O_5	0.55328	9.74294
SO_3	HNO_3	1.5742	10.19706
	N	0.34994	9.54399
	N_2O_5	1.3492	10.13007
Osmium: Os=190.8			
Os	OsO_4	1.3354	10.12562
OsO_4	Os	0.74882	9.87438
Palladium: Pd=106.7			
Pd	K_2PdCl_6	3.7267	10.57133

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
			—10
Palladium:			
Pd	PdI_2	3.3790	10.52878
	$PdCl_2.2H_2O$	2.0023	10.30153
	$Pd(NO_3)_2$	2.1623	10.33491
$PdCl_2.2H_2O$	K_2PdCl_6	1.8612	10.26980
	Pd	0.49943	9.69847
$Pd(NO_3)_2$	Pd	0.46247	9.66509
PdI_2	Pd	0.29594	9.47121
K_2PdCl_6	Pd	0.26833	9.42867
	$PdCl_2.2H_2O$	0.53728	9.73020
Phosphorus: P=31.02			
Ag_3PO_4	P	0.070494	8.86978
	PO_4	0.22696	9.35595
	P_2O_5	0.16964	9.22952
$Ag_4P_2O_7$	P	0.10245	9.01051
	PO_4	0.31383	9.49669
	P_2O_5	0.23456	9.37025
Al_2O_3	P_2O_5	1.3934	10.14407
$AlPO_4$	PO_4	0.77892	9.89149
	P_2O_5	0.58218	9.76506
$Ca_3(PO_4)_2$	P_2O_5	0.45778	9.66066
$FePO_4$	PO_4	0.62986	9.79924
	P_2O_5	0.47077	9.67281
$Mg_2P_2O_7$	Na_2HPO_4	1.2756	10.10570
	$Na_2HPO_4.12H_2O$	3.2173	10.50749
	$NaNH_4HPO_4.4H_2O$	1.8783	10.27376
	P	0.27861	9.44499
	PO_4	0.85342	9.93116
	P_2O_5	0.63787	9.80473
Na_2HPO_4	$Mg_2P_2O_7$	0.78396	9.89430
	P_2O_5	0.50006	9.69903
$Na_2HPO_4.12H_2O$	$Mg_2P_2O_7$	0.31082	9.49251
	P_2O_5	0.19826	9.29724
$NaNH_4HPO_4.4H_2O$	$Mg_2P_2O_7$	0.53241	9.72624
	P_2O_5	0.33960	9.53097
$(NH_4)_3PO_4.12MoO_3$	P	0.016525	8.21815
	PO_4	0.050620	8.70432
	P_2O_5	0.037834	8.57788
P	Ag_3PO_4	13.496	11.13022
	$Ag_4P_2O_7$	9.7608	10.98949
	$Mg_2P_2O_7$	3.5893	10.55501
	$(NH_4)_3PO_4.12MoO_3$	60.514	11.78185
	P_2O_5	2.2895	10.35974
	$P_2O_5.24MoO_3$	57.995	11.76339

Weighed	Sought	Factor	Logarithm
			—10
Phosphorus:			
P	$U_2P_2O_{11}$	11.514	11.06122
PO_4	Ag_3PO_4	4.4060	10.64405
	$Ag_4P_2O_7$	3.1865	10.50331
	$AlPO_4$	1.2838	10.10851
	$FePO_4$	1.5877	10.20076
	$Mg_2P_2O_7$	1.1718	10.06884
	$(NH_4)_3PO_4.12MoO_3$	19.755	11.29568
	$P_2O_5.24MoO_3$	18.933	11.27722
	$U_2P_2O_{11}$	3.7588	10.57505
P_2O_5	Ag_3PO_4	5.8950	10.77048
	$Ag_4P_2O_7$	4.2633	10.62975
	Al_2O_3	0.71769	9.85593
	$AlPO_4$	1.7177	10.23494
	$Ca_3(PO_4)_2$	2.1845	10.33934
	$FePO_4$	2.1242	10.32719
	$Mg_2P_2O_7$	1.5677	10.19527
	Na_2HPO_4	1.9997	10.30097
	$Na_2HPO_4.12H_2O$	5.0438	10.70276
	$NaNH_4HPO_4.4H_2O$	2.9446	10.46903
	$(NH_4)_3PO_4.12MoO_3$	26.431	11.42212
	P	0.43678	9.64026
	$P_2O_5.24MoO_3$	25.331	11.40366
	$U_2P_2O_{11}$	5.0290	10.70148
$P_2O_5.24MoO_3$	P	0.017243	8.23661
	PO_4	0.052818	8.72278
	P_2O_5	0.039477	8.59634
$U_2P_2O_{11}$	P	0.086852	8.93878
	PO_4	0.26604	9.42495
	P_2O_5	0.19885	9.29852
Platinum: Pt=195.23			
$H_2PtCl_6.6H_2O$	K_2PtCl_6	0.93841	9.97239
	Pt	0.37683	9.57615
K_2PtCl_6	$H_2PtCl_6.6H_2O$	1.0656	10.02761
	Pt	0.40157	9.60376
	$PtCl_4$	0.69829	9.84091
	$PtCl_4.5H_2O$	0.87857	9.94378
$(NH_4)_2PtCl_6$	Pt	0.43966	9.64311
	$PtCl_4$	0.75905	9.88027
	$PtCl_6$	0.91875	9.96320
Pt	$H_2PtCl_6.6H_2O$	2.6537	10.42385
	K_2PtCl_6	2.4903	10.39624
	$(NH_4)_2PtCl_6$	2.2745	10.35689

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Platinum:			—10
Pt	$PtCl_4$	1.7265	10.28716
	$PtCl_4.5H_2O$	2.1879	10.34002
$PtCl_4$	K_2PtCl_6	1.4424	10.15909
	$(NH_4)_2PtCl_6$	1.3174	10.11973
	Pt	0.57922	9.76284
$PtCl_6$	$(NH_4)_2PtCl_6$	1.0884	10.03680
$PtCl_4.5H_2O$	K_2PtCl_6	1.1382	10.05622
	Pt	0.45707	9.65998
Potassium: K= 39.10			
Ag	KBr	1.1032	10.04266
	KCl	0.69111	9.83955
	$KClO_3$	1.1360	10.05540
	$KClO_4$	1.2844	10.10869
	KCN	0.60352	9.78069
	KI	1.53893	10.18722
AgBr	KBr	0.63375	9.80192
	$KBrO_3$	0.88935	9.94907
AgCl	KCl	0.52015	9.71613
	$KClO_3$	0.85503	9.93198
	$KClO_4$	0.96665	9.98527
AgCN	KCN	0.48629	9.68689
AgI	KI	0.70707	9.84946
	KIO_3	0.91150	9.95976
$BaCrO_4$	K_2CrO_4	0.76651	9.88452
	$K_2Cr_2O_7$	0.58061	9.76389
$BaSO_4$	$KHSO_4$	0.58336	9.76594
	K_2S	0.47237	9.67428
	K_2SO_4	0.74655	9.87306
Br	K	0.48926	9.68954
	KBr	1.4893	10.17297
CaF_2	$KF.2H_2O$	2.4111	10.38222
$CaSO_4$	$KF.2H_2O$	1.3829	10.14078
Cl	K	1.1027	10.04247
	KCl	2.1027	10.32279
	$KClO_3$	3.4565	10.53864
	$KClO_4$	3.9077	10.59193
	K_2O	1.3284	10.12332
CO_2	K_2O	2.1409	10.33060
	K_2CO_3	3.1409	10.49706
I	KI	1.3081	10.11663
	KIO_3	1.6863	10.22692
K	Br	2.0439	10.31046
	Cl	0.90683	9.95753
	KBr	3.0439	10.48343
	KCl	1.9068	10.28031
	$KClO_3$	3.1345	10.49616
	$KClO_4$	3.5437	10.54945
	KI	4.2460	10.62798
	K_2O	1.2046	10.08084
	KNO_3	2.5859	10.41261
	K_2PtCl_6	6.2170	10.79358
	K_2SO_4	2.2284	10.34799
Potassium:			—10
K	Pt	2.4965	10.39734
K_3AsO_4	$Mg_2As_2O_7$	0.60590	9.78240
KBr	Ag	0.90643	9.95734
	AgBr	1.5779	10.19808
	Br	0.67147	9.82703
	K	0.32853	9.51657
	K_2O	0.39575	9.59742
$KBrO_3$	AgBr	1.1244	10.05093
KCl	Ag	1.4469	10.16045
	AgCl	1.9225	10.28387
	Cl	0.47557	9.67721
	K	0.52443	9.71969
	$KClO_3$	1.6438	10.21585
	$KClO_4$	1.8584	10.26914
	K_2CO_3	0.92681	9.96699
	$K_2Cr_2O_7$	1.9731	10.29515
	$KHCO_3$	1.3427	10.12798
	KNO_3	1.3561	10.13230
	K_2O	0.63173	9.80053
	K_2PtCl_6	3.2604	10.51327
	K_2SO_4	1.1686	10.06768
	Pt	1.3093	10.11703
$KClO_3$	Ag	0.88024	9.94460
	AgCl	1.1696	10.06802
	Cl	0.28931	9.46136
	KCl	0.60835	9.78415
$KClO_4$	Ag	0.77860	9.89131
	AgCl	1.0345	10.01473
	Cl	0.25590	9.40807
	K	0.28219	9.45055
	KCl	0.53810	9.73086
	K_2O	0.33993	9.53139
KCN	AgCN	2.0564	10.31311
	Ag	1.6569	10.21931
K_2CO_3	CO_2	0.31838	9.50294
	KCl	1.0790	10.03301
	KOH	0.81198	9.90955
	K_2O	0.68162	9.83354
	K_2PtCl_6	3.5179	10.54628
	K_2SO_4	1.2609	10.10069
K_2CrO_4	$BaCrO_4$	1.3046	10.11548
$K_2Cr_2O_7$	$BaCrO_4$	1.7223	10.23611
	KCl	0.50681	9.70485
	K_2O	0.32017	9.50538
$KF.2H_2O$	CaF_2	0.41474	9.61778
	$CaSO_4$	0.72314	9.85922
K_2HAsO_4	$Mg_2As_2O_7$	0.71171	9.85230
$KHCO_3$	KCl	0.74477	9.87202
	K_2O	0.47049	9.67255
	K_2PtCl_6	2.4282	10.38529
	K_2SO_4	0.87036	9.93970
$KHSO_4$	$BaSO_4$	1.7142	10.23406
	K_2SO_4	0.63987	9.80609
KI	Ag	0.64980	9.81278
	AgI	1.4143	10.15054
	I	0.76449	9.88337
	K	0.23550	9.37198

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm —10
Potassium:			
KI	K_2O	0.283700	9.45286
KIO_3	AgI	1.0971	10.04024
	I	0.59303	9.77308
K_2MnO_4	Mn_2O_3	0.40040	9.60249
	MnS	0.44128	9.64472
$KMnO_4$	Mn_2O_3	0.49946	9.69850
	MnS	0.55047	9.74073
KNO_2	K_2SO_4	1.0238	10.01020
	N_2O_3	0.44659	9.64990
KNO_3	K	0.38672	9.58739
	KCl	0.73740	9.86770
	K_2O	0.46584	9.66824
	K_2PtCl_6	2.4042	10.38097
	K_2SO_4	0.86175	9.93538
	N	0.13854	9.14159
	NH_3	0.16845	9.22646
	NO	0.29679	9.47245
	N_2O_5	0.53416	9.72767
K_2O	Cl	0.75280	9.87668
	CO_2	0.46709	9.66940
	K	0.83015	9.91916
	KBr	2.5269	10.40258
	KCl	1.5830	10.19947
	$KClO_3$	2.6021	10.41532
	$KClO_4$	2.9418	10.46861
	K_2CO_3	1.4671	10.16646
	$K_2Cr_2O_7$	3.1234	10.49462
	$KHCO_3$	2.1254	10.32745
	KI	3.5248	10.54714
	KOH	1.1912	10.07600
	KNO_3	2.1467	10.33176
	K_2PtCl_6	5.1611	10.71274
	K_2SO_4	1.8499	10.26715
	N_2O_5	1.1467	10.05944
KOH	K_2CO_3	1.2316	10.09045
	K_2O	0.83946	9.92400
K_2PtCl_6	K	0.16085	9.20642
	K_2CO_3	0.28426	9.45372
	KCl	0.30671	9.48673
	$KHCO_3$	0.41182	9.61471
	KNO_3	0.41594	9.61903
	K_2O	0.19376	9.28726
	K_2SO_4	0.35843	9.55441
	$K_2SO_4.Al_2(SO_4)_3.24H_2O$	1.9515	10.29036
	$K_2SO_4.Cr_2(SO_4)_3.24H_2O$	2.0545	10.31270
K_2S	$BaSO_4$	2.1170	10.32572
	K_2SO_4	1.5804	10.19878
K_2SiO_3	SiO_2	0.38934	9.59033
K_2SO_4	$BaSO_4$	1.3395	10.12694
	KCl	0.85570	9.93232
	K_2CO_3	0.79307	9.89931
	$KHCO_3$	1.1489	10.06030
	$KHSO_4$	1.5628	10.19391

Weighed	Sought	Factor	Logarithm —10
Potassium:			
K_2SO_4	KNO_2	0.97679	9.98980
	KNO_3	1.1604	10.06462
	K	0.44875	9.65201
	K_2O	0.54057	9.73285
	K_2PtCl_6	2.7899	10.44559
	K_2S	0.63273	9.80122
	SO_3	0.45943	9.66222
$K_2SO_4.Al_2(SO_4)_3.24H_2O$	K_2PtCl_6	0.51243	9.70964
$K_2SO_4.Cr_2(SO_4)_3.24H_2O$	K_2PtCl_6	0.48674	9.68730
$Mg_2As_2O_7$	K_3AsO_4	1.6504	10.21760
	K_2HAsO_4	1.4051	10.14770
Mn_2O_3	K_2MnO_4	2.4975	10.39751
	$KMnO_4$	2.0022	10.30150
MnS	K_2MnO_4	2.2661	10.35528
	$KMnO_4$	1.8166	10.25927
N	KNO_3	7.2179	10.85841
NH_3	KNO_3	5.9366	10.77354
NO	KNO_3	3.3694	10.52755
N_2O_3	KNO_2	2.2392	10.35010
N_2O_5	K_2O	0.87209	9.94056
	KNO_3	1.8721	10.27233
Pt	K	0.40055	9.60266
	KCl	0.76379	9.88297
SiO_2	K_2SiO_3	2.5684	10.40967
SO_3	K_2SO_4	2.1766	10.33778
Praseodymium: Pr = 140.92			
Pr	Pr_2O_3	1.1703	10.06830
Pr_2O_3	Pr	0.85448	9.93170
Rhodium: Rh = 102.91			
Rh	Na_3RhCl_6	3.7377	10.57260
	$RhCl_3$	2.0336	10.30827
$RhCl_3$	Rh	0.49173	9.69173
Na_3RhCl_6	Rh	0.26755	9.42740
Rubidium: Rb = 85.44			
AgCl	Rb	0.59608	9.77530
	RbCl	0.84345	9.92606
Cl	Rb	2.4097	10.38196
	RbCl	3.4097	10.53271
Rb	AgCl	1.6776	10.22470
	Cl	0.41499	9.61804
	RbCl	1.4150	10.15075
	Rb_2CO_3	1.3511	10.13070
	Rb_2O	1.0936	10.03887

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Rubidium:			—10
Rb	Rb_2PtCl_6	3.3875	10.52988
	Rb_2SO_4	1.5621	10.19372
RbCl	AgCl	1.1856	10.07394
	Cl	0.29328	9.46729
	Rb	0.70672	9.84925
	Rb_2CO_3	0.95486	9.97994
	Rb_2O	0.77289	9.88812
	Rb_2PtCl_6	2.3940	10.37912
	Rb_2SO_4	1.1040	10.04297
Rb_2CO_3	Rb	0.74012	9.86930
	RbCl	1.0473	10.02006
	$RbHCO_3$	1.2686	10.10333
	Rb_2PtCl_6	2.5072	10.39918
	Rb_2SO_4	1.1562	10.06303
$RbHCO_3$	Rb_2CO_3	0.78827	9.89667
	Rb_2PtCl_6	1.9763	10.29585
	Rb_2SO_4	0.91138	9.95970
Rb_2O	Rb	0.91438	9.96113
	RbCl	1.2938	10.11188
	Rb_2PtCl_6	3.0975	10.49100
	Rb_2SO_4	1.4284	10.15485
Rb_2PtCl_6	Rb	0.29520	9.47012
	RbCl	0.41771	9.62088
	Rb_2CO_3	0.39886	9.60082
	$RbHCO_3$	0.50599	9.70415
	Rb_2O	0.32285	9.50900
Rb_2SO_4	Rb	0.64014	9.80628
	RbCl	0.90580	9.95703
	Rb_2CO_3	0.86491	9.93697
	$RbHCO_3$	1.0972	10.04030
	Rb_2O	0.70008	9.84515
Selenium: Se= 79.2			
Se	H_2SeO_3	1.6315	10.21259
	H_2SeO_4	1.8335	10.26329
	SeO_2	1.4040	10.14738
	SeO_3	1.6061	10.20576
H_2SeO_3	Se	0.61293	9.78741
H_2SeO_4	Se	0.54540	9.73671
SeO_2	Se	0.71223	9.85262
SeO_3	Se	0.62264	9.79424
Silicon: Si= 28.06			
$BaSiF_6$	SiF_4	0.37241	9.57103
	SiO_2	0.21495	9.33233
H_2SiO_3	SiO_2	0.76925	9.88607
K_2SiF_6	SiF_4	0.47244	9.67435
	SiO_2	0.27268	9.43565
Si	SiO_2	2.1404	10.33050
SiF_4	$BaSiF_6$	2.6852	10.42897
	K_2SiF_6	2.1167	10.32565
	SiO_2	0.57717	9.76130
SiO_2	$BaSiF_6$	4.6523	10.66767
	H_2SiO_3	1.3000	10.11393
			—10
SiO_2	K_2SiF_6	3.6673	10.56435
	Si	0.46720	9.66950
	SiF_4	1.7326	10.23870
	SiO_3	1.2664	10.10257
	SiO_4	1.5328	10.18549
	Si_2O	0.60040	9.77844
	$Si(OH)_4$	1.5999	10.20410
SiO_3	SiO_2	0.78964	9.89743
SiO_4	SiO_2	0.65240	9.81451
Si_2O	SiO_2	1.6656	10.22156
$Si(OH)_4$	SiO_2	0.62503	9.79590
Silver: Ag= 107.880			
Ag	AgBr	1.7408	10.24075
	AgCl	1.3287	10.12342
	AgCN	1.2411	10.09380
	AgI	2.1765	10.33776
	$AgNO_3$	1.5748	10.19722
	Ag_2O	1.0742	10.03107
	Ag_3PO_4	1.2936	10.11180
	$Ag_4P_2O_7$	1.4033	10.14716
	Br	0.74079	9.86969
	Cl	0.32867	9.51676
	I	1.1765	10.07059
AgBr	Ag	0.57445	9.75925
	Br	0.42555	9.62895
AgCl	Ag	0.75263	9.87658
	$AgNO_3$	1.1852	10.07380
	Ag_2O	0.80844	9.90765
	Br	0.55754	9.74628
	Cl	0.24737	9.39334
AgCN	Ag	0.80575	9.90620
$AgNO_3$	Ag	0.63501	9.80278
	AgCl	0.84371	9.92620
AgI	Ag	0.45945	9.66224
	I	0.54055	9.73283
Ag_2O	Ag	0.93096	9.96893
	AgCl	1.2369	10.09235
Ag_3PO_4	Ag	0.77304	9.88820
$Ag_4P_2O_7$	Ag	0.71260	9.85284
Br	Ag	1.3499	10.13031
	AgBr	2.3499	10.37105
	AgCl	1.7936	10.25372
Cl	Ag	3.0426	10.48324
	AgCl	4.0426	10.60666
I	Ag	0.84998	9.92941
	AgI	1.8500	10.26717
Sodium: Na= 22.997			
Ag	NaBr	0.95396	9.97953
	NaCl	0.54184	9.73387
	NaI	1.3897	10.14291
AgBr	NaBr	0.54800	9.73878
AgCl	NaCl	0.40781	9.61046
	$NaClO_3$	0.74268	9.87080

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Sodium:			—10
AgCl	$NaClO_4$	0.85431	9.93161
AgI	NaI	0.63849	9.80515
$BaSO_4$	$NaHSO_4$	0.51437	9.71128
	$NaHSO_4.H_2O$	0.59155	9.77199
	Na_2S	0.33439	9.52426
	Na_2SO_3	0.54003	9.73242
	$Na_2SO_3.7H_2O$	1.0803	10.03354
	Na_2SO_4	0.60858	9.78432
	$Na_2SO_4.10H_2O$	1.3804	10.14000
B_2O_3	$Na_2B_4O_7$	1.4451	10.15990
	$Na_2B_4O_7.10H_2O$	2.7386	10.43753
Br	Na	0.28776	9.45904
	NaBr	1.2878	10.10984
	Na_2O	0.38787	9.58869
$CaCl_2$	NaCl	1.0533	10.02254
$CaCO_3$	Na_2CO_3	1.0591	10.02493
CaF_2	NaF	1.0757	10.03171
CaO	Na_2CO_3	1.8900	10.27647
$CaSO_4$	Na_2CO_3	0.77857	9.89130
Cl	Na	0.64859	9.81197
	NaCl	1.6486	10.21711
	Na_2O	0.87422	9.94162
CO_2	Na_2CO_3	2.4090	10.38183
	Na_2O	1.4090	10.14890
H_3BO_3	$Na_2B_4O_7$	0.81364	9.91043
	$Na_2B_4O_7.10H_2O$	1.5419	10.18806
I	Na	0.18119	9.25814
	NaI	1.1812	10.07232
	Na_2O	0.24422	9.38779
KBF_4	$Na_2B_4O_7$	0.39961	9.60163
	$Na_2B_4O_7.10H_2O$	0.75729	9.87926
$Mg_2As_2O_7$	Na_2HAsO_3	1.0946	10.03924
	Na_2HAsO_4	1.1976	10.07832
$MgCl_2$	NaCl	1.2276	10.08905
$Mg_2P_2O_7$	Na_2HPO_4	1.2756	10.10570
	$Na_2HPO_4.12H_2O$	3.2173	10.50749
	$NaNH_4HPO_4.4H_2O$	1.8783	10.27376
	$Na_4P_2O_7.10H_2O$	2.0037	10.30183
Na	Br	3.4751	10.54096
	Cl	1.5418	10.18803
	I	5.5190	10.74186
	NaBr	4.4751	10.65080
	NaCl	2.5418	10.40514
	Na_2CO_3	2.3045	10.36258
	$NaHCO_3$	3.6529	10.56263
	NaI	6.5190	10.81418
	Na_2O	1.3479	10.12965

Weighed	Sought	Factor	Logarithm
Sodium:			—10
Na	Na_2SO_4	3.0885	10.48975
$Na_2B_4O_7$	B_2O_3	0.69199	9.84010
	H_3BO_3	1.2290	10.08957
	KBF_4	2.5025	10.39837
$Na_2B_4O_7.10H_2O$	B_2O_3	0.36515	9.56247
	H_3BO_3	0.64854	9.81194
	KBF_4	1.3205	10.12074
NaBr	Ag	1.0483	10.02047
	AgBr	1.8248	10.26122
	Br	0.77654	9.89016
	Na	0.22346	9.34920
	Na_2O	0.30120	9.47885
NaCl	Ag	1.8456	10.26613
	AgCl	2.4521	10.38954
	Cl	0.60658	9.78289
	Na	0.39342	9.59486
	$NaClO_3$	1.8212	10.26035
	$NaClO_4$	2.0949	10.32116
	Na_2CO_3	0.90664	9.95744
	$NaHCO_3$	1.4371	10.15749
	Na_2HPO_4	1.2148	10.08451
	Na_2O	0.53028	9.72451
	Na_2SO_4	1.2151	10.08461
$NaClO_3$	AgCl	1.3465	10.12920
	NaCl	0.54910	9.73965
$NaClO_4$	AgCl	1.1705	10.06839
	NaCl	0.47735	9.67884
Na_2CO_3	$CaCO_3$	0.94420	9.97507
	CaO	0.52909	9.72353
	$CaSO_4$	1.2844	10.10870
	CO_2	0.41512	9.61817
	Na	0.43393	9.63742
	NaCl	1.1030	10.04256
	$NaHCO_3$	1.5851	10.20005
	Na_2O	0.58488	9.76707
	NaOH	0.75485	9.87786
	Na_2SO_4	1.3402	10.12717
$Na_2CO_3.10H_2O$	Na_2SO_4	0.49643	9.69586
NaF	CaF_2	0.92959	9.96829
Na_2HAsO_3	$Mg_2As_2O_7$	0.91360	9.96076
Na_2HAsO_4	$Mg_2As_2O_7$	0.83498	9.92168
$NaHCO_3$	Na	0.27376	9.43737
	NaCl	0.69584	9.84251
	Na_2CO_3	0.63088	9.79995
	Na_2O	0.36899	9.56702
$NaNH_4HPO_4.4H_2O$	$Mg_2P_2O_7$	0.53241	9.72624
	NH_3	0.081441	8.91084
	P_2O_5	0.33960	9.53097
Na_2HPO_4	$Mg_2P_2O_7$	0.78396	9.89430
	NaCl	0.82317	9.91549
	Na_2O	0.43651	9.63999

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Sodium:			—10
Na_2HPO_4	$Na_4P_2O_7$	0.93675	9.97162
	P_2O_5	0.50006	9.69903
$Na_2HPO_4.12H_2O$	$Mg_2P_2O_7$	0.31082	9.49251
	$Na_4P_2O_7$	0.37140	9.56984
	P_2O_5	0.19826	9.29724
$NaHSO_3$	SO_2	0.61558	9.78928
$NaHSO_4$	$BaSO_4$	1.9441	10.28872
$NaHSO_4.H_2O$	$BaSO_4$	1.6905	10.22801
NaI	Ag	0.71960	9.85709
	AgI	1.5662	10.19485
	I	0.84660	9.92768
	Na	0.15340	9.18582
	Na_2O	0.20674	9.31543
$NaNO_3$	Na_2O	0.36465	9.56188
	N	0.16479	9.21693
	NH_3	0.20036	9.30181
	NO	0.35301	9.54779
	N_2O_5	0.63535	9.80301
Na_2O	Br	2.5782	10.41131
	Cl	1.1439	10.05838
	CO_2	0.70975	9.85110
	I	4.0946	10.61221
	Na	0.74191	9.87035
	NaBr	3.3201	10.52115
	NaCl	1.8858	10.27549
	Na_2CO_3	1.7097	10.23293
	$NaHCO_3$	2.7101	10.43298
	NaI	4.8365	10.68453
	Na_2HPO_4	2.2909	10.36001
	$NaNO_3$	2.7424	10.43812
	NaOH	1.2906	10.11079
	Na_2SO_4	2.2914	10.36010
	N_2O_5	1.7424	10.24114
	SO_3	1.2914	10.11107
NaOH	Na_2CO_3	1.3248	10.12214
	Na_2O	0.77483	9.88921
$Na_4P_2O_7$	Na_2HPO_4	1.0675	10.02838
	$Na_2HPO_4.12H_2O$	2.6925	10.43016
$Na_4P_2O_7.10H_2O$	$Mg_2P_2O_7$	0.49908	9.69817
Na_2S	$BaSO_4$	2.9905	10.47574
Na_2SO_3	$BaSO_4$	1.8517	10.26758
	SO_2	0.50820	9.70603
$Na_2SO_3.7H_2O$	$BaSO_4$	0.92567	9.96646
	SO_2	0.25404	9.40491
Na_2SO_4	$BaSO_4$	1.6432	10.21568
	Na	0.32378	9.51025
	NaCl	0.82298	9.91539
	Na_2CO_3	0.74615	9.87283
	$Na_2CO_3.10H_2O$	2.0144	10.30414
Sodium:			—10
Na_2SO_4	Na_2O	0.43641	9.63990
	SO_3	0.56359	9.75096
$Na_2SO_4.10H_2O$	$BaSO_4$	0.72443	9.86000
N	$NaNO_3$	6.0683	10.78307
NH_3	$NaNO_3$	4.9911	10.69819
	$NaNH_4HPO_4.4H_2O$	12.279	11.08916
NO	$NaNO_3$	2.8327	10.45221
N_2O_5	$NaNO_3$	1.5739	10.19699
	Na_2O	0.57393	9.75886
P_2O_5	Na_2HPO_4	1.9997	10.30097
	$Na_2HPO_4.12H_2O$	5.0438	10.70276
	$NaNH_4HPO_4.4H_2O$	2.9446	10.46903
SO_2	$NaHSO_3$	1.6245	10.21072
	Na_2SO_3	1.9677	10.29397
	$Na_2SO_3.7H_2O$	3.9364	10.59509
SO_3	Na_2O	0.77434	9.88893
	Na_2SO_4	1.7743	10.24904
Strontium: Sr= 87.63			
CO_2	$SrCO_3$	3.3552	10.52572
SO_3	SrO	1.2944	10.11207
	$SrSO_4$	2.2944	10.36067
Sr	$SrCO_3$	1.6847	10.22652
	$Sr(NO_3)_2$	2.4152	10.38296
	SrO	1.1826	10.07283
	$SrSO_4$	2.0962	10.32143
$SrCl_2$	$SrCO_3$	0.93116	9.96902
	SrO	0.65364	9.81534
	$SrSO_4$	1.1586	10.06394
$SrCO_3$	CO_2	0.29804	9.47428
	Sr	0.59358	9.77348
	$SrCl_2$	1.0739	10.03098
	$Sr(HCO_3)_2$	1.4201	10.15231
	$Sr(NO_3)_2$	1.4336	10.15644
	SrO	0.70196	9.84631
	$SrSO_4$	1.2443	10.09491
$Sr(HCO_3)_2$	$SrCO_3$	0.70419	9.84769
	SrO	0.49431	9.69400
$Sr(NO_3)_2$	Sr	0.41404	9.61704
	$SrCO_3$	0.69753	9.84356
	SrO	0.48964	9.68988
	$SrSO_4$	0.86791	9.93848
SrO	SO_3	0.77256	9.88793
	Sr	0.84560	9.92717
	$SrCl_2$	1.5299	10.18466
	$SrCO_3$	1.4246	10.15369
	$Sr(HCO_3)_2$	2.0230	10.30600
	$Sr(NO_3)_2$	2.0423	10.31012
	$SrSO_4$	1.7726	10.24860

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
Strontium:			—10
$SrSO_4$	SO_3	0.43584	9.63933
	Sr	0.47705	9.67857
	$SrCl_2$	0.86311	9.93606
	$SrCO_3$	0.80369	9.90509
	$Sr(NO_3)_2$	1.1522	10.06152
	SrO	0.56416	9.75140
Sulfur: S = 32.06			
As_2S_3	H_2S	0.41549	9.61856
	S	0.39091	9.59208
$BaSO_4$	FeS_2	0.25696	9.40987
	H_2S	0.14598	9.16431
	H_2SO_3	0.35162	9.54608
	H_2SO_4	0.42017	9.62342
	S	0.13735	9.13783
	SO_2	0.27444	9.43845
	SO_3	0.34299	9.53528
	SO_4	0.41153	9.61440
CdS	H_2S	0.23587	9.37267
	S	0.22191	9.34619
FeS_2	$BaSO_4$	3.8916	10.59013
H_2S	As_2S_3	2.4068	10.38144
	$BaSO_4$	6.8501	10.83569
	CdS	4.2397	10.62733
	SO_3	2.3495	10.37097
H_2SO_3	$BaSO_4$	2.8440	10.45392
H_2SO_4	$BaSO_4$	2.3800	10.37658
	$(NH_4)_2SO_4$	1.3473	10.12947
	SO_3	0.81631	9.91185
$(NH_4)_2SO_4$	SO_3	0.60588	9.78239
	H_2SO_4	0.74222	9.87053
S	As_2S_3	2.5581	10.40792
	$BaSO_4$	7.2807	10.86217
	CdS	4.5062	10.65381
SO_2	$BaSO_4$	3.6438	10.56155
SO_3	$BaSO_4$	2.9156	10.46472
	H_2S	0.42563	9.62903
	$(NH_4)_2SO_4$	1.6505	10.21761
SO_4	$BaSO_4$	2.4299	10.38560
Tantalum: Ta = 181.4			
Ta	Ta_2O_5	1.2205	10.08654
	$TaCl_5$	1.9773	10.29608
$TaCl_5$	Ta	0.50574	9.70392
	Ta_2O_5	0.61725	9.79046
Ta_2O_4	Ta_2O_5	1.0375	10.01598
Ta_2O_5	Ta	0.81933	9.91346
	$TaCl_5$	1.6201	10.20954
	Ta_2O_4	0.96387	9.98402
Tellurium: Te = 127.5			
Te	H_2TeO_4	1.5178	10.18121

Weighed	Sought	Factor	Logarithm
Tellurium:			—10
Te	$H_2TeO_4 \cdot 2H_2O$	1.8004	10.25536
	TeO_2	1.2510	10.09725
	TeO_3	1.3765	10.13877
	$(TeO_2)_2SO_3$	1.5649	10.19450
H_2TeO_4	Te	0.65886	9.81879
$H_2TeO_4 \cdot 2H_2O$	Te	0.55544	9.74464
TeO_2	Te	0.79937	9.90275
TeO_3	Te	0.72650	9.86123
$(TeO_2)_2SO_3$	Te	0.63900	9.80550
Thallium: Tl = 204.39			
Tl	Tl_2CO_3	1.1468	10.05948
	TlCl	1.1735	10.06947
	Tl_2CrO_4	1.2838	10.10850
	$TlHSO_4$	1.4749	10.16877
	TlI	1.6210	10.20977
	$TlNO_3$	1.3034	10.11507
	Tl_2O	1.0391	10.01667
	Tl_2PtCl_6	1.9980	10.30060
	Tl_2SO_4	1.2350	10.09166
Tl_2CO_3	Tl	0.87201	9.94052
	Tl_2PtCl_6	1.7423	10.24112
TlCl	Tl	0.85217	9.93053
	Tl_2PtCl_6	1.7027	10.23113
Tl_2CrO_4	Tl	0.77894	9.89150
$TlHSO_4$	Tl	0.67801	9.83123
TlI	Tl	0.61691	9.79022
	Tl_2PtCl_6	1.2326	10.09081
$TlNO_3$	Tl	0.76724	9.88493
	Tl_2PtCl_6	1.5330	10.18553
Tl_2O	Tl	0.96233	9.98333
	Tl_2PtCl_6	1.9228	10.28393
Tl_2PtCl_6	Tl	0.50049	9.69940
	TlCl	0.58732	9.76887
	Tl_2CO_3	0.57396	9.75888
	TlI	0.81129	9.90917
	$TlNO_3$	0.65234	9.81447
	Tl_2O	0.52008	9.71607
	Tl_2SO_4	0.61811	9.79106
Tl_2SO_4	Tl	0.80972	9.90834
	Tl_2PtCl_6	1.6178	10.20894
Thorium: Th = 232.12			
Th	ThO_2	1.1379	10.05609
$ThCl_4$	ThO_2	0.70630	9.84899
$Th(NO_3)_4 \cdot 6H_2O$	ThO_2	0.44900	9.65224
ThO_2	Th	0.87884	9.94391
	$ThCl_4$	1.4158	10.15101
	$Th(NO_3)_4 \cdot 6H_2O$	2.2272	10.34776

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS—(Continued)

Weighed	Sought	Factor	Logarithm
			—10
Tin: Sn = 118.70			
Sn	$SnCl_2$	1.5974	10.20342
	$SnCl_2.2H_2O$	1.9010	10.27898
	$SnCl_4$	2.1948	10.34140
	$SnCl_4.(NH_4Cl)_2$	3.0962	10.49083
	SnO	1.1348	10.05492
	SnO_2	1.2696	10.10366
$SnCl_2$	Sn	0.62601	9.79658
	SnO_2	0.79477	9.90024
$SnCl_2.2H_2O$	Sn	0.52605	9.72102
	SnO_2	0.66786	9.82469
$SnCl_4$	Sn	0.45561	9.65860
	SnO_2	0.57844	9.76226
$SnCl_4(NH_4Cl)_2$	Sn	0.32298	9.50917
	SnO_2	0.41005	9.61283
SnO	Sn	0.88122	9.94508
	SnO_2	1.1188	10.04875
SnO_2	Sn	0.78766	9.89634
	$SnCl_2$	1.2582	10.09976
	$SnCl_2.2H_2O$	1.4973	10.17531
	$SnCl_4$	1.7288	10.23774
	$SnCl_4(NH_4Cl)_2$	2.4388	10.38717
	SnO	0.89383	9.95125
Titanium: Ti = 47.90			
Ti	TiO_2	1.6681	10.22221
TiO_2	Ti	0.59950	9.77779
Tungsten: W = 184.0			
W	WO_2	1.1739	10.06964
	WO_3	1.2609	10.10067
WO_2	W	0.85185	9.93036
WO_3	W	0.79310	9.89933
Uranium: U = 238.14			
U	UO_2	1.1344	10.05476
	$(UO_2)_2P_2O_7$	1.4998	10.17603
	U_3O_8	1.1792	10.07158
	$U_2P_2O_{11}$	1.4998	10.17603
UO_2	U	0.88154	9.94524
	U_3O_8	1.0395	10.01682
	$U_2P_2O_{11}$	1.3221	10.12127
U_3O_8	U	0.84806	9.92842
	UO_2	0.96201	9.98318
	$UO_2(NO_3)_2.6H_2O$	1.7886	10.25251
$UO_2(NO_3)_2.6H_2O$	U_3O_8	0.55910	9.74749
Uranium:			
$(UO_2)_2P_2O_7$	U	0.66676	9.82397
$U_2P_2O_{11}$	U	0.66676	9.82397
	UO_2	0.75636	9.87873
Vanadium: V = 50.95			
V	V_2O_5	1.7851	10.25166
VO_4	V_2O_5	0.79121	9.89829
V_2O_5	V	0.56020	9.74834
	VO_4	1.2639	10.10171
Ytterbium: Yb = 173.5			
Yb	Yb_2O_3	1.1383	10.05627
Yb_2O_3	Yb	0.87848	9.94373
Yttrium: Y = 88.92			
Y	Y_2O_3	1.2699	10.10377
Y_2O_3	Y	0.78746	9.89623
Zinc: Zn = 65.38			
$BaSO_4$	ZnS	0.41744	9.62060
	$ZnSO_4.7H_2O$	1.2319	10.09057
Zn	$ZnNH_4PO_4$	2.7293	10.43605
	ZnO	1.2447	10.09507
	$Zn_2P_2O_7$	2.3310	10.36754
	ZnS	1.4904	10.17329
$ZnCl_2$	ZnO	0.59709	9.77604
$ZnCO_3$	ZnO	0.64907	9.81229
$ZnNH_4PO_4$	Zn	0.36640	9.56395
	ZnO	0.45607	9.65903
ZnO	Zn	0.80339	9.90493
	$ZnCl_2$	1.6748	10.22396
	$ZnCO_3$	1.5407	10.18771
	$ZnNH_4PO_4$	2.1927	10.34097
	$Zn_2P_2O_7$	1.8727	10.27247
	ZnS	1.1973	10.07822
	$ZnSO_4.7H_2O$	3.5334	10.54819
$Zn_2P_2O_7$	Zn	0.42900	9.63246
	ZnO	0.53399	9.72753
ZnS	$BaSO_4$	2.3955	10.37940
	Zn	0.67098	9.82671
	ZnO	0.83518	9.92178
	$ZnSO_4.7H_2O$	2.9510	10.46997
$ZnSO_4.7H_2O$	$BaSO_4$	0.81176	9.90943
	ZnO	0.28301	9.45181
	ZnS	0.33886	9.53003
Zirconium: Zr = 91.22			
Zr	ZrO_2	1.3508	10.13059
ZrO_2	Zr	0.74030	9.86941

HEAT OF FORMATION AND SOLUTION

The following table gives the heat of formation of compounds from the elements in their standard states (18° C, 1 atm.) and the heat of solution in water in kilogram calories (mean) per gram-formula weight. To convert to B.T.U. multiply by 3.9685. To convert to kilojoules multiply by 4.186.

Values given are for 18° C and 1 atm. unless otherwise indicated. The heat of solution is given in most cases for a definite number of water molecules to one of the substance. Where this is not stated the dilution is understood to be such that additional dilution produces a negligible thermal effect.

The symbol ∞ indicates that the substance is formed in an "infinite" amount of water.

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Acetic acid	$HC_2H_3O_2$	solid$^{7°}$	120.2	150	$-2.15^{7°}$
		liquid	117.71		
		200	118.07		
Acetylene	C_2H_2	gas	− 54.337		
Aluminum					
bromide	$AlBr_3$	solid	+126.6	3000	$+85.3^{9°}$
		dil. sol.	211.9		
carbide	Al_4C_3	solid	81.48		
chloride	$AlCl_3$	solid	166.8		+77.90
		600	244.68		
	$AlCl_3.6H_2O$	solid	641.82	450	$+13.1^{16°}$
fluoride	AlF_3	solid	329.03		
	$AlF_3.5H_2O$	solid	375.39		
hydroxide	$Al(OH)_3$	ppt.	304.66		
iodide	AlI_3	solid	71.21	2200	$+88.89^{9°}$
		dil. sol.	160.3		
nitride	AlN	solid	131.4		
oxide (corundum)	Al_2O_3	solid	399.05		
oxide (powder)	Al_2O_3	amorph.	389.49		
silicate	$Al_2Si_2O_7$	solid	767.5		
sulfate	$Al_2(SO_4)_3$	solid	714.46		
		dil. sol.	883.88		
	$Al_2(SO_4)_3.18H_2O$	solid	2106.6		+8.1
sulfide	Al_2S_3	solid	344.80		+75.03
Alum, see under appropriate metal					
Ammonia	NH_3	liquid	15.84		
		gas	10.94		
		200	19.43	200	$+8.459^{18°}$
Ammonium					
acetate	$NH_4C_2H_3O_2$	solid	150.25	200	$+0.250^{24°}$
bromide	NH_4Br	solid	64.708	200	$-4.444^{18°}$
	$NH_3 + HBr$	solid	45.5		
carbonate	$(NH_4)_2CO_3$	dil. sol.	223.4		
carbonate, acid	NH_4HCO_3	solid	203.1	1200	$-6.69^{15°}$
chloride	NH_4Cl	solid	75.080	200	$-3.895^{18°}$
		∞	71.279		
chloroplatinite	$(NH_4)_2PtCl_4$	solid	194.0		−8.411
chromate	$(NH_4)_2CrO_4$	solid	274.31	700	$-5.73^{18°}$
		dil. sol.	267.62		
cyanate	NH_4CNO	dil. sol.	68.9		
cyanide	NH_4CN	solid	0.956	400	−4.349
dichromate	$(NH_4)_2Cr_2O_7$	solid	420.07	550	$-12.9^{16°}$
		600	407.41		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Ammonium					
ferrocyanide	$(NH_4)_4Fe(CN)_6.3H_2O$	solid	216.0	....	$-6.69^{14°}$
fluoride	NH_4F	solid	111.71	....	-1.51
		dil. sol.	110.20	....	....
fluosilicate	$(NH_4)_2SiF_6$	solid	619.36	1200	$-8.36^{7°}$
hydroxide	NH_4OH	200	87.814	....	....
iodide	NH_4I	solid	48.555	200	$-3.560^{18°}$
		200	44.994	....	....
nitrate	NH_4NO_3	solid	87.93	200	$-6.332^{18°}$
nitrite	NH_4NO_2	solid	62.15	400	$-4.755^{12°}$
		400	57.491	....	....
oxalate	$(NH_4)_2C_2O_4$	solid	267.15	....	-7.89
	$(NH_4)_2C_2O_4.H_2O$	solid	339.07	....	-11.5
oxalate, acid	$NH_4HC_2O_4$	400	226.69	....	....
perchlorate	NH_4ClO_4	solid	78.304	220	$-6.356^{20°}$
persulfate	$(NH_4)_2S_2O_8$	solid	382.80	1000	$-9.08^{16°}$
phosphate, mono-	$NH_4H_2PO_4$	dil. sol.	339.07	....	....
phosphate, ortho-	$(NH_4)_3PO_4$	dil. sol.	397.61	....	....
selenide	$(NH_4)_2Se$	dil. sol.	38.95	....	....
sulfate	$(NH_4)_2SO_4$	solid	277.66	400	$-2.39^{18°}$
		400	275.29	....	....
sulfate, acid	NH_4HSO_4	solid	240.43	200	$-0.024^{18°}$
		800	240.98	....	....
sulfhydrate	NH_4HS	solid	38.95	....	-3.3
		dil. sol.	35.675	....	....
sulfide	$(NH_4)_2S$	200	55.245	....	....
sulfide, penta-	$(NH_4)_2S_5$	solid	64.76	....	....
		dil. sol.	56.15	1000	$-8.6^{13°}$
sulfite	$(NH_4)_2SO_3$	solid	210.20	440	$-1.53^{18°}$
		dil. sol.	208.70	....	....
sulfite, acid	NH_4HSO_3	dil. sol.	179.2	....	....
sulfocyanate	NH_4CNS	solid	19.4	....	$-5.663^{12°}$
Antimonic acid, ortho-	H_3SbO_4	dil. sol.	216.56	....	....
Antimonous acid	H_3SbO_3	dil. sol.	166.8	....	....
Antimony					
bromide	$SbBr_3$	solid	61.41	....	....
		liquid	58.28	....	....
chloride, tri-	$SbCl_3$	solid	91.398	....	....
		liquid	88.292	....	....
chloride, penta-	$SbCl_5$	solid	107.31	....	....
		liquid	104.88	....	....
		gas	93.812	....	....
fluoride	SbF_3	solid	216.5	200	-1.67
		dil. sol.	214.8	....	....
hydride (stibine)	SbH_3	gas	-34.815	....	....
iodide	SbI_3	solid	$+44.21$	....	....
oxide, tri-	Sb_2O_3	solid	165.4	....	....
oxide, tetra	Sb_2O_4	solid	211.2	....	....
oxide, penta-	Sb_2O_5	solid	230.8	....	....
		dil. sol.	227.96	....	....
oxychloride (ous)	$SbOCl$	solid	89.200	....	....
sulfide (black)	Sb_2S_3	solid	35.84	....	....
Arsenic					
acid, ortho-	H_3AsO_4	solid	214.98	300	$-0.406^{18°}$
		dil. sol.	214.6	....	....
bromide (ous)	$AsBr_3$	solid	46.36	....	....
		liquid	43.49	....	....
chloride (ous)	$AsCl_3$	solid	72.40	....	....
		liquid	71.390	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Arsenic					
hydride (arsine)	AsH_3	gas	− 43.49		
	$AsH_3.6H_2O$	solid$^{-10°}$	+366.79		
iodide (ous)	AsI_3	solid	14.3		
oxide, tri-	As_2O_3	solid	147.9		
		dil. sol.	148.6		
oxide, penta-	As_2O_5	solid	217.90		+5.998
		dil. sol.	223.9		
oxide	As_4O_6	gas	267.86		
sulfide, di-	As_2S_2	solid	19.1		
Arsenious acid, ortho-	H_3AsO_3	dil. sol.	176.8		
Auric, see *gold*					
Barium					
acetate	$Ba(C_2H_3O_2)_2$	solid	358.4	600	$+5.26^{11°}$
arsenate	$Ba_3(AsO_4)_2$	ppt.	817.69		
bromide	$BaBr_2$	solid	180.4	400	$+4.97^{18°}$
		400	185.4		
	$BaBr_2.2H_2O$	solid	326.4	400	$-4.182^{18°}$
carbonate	$BaCO_3$	ppt.	290.85		
chlorate	$Ba(ClO_3)_2$	solid	174.0	600	$-6.69^{10°}$
	$Ba(ClO_3)_2.H_2O$	solid	246.8	600	$-11.23^{18°}$
chloride	$BaCl_2$	solid	205.33	400	$+2.08^{18°}$
		2000	207.55		
	$BaCl_2.2H_2O$	solid	349.08	400	$-4.922^{18°}$
chromate	$BaCrO_4$	ppt.	334.05		
cyanide	$Ba(CN)_2$	solid	57.11		$+1.768^{9°}$
		dil. sol.	59.02		
ferrocyanide	$Ba_2Fe(CN)_6$	dil. sol.	135.0		
	$Ba_2Fe(CN)_6.6H_2O$	solid	556.51		$-11.5^{14°}$
fluoride	BaF_2	ppt.	287.70		
fluosilicate	$BaSiF_6$	solid	677.42		
hydride	BaH_2	solid	40.86		
hydroxide	$Ba(OH)_2$	solid	225.86	660	$+11.40^{16°}$
		400	237.49		
	$Ba(OH)_2.8H_2O$	solid	799.05	660	$-14.5^{15°}$
hypobromite	$Ba(BrO)_2$	dil. sol.	174.4		
hypochlorite	$Ba(ClO)_2$	dil. sol.	180.9		
hypophosphite	$Ba(H_2PO_2)_2$	dil. sol.	414.10		
	$Ba(H_2PO_2)_2.H_2O$	solid	482.20	400	$+0.287^{18°}$
iodate	$Ba(IO_3)_2$	solid	245.16		
		dil. sol.	236.6		
	$Ba(IO_3)_2.H_2O$	solid	316.37		
iodide	BaI_2	solid	144.8		$+10.30^{16°}$
		dil. sol.	155.08		
nitrate	$Ba(NO_3)_2$	solid	238.28	400	$-9.462^{18°}$
		1600	228.44		
nitride	Ba_3N_2	solid	90.80		
nitrite	$Ba(NO_2)_2$	solid	185.7	800	$-5.687^{12°}$
	$Ba(NO_2)_2.H_2O$	solid	256.87	800	$-8.60^{12°}$
oxalate	$BaC_2O_4.H_2O$	ppt.	397.37		
oxide	BaO	solid	133.1	600	$+35.84^{15°}$
oxide, di-	BaO_2	solid	151.7		
perchlorate	$Ba(ClO_4)_2$	solid	210.3	800	$-1.67^{10°}$
phosphate, mono-	$BaH_4(PO_4)_2$	solid	735.9		
phosphate, di-	$BaHPO_4$	solid	424.6		
phosphate, tri-	$Ba_3(PO_4)_2$	solid	991.64		
platinochloride	$BaPtCl_6$	solid	284.83	5000	$+9.08^{19°}$
selenide	$BaSe$	solid	88.17		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Barium					
silicate	$BaSiO_3$	fused	356.04		
sulfate	$BaSO_4$	ppt.	345.28		
		dil. sol.	339.31		
sulfhydrate	$Ba(SH)_2$	dil. sol.	136.2		
sulfide	BaS	solid	111.1		
		dil. sol.	118.5		
sulfite	$BaSO_3$	ppt.	279.57		
Beryllium					
chloride	$BeCl_2$	solid	112.5		
	$BeCl_2.4H_2O$	solid	188.1		
fluoride	BeF_2	dil. sol.	240.84		
hydroxide	$Be(OH)_2$	ppt.	206.7		
iodide	BeI_2	sol.	67.38		
nitrate	$Be(NO_3)_2$	dil. sol.	184.7		
sulfate	$BeSO_4$	solid	276.47		
	$BeSO_4.4H_2O$	solid	567.51		+1.10
Bismuth					
chloride	$BiCl_3$	solid	90.61		
hydroxide	$Bi(OH)_3$	dil. sol.	171.1		
oxide	Bi_2O_3	solid	135.5		
oxychloride	$BiOCl$	solid	87.69		
Boric acid	H_3BO_3	solid	251.61	400	$-5.401^{18°}$
		dil. sol.	246.12		
Boron					
bromide	BBr_3	liquid	42.77	400	+83.63
chloride	BCl_3	liquid	93.67		
		gas	89.13		
fluoride	BF_3	gas	256.87		+24.37
oxide	B_2O_3	solid	279.81		
Bromic acid	$HBrO_3$	200	12.7		
Bromine (atomic)	Br	gas	− 26.691		
Bromine	Br_2	solid	+ 2.581		
		gas	− 7.646		
chloride	$BrCl$	liquid	0.700		
Bromous acid	$HBrO$	dil. sol.	25.57		
Cadmium					
bromide	$CdBr_2$	solid	75.79	400	$+0.43^{18°}$
		400	76.23		
carbonate	$CdCO_3$	ppt.	178.7		
chloride	$CdCl_2$	solid	92.999	400	$+3.106^{18°}$
		400	96.08		
	$CdCl_2.2\frac{1}{2}H_2O$	solid	269.99	400	$-2.939^{18°}$
cyanide	$Cd(CN)_2$	solid	− 36.80		
fluoride	CdF_2	1200	172.50		
hydroxide (ord. ppt.)	$Cd(OH)_2$	ppt.	133.57		
iodide	CdI_2	solid	48.387		
		400	47.431	400	$-0.956^{19°}$
nitrate	$Cd(NO_3)_2$	400	117.06		
	$Cd(NO_3)_2.4H_2O$	solid	395.63	400	$-5.042^{19°}$
oxide	CdO	solid	65.23		
selenide	$CdSe$	solid	16.7		
		ppt.	22.		
sulfate	$CdSO_4$	solid	217.92	400	$+10.68^{18°}$
		400	228.61		
sulfide	CdS	solid	33.93		
telluride	$CdTe$	solid	15.8		
Caesium					
bromide	$CsBr$	solid	97.468	110	$-6.738^{21°}$
		dil. sol.	90.80		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Caesium					
carbonate	Cs_2CO_3	solid	273.14	220	$+11.83^{15°}$
		dil. sol.	285.21		
carbonate, acid	$CsHCO_3$	solid	231.3	220	$-4.30^{16°}$
		dil. sol.	227.0		
chloride	$CsCl$	solid	106.48	220	$-4.588^{19°}$
		400	101.77		
fluoride	CsF	solid	131.97	110	$+8.363^{15°}$
		400	140.38		
hydroxide	$CsOH$	solid	100.26	110	$+16.4^{15°}$
		400	116.82		
iodide	CsI	solid	83.752	110	$-8.24^{15°}$
		dil. sol.	75.75		
nitrate	$CsNO_3$	solid	121.79	400	$-9.606^{20°}$
		400	112.19		
oxide, mono-	Cs_2O	solid	82.20	600	$+83.15^{18°}$
oxide, tetra-	Cs_2O_4	solid	137.64		
sulfate	Cs_2SO_4	solid	340.98	220	$-4.97^{15°}$
		440	335.96		
sulfate, acid	$CsHSO_4$	solid	275.27	220	$-3.728^{15°}$
		220	271.69		
sulfide	Cs_2S	solid	87.46		$+27.24$
		dil. sol.	114.70		
Calcium					
acetate	$Ca(C_2H_3O_2)_2$	solid	357.95	440	$+6.93^{16°}$
		dil. sol.	364.88		
	$Ca(C_2H_3O_2)_2.H_2O$	solid	427.48	600	$+5.85^{17°}$
aluminate, mono-	$CaO.Al_2O_3$	fused	549.59		
aluminate, di-	$2CaO.Al_2O_3$	fused	692.96		
aluminate, tri-	$3CaO.Al_2O_3$	fused	836.33		
aluminum silicate	$3CaO.Al_2O_3.2SiO_2$	solid	1486.3		
arsenate	$Ca_3(AsO_4)_2$	ppt.	793.31		
bromide	$CaBr_2$	solid	162.2		$+24.37$
		dil. sol.	186.9		
	$CaBr_2.6H_2O$	solid	598.09	400	$-1.10^{20°}$
carbide	CaC_2	solid	14.6		
carbonate	$CaCO_3$	colloid	287.93		
chloride	$CaCl_2$	solid	190.7	400	$+17.99^{18°}$
	$CaCl_2.H_2O$	solid	265.23	300	$+11.71^{18°}$
	$CaCl_2.6H_2O$	solid	623.44	400	$-4.564^{18°}$
cyanamide	$CaCN_2$	solid	85.07		
cyanide	$Ca(CN)_2$	dil. sol.	60.45		
ferrocyanide	$Ca_2Fe(CN)_6.12H_2O$	solid	963.21		$-4.54^{10°}$
fluoride	CaF_2	ppt.	286.26		
formate	$Ca(CHO_2)_2$	solid	326.88	360	$+0.669^{16°}$
hydride	CaH_2	solid	45.88		
hydroxide	$Ca(OH)_2$	solid	236.1		
		dil. sol.	238.76		
hypochlorite	$Ca(ClO)_2$	dil. sol.	181.60		
iodide	CaI_2	solid	128.6	400	$+27.69^{18°}$
		dil. sol.	156.3		
	$CaI_2.8H_2O$	solid	701.56		$+1.74^{20°}$
nitrate	$Ca(NO_3)_2$	solid	225.3	400	$+3.943^{19°}$
		400	229.15		
	$Ca(NO_3)_2.4H_2O$	solid	509.92	400	$-7.24^{19°}$
nitride	Ca_3N_2	solid	109.0		
nitrite	$Ca(NO_2)_2.4H_2O$	solid	405.50		
oxalate	CaC_2O_4	ppt.	333.3		
oxide	CaO	solid	151.71		
peroxide	CaO_2	solid	155.8		
	$CaO_2.8H_2O$	solid	718.52		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Calcium					
phosphate, mono-	$CaH_4(PO_4)_2$	ppt.	743.13		
phosphate, tri-	$Ca_3(PO_4)_2$	solid	982.1		
phosphate, acid	$CaHPO_4$	ppt.	432.50		
selenide	$CaSe$	solid	88.41		
silicate	$CaSiO_3$	fused	375.15		
silicide	$CaSi_2$	solid	224.6		
sulfate (anhydrite)	$CaSO_4$	solid	335.72		+5.26
	$CaSO_4.2H_2O$	solid	477.80		−0.24
sulfhydrate	$Ca(SH)_2$	dil. sol.	137.4		
sulfide	CaS	solid	113.50		
		dil. sol.	119.71		
thiosulfate	CaS_2O_3	∞	270.49		
Carbon					
dichloride	C_2Cl_4	liquid	6.0		
		gas	− 1.150		
dioxide	CO_2	gas	+ 94.385		
		sat.	99.140		+4.755
disulfide	CS_2	liquid	− 22.0		
		gas	− 28.67		
monoxide	CO	gas	+ 26.428		
oxybromide	$COBr_2$	gas	22.0		
oxychloride	$COCl_2$	gas	52.09		
		liquid	57.993		
tetrachloride	CCl_4	gas	25.400		
		liquid	33.190		
Carbonic acid	H_2CO_3	dil. sol.	167.53		
Cerium	Ce	dil. sol.	164.9		
chloride (ous)	$CeCl_3$	600	283.39		
oxide (ic)	CeO_2	solid	234.9		
sulfate (ous)	$Ce_2(SO_4)_3$	dil. sol.	792.84		
Chloric acid	$HClO_3$	400	19.1		
Chlorine (atomic)	Cl	gas	− 28.746		
oxide, mono-	Cl_2O	gas	− 18.26	800	$+9.439^{18°}$
oxide, di-	ClO_2	liquid	− 30.11		
		gas	− 23.49		
Chlorous acid, hypo-	$HClO$	200	+ 29.773		
Chromic acid	H_2CrO_4	dil. sol.	206.69		
Chromium					
bromide (ic) (blue)	$CrBr_3$	dil. sol.	146.5		
bromide (ic) (green)	$[CrBr_2]Br$	dil. sol.	135.0		
	$(Cr.4H_2O.Br_2)Br.2H_2O$	solid	544.57	250	+0.669
bromide (ic)	$(Cr.6H_2O)Br_3$	solid	542.42		−14.34
chloride (ic) (rose) (forms green solution)	$CrCl_3$	solid	139.55		+30.59
chloride (ic) (green)	$(CrCl_2.4H_2O)Cl.2H_2O$	solid	580.41	150	−0.048
chloride (ic) (gray)	$(Cr.6H_2O)Cl_3$	solid	577.30		+12.02
chloride (ic)	$(Cr.4H_2O.Cl)Cl_2.6H_2O$	solid	854.01		0
chloride (ic)	$(Cr.4H_2O.Cl)Cl_2$	solid	435.37		+8.36
chloride (ous)	$CrCl_2$	solid	99.64		+18.6
		dil. sol.	118.3		
	$CrCl_2.4H_2O$	solid	389.73		+1.9
hydroxide (ic)	$Cr(OH)_3$	ppt.	245.88		
oxide (ic)	Cr_2O_3	solid	267.39		
		amorph.	266.19		
oxide, tri-	CrO_3	solid	136.0	80	$+2.461^{18°}$

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal
Chromium					
sulfate (ic) (violet)	$Cr_2(SO_4)_3$	dil. sol.	753.89	....	....
sulfate (ic) (green)	$Cr_2(SO_4)_3$	dil. sol.	730.95	....	....
sulfate (ic) (violet)	$(Cr.6H_2O)_2(SO_4)_3.2H_2O$	solid	1701.1	....	+10.11
sulfate (ic)	$(Cr.6H_2O)_2(SO_4)_3.3H_2O$	solid	1771.1	....	+8.29
sulfate (ic) (green)	$Cr_2(SO_4)_3.6H_2O$	solid	1127.4	....	+13.4
Cobalt					
bromide (ous)	$CoBr_2$	solid	54.96	....	+18.4
		dil. sol.	73.36	....	....
	$CoBr_2.6H_2O$	solid	485.07	....	−1.29
chloride (ous)	$CoCl_2$	solid	76.942	400	+18.45[17°]
fluoride (ous)	CoF_2	dil. sol.	172.81	....	....
hydroxide (ic)	$Co(OH)_3$	ppt.	219.36	....	....
hydroxide (ous)	$Co(OH)_2$	ppt.	128.32	....	....
iodide (ous)	CoI_2	dil. sol.	42.77	....	....
nitrate	$Co(NO_3)_2$	solid	104.2	300	+11.95[18°]
	$Co(NO_3)_2.6H_2O$	solid	531.19	400	−4.97[18°]
oxide (ous)	CoO	solid	57.49	....	....
		amorph.	50.18	....	....
oxide (ous) (ic)	Co_3O_4	solid	192.6	....	....
selenide	$CoSe$	solid	13.4	....	....
		ppt.	11.5	....	....
sulfate	$CoSO_4$	800	225.09	....	....
	$CoSO_4.7H_2O$	solid	707.29	800	−3.560[19°]
sulfide	CoS	ppt.	19.8	....	....
telluride	$CoTe$	solid	11.5	....	....
Copper					
acetate (ic)	$Cu(C_2H_3O_2)_2$	solid	214.6	320	+2.39[16°]
		dil. sol.	217.0	....	....
	$Cu(C_2H_3O_2)_2.H_2O$	solid	285.07	400	+0.167[18°]
am. chloride (ic)	$CuCl_2.2NH_4Cl$	solid	197.6	550	+4.78[15°]
	$CuCl_2.2NH_4Cl.2H_2O$	solid	332.86	....	−6.21
am. sulfate (ic)	$CuSO_4.4NH_3$	solid	295.10	....	....
bromide (ic)	$CuBr_2$	solid	32.02	400	+8.244[20°]
		400	40.14	....	....
	$CuBr_2.4H_2O$	solid	315.18	....	−1.43
bromide (ous)	$CuBr$	solid	24.61	....	....
carbonate	$CuCO_3$	ppt.	141.5	....	....
chlorate (ic)	$Cu(ClO_3)_2$	400	22.2	....	....
chloride (ic)	$CuCl_2$	solid	51.422	600	+11.11[18°]
		800	62.605	....	....
	$CuCl_2.2H_2O$	solid	195.03	200	+3.704[18°]
chloride (ous)	$CuCl$	solid	32.50	....	....
cyanide (ous)	$CuCN$	solid	− 27.96	....	....
fluoride (ic)	CuF_2	400	+139.8	....	....
formate (ic)	$Cu(CHO_2)_2$	solid	179.5	600	+0.526[15°]
		dil. sol.	179.9	....	....
	$Cu(CHO_2)_2.4H_2O$	solid	461.17	500	−7.89[10°]
hydroxide (ic) (green)	$Cu(OH)_2$	ppt.	104.97	....	....
iodide (ic)	CuI_2	solid	3.10	....	....
		dil. sol.	9.08	....	....
iodide (ous)	CuI	solid	15.8	....	....
nitrate	$Cu(NO_3)_2$	solid	72.40	280	+10.47[8°]
		200	82.796	....	....
	$Cu(NO_3)_2.3H_2O$	solid	290.56	....	−2.39
	$Cu(NO_3)_2.6H_2O$	solid	503.80	400	−10.70[16°]
oxide (ic)	CuO	solid	34.89	....	....
oxide (ous)	Cu_2O	solid	39.90	....	....
oxychloride	$CuCl_2.3CuO$	solid	160.57	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Copper					
selenate	$CuSeO_4$	400	128.6	....	....
	$CuSeO_4.5H_2O$	solid	473.1	....	−2.652
selenide (ic)	CuSe	ppt.	4.78	....	....
selenide (ous)	Cu_2Se	solid	7.41	....	....
sulfate (ic)	$CuSO_4$	solid	178.7	800	+15.89$^{18°}$
		800	194.65	....	....
	$CuSO_4.5H_2O$	solid	539.33	800	−2.796$^{18°}$
sulfate (ous)	Cu_2SO_4	solid	173.5	....	....
sulfide (ic)	CuS	solid	11.61	....	....
sulfide (ous)	Cu_2S	solid	18.97	....	....
telluride	Cu_2Te	solid	4.06	....	....
Cyanic acid	HCNO	dil. sol.	36.56	....	....
Cyanogen	C_2N_2	liquid	− 65.47	....	....
		gas	− 70.73	....	....
chloride	CNCl	liquid	− 28.20	....	....
		gas	− 36.56	....	....
iodide	CNI	solid	− 42.29	....	....
		dil. sol.	− 44.92	100	−2.77$^{20°}$
Dysprosium					
sulfate	$Dy_2(SO_4)_3 + 8H_2O$	....	....	1200	+6.3
Erbium acetate	$Er(C_2H_3O_2)_3 + 4H_2O$	....	....	1500	+0.7
Ethane	C_2H_6	gas	23.4	....	....
Ethyl alcohol	C_2H_5OH	liquid	65.902	....	....
		gas	55.795	....	....
Ethylene	C_2H_4	gas	− 9.56	....	....
Ferric and Ferrous salts, see under *Iron*					
Fluosilicic acid	H_2SiF_6	200	545.04	....	....
	$H_2SiF_6.4H_2O$	liquid	789.25	....	+7.9
Gold					
bromide (ic)	$AuBr_3$	solid	13.38	2000	−3.752$^{15°}$
bromide (ous)	AuBr	solid	4.54	....	....
chloride (ic)	$AuCl_3$	solid	27.00	900	+4.444$^{18°}$
chloride (ous)	AuCl	solid	10.27	....	....
iodide (ous)	AuI	solid	0.96	....	....
Hydrazine	N_2H_4	dil. sol.	− 3.250	....	....
sulfate	$N_2H_4.H_2SO_4$	solid	+224.37	....	....
		dil. sol.	215.77	1200	−8.531$^{19°}$
Hydrazoic acid	HN_3	dil. sol.	− 54.48	....	....
Hydrobromic acid	HBr	gas	+ 8.650	200	+19.88$^{15°}$
		∞	28.602	....	....
	$HBr.2H_2O$	solid$^{-15°}$	164.40	....	....
Hydrochloric acid	HCl	gas	22.03	....	....
		∞	39.558	200	+17.44$^{18°}$
Hydrocyanic acid	HCN	gas	− 30.108	....	....
		dil. sol.	− 23.90	....	+5.97
Hydroferricyanide acid	$H_3Fe(CN)_6$	dil. sol.	−148.1	....	....
Hydroferrocyanic acid	$H_4Fe(CN)_6$	solid	−122.8	200	+0.406$^{10°}$
		dil. sol.	−122.3	....	....
Hydrofluoric acid	HF	liquid	+ 94.86	....	+4.54
		600	75.699	....	....
		gas	63.991	....	....
Hydriiodic acid	HI	gas	− 5.926	200	+19.24$^{18°}$
		∞	+ 13.333	....	....
Hydrogen (atomic)	H	gas	− 50.42	....	....
oxide (water)	H_2O	liquid	+68.387	....	....
		gas	57.826	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Hydrogen					
peroxide	H_2O_2	liquid	44.516	200	$+0.454^{15°}$
		gas	32.903		
		200	44.970		
selenide	H_2Se	dil. sol.	− 13.4		$+2.39^{18°}$
		gas	− 15.8		
sulfide	H_2S	liquid	+ 9.56		
		gas	5.26		
		dil. sol.	9.869		+4.564
telluride	H_2Te	gas	− 33.93		
Hydrosulfurous acid	$H_2S_2O_4$	dil. sol.	+166.1		
Hydroxylamine	NH_2OH	solid	27.60		
Indium					
bromide	$InBr_3$	solid	97.25		
		dil. sol.	112.8		
chloride, mono-	$InCl$	solid	44.68		
chloride, di-	$InCl_2$	solid	86.74		
chloride, tri-	$InCl_3$	solid	128.6		
		dil. sol.	145.28		
iodide	InI_3	solid	32.50		
		dil. sol.	66.91		
oxide, sesqui-	In_2O_3	solid	23.90		
Iodic acid	HIO_3	solid	56.392		−2.15
Iodine (atomic)	I	gas	− 25.470		
Iodine	I_2	gas	− 15.1		
bromide, mono-	IBr	liquid	+ 2.63		
chloride, mono-	ICl	solid	6.69		
		liquid	4.54		
chloride, tri-	ICl_3	solid	16.7		
oxide, penta-	I_2O_5	solid	42.055	1500	$-1.79^{18°}$
Iridium					
chloride, di-	$IrCl_2$	solid	20.5		
chloride, tri-	$IrCl_3$	solid	60.45		
oxide, di-	IrO_2	solid	5.02		
Iron					
acetate	$Fe(C_2H_3O_2)_3$	1800	357.23		
ammonium sulfate	$Fe_2(SO_4)_3.(NH_4)_2SO_4$	1000	458.55		
ammonium sulfate (ic)	$FeNH_4(SO_4)_2.12H_2O$	solid	1295.8		
ammonium sulfate (ous)	$FeSO_4.(NH_4)_2SO_4.6H_2O$	solid	927.36		
bromide (ic)	$FeBr_3$	1000	95.10		
bromide (ous)	$FeBr_2$	dil. sol.	77.90		
carbonate (ous)	$FeCO_3$	solid	185.2		
		ppt.	179.2		
chlorate (ic)	$Fe(ClO_3)_3$	600	67.38		
chloride (ic)	$FeCl_3$	solid	96.30		+31.78
	$FeCl_3.2\frac{1}{2}H_2O$	solid	277.90	1200	$+21.0^{18°}$
	$FeCl_3.6H_2O$	solid	532.62	1200	$+5.73^{21°}$
chloride (ous)	$FeCl_2$	solid	81.864	400	$+17.90^{18°}$
	$FeCl_2.2H_2O$	solid	227.7	300	$+8.6^{20°}$
	$FeCl_2.4H_2O$	solid	370.37	400	$+2.748^{15°}$
ferrocyanide (ic)	$Fe_4[Fe(CN_6]_3$	ppt.	−319.00		
fluoride (ic)	FeF_3	150	+242.53		
fluoride (ous)	FeF_2	1200	177.1		
hydroxide (ic)	$Fe(OH)_3$	ppt.	197.37		
hydroxide (ous)	$Fe(OH)_2$	ppt.	135.87		
iodide (ic)	FeI_3	1000	49.46		
iodide (ous)	FeI_2	dil. sol.	47.55		
nitrate (ic)	$Fe(NO_3)_3$	800	158.4		
	$Fe(NO_3)_3.9H_2O$	solid	782.80	150	−9.08

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Iron					
nitrate (ous)	$Fe(NO_3)_2$	dil. sol.	120.2		
oxide (ic) (ordinary)	Fe_2O_3	solid	190.7		
oxide (ous)	FeO	solid	64.04		
oxide (ous) (ic) (fused)	Fe_3O_4	solid	265.95		
oxide (ous) (ic) (magnetite)	Fe_3O_4	solid	266.91		
selenide (ous)	$FeSe$	solid	19.1		
		ppt.	14.3		
silicate	$FeSiO_3$	solid	264.52		
sulfate (ic)	$Fe_2(SO_4)_3$	1200	641.77		
sulfate (ous)	$FeSO_4$	solid	217.23	110	$+14.901^{14°}$
		400	231.95		
	$FeSO_4.7H_2O$	solid	715.11	200	$-4.32^{14°}$
sulfide (ous)	FeS	solid	23.06		
sulfide, di- (pyrite)	FeS_2	solid	35.60		
telluride (ous)	$FeTe$	solid	7.65		
Lanthanum					
chloride	$LaCl_3$	solid	266.67	1200	$+31.30^{16°}$
oxide	La_2O_3	solid	456.87		
sulfate	$La_2(SO_4)_3$	dil. sol.	987.10		
	$La_2(SO_4)_3.8H_2O$	solid	1530.0	2400	$+4.06^{8°}$
sulfide, di-	LaS_2	solid	162.0		
sulfide	La_2S_3	solid	317.33		
Lead					
acetate	$Pb(C_2H_3O_2)_2$	solid	234.00	220	$+1.41^{11°}$
	$Pb(C_2H_3O_2)_2.3H_2O$	solid	446.12	100	$-5.50^{11°}$
bromide	$PbBr_2$	solid	66.261		
		dil. sol.	56.225	2500	$-10.04^{18°}$
carbonate	$PbCO_3$	solid	168.9		
chloride	$PbCl_2$	solid	85.664		
		dil. sol.	79.416		-6.55
chromate	$PbCrO_4$	solid	218.2		
fluoride	PbF_2	solid	159.40		
hydroxide	$Pb(OH)_2$	ppt.	137.6		
iodide	PbI_2	solid	41.840		
nitrate	$Pb(NO_3)_2$	solid	108.292	400	$-7.599^{18°}$
		100	100.67		
nitride	PbN_6	solid	-100.60		
oxalate	PbC_2O_4	solid	$+206.2$		
oxide, mono-	PbO	solid	52.473		
oxide, di-	PbO_2	solid	62.60		
oxide, sub-	Pb_2O	solid	51.255		
oxide, (red)	Pb_3O_4	solid	174.19		
oxybromide	$PbBr_2.PbO$	solid	119.7		
	$PbBr_2.2PbO$	solid	171.3		
oxychloride	$PbCl_2.PbO$	solid	142.65		
	$PbCl_2.2PbO$	solid	195.9		
	$PbCl_2.3PbO$	solid	247.79		
oxyiodide	$PbI_2 + PbO$	solid	3.6		
phosphite	$PbHPO_3$	solid	231.8		
selenide	$PbSe$	solid	12.4		
		ppt.	23.7		
sulfate	$PbSO_4$	solid	214.6		
sulfide	PbS	ppt.	22.2		
sulfocyanate	$Pb(CNS)_2$	solid	-28.67		
telluride	$PbTe$	solid	$+5.5$		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Lead					
thiosulfate	PbS_2O_3	solid	147.2	....	....
Lithium					
bromide	$LiBr$	solid	83.728	850	$+11.25^{14°}$
		200	95.064	....	....
carbide	Li_2C_2	solid	13.6	....	$+37.04^{17°}$
carbonate	Li_2CO_3	solid	290.8	220	$+3.06^{15°}$
	Li_2CO_3	dil. sol.	293.91	....	....
carbonate, acid	$LiHCO_3$	500	232.3	....	....
chloride	$LiCl$	solid	97.420	200	$+8.507^{18°}$
		∞	106.04	....	....
cyanide	$LiCN$	200	31.30	....	....
fluoride	LiF	solid	145.54	110	$-1.03^{15°}$
		dil. sol.	144.49	....	....
fluosilicate	Li_2SiF_6	solid	677.49	800	+1.816
		dil. sol.	679.31	....	....
hydride	LiH	solid	21.5	2000	$+31.30^{18°}$
hydroxide	$LiOH$	solid	116.4	110	$+4.468^{24°}$
		∞	121.00	....	....
iodide	LiI	solid	64.994	200	$+14.77^{18°}$
		200	79.759	....	....
nitrate	$LiNO_3$	solid	115.82	400	$+0.430^{21°}$
		∞	116.27	....	....
	$LiNO_3.3H_2O$	solid	328.32	....	....
nitride	Li_3N	solid	45.88	....	+131.2
oxide	Li_2O	solid	141.7	220	$+31.30^{15°}$
selenide	Li_2Se	solid	95.34	....	$+10.66^{20°}$
		dil. sol.	106.1	....	....
silicate	Li_2SiO_3	fused	372.76	....	....
		solid	434.89	....	....
sulfate	Li_2SO_4	solid	337.9	....	+6.380
	$Li_2SO_4.H_2O$	solid	409.08	400	$+3.417^{18°}$
sulfhydrate	$LiSH$	dil. sol.	64.11	....	....
sulfide	Li_2S	dil. sol.	115.4	....	....
Magnesium					
ammonium arsenate	$MgNH_4AsO_4.6H_2O$	solid	763.92	....	....
ammonium phosphate	$MgNH_4PO_4.6H_2O$	solid	901.56	....	....
ammonium sulfate	$MgSO_4.(NH_4)_2SO_4.6H_2O$	solid	1016.5	....	−9.80
ammonium sulfite	$3MgSO_3.(NH_4)_2SO_3.6H_2O$	solid	1375.6	....	....
arsenate	$Mg_3(AsO_4)_2$	solid	731.43	....	....
arsenate, acid	$MgHAsO_4$	dil. sol.	322.8	....	....
bromide	$MgBr_2$	solid	124.0	....	$+43.25^{16°}$
		400	167.3	....	....
carbonate	$MgCO_3$	solid	267.39	....	....
chloride	$MgCl_2$	solid	153.2	800	$+35.956^{16°}$
	$MgCl_2.6H_2O$	solid	596.37	200	$+2.939^{15°}$
cyanamide	$MgCN_2$	solid	59.26	....	....
cyanide	$Mg(CN)_2$	dil. sol.	40.38	....	....
dithionate	$MgS_2O_6.6H_2O$	solid	797.38	400	$-2.963^{19°}$
fluoride	MgF_2	ppt.	263.80	....	....
hydroxide (brucite)	$Mg(OH)_2$	solid	223.4	....	....
hydroxide	$Mg(OH)_2$	ppt.	218.6	....	....
iodide	MgI_2	solid	86.74	....	−49.70
		dil. sol.	136.7	....	....
nitrate	$Mg(NO_3)_2$	400	209.51	....	....
	$Mg(NO_3)_2.6H_2O$	solid	623.90	400	$-4.229^{15°}$
nitride	Mg_3N_2	solid	118.3	....	....
oxide (bomb)	MgO	....	145.76	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Magnesium					
phosphate	$Mg_3(PO_4)_2$	colloid	915.18		
silicate	$MgSiO_3$	solid	346.48		
sulfate	$MgSO_4$	solid	301.08	400	$+20.3^{18°}$
		400	321.33		
	$MgSO_4.7H_2O$	solid	803.85	400	$-3.871^{18°}$
sulfide	MgS	solid	82.20		
sulfite	$MgSO_3$	solid	238.5		
	$MgSO_3.6H_2O$	solid	671.21		
sulfhydrate	$Mg(SH)_2$	dil. sol.	117.3		
Manganese					
acetate	$Mn(C_2H_3O_2)_2$	solid	272.88	500	$+12.2^{17°}$
		dil. sol.	285.31		
	$Mn(C_2H_3O_2)_2.4H_2O$	solid	556.99	600	$+1.67^{16°}$
bromide	$MnBr_2$	solid	90.80		
		dil. sol.	106.8		
carbide	Mn_3C	solid	12.4		
carbonate	$MnCO_3$	solid	212.9		
chloride	$MnCl_2$	solid	112.69	350	$+16.01^{18°}$
		400	128.79		
	$MnCl_2.4H_2O$	solid	400.72	400	$+1.53^{18°}$
dithionate	$MnS_2O_6.6H_2O$	solid	736.20	400	$-1.9^{18°}$
fluoride, di-	MnF_2	dil. sol.	206.0		
fluoride, sesqui-	MnF_3	dil. sol.	260.46		
formate	$Mn(CHO_2)_2$	solid	242.3	500	$+4.30^{24°}$
	$Mn(CHO_2)_2.2H_2O$	solid	386.38	300	$-2.87^{24°}$
hydroxide	$Mn(OH)_3$	ppt.	219.8		
hydroxide (ous)	$Mn(OH)_2$	ppt.	163.4		
iodide	MnI_2	dil. sol.	76.46		
nitrate	$Mn(NO_3)_2$	solid	136.2	300	$+12.69^{14°}$
		400	149.1		
	$Mn(NO_3)_2.6H_2O$	solid	565.59	400	$-6.141^{18°}$
oxalate	MnC_2O_4	ppt.	259.50		
oxide (ic)	Mn_2O_3	solid	227.0		
oxide (ous)	MnO	solid	90.8		
oxide, di-	MnO_2	solid	125.4		
oxide, di- (hydrated ppt.)	MnO_2	amorph.	115.89		
oxide (ous) (ic)	Mn_3O_4	solid	327.84		
phosphate	$Mn_3(PO_4)_2$	solid	733.10		
selenide	$MnSe$	ppt.	27.		
		solid	23.9		
silicate	$MnSiO_3$	solid	299.40		
sulfate (ous)	$MnSO_4$	solid	247.07	400	$+13.79^{18°}$
		400	261.01		
	$MnSO_4.H_2O$	solid	321.39	400	$+7.790^{18°}$
	$MnSO_4.5H_2O$	solid	602.87	400	$+0.0478^{18°}$
	$MnSO_4.7H_2O$	solid	744.81		
sulfide (ous)	MnS	ppt.	47.31		
		solid	60.		
Manganic acid	$HMnO_4$	dil. sol.	123.3		
Methane	CH_4	gas	19.1		
Methyl alcohol	CH_3OH	liquid	60.004		
		gas	50.896		
		dil. sol.	61.89		+2.01
Mercury					
acetate (ic)	$Hg(C_2H_3O_2)_2$	solid	198.1		
acetate (ous)	$Hg_2(C_2H_3O_2)_2$	solid	203.35		
bromide (ic)	$HgBr_2$	solid	41.58		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Mercury					
bromide (ous)	Hg_2Br_2	ppt.	49.22	......	....
chloride (ic)	$HgCl_2$	solid	53.429	300	$-3.321^{18°}$
chloride (ous)	Hg_2Cl_2	ppt.	63.01	......	....
cyanide (ic)	$Hg(CN)_2$	solid	− 62.13	......	−3.11
dimercuri-diammonium chloride	$NHg_2Cl.NH_4Cl$	solid	141.5	......	....
dimercuri-tetra ammonium chloride	$NHg_2Cl.3NH_4Cl$	solid	289.6	......	....
fulminate (ic)	$HgC_2N_2O_2$	solid	− 64.52	......	....
iodide (ic) (red)	HgI_2	solid	25.33	......	....
iodide (ic) (yellow)	HgI_2	solid	22.2	......	....
iodide (ous) (yellow)	Hg_2I_2	solid	28.865	......	....
nitrate (ic)	$Hg(NO_3)_2$	dil. sol.	58.1	......	....
nitrate (ous)	$Hg_2(NO_3)_2$	dil. sol.	59.499	......	....
	$Hg_2(NO_3)_2.2H_2O$	solid	207.9	......	....
nitride (ous)	Hg_2N_6	solid	− 97.49	......	....
oxalate (ic)	HgC_2O_4	solid	160.10	......	....
oxide (ic) (red)	HgO	solid	21.7	......	....
oxide (ous)	Hg_2O	solid	21.5	......	....
oxybromide (ic)	$HgBr_2.HgO$	solid	64.52	......	....
	$HgBr_2.3HgO$	solid	108.2	......	....
oxychloride (ic)	$HgCl_2.HgO$	solid	75.75	......	....
	$HgCl_2.2HgO$	solid	97.73	......	....
	$HgCl_2.3HgO$	solid	118.5	......	....
	$HgCl_2.4HgO$	solid	139.3	......	....
selenide (ic)	$HgSe$	ppt.	5.26	......	....
sulfate (ic)	$HgSO_4$	solid	162.5	......	....
sulfate (ous)	Hg_2SO_4	solid	171.59	......	....
sulfide (red)	HgS	solid	10.90	......	....
sulfide (black)	HgS	amorph.	10.5	......	....
sulfocyanate	$Hg(CNS)_2$	solid	− 50.42	......	....
Molybdenum					
oxide, di-	MoO_2	solid	131.4	......	....
oxide, tri-	MoO_3	solid	174.0	......	....
Molybdic acid	H_2MoO_4	solid	+247.07	......	....
		dil. sol.	246.60	......	....
Neodymium					
chloride	$NdCl_3$	solid	- 246.60	2000	+35.60
		dil. sol.	282.20	......	....
iodide	NdI_3	solid	155.3	2000	$+48.98^{19°}$
		dil. sol.	204.3	......	....
oxide	Nd_2O_3	solid	434.89	......	....
sulfate	$Nd_2(SO_4)_3$	solid	919.48	500	+36.56
		dil. sol.	956.04	......	....
sulfide	Nd_2S_3	solid	262.61	......	....
Nickel					
bromide	$NiBr_2$	solid	53.29	......	+18.9
		dil. sol.	72.40	......	....
bromide ammonia	$NiBr_2.6NH_3$	solid	221.7	......	....
chloride	$NiCl_2$	solid	74.983	400	$+19.16^{18°}$
		800	94.266	......	....
	$NiCl_2.6H_2O$	solid	505.55	400	$-1.15^{19°}$
chloride ammonia	$NiCl_2.6NH_3$	solid	248.75	......	....
cyanide	$Ni(CN)_2$	solid	− 23.25	......	....
dithionate	NiS_2O_6	dil. sol.	+290.09	......	....
	$NiS_2O_6.6H_2O$	solid	702.75	400	$-2.413^{19°}$

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Nickel					
fluoride	NiF_2	dil. sol.	171.4		
hydroxide (ic)	$Ni(OH)_3$	ppt.	196.66		
hydroxide (ous)	$Ni(OH)_2$	ppt.	129.80		
iodide	NiI_2	dil. sol.	41.82		
nitrate	$Ni(NO_3)_2$	solid	102.7	280	$+11.7^{18°}$
	$Ni(NO_3)_2.6H_2O$	solid	532.26	400	$-7.479^{18°}$
oxide	NiO	solid	57.83		
selenide	$NiSe$	solid	13.4		
		ppt.	14.8		
sulfate	$NiSO_4$	400	227.05		
	$NiSO_4.7H_2O$	solid	710.11	800	$-4.253^{19°}$
sulfide	NiS	ppt.	20.8		
telluride	$NiTe$	solid	10.8		
Nitric acid	HNO_3	liquid	42.366		$+7.169^{10°}$
		gas	35.341		
		∞	49.797		
Nitrogen (atomic)	N	gas	−129.0		
oxide (ic)	NO	gas	− 21.5		
oxide (ous)	N_2O	gas	− 17.0		
		liquid	− 18.73		
oxide, tetra-	NO_2	gas (ideal)	− 7.431		
	N_2O_4	gas (ideal)	− 1.86		
oxide, penta-	N_2O_5	solid	+ 14.6	400	$+16.68^{10°}$
		gas	− 1.2		$+29.797^{10°}$
oxybromide	$NOBr$	gas	− 17.54		
oxychloride	$NOCl$	gas	− 12.66		
selenide	NSe	solid	− 42.29		
sulfide	NS	solid	− 31.78		
Nitrous acid	HNO_2	200	+ 28.91		
Osmium					
oxide, tetra-	OsO_4	solid	93.43		
		liquid$^{40°}$	90.036		
Oxalic acid	$H_2C_2O_4$	solid	197.04		
		dil. sol.	194.5	300	$-2.27^{18°}$
	$H_2C_2O_4.2H_2O$	solid	339.79	300	$-8.578^{20°}$
Oxygen (atomic)	O	gas	− 81.48		
(ozone)	O_3	gas	− 34.41		
		dil. sol.	− 32.50		+1.9
Palladium					
am. chloride	$PdCl_2.2NH_3$	solid	105.4		
	$PdCl_2.4NH_3$	solid	158.2		
am. iodide	$PdI_2.2NH_3$	solid	73.84		
	$PdI_2.4NH_3$	solid	121.6		
bromide	$PdBr_2$	solid	27.96		
chloride	$PdCl_2$	solid	43.49		
cyanide	$Pd(CN)_2$	solid	− 49.0		
hydride	Pd_2H	solid	+ 17.7		
hydroxide (ic)	$Pd(OH)_4$	ppt.	168.0		
hydroxide (ous)	$Pd(OH)_2$	ppt.	91.76		
iodide	PdI_2	solid	17.92		
oxide, mono-	PdO	solid	21.5		
Perchloric acid	$HClO_4$	liquid	19.4	500	$+20.3^{19°}$
		200	39.67		
	$HClO_4.2H_2O$	solid	100.4		+7.65
Periodic acid	HIO_4	dil. sol.	45.40		
Phosphonium					
bromide	$PH_3.HBr$	solid	25.57		−3.03
chloride	PH_3HCl	solid	31.06		
iodide	$PH_3.HI$	solid	12.07		−4.78

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Phosphoric acid					
meta-	HPO_3	solid	224.90	....	+9.749
ortho-	H_3PO_4	solid	303.13	150	$+2.700^{19°}$
		liquid	300.74	200	$+5.352^{20°}$
		400	306.17	....	....
pyro	$H_4P_2O_7$	solid	531.64	....	+8.005
		liquid	529.37	....	+10.23
Phosphorous acid					
hypo-	H_3PO_2	solid	141.36	150	$-0.167^{12°}$
		liquid	139.02	150	$+2.17^{19°}$
ortho-	H_3PO_3	solid	228.94	150	$+0.119^{19°}$
		liquid	225.86	150	$+2.939^{19°}$
pyro-	$H_4P_2O_5$	dil. sol.	384.23	....	....
Phosphorus					
bromide, tri-	PBr_3	liquid	45.40	....	....
bromide, penta-	PBr_5	solid	60.69	....	....
chloride, tri-	PCl_3	liquid	76.94	1000	$+65.138^{19°}$
		gas	70.01	....	....
chloride, penta-	PCl_5	solid	106.6	1000	$+123.44^{22°}$
hydride (phosphine)	PH_3	gas	− 5.97	....	....
hydride (solid)	P_2H	solid	+ 11.9	....	....
iodide, tri-	PI_3	solid	11.0	....	....
iodide, tetra-	P_2I_4	solid	19.8	....	....
nitride	P_3N_5	solid	75.03	....	....
oxide, penta-	P_2O_5	solid	365.83	....	....
oxybromide	$POBr_3$	solid	106.8	....	....
oxychloride	$POCl_3$	liquid	147.15	1000	$+72.187^{20°}$
Platinic acid					
bromo-	H_2PtBr_6	dil. sol.	115.4	....	....
	$H_2PtBr_6.9H_2O$	solid	733.8	....	−2.87
chloro-	H_2PtCl_6	dil. sol.	165.6	....	....
	$H_2PtCl_6.6H_2O$	solid	571.57	500	+4.349
Platinum					
bromide	$PtBr_4$	solid	40.14	1000	+9.80
chloride, di-	$PtCl_2$	solid	35.84	....	....
chloride, tetra-	$PtCl_4$	solid	62.60	....	....
		dil. sol.	81.96	....	....
	$PtCl_4.5H_2O$	solid	425.81	400	−1.84
hydroxide	$Pt(OH)_2$	ppt.	87.69	....	....
iodide	PtI_4	solid	16.7	....	....
oxide, mono-	PtO	solid	17.0	....	....
Potassium					
acetate	$KC_2H_3O_2$	solid	174.48	200	$+3.35^{20°}$
aluminum sulfate	$KAl(SO_4)_2.12H_2O$	solid	1439.9	1200	$-10.11^{18°}$
arsenate (tribasic)	K_3AsO_4	400	389.73	....	....
arsenate (dibasic)	K_2HAsO_4	400	335.01	....	....
arsenate (monobasic)	KH_2AsO_4	dil. sol.	280.77	....	−4.78
		400	275.99	....	....
arsenite, ortho-	KH_2AsO_3	800	230.1	....	....
bromate	$KBrO_3$	solid	83.107	400	$-10.0^{18°}$
bromide	KBr	solid	94.027	200	$-5.066^{18°}$
		∞	88.889	....	....
bromopalladite	K_2PdBr_4	dil. sol.	208.4	....	....
bromoplatinate	K_2PtBr_6	solid	248.51	....	−12.26
		dil. sol.	236.1	....	....
bromoplatinite	K_2PtBr_4	solid	221.0	....	−10.56
		dil. sol.	210.5	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Potassium					
carbonate	K_2CO_3	solid	274.96	400	$+6.499^{16°}$
		400	281.46	....	....
carbonate, acid	$KHCO_3$	solid	231.3	220	$-5.329^{15°}$
		200	225.8	....	....
chlorate	$KClO_3$	solid	89.869	400	$-10.27^{18°}$
		∞	79.379	....	....
chloride	KCl	solid	104.30	200	$-4.444^{18°}$
		∞	99.879	....	....
chloriridate	K_2IrCl_6	solid	279.57	....	....
		dil. sol.	266.91	....	-3.11
	K_3IrCl_6	solid	365.59	....	....
chloropalladate	K_2PdCl_6	solid	290.09	....	-15.1
		dil. sol.	275.03	....	....
chloropalladite	K_2PdCl_4	solid	261.41	300	$-13.62^{19°}$
		dil. sol.	247.79	....	....
chloroplatinate	K_2PtCl_6	solid	299.64	....	....
		dil. sol.	286.26	....	-13.76
chloroplatinite	K_2PtCl_4	solid	254.72	....	-12.11
		dil. sol.	242.53	....	....
chromate	K_2CrO_4	solid	329.51	540	-5.26
		800	324.30	....	....
cyanate	$KCNO$	solid	100.12	400	$-5.161^{20°}$
		dil. sol.	94.86	....	....
cyanide	KCN	solid	28.20	200	$-2.87^{18°}$
		200	25.09	....	....
dichromate	$K_2Cr_2O_7$	solid	481.72	1000	$-17.44^{18°}$
		∞	463.35	....	....
dithionate, see under *thionate, di-*					
ferric sulfate	$KFe(SO_4)_2.12H_2O$	solid	1323.5	....	-16.0
ferricyanide	$K_3Fe(CN)_6$	solid	48.98	400	$-14.3^{13°}$
		dil. sol.	34.41	....	....
ferrocyanide	$K_4Fe(CN)_6$	solid	131.7	1000	$-12.4^{17°}$
		dil. sol.	119.24	....	....
	$K_4Fe(CN)_6.3H_2O$	solid	340.98	1000	$-16.5^{17°}$
ferrous sulfate	$K_2Fe(SO_4)_2.6H_2O$	solid	985.19	....	-11.0
fluoride	KF	solid	134.10	110	$+4.110^{15°}$
		400	138.21	....	....
	$KF.2H_2O$	solid	277.11	110	$-2.2^{15°}$
fluoride, acid	KHF_2	solid	219.36	400	$-5.97^{15°}$
fluosilicate	K_2SiF_6	solid	681.96	....	....
		dil. sol.	667.63	....	....
hydride	KH	solid	14.1	....	....
hydroxide	KOH	solid	102.01	175	$+12.95^{21°}$
		∞	114.85	....	....
hypochlorite	$KClO$	400	86.141	....	....
hypophosphite	KH_2PO_2	dil. sol.	202.9	....	....
iodate	KIO_3	solid	121.48	400	$-6.762^{18°}$
iodide	KI	solid	78.758	400	$-5.114^{18°}$
		∞	73.62	....	....
iodide, tri-	KI_3	dil. sol.	71.92	....	....
magnesium chloride (melt)	$KCl.MgCl_2$	solid	260.69	....	$+28.20^{18°}$
	$KCl.MgCl_2.6H_2O$	solid	702.27	....	$-3.08^{15°}$
magnesium sulfate	$K_2Mg(SO_4)_2$	solid	642.78	600	$+10.5^{19°}$
	$K_2Mg(SO_4)_2.6H_2O$	solid	1073.6	600	$-10.01^{18°}$
mercuric bromide	$KBr.HgBr_2$	solid	137.9	....	....
	$2KBr.HgBr_2$	solid	229.9	660	$-9.749^{18°}$
mercuric chloride	$KCl.HgCl_2$	solid	159.9	700	$-9.56^{14°}$
	$2KCl.HgCl_2$	solid	266.67	1000	$-15.03^{14°}$
	$2KCl.HgCl_2.H_2O$	solid	336.44	600	$-16.39^{18°}$

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Potassium					
nitrate	KNO_3	solid	118.78	200	$-8.459^{18°}$
		∞	110.11		
nitrite	KNO_2	dil. sol.	85.78		
oxalate	$K_2C_2O_4$	solid	320.43		−4.78
oxalate, acid	KHC_2O_4	solid	264.52		−9.56
oxalate, tetra-	$KHC_2O_4.H_2C_2O_4$	solid	465.00		−15.8
oxide	K_2O	solid	86.26	300	$+75.03^{17°}$
perchlorate	$KClO_4$	dil. sol.	112.07		
		∞	99.236		
periodate	KIO_4	dil. sol.	97.73		
permanganate	$KMnO_4$	solid	194.3		
persulfate	$K_2S_2O_8$	solid	444.69	3300	$-14.6^{9°}$
		dil. sol.	430.11		
phos. ortho-	K_3PO_4	dil. sol.	479.33		
phos. hydrogen	K_2HPO_4	dil. sol.	426.05		
phos. dihydrogen	KH_2PO_4	solid	372.05		−4.78
		dil. sol.	367.27		
phosphite	K_2HPO_3	dil. sol.	350.06		
selenide	K_2Se	solid	85.3	1800	$+8.60^{13°}$
	$K_2Se.9H_2O$	solid	728.32	4000	$-19.1^{14°}$
	$K_2Se.14H_2O$	solid	1071.5	4000	$-20.3^{13°}$
	$K_2Se.19H_2O$	solid	1422.2		$-29.39^{14°}$
silver bromide	$AgBr + KBr$	solid	−0.4		
silver cyanide	$KAg(CN)_2$	solid	+6.69	400	$-8.554^{11°}$
silver iodide	$KI.AgI$	solid	97.49		
silver iodide	$3KI.AgI$	solid	255.92		
sulfate	K_2SO_4	solid	338.62	400	$-6.547^{18°}$
		∞	331.93		
sulfate, acid	$KHSO_4$	solid	272.88	200	$-3.799^{17°}$
		800	269.75		
sulfate, pyro-	$K_2S_2O_7$	solid	466.91		−3.82
		dil. sol.	463.09		
sulfhydrate	KHS	400	63.967		
	$KHS.\frac{1}{4}H_2O$	solid	80.29	1000	$+0.765^{17°}$
sulfide, mono-	K_2S	solid	88.17		+22.5
		400	110.59		
	$K_2S.2H_2O$	solid	243.49	1200	$+3.82^{18°}$
	$K_2S.5H_2O$	solid	457.59	1000	$-5.26^{16°}$
sulfide, tetra-	K_2S_4	solid	113.7	100	$+1.2^{10°}$
	$K_2S_4.\frac{1}{2}H_2O$	solid	151.3		$-2.20^{12°}$
sulfite	K_2SO_3	solid	265.95	300	$+1.4^{17°}$
		600	267.39		
	$K_2SO_3.H_2O$	solid	334.53		
sulfite, acid	$KHSO_3$	400	207.74		
sulfocyanate	$KCNS$	solid	54.24	100	−12.2
		dil. sol.	42.06		
tartrate	$K_2C_4H_4O_6$	solid	419.36	400	$-2.844^{18°}$
		dil. sol.	416.49		
	$K_2C_4H_4O_6.\frac{1}{2}H_2O$	solid	456.87	400	$-6.141^{18°}$
tartrate, acid	$KHC_4H_4O_6$	solid	369.18		
		dil. sol.	357.71		
thionate, di-	$K_2S_2O_6$	solid	407.91		
thionate, tri-	$K_2S_3O_6$	solid	394.27	500	$-12.45^{18°}$
thionate, tetra-	$K_2S_4O_6$	solid	395.46	500	$-13.14^{17°}$
thionate, penta-	$K_2S_5O_6$	solid	398.09		−10.0
		dil. sol.	388.05		
	$K_2S_5O_6.\frac{1}{2}H_2O$	solid	503.7	2000	$-13.14^{10°}$
thiosulfate	$K_2S_2O_3$	solid	266.67	800	$-5.02^{10°}$
		dil. sol.	261.65		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Potassium					
thiosulfate	$K_2S_2O_3.H_2O$	solid	336.20	......	$-6.21^{14°}$
zinc sulfate	$K_2Zn(SO_4)_2$	solid	572.05	600	$+7.909^{18°}$
	$K_2Zn(SO_4)_2.6H_2O$	solid	1002.2	600	$-11.80^{18°}$
Praseodymium					
chloride	$PrCl_3$	solid	240.38	2500	$+33.45^{18°}$
		dil. sol.	273.84	......	......
	$PrCl_3.7H_2O$	solid	747.20	2000	$+5.26^{17°}$
nitrate	$Pr(NO_3)_2$	dil. sol.	315.41	......	......
oxide	PrO_2	solid	215.1	......	......
oxide, tri-	Pr_2O_3	solid	416.97	......	......
Rubidium					
bromide	$RbBr$	solid	96.06	110	$-5.95^{15°}$
		400	89.61	......	......
carbonate	Rb_2CO_3	solid	273.84	......	+8.746
		dil. sol.	282.68	......	......
carbonate, acid	$RbHCO_3$	solid	230.6	110	$-4.731^{15°}$
		dil. sol.	225.8	......	......
chloride	$RbCl$	solid	104.97	400	$-4.23^{21°}$
		400	100.53	......	......
fluoride	RbF	solid	133.31	110	$+5.806^{16°}$
		400	139.12	......	......
hydroxide	$RbOH$	solid	101.20	110	$+14.27^{15°}$
iodide	RbI	solid	80.77	110	$-6.499^{15°}$
		dil. sol.	74.31	......	......
nitrate	$RbNO_3$	solid	119.62	400	$-8.769^{21°}$
		200	110.99	......	......
oxide, mono-	Rb_2O	solid	82.92	......	$+80.05^{19°}$
oxide, di-	Rb_2O_2	solid	107.05	......	......
oxide, tetra-	Rb_2O_4	solid	135.0	......	......
sulfate	Rb_2SO_4	solid	339.98	220	$-6.667^{18°}$
		440	333.45	......	......
sulfate, acid	$RbHSO_4$	solid	274.10	220	$-3.728^{15°}$
		330	270.32	......	......
sulfide	Rb_2S	solid	87.69	......	+24.61
		dil. sol.	112.31	......	......
sulfocyanate	$RbCNS$	solid	56.87	......	−14.3
		dil. sol.	42.77	......	......
Ruthenium					
chloride	$RuCl_3$	solid	62.84	......	......
oxide, di-	RuO_2	solid	52.57	......	......
Selenic acid	H_2SeO_4	solid	130.23	400	+13.36
		liquid	126.64	400	+16.7
Selenious acid	H_2SeO_3	solid	128.03	......	−4.110
		dil. sol.	123.92	......	......
Selenium	Se_2	gas	34.89	......	......
chloride, mono-	Se_2Cl_2	liquid	22.15	......	......
chloride, tetra-	$SeCl_4$	solid	46.165	......	......
hydride, see *hydrogen selenide*					
nitride, see *nitrogen selenide*					
oxide, di-	SeO_2	solid	56.416	......	−0.908
Silicic acid, ortho-	H_4SiO_4	colloid	333.81	......	......
Silicon					
bromide, tetra	$SiBr_4$	liquid	91.52	2000	$+19.8^{9°}$
carbide	SiC	solid	1.43	......	......
chloride, tetra	$SiCl_4$	liquid	149.1	......	......
		gas	142.7	......	......

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Silicon					
fluoride, tetra	SiF_4	gas	361.29	....	....
hydride	SiH_4	gas	11.9	....	....
iodide, tetra-	SiI_4	solid	27.72	12,000	$-20.5^{9°}$
oxide, di-	SiO_2	fused	198.3	....	....
oxide, di- (α quartz)	SiO_2	solid	201.34	....	....
sulfide (white)	SiS_2	solid	32.02	....	$+9.32^{20°}$
sulfide (yellow)	SiS_2	solid	28.91	....	$+10.8^{20°}$
Silver					
acetate	$AgC_2H_3O_2$	solid	97.01	....	-4.397
bromide	$AgBr$	solid	23.85	....	....
carbide	Ag_2C_2	solid	− 83.87	....	....
carbonate	Ag_2CO_3	solid	+120.9	....	....
chlorate	$AgClO_3$	solid	1.67	....	-7.53
		dil. sol.	− 5.73	....	....
chloride	$AgCl$	solid	+ 30.59	....	....
cyanate	$AgCNO$	solid	23.7	....	....
cyanide	$AgCN$	solid	− 33.45	....	....
fluoride	AgF	solid	+ 48.698	....	$+4.301^{10°}$
	$AgF.2H_2O$	solid	191.26	....	$-1.4^{10°}$
iodide	AgI	ppt.	14.93	....	....
nitrate	$AgNO_3$	solid	30.11	400	$-5.472^{15°}$
		400	24.66	....	....
nitride	AgN_3	solid	− 66.19	....	....
nitrite	$AgNO_2$	solid	+ 12.7	....	-8.84
oxalate	$Ag_2C_2O_4$	solid	159.6	....	....
oxide	Ag_2O	solid	6.953	....	....
oxide, per	Ag_2O_2	solid	5.400	....	....
perchlorate	$AgClO_4$	solid	12.23	....	$+2.17$
		dil. sol.	14.41	....	....
selenide	$AgSe$	ppt.	− 0.956	....	....
sulfate	Ag_2SO_4	solid	+166.1	....	....
		dil. sol.	161.5	....	....
sulfide	Ag_2S	solid	5.02	....	....
sulfocyanate	$AgCNS$	solid	− 21.03	....	....
Sodium					
acetate	$NaC_2H_3O_2$	solid	+171.16	200	$+3.943^{15°}$
		400	175.10	....	....
	$NaC_2H_3O_2.3H_2O$	solid	384.71	400	-4.588
aluminate	$NaAlO_2$	solid	271.69	....	....
amide	$NaNH_2$	solid	32.26	....	$+31.06^{21°}$
arsenate	Na_3AsO_4	solid	358.	....	....
		500	381.60	....	....
	$Na_3AsO_4.12H_2O$	solid	1214.8	600	$-12.7^{18°}$
arsenate (disodium)	Na_2HAsO_4	400	329.03	....	....
arsenate, acid	NaH_2AsO_4	300	273.12	....	....
arsenite	Na_2HAsO_3	400	271.69	....	....
borate	$NaBO_2$	300	231.5	....	....
borate, tetra-	$Na_2B_4O_7$	solid	742.18	....	$+10.27$
		dil. sol.	752.45	....	....
	$Na_2B_4O_7.10H_2O$	solid	1462.14	1600	$-25.854^{15°}$
bromide	$NaBr$	solid	86.333	200	$-0.191^{15°}$
		200	86.15	....	....
	$NaBr.2H_2O$	solid	227.72	300	$-4.71^{15°}$
bromoplatinate	Na_2PtBr_6	solid	220.8	800	$+9.940^{15°}$
		dil. sol.	230.8	....	....
	$Na_2PtBr_6.6H_2O$	solid	649.71	800	$-8.60^{15°}$
carbide	Na_2C_2	solid	−4.78	....	....
carbonate	Na_2CO_3	solid	+270.56	400	$+5.639^{15°}$
		400	276.18	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Sodium					
carbonate	$Na_2CO_3.H_2O$	solid	342.32	400	$+2.25^{18°}$
	$Na_2CO_3.10H_2O$	solid	976.16	400	$-16.15^{18°}$
carbonate, acid	$NaHCO_3$	solid	227.5		$-4.30^{15°}$
		200	223.35		
chlorate	$NaClO_3$	solid	82.34		
		dil. sol.	77.06		
chloride	$NaCl$	solid	98.36	200	$-1.281^{18°}$
		∞	97.08		
chloroplatinate	Na_2PtCl_6	solid	271.93	800	$+8.507^{18°}$
		dil. sol.	280.29		
	$Na_2PtCl_6.6H_2O$	solid	701.32	900	$-10.61^{18°}$
chloroplatinite	Na_2PtCl_4	solid	227.0		+10.04
		dil. sol.	237.0		
chromate	$NaCrO_4$	solid	316.61	600	$+2.39^{11°}$
		800	319.00		
	$NaCrO_4.10H_2O$	solid	1018.4	1200	$-15.79^{11°}$
cyanate	$NaCNO$	solid	97.01	2000	$-4.803^{13°}$
		dil. sol.	92.23		
cyanide	$NaCN$	solid	22.9	100	$-0.502^{9°}$
		200	22.5		
	$NaCN.\frac{1}{2}H_2O$	solid	57.59	110	$-1.0^{6°}$
	$NaCN.2H_2O$	solid	163.7	100	$-4.421^{4°}$
dichromate	$Na_2Cr_2O_7$	dil. sol.	458.86		
dithionate, see under *thionate, di-*					
fluoride	NaF	solid	136.30	400	$-0.478^{12°}$
		dil. sol.	135.70		
formate	$NaCHO_2$	solid	157.01	150	$-0.526^{12°}$
		400	156.49		
fluosilicate	Na_2SiF_6	solid	660.94		
		dil. sol.	658.31		
hydride	NaH	solid	13.14	200	$+26.05^{18°}$
hydroxide	$NaOH$	solid	101.91	160	$+10.30^{22°}$
		∞	112.04		
	$NaOH.H_2O$	solid	173.24	180	$+7.192^{22°}$
hypochlorite	$NaOCl$	dil. sol.	83.39		
iodide	NaI	solid	69.46	200	$+1.410^{18°}$
		200	70.870		
	$NaI.2H_2O$	solid	211.64	200	$-4.014^{18°}$
iodoplatinate	Na_2PtI_6	dil. sol.	167.0		
manganate	Na_2MnO_4	solid	267.62		
manganese sulfate	$Na_2SO_4.MnSO_4$	solid	574.91		+12.9
molybdate	Na_2MoO_4	solid	361.77		
nitrate	$NaNO_3$	solid	112.45	200	$-5.018^{17°}$
		∞	107.33		
nitrite	$NaNO_2$	solid	86.50	250	−3.513
		dil. sol.	83.15		
oxalate	$Na_2C_2O_4$	solid	316.01	1500	−5.50
		450	310.44		
oxalate, acid	$NaHC_2O_4$	solid	257.83	300	−5.50
		400	252.33		
	$NaHC_2O_4.H_2O$	solid	330.23	300	−9.56
oxide	Na_2O	solid	99.16		+56.39
perchlorate	$NaClO_4$	solid	100.60	400	$-3.58^{10°}$
		dil. sol.	97.25		
peroxide	Na_2O_2	solid	118.42		
phos. (trisod.)	Na_3PO_4	solid	447.08		
		900	471.30		
	$Na_3PO_4.12H_2O$	solid	1306.3	600	$-14.6^{18°}$

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Sodium					
phos. (disod.)	Na_2HPO_4	solid	414.98	400	+5.639[18°]
		600	420.62	....	....
	$Na_2HPO_4.2H_2O$	solid	557.78	400	−0.382[18°]
	$Na_2HPO_4.7H_2O$	solid	910.88	400	−11.5[18°]
phos., pyro-	$Na_4P_2O_7$	solid	755.08	800	+11.85[18°]
		1600	767.03	....	....
	$Na_4P_2O_7.10H_2O$	solid	1462.4	800	−11.66[18°]
phos., pyro-(disod.)	$Na_2H_2P_2O_7$	solid	657.83	....	−2.27
		1200	655.68	....	....
	$Na_2H_2P_2O_7.6H_2O$	solid	1079.8	....	−13.91
phosphite	Na_2HPO_3	solid	335.44	500	+9.152[14°]
		dil. sol.	344.57	....	....
	$Na_2HPO_3.5H_2O$	solid	344.57	500	−4.588[15°]
phosphite, acid	NaH_2PO_3	solid	286.50	500	+0.741[15°]
		600	287.22	....	....
	$NaH_2PO_3.2\frac{1}{2}H_2O$	solid	463.56	500	−5.26[15°]
		300	364.61	....	....
selenate	Na_2SeO_4	solid	261.41	....	....
selenate, acid	$NaHSeO_4$	dil. sol.	201.84	....	....
selenide	Na_2Se	solid	69.53	200	+18.59[14°]
	$Na_2Se.4\frac{1}{2}H_2O$	solid	403.83	....	−7.89
	$Na_2Se.9H_2O$	solid	714.22	....	−10.5
	$Na_2Se.16H_2O$	solid	1190.0	3000	−22.0[14°]
selenide, acid	$NaHSe$	dil. sol.	44.68	....	....
silicate	Na_2SiO_3	solid	368.94	....	....
sulfate	Na_2SO_4	solid	326.31	400	+5.50[18°]
		∞	326.67	....	....
	$Na_2SO_4.10H_2O$	solid	1029.6	400	−18.90[18°]
sulfate, acid	$NaHSO_4$	solid	265.19	200	+1.2[17°]
		800	266.86	....	....
sulfhydrate	$NaHS_2$	solid	57.11	600	+4.30[16°]
		400	61.458	....	....
sulfhydrate	$NaHS.2H_2O$	solid	199.8	400	−1.53[18°]
sulfide, mono-	Na_2S	solid	89.85	....	+15.5
		400	105.21	....	....
	$Na_2S.4\frac{1}{2}H_2O$	solid	417.92	1000	−5.02[17°]
	$Na_2S.5H_2O$	solid	453.766	1000	−6.69[13°]
	$Na_2S.9H_2O$	solid	737.40	1000	−16.7[13°]
sulfide, di-	Na_2S_2	dil. sol.	105.62	....	....
sulfide, tri-	Na_2S_3	dil. sol.	107.3	....	....
sulfide, tetra-	Na_2S_4	solid	98.93	1200	+9.80[17°]
sulfite	Na_2SO_3	solid	259.26	....	+2.39[10°]
		800	261.89	....	....
	$Na_2SO_3.7H_2O$	solid	751.50	500	−10.99[10°]
sulfite, acid	$NaHSO_3$	600	205.0	....	....
sulfocyanate	$NaCNS$	solid	42.77	100	−3.321[18°]
tartrate	$Na_2C_4H_4O_6$	solid	412.19	....	−1.12
		dil. sol.	411.23	....	....
	$Na_2C_4H_4O_6.2H_2O$	solid	553.89	....	−5.878
tartrate, acid	$NaHC_4H_4O_6$	solid	360.58	....	−5.663
		dil. sol.	355.08	....	....
	$NaHC_4H_4O_6.H_2O$	solid	431.73	....	−8.531
thionate, di-	$Na_2S_2O_6$	solid	394.98	400	−5.687[19°]
	$Na_2S_2O_6.2H_2O$	solid	537.64	....	−11.66
thionate, tri-	$Na_2S_3O_6$	dil. sol.	376.35	....	....
	$Na_2S_3O_6.3H_2O$	solid	591.40	1000	−10.0[11°]
thionate, tetra-	$Na_2S_4O_6$	dil. sol.	377.06	....	....
	$Na_2S_4O_6.2H_2O$	solid	523.54	600	−9.80[10°]

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Sodium					
thiosulfate	$Na_2S_2O_3$	solid	254.24	440	$+1.7^{15°}$
		dil. sol.	255.92	....	....
	$Na_2S_2O_3.5H_2O$	solid	609.32	400	$-11.37^{18°}$
tungstate	Na_2WO_4	solid	388.05	....	....
		dil. sol.	383.99	....	+4.06
uranate	Na_2UO_4	solid	420.31	....	....
vanadate	Na_3VO_4	solid	449.23	....	....
Stannic acid	SnO_2+H_2O	solid	133.5	....	....
Stannic and **Stannous** salts, see under *Tin*					
Strontium					
acetate	$Sr(C_2H_3O_2)_2$	solid	359.62	200	$+5.568^{12°}$
		dil. sol.	365.35	....	....
	$Sr(C_2H_3O_2)_2.\frac{1}{2}H_2O$	solid	394.27	220	$+52.57^{12°}$
arsenate	$Sr_3(AsO_4)_2$	ppt.	795.70	....	....
bromide	$SrBr_2$	solid	171.09	400	$+16.0^{18°}$
		dil. sol.	187.34	....	....
	$SrBr_2.6H_2O$	solid	604.07	400	$-6.452^{18°}$
carbonate	$SrCO_3$	ppt.	291.28	....	....
chloride	$SrCl_2$	solid	197.85	400	$+11.16^{18°}$
		2000	209.14	....	....
	$SrCl_2.6H_2O$	solid	626.81	400	$-7.503^{18°}$
cyanide	$Sr(CN)_2$	dil. sol.	60.69	....	....
	$Sr(CN)_2.4H_2O$	solid	338.35	200	$-4.158^{8°}$
dithionate	SrS_2O_6	dil. sol.	404.54	....	....
	$SrS_2O_6.4H_2O$	solid	687.22	400	$-9.247^{18°}$
fluoride	SrF_2	ppt.	288.89	....	....
hydride	SrH_2	solid	42.06	....	....
hydroxide	$Sr(OH)_2$	solid	228.7	1100	$+10.32^{15°}$
	$Sr(OH)_2.8H_2O$	solid	800.48	1100	$-14.27^{15°}$
iodide	SrI_2	solid	136.2	....	$+20.45^{12°}$
		dil. sol.	156.8	....	....
	$SrI_2.7H_2O$	solid	639.91	....	$-4.468^{15°}$
nitrate	$Sr(NO_3)_2$	solid	234.4	400	$-4.660^{18°}$
		1000	229.82	....	....
	$Sr(NO_3)_2.4H_2O$	solid	515.65	400	$-12.31^{18°}$
oxide	SrO	solid	140.7	1100	$+29.99^{15°}$
peroxide	SrO_2	solid	153.2	....	....
phosphate	$Sr_3(PO_4)_2$	ppt.	979.7	....	....
selenide	$SrSe$	solid	90.08	....	....
silicate	$SrSiO_3$	fused	363.20	....	....
sulfate	$SrSO_4$	solid	341.22	....	....
sulfhydrate	$Sr(SH)_2$	dil. sol.	137.9	....	....
sulfide, mono-	SrS	solid	113.02	....	....
Sulfocyanic acid	$HCNS$	dil. sol.	− 18.4	....	....
Sulfur					
bromide, mono-	S_2Br_2	liquid	+ 2.01	....	....
chloride, mono-	S_2Cl_2	liquid	14.34	....	....
		gas	5.64	....	....
chloride, di-	S_2Cl_4	liquid	14.	....	....
iodide, mono-	S_2I_2	solid	0.0	....	....
oxide, di-	SO_2	liquid	75.269	....	....
		gas	69.3	....	....
		2000	77.850	....	+ 8.554
oxide, tri-	SO_3	solid	103.2	....	+37.28
		liquid	101.1	1600	$+39.164^{20°}$
		gas	91.52	....	+49.22
		200	139.1	....	....
oxychloride (ic)	SO_2Cl_2	liquid	87.69	800	+62.84
		gas	80.76	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution Kilo-cal.
Sulfur					
oxychloride (ous)	$SOCl_2$	liquid	48.03		
		gas	41.58		
pentoxydichloride	$S_2O_5Cl_2$	liquid	161.8		
		gas	148.9		
Sulfuric acid	H_2SO_4	solid	192.24		
		liquid	189.75	200	$+17.75^{18°}$
		∞	210.28		
	$H_2SO_4.H_2O$	liquid	264.83		
per-	$H_2S_2O_8$	dil. sol.	309.92		
pyro-	$H_2SO_4.SO_3$	liquid	293.91		
thio-	$H_2S_2O_3$	1500	138.6		
Sulfurous acid	H_2SO_3	200	145.09		
(See also *thionic acids*)					
Tantalum					
oxide	Ta_2O_5	solid	300.12		
Telluric acid	H_2TeO_4	dil. sol.	169.2		
Tellurium					
chloride	$TeCl_4$	solid	77.42		
oxide, di-	TeO_2	solid	78.304		
	$TeO_2.H_2O$	solid	144.8		
oxide, tri-	TeO_3	solid	83.15		
Tellurous acid	H_2TeO_3	solid	145.6		
Thallium					
bromide, mono-	$TlBr$	solid	41.052		
bromide, tri-	$TlBr_3$	dil. sol.	56.416		
chloride, mono-	$TlCl$	solid	48.698		
		dil. sol.	38.47	4500	$-10.04^{18°}$
chloride, tri-	$TlCl_3$	solid	80.74	300	+ 8.435
		dil. sol.	89.176		
	$TlCl_3.4H_2O$	solid	364.90	300	− 2.13
fluoride	TlF	dil. sol.	77.300		
hydroxide (ic)	$Tl(OH)_3$	solid	145.07		
hydroxide (ous)	$TlOH$	solid	56.87	235	$-3.154^{18°}$
iodide	TlI	solid	30.11		
nitrate (ous)	$TlNO_3$	solid	58.806	300	$-9.964^{18°}$
		dil. sol.	48.841		
nitride	TlN_3	solid	− 54.72		
oxide (ous)	Tl_2O	solid	+ 42.151	570	$-3.082^{18°}$
selenide	Tl_2Se	solid	11.9		
sulfate (ous)	Tl_2SO_4	solid	217.78	1600	$-8.268^{18°}$
		800	209.51		
sulfide	Tl_2S	solid	22.0		
telluride	Tl_2Te	solid	7.17		
Thionic acid					
thionic, di-	$H_2S_2O_6$	400	274.31		
thionic, tri-	$H_2S_3O_6$	dil. sol.	261.89		
thionic, tetra-	$H_2S_4O_6$	dil. sol.	262.37		
thionic, penta-	$H_2S_5O_6$	dil. sol.	267.62		
(See also *sulfuric acids*)					
Thorium					
bromide	$ThBr_4$	solid	281.01		+70.130
		dil. sol.	351.26		
carbonate	$Th(CO_3)_2$		855.20		
chloride	$ThCl_4$	solid	335.01		$+56.63^{15°}$
		dil. sol.	392.12		
	$ThCl_4.2H_2O$	solid	487.70		+41.076
hydroxide (dried ppt.)	$Th(OH)_4$	ppt.	336.20		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Thorium					
iodide	ThI_4	dil. sol.	291.76	......	......
oxide	ThO_2	solid	330.95	......	......
sulfate	$Th(SO_4)_2$	dil. sol.	661.89	......	......
	$Th(SO_4)_2.4H_2O$	solid	930.23	......	+ 5.02
Tin					
bromide (ic)	$SnBr_4$	solid	95.10	......	+16.5
		liquid	92.23	......	......
bromide (ous)	$SnBr_2$	solid	61.41	......	− 1.67
chloride (ic)	$SnCl_4$	liquid	127.4	250	$+29.917^{20°}$
chloride (ous)	$SnCl_2$	solid	81.147	300	$+ 0.358^{15°}$
	$SnCl_2.2H_2O$	solid	223.7	200	$- 5.28^{18°}$
hydroxide (ous)	$Sn(OH)_2$	colloid	136.37	......	......
iodide (ous)	SnI_2	solid	35.84	......	......
oxide (ic) (fused)	SnO_2	solid	138.1	......	......
oxide (ous)	SnO	solid	69.77	......	......
pot. chloride	K_2SnCl_6	solid	360.17	800	$- 3.369^{12°}$
		600	356.80	......	......
Titanium					
chloride, tetra-	$TiCl_4$	liquid	183.5	2000	$+57.83^{18°}$
oxide, di-	TiO_2	solid	217.4	......	......
		amorph.	214.1	......	......
Tungsten					
oxide, di-	WO_2	solid	126.2	......	......
oxide, tri-	WO_3	solid	191.4	......	......
oxide, penta-	W_2O_5	solid	311.11	......	......
Tungstic acid	H_2WO_4	solid	280.05	......	......
		dil. sol.	280.05	......	......
Uranium					
oxide, di-	UO_2	solid	256.63	......	......
oxide, tri-	UO_3	solid	290.09	......	......
oxide (ous) (ic)	U_3O_8	solid	845.17	......	......
oxide, per	$UO_4.2H_2O$	solid	439.91	......	......
Uranyl					
acetate	$UO_2(C_2H_3O_2)_2$	dil. sol.	476.47	......	......
	$UO_2(C_2H_3O_2)_2.2H_2O$	solid	617.69	1000	$- 4.30^{18°}$
nitrate	$UO_2(NO_3)_2$	solid	322.10	220	$+18.9^{12°}$
	$UO_2(NO_3)_2.6H_2O$	solid	756.75	220	$- 5.448^{12°}$
sulfate	UO_2SO_4	dil. sol.	449.46	......	......
	$UO_2SO_4.3H_2O$	solid	649.94	1000	$+ 5.02^{18°}$
Vanadium					
chloride, di-	VCl_2	solid	147.2	......	......
chloride, tri-	VCl_3	liquid	187.1	......	......
chloride, tetra-	VCl_4	liquid	162.01	......	......
oxide, di-	V_2O_2	solid	209.08	......	......
oxide, tri-	V_2O_3	solid	349.58	......	......
oxide, tetra-	V_2O_4	solid	409.08	......	......
oxide, penta-	V_2O_5	solid	437.28	......	......
oxytrichloride	$VOCl_3$	liquid	201.2	......	......
Water, see *hydrogen oxide*					
Zinc					
acetate	$Zn(C_2H_3O_2)_2$	solid	261.17	720	$+ 9.80^{22°}$
	$Zn(C_2H_3O_2)_2.H_2O$	solid	332.62	800	$+ 6.93^{23°}$
	$Zn(C_2H_3O_2)_2.2H_2O$	solid	403.59	500	$+ 4.30^{10°}$
bromide	$ZnBr_2$	solid	77.90	......	+15.03
		400	92.95	......	......
carbonate	$ZnCO_3$	ppt.	193.3	......	......
chloride	$ZnCl_2$	solid	99.547	600	$+15.72^{18°}$
		400	115.27	......	......

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Zinc					
cyanide	$Zn(CN)_2$	solid	− 16.2	......	......
ethyl	ZnC_4H_{10}	liquid	+ 7.41	......	......
fluoride	ZnF_2	dil. sol.	192.31	......	......
dithionate	ZnS_2O_6	400	310.87	......	......
	$ZnS_2O_6.6H_2O$	solid	723.54	......	−2.25
hydroxide	$Zn(OH)_2$	solid	158.4	......	......
	$Zn(OH)_2.H_2O$	amorph	221.87	......	......
	$ZnO_2.2H_2O$	solid	252.33	......	......
iodide	ZnI_2	solid	49.70	......	+11.7
nitrate	$Zn(NO_3)_2$	400	136.11	......	......
	$Zn(NO_3)_2.6H_2O$	solid	552.24	400	−5.854[18°]
oxide (fused)	ZnO	solid	84.35	......	......
selenide	$ZnSe$	solid	33.45	......	......
		ppt.	31.30	......	......
silicate	$ZnSiO_3$	solid	286.50	......	......
sulfate	$ZnSO_4$	solid	229.51	400	+18.54[17°]
		400	248.05	......	......
	$ZnSO_4.6H_2O$	solid	659.26	400	−0.836[18°]
	$ZnSO_4.7H_2O$	solid	731.00	400	−4.277[18°]
sulfide	ZnS	solid	45.88	......	......
telluride	$ZnTe$	solid	33.21	......	......
Zirconium					
oxide	ZrO_2	fused	178.7	......	......

HEAT OF COMBUSTION

For Organic Compounds

The heat of combustion is given in kilogram calories per gram molecular weight of the substance when combustion takes place at atmospheric pressure and 20° C. The final products of combustion are gaseous carbon dioxide, liquid water and nitrogen gas for C, H, N compounds. For method of computing heats of formation see statement following this table.

Selections from a compilation by Kharasch, Bureau of Standards Journal of Research **2,** 359 (1929).

Name	Formula	Physical state	Heat of combustion, kg. calories
Acetaldehyde	CH_3CHO	liquid	279.0
Acetamide	CH_3CONH_2	solid	282.6
Acetanilide	$CH_3CONHC_6H_5$	solid	1,010.4
Acetic acid	CH_3CO_2H	liquid	209.4
Acetic anhydride	$(CH_3CO)_2O$	liquid	431.9
Acetone	$(CH_3)_2CO$	liquid	426.8
Acetonitrile	CH_3CN	liquid	302.4
Acetophenone	$C_6H_5COCH_3$	solid	988.9
Acetylacetone	$CH_3COCH_2COCH_3$	liquid	615.9
Acetylene	$(CH)_2$	gas	312.0
Acrolein	$CH_2:CHCHO$	liquid	389.6
Acrylic acid	$CH_2:CHCO_2H$	liquid	327.5
Adipic acid	$(CH_2)_4(CO_2H)_2$	solid	669.0
Alanine	$CH_3CH(NH_2)CO_2H$	solid	387.7
Aldol, *see β-hydroxybutyr-aldehyde*			
Alizarin, *see Dihydroxyanthraquinone*			
Allyl alcohol	$CH_2:CHCH_2OH$	liquid	442.4
Allylene	$CH_3C:CH$	gas	465.1
p-Aminoazobenzene	$H_2NC_6H_4N_2C_6H_5$	solid	1,574.0
p-Aminophenol	$HOC_6H_4NH_2$	solid	760.0
Amygdalin	$C_{20}H_{27}O_{11}N$	solid	2,348.4
Amyl acetate	$C_4H_9CO_2C_2H_5$	liquid	1,042.5
Amyl alcohol (ferm.)	$(CH_3)_2CH_2CH_2CH_2OH$	liquid	793.7
Amylene	C_5H_{10}	liquid	803.4
Anethole	$C_{10}H_{12}O$	solid	1,324.4
Aniline	$C_6H_5NH_2$	liquid	811.7
p-Anisidine	$CH_3OC_6H_4NH_2$	solid	924.0
Anisole	$C_6H_5OCH_3$	liquid	905.1
Anthracene	$C_6H_4:(CH)_2:C_6H_4$	solid	1,700.4
Anthraquinone	$C_{14}H_8O_2$	solid	1,544.5
Arabinose	$C_5H_{10}O_5$	solid	559.9
Arabitol	$C_5H_{12}O_5$	solid	661.2
Arachidic acid	$C_{20}H_{40}O_2$	solid	3,025.9
Azelaic acid	$(CH_2)_7(CO_2H)_2$	solid	1,141.7
Azobenzene	$(C_6H_5N)_2$	solid	1,545.9
Azoxybenzene	$(C_6H_5N)_2O$	solid	1,534.5
Behenic acid	$C_{22}H_{44}O_2$	solid	3,338.4
Benzalacetone	$C_6H_5CH:CHCOCH_3$	solid	1,257.4
Benzaldehyde	C_6H_5CHO	liquid	841.3
Benzamide	$C_6H_5CONH_2$	solid	847.6
Benzanilide	$C_6H_5CONHC_6H_5$	solid	1,575.5
Benzene	C_6H_6	liquid	782.3
Benzenediazonium nitrate	$C_6H_5N_2NO_3$	solid	782.6
Benzidine	$(C_6H_4NH_2)_2$	solid	1,560.9
Benzil	$(C_6H_5CO)_2$	solid	1,624.6
* Benzoic acid	$C_6H_5CO_2H$	solid	771.2
Benzoic anhydride	$(C_6H_5CO)_2O$	solid	1,555.1
Benzoin	$C_6H_5.CHOH.COC_6H_5$	solid	1,671.4
Benzonitrile	C_6H_5CN	liquid	865.5
Benzophenone	$(C_6H_5)_2CO$	solid	1,556.5

* Accepted value by Int. Union of Pure and Appld. Chem., Lyons, 1922

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Benzoyl chloride	C_6H_5COCl	liquid	782.8
Benzoyl peroxide	$(C_6H_5CO)_2O_2$	solid	1,551.7
Benzyl alcohol	$C_6H_5CH_2OH$	liquid	894.3
Benzyl amine	$C_6H_5CH_2NH_2$	liquid	969.4
Benzyl carbylamine	$C_6H_5CH_2NC$	liquid	1,046.5
Benzyl chloride	$C_6H_5CH_2Cl$	liquid	886.4
Benzyl cyanide	$C_6H_5CH_2CN$	liquid	1,023.5
Borneol	$C_{10}H_{18}O$	liquid	1,469.6
Brucine	$C_{23}H_{26}O_4N_2$	solid	2,933.0
n-Butyl alcohol	C_4H_9OH	liquid	638.6
tert.-Butyl alcohol, *see Trimethyl carbinol*			
n-Butyl amine	$C_4H_9NH_2$	liquid	710.6
sec.-Butyl amine	$(CH_3)(C_2H_5):CHNH_2$	liquid	713.0
tert.-Butyl amine	$(CH_3)_3CNH_2$	liquid	716.0
tert.-Butylbenzene	$C_6H_5C(CH_3)_3$	liquid	1,400.4
n-Butyramide	$C_3H_7CONH_2$	solid	596.0
n-Butyric acid	$C_3H_7CO_2H$	liquid	524.3
n-Butyronitrile	C_3H_7CN	liquid	613.3
Caffeine	$C_8H_{10}O_2N_4$	solid	1,014.2
Camphene	$C_{10}H_{16}$	solid	1,468.8
Camphor	$C_{10}H_{16}O$	solid	1,411.0
Cane sugar, *see Sucrose*			
Capric acid	$C_9H_{18}O_2$	solid	1,458.1
Caproic acid	$C_5H_{11}CO_2H$	liquid	831.0
Carbon disulfide	CS_2	liquid	246.6
Carbon subnitride	$(C.CN)_2$	solid	514.8
Carbon tetrachloride	CCl_4	liquid	37.3
Carbonyl sulfide	COS	gas	130.5
Carvacrol	$C_{10}H_{14}O$	liquid	1,354.5
Cetyl alcohol	$C_{16}H_{34}O$	solid	2,504.5
Cetyl palmitate	$C_{32}H_{64}O$	solid	4,872.8
Chloracetic acid	$ClCH_2CO_2H$	solid	171.0
o-Chlorobenzoic acid	$ClC_6H_4CO_2H$	solid	734.5
Chloroform	$CHCl_3$	liquid	89.2
Chrysene	$C_{14}H_{10}$	solid	2,139.1
Cinnamic acid (*trans*)	$C_6H_5CH:CHCO_2H$	solid	1,040.2
Cinnamic aldehyde	$C_6H_5CH:CHCHO$	liquid	1,112.3
Cinnamic anhydride	$C_{18}H_{14}O_3$	solid	2,091.3
d-Citrene	$C_{10}H_{16}$	liquid	1,473.0
Citric acid (anhydr.)	$C_6H_8O_7$	solid	474.5
Codeine	$C_{18}H_{21}O_3N.H_2O$	solid	2,327.6
Coniine	$C_8H_{17}N$	liquid	1,275.5
Creatine (anhydr.)	$C_4H_9O_2N_3$	solid	559.8
Creatinine	$C_4H_7ON_3$	solid	563.4
o-Cresol	$CH_3C_6H_4OH$	liquid	882.6
o-Cresol	$CH_3C_6H_4OH$	solid	879.5
m-Cresol	$CH_3C_6H_4OH$	liquid	880.5
p-Cresol	$CH_3C_6H_4OH$	liquid	882.5
p-Cresol	$CH_3C_6H_4OH$	solid	880.0
m-Cresolmethyl ether	$CH_3C_6H_4OCH_3$	liquid	1,057.0
Crotonaldehyde	C_3H_5CHO	liquid	542.1
Cyanoacetic acid	$NC.CH_2CO_2H$	solid	298.8
Cyanogen	$(CN)_2$	gas	258.3
Cycloheptanol	$CH_2(CH_2)_5CHOH$	liquid	1,050.2
Cyclohexanol	$CH_2(CH_2)_4CHOH$	liquid	890.7
Cycloheptene	C_7H_{12}	liquid	1,049.9
Cycloheptane	$(CH_2)_7$	liquid	1,087.3

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Cyclohexane	$(CH_2)_6$	liquid	937.8
Cyclohexene, *see Tetrahydrobenzene*			
Cyclopentane	$(CH_2)_5$	liquid	783.6
Cyclopropane, *see Trimethylene*			
Cymene	$C_6H_4(CH_3)(CH_3CHCH_3)$—(1, 4)	liquid	1,402.8
Decahydronaphthalene (*cis*)	$C_{10}H_{18}$	liquid	1,502.5
Decahydronaphthalene (*trans*)	$C_{10}H_{18}$	liquid	1,499.5
Decane	$C_{10}H_{22}$	liquid	1,610.2
Dextrose, *see Glucose*			
Diallyl	$(CH_3CH:CH_2)_2$	vapor	903.4
Diamyl ether	$(C_5H_{11})_2O$	liquid	1,609.3
Diamylene	$C_{10}H_{20}$	liquid	1,582.2
Dibenzyl	$(C_6H_5CH_2)_2$	solid	1,810.6
Dibenzyl amine	$(C_6H_5CH_2)_2NH$	solid	1,853.0
o-Dichlorobenzene	$C_6H_4Cl_2$	liquid	671.8
Diethylacetic acid	$(C_2H_5)_2CHCO_2H$	liquid	830.8
Diethyl amine	$(C_2H_5)_2NH$	liquid	716.9
Diethylaniline	$C_6H_5N(C_2H_5)_2$	liquid	1,451.6
Diethyl carbonate	$CO(OC_2H_5)_2$	liquid	647.9
Diethyl ether	$(C_2H_5)_2O$	liquid	651.7
Diethyl ketone	$(C_2H_5)_2CO$	liquid	735.6
Diethyl malonate	$CH_2(CO_2C_2H_5)_2$	liquid	860.4
Diethyl oxalate	$(CO_2C_2H_5)_2$	liquid	716.0
Diethyl succinate	$(CH_2CO_2C_2H_5)_2$	liquid	1,007.3
Dihydrobenzene	C_6H_8	liquid	847.8
Δ_1-Dihydronaphthalene	$C_{10}H_{10}$	liquid	1,296.3
Δ_1-Dihydronaphthalene	$C_{10}H_{10}$	solid	1,298.3
Dihydroxyanthraquinone	$C_{14}H_6O_2(OH)_2$—(1, 2)	solid	1,448.9
Diisoamyl	$[(CH_3)_2CHCH_2CH_2]_2$	liquid	1,615.8
Diisobutylene	$[(CH_3)_2CHCH_2]_2$	liquid	1,252.4
Diisopropyl	$[(CH_3)_2CH]_2$	vapor	993.9
Diisopropyl ketone	$[(CH_3)_2CH]_2CO$	liquid	1,045.5
Dimethyl amine	$(CH_3)_2NH$	liquid	416.7
Dimethylaniline	$C_6H_5N(CH_3)_2$	liquid	1,142.7
Dimethyl carbonate	$CO(OCH_3)_2$	liquid	340.8
Dimethyl ether	$(CH_3)_2O$	gas	347.6
Dimethylethyl carbinol	$C_2H_5(CH_3)_2CHOH$	liquid	784.6
Dimethyl fumarate	$(CHCO_2CH_3)_2$	solid	664.3
2, 5-Dimethylhexane	$(CH_3)_2CH.C_2H_4.CH(CH_3)_2$	liquid	1,303.3
3, 4-Dimethylhexane	$[(C_2H_5)(CH_3)CH]_2$	liquid	1,303.7
Dimethyl maleate	$(CHCO_2CH_3)_2$	solid	669.2
Dimethyl oxalate	$(CO_2CH_3)_2$	solid	401.9
2, 2-Dimethylpentane	$(CH_3)_3C.C_3H_7$	liquid	1,148.9
2, 3-Dimethylpentane	$(CH_3)_2CHCH(CH_3)C_2H_5$	liquid	1,148.9
2, 4-Dimethylpentane	$(CH_3)_2CHCH_2CH(CH_3)_2$	liquid	1,148.9
3, 3-Dimethylpentane	$(CH_3)_2C(C_2H_5)_2$	liquid	1,147.9
Dimethyl phthalate	$C_6H_4(CO_2CH_3)_2$	liquid	1,119.7
Dimethyl succinate	$(CH_2CO_2CH_3)_2$	solid	703.3
m-Dinitrobenzene	$C_6H_4(NO_2)_2$	solid	696.8
Dinitrophenol	$C_6H_3(OH)(NO_2)_2$—(1, 2, 4)	solid	648.0
Dinitrotoluene	$C_6H_3(CH_3)(NO_2)_2$—(1, 2, 4)	solid	852.8
Diphenyl	$(C_6H_5)_2$	solid	1,493.6
Diphenyl amine	$(C_6H_5)_2NH$	solid	1,536.2
Diphenyl carbinol	$(C_6H_5)_2CHOH$	solid	1,615.4
Diphenylmethane	$(C_6H_5)_2CH_2$	solid	1,655.0
Diphenylnitrosamine	$(C_6H_5)_2N.NO$	solid	1,532.6

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Dipropargyl	$(CH\vdots C.CH_2)_2$	vapor	882.9
Dipropyl ketone	$(C_3H_7)_2CO$	liquid	1,050.5
Dulcitol	$C_6H_{14}O_6$	solid	729.1
Durene	$C_6H_2(CH_3)_4$—(1, 2, 4, 5)	solid	1,393.6
Eicosane	$C_{20}H_{42}$	solid	3,183.1
Erythritol	$C_4H_{10}O_4$	solid	504.1
Ethane	C_2H_6	gas	368.4
Ethine, *see Acetylene*			
Ethyl acetate	$CH_3CO_2C_2H_5$	liquid	536.9
Ethyl acetoacetate	$CH_3COCH_2CO_2C_2H_5$	liquid	690.8
Ethyl alcohol	C_2H_5OH	liquid	327.6
Ethyl amine	$C_2H_5NH_2$	liquid	408.5
Ethylaniline	$C_6H_5NHC_2H_5$	liquid	1,121.5
Ethylbenzene	$C_2H_5C_6H_5$	liquid	1,091.2
Ethyl benzoate	$C_6H_5CO_2C_2H_5$	liquid	1,098.7
Ethyl bromide	C_2H_5Br	vapor	340.5
Ethyl *n*-butyrate	$C_3H_7CO_2C_2H_5$	liquid	851.2
Ethyl carbylamine	C_2H_5NC	liquid	477.1
Ethyl chloride	C_2H_5Cl	vapor	316.7
Ethylcycloheptane	$C_2H_5C_7H_{13}$	liquid	1,406.8
Ethyl formate	$HCO_2C_2H_5$	liquid	391.7
3-Ethylhexane	$(C_2H_5)_2CH.C_3H_7$	liquid	1,302.3
Ethyl iodide	C_2H_5I	liquid	356.0
Ethyl isobutyrate	$(CH_3)_2CHCH_2CO_2C_2H_5$	liquid	845.7
Ethyl isocyanate	C_2H_5NCO	liquid	424.5
Ethyl nitrate	$C_2H_5ONO_2$	vapor	322.4
Ethyl nitrite	C_2H_5ONO	vapor	332.6
3-Ethylpentane	$(C_2H_5)_3CH$	liquid	1,149.9
Ethyl propionate	$C_2H_5CO_2C_2H_5$	liquid	690.8
Ethyl salicylate	$HOC_6H_4CO_2C_2H_5$	liquid	1,051.2
Ethyl valerate	$C_4H_9CO_2C_2H_5$	liquid	1,017.5
Ethylene	$CH_2{:}CH_2$	gas	331.6
Ethylene chloride	$(CH_2Cl)_2$	vapor	271.0
Ethylene diamine	$(CH_2NH_2)_2$	liquid	452.6
Ethylene glycol	$(CH_2OH)_2$	liquid	281.9
Ethylene iodide	$(CH_2I)_2$	solid	324.8
Ethylene oxide	CH_2CH_2O	liquid	302.1
Ethylidene chloride	CH_3CHCl_2	liquid	267.1
Eugenol	$C_{10}H_{12}O_2$	liquid	1,286.6
Fenchane	$C_{10}H_{18}$	liquid	1,502.6
Fluorene	$(C_6H_4)_2{:}CH_2$	solid	1,584.9
Fluorobenzene	C_6H_5F	liquid	747.2
Formaldehyde	CH_2O	gas	134.1
Formamide	$HCONH_2$	solid	134.9
Formic acid	HCO_2H	liquid	62.8
l-Fructose	$C_6H_{12}O_6$	solid	675.6
Fumaric acid (*trans*)	$(CHCO_2H)_2$	solid	320.0
Furfural	C_4H_3OCHO	liquid	559.5
Galactose	$C_6H_{12}O_6$	solid	670.7
Gallic acid	$C_6H_2(OH)_3CO_2H$—(1, 3, 5, 6)	solid	633.7
d-Glucose	$C_6H_{12}O_6$	solid	673.0
Glutaric acid	$(CH_2)_3(CO_2H)_2$	solid	514.9
Glycerol	$(CH_2OH)_2CHOH$	liquid	397.0
Glyceryl tributyrate	$C_{15}H_{26}O_6$	liquid	1,941.1
Glycine	$H_2NCH_2CO_2H$	solid	234.5
Glycogen	$(C_6H_{10}O_5)x$	solid	4,186.8
Glycollic acid	CH_2OHCO_2H	solid	166.6
Glycylglycine	$C_4H_8O_3N_2$	solid	470.7

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
n-Heptaldehyde	$CH_3(CH_2)_5CHO$	liquid	1,062.4
n-Heptane	C_7H_{16}	liquid	1,149.9
Heptine-1	$CH:C(CH_2)_4CH_3$	liquid	1,091.2
n-Heptyl alcohol	$CH_3(CH_2)_5CH_2OH$	liquid	1,104.9
Heptyl amine	$C_7H_{15}NH_2$	liquid	1,178.9
Heptylic acid	$C_7H_{14}O_2$	liquid	986.1
n-Hexane	C_6H_{14}	liquid	989.8
Hexachlorbenzene	C_6Cl_6	solid	509.0
Hexachlorethane	C_2Cl_6	solid	110.0
Hexadecane	$C_{16}H_{34}$	solid	2,559.1
Hexahydronaphthalene	$C_{10}H_{14}$	liquid	1,419.3
Hexamethylbenzene	$C_6(CH_3)_6$	solid	1,711.9
Hexamethylenetetramine	$(CH_2)_6N_4$	solid	1,006.7
Hexamethylethane	$[(CH_3)_3C]_2$	solid	1,301.8
Hexyl amine	$C_6H_{13}NH_2$	liquid	1,022.2
Hexylene	C_6H_{12}	liquid	952.6
Hippuric acid	$C_6H_5CONHCH_2CO_2H$	solid	1,012.4
Hydantoic acid	$C_3H_6O_3N_2$	solid	308.6
Hydrazobenzene	$(C_6H_5NH)_2$	solid	1,597.3
Hydroquinol	$C_6H_4(OH)_2$	solid	683.7
Hydroquinoldimethyl ether	$(CH_3O)_2C_6H_4$	solid	1,014.7
p-Hydroxyazobenzene	$HOC_6H_4N_2C_6H_5$	solid	1,502.0
o-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	liquid	796.0
m-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	solid	788.7
p-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	solid	792.7
m-Hydroxybenzoic acid	$HOC_6H_4CO_2H$	solid	726.1
p-Hydroxybenzoic acid	$HOC_6H_4CO_2H$	solid	725.4
β-Hydroxybutyraldehyde	$CH_3CHOHCH_2CHO$	liquid	546.6
Indigo	$C_{16}H_{10}O_2N_2$	solid	1,815.0
Indole	C_8H_7N	solid	1,022.2
Inositol	$C_6H_{12}O_6$	solid	662.1
Iodoform	CHI_3	solid	161.9
Isoamyl amine	$(CH_3)_2CHC_2H_4NH_2$	liquid	866.8
Isobutane	$(CH_3)_3CH$	gas	683.4
Isobutyl alcohol	$(CH_3)_2CH_2CH_2OH$	liquid	638.2
Isobutyl amine	$C_4H_9NH_2$	liquid	713.6
Isobutylene	$(CH_3)_2C:CH_2$	gas	647.2
Isobutyraldehyde	$(CH_3)_2CHCHO$	vapor	596.8
Isobutyramide	$(CH_3)_2CHCONH_2$	solid	595.9
Isobutyric acid	$(CH_3)_2CHCO_2H$	liquid	517.4
Isoeugenol	$C_{10}H_{12}O_2$	liquid	1,277.6
Isopentane	C_5H_{12}	gas	843.5(?
Isopentane	C_5H_{12}	liquid	838.3(?
Isophthalic acid	$C_6H_4(CO_2H)_2$	solid	768.3
Isopropyl alcohol	$(CH_3)_2CHOH$	liquid	474.8
Isopropylbenzene	$(CH_3)_2CHC_6H_5$	liquid	1,247.3
Isopropyltoluene	$C_6H_4(CH_3)(CH_3CHCH_3)$—(1, 3)	liquid	1,409.5
Isopropyltoluene, *see Cymene*			
Isosafrole	$C_{10}H_{10}O_2$	liquid	1,233.9
Lactic acid	$CH_3CHOHCO_2H$	liquid	326.0
Lactose (anhydr.)	$C_{12}H_{22}O_{11}$	solid	1,350.8
Lauric acid	$C_{12}H_{24}O_2$	solid	1,771.7
Leucine	$C_6H_{13}O_2N$	solid	855.6
d-Limonene	$C_{10}H_{16}$	liquid	1,471.2
Maleic acid (*cis*)	$(CHCO_2H)_2$	solid	326.1
Maleic anhydride	$(CHCO)_2O$	solid	333.9
l-Malic acid	$(CHOHCH_2):(CO_2H)_2$	solid	320.1

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion kg. calories
Malonic acid	$CH_2(CO_2H)_2$	solid	207.2
Maltose	$C_{12}H_{22}O_{11}$	solid	1,350.2
Mandelic acid	$C_6H_5CHOHCO_2H$	solid	890.3
d-Mannitol	$C_6H_{14}O_6$	solid	727.6
Menthene	$C_{10}H_{18}$	liquid	1,523.2
Menthol	$C_{10}H_{20}O$	solid	1,508.8
Mesitylene	$(CH_3)_3C_6H_3$—(1, 3, 5)	liquid	1,243.6
Mesityl oxide	$(CH_3)_2C{:}CHCOCH_3$	liquid	846.7
Mesotartaric acid	$(CHOH)_2(CO_2H)_2$	solid	276.0
Methane	CH_4	gas	210.8
Methyl acetate	$CH_3CO_2CH_3$	liquid	381.2
Methyl alcohol	CH_3OH	liquid	170.9
Methyl amine	CH_3NH_2	liquid	256.1
Methylaniline	$C_6H_5NHCH_3$	liquid	973.5
Methyl benzoate	$C_6H_5CO_2CH_3$	liquid	943.5
Methyl bromide	CH_3Br	vapor	184.0
Methyl butyl ketone	$CH_3COC_4H_9$	liquid	895.2
Methyl *tert*-butyl ketone, *see Pinacoline*			
Methyl butyrate	$C_3H_7COC_2H_3$	liquid	692.8
Methyl carbylamine	CH_3NC	liquid	320.1
Methyl chloride	CH_3Cl	gas	164.2
Methyl cinnamate	$C_{10}H_{10}O_2$	solid	1.213.0
Methylcyclobutane	$CH_3CHCH_2CH_2CH_2$	liquid	784.2
Methylcycloheptane	$CH_3C_7H_{13}$	liquid	1,244.5
Methylcyclohexane	$CH_3C_6H_{11}$	liquid	1,091.8
Methylcyclopentane	$CH_3CH.C_3H_6.CH_2$	liquid	937.9
Methyldiethyl carbinol	$CH_3(C_2H_5)_2CHOH$	liquid	927.0
Methylene chloride	CH_2Cl_2	vapor	106.8
Methylene iodide	CH_2I_2	liquid	178.4
Methylethyl ether	$CH_3OC_2H_5$	vapor	503.4
Methylethyl ketone	$CH_3COC_2H_5$	liquid	582.3
Methyl formate	HCO_2CH_3	liquid	233.1
2-Methylheptane	$(CH_3)_2CH.C_5H_{11}$	liquid	1.306.1
2-Methylhexane	$(CH_3)_2CHC_4H_9$	liquid	1,148.9
3-Methylhexane	$(C_2H_5)(CH_3)CHC_3H_7$	liquid	1,148.9
Methylhexyl ketone	$CH_3COC_6H_{13}$	liquid	1,205.1
Methyl iodide	CH_3I	liquid	194.7
Methyl isobutyrate	$(CH_3)_2CHCO_2CH_3$	liquid	694.2
Methyl isocyanate	CH_3NCO	liquid	269.4
Methylisopropyl ketone	$CH_3COCH(CH_3)_2$	liquid	733.9
Methyl lactate	$CH_3CHOHCO_2CH_3$	liquid	497.2
Methyl propionate	$C_2H_5CO_2CH_3$	vapor	552.3
Methylpropyl ketone	$CH_3COC_3H_7$	liquid	735.6
Methyl salicylate	$HOC_6H_4CO_2CH_3$	liquid	898.3
Milk sugar, *see Lactose*			
Morphine	$C_{17}H_{19}O_3N.H_2O$	solid	2,146.3
Mucic acid	$C_6H_{10}O_8$	solid	483.6
Myristic acid	$C_{14}H_{28}O_2$	solid	2,085.8
Naphthalene	$C_{10}H_8$	solid	1,232.5
α-Naphthoic acid	$C_{10}H_7CO_2H$	solid	1,231.8
β-Naphthoic acid	$C_{10}H_7CO_2H$	solid	1,227.6
α-Naphthol	$C_{10}H_7OH$	solid	1,185.4
β-Naphthol	$C_{10}H_7OH$	solid	1,187.2
α-Naphthonitrile	$C_{10}H_7CN$	solid	1,326.2
β-Naphthonitrile	$C_{10}H_7CN$	solid	1,321.0
α-Naphthoquinone	$C_{10}H_6O_2$	solid	1,100.8
β-Naphthoquinone	$C_{10}H_6O_2$	solid	1,106.4
α-Naphthyl amine	$C_{10}H_7NH_2$	solid	1,263.5

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
β-Naphthyl amine	$C_{10}H_7NH_2$	solid	1,261.0
Narceine	$C_{23}H_{27}O_8N.2H_2O$	solid	2,802.9
Narcotine	$C_{22}H_{23}O_7N$	solid	2,644.5
Nicotine	$C_{10}H_{14}N_2$	liquid	1,427.7
o-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	765.8
m-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	765.2
p-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	761.0
m-Nitrobenzaldehyde	$O_2NC_6H_4CHO$	solid	800.4
Nitrobenzene	$C_6H_5NO_2$	liquid	739.2
m-Nitrobenzoic acid	$O_2NC_6H_4CO_2H$	solid	729.1
Nitroethane	$C_2H_5NO_2$	liquid	322.2
Nitroglycerine, *see Trinitroglycerol*			
Nitromethane	CH_3NO_2	liquid	169.4
o-Nitrophenol	$HOC_6H_6NO_2$	solid	689.1
m-Nitrophenol	$HOC_5H_4NO_2$	solid	684.4
p-Nitrophenol	$HOC_6H_4NO_2$	solid	688.8
Nitropropane	$C_3H_7NO_2$	liquid	477.9
o-Nitrotoluene	$CH_3C_6H_4NO_2$	liquid	897.0
p-Nitrotoluene	$CH_3C_6H_6NO_2$	solid	888.6
Octahydronaphthalene	$C_{10}H_{16}$	liquid	1,461.7
n-Octane	C_8H_{18}	liquid	1,302.7
Octyl alcohol	$C_8H_{18}O$	liquid	1,262.0
Oleic acid	$C_{18}H_{34}O_2$	liquid	2,657.0
Oxalic acid	$(CO_2H)_2$	solid	60.2
Oxamide	$(CONH_2)_2$	solid	203.2
Palmitic acid	$C_{16}H_{32}O_2$	solid	2,398.4
Papaverine	$C_{20}H_{21}O_4N$	solid	2,478.1
Pentamethylbenzene	$C_6H(CH_3)_5$	solid	1,554.0
n-Pentane	C_5H_{12}	gas	838.3
n-Pentane	C_5H_{12}	liquid	833.4
Phenacetin	$C_{10}H_{13}O_2N$	solid	1,285.2
Phenanthraquinone	$C_{14}H_8O_2$	solid	1,544.0
Phenanthrene	$C_{14}H_{10}$	solid	1,692.5
Phenetole	$C_6H_5OC_2H_5$	liquid	1,060.3
Phenol	C_6H_5OH	solid	732.2
Phenylacetic acid	$C_6H_5CH_2CO_2H$	solid	930.2
Phenylacetylene	$C_6H_5C:CH$	liquid	1,024.2
Phenylalanine	$C_9H_{11}O_2N$	solid	1,111.3
p-Phenylenediamine	$C_6H_4(NH_2)_2$	solid	843.4
Phenylethylene, *see Styrene*			
Phenylglycine	$C_2H_5NHCH_2CO_2H$	solid	955.1
Phenylhydrazine	$C_6H_5N_2H_3$	solid	875.4
Phenylhydroxylamine	C_6H_5NHOH	liquid	803.7
Phenyl iodide	C_6H_6I	liquid	770.7
Phloroglucinol	$C_6H_3(OH)_3$	solid	635.7
Phthalic acid	$C_6H_4(CO_2H)_2$	solid	771.0
Phthalic anhydride	$C_6H_4(CO)_2O$	solid	783.4
Phthalimide	$C_8H_5O_2N$	solid	849.5
Picric acid	$C_6H_2(OH)(NO_2)_3$—(1, 2, 4, 6)	solid	611.8
Pinacoline	$CH_3COC(CH_3)_3$	solid	891.8
Piperidine	$C_5H_{11}N$	liquid	826.6
Piperonal	$C_8H_6O_3$	solid	870.7
Propane	C_3H_8	gas	526.3
Propine, *see Allylene*			
Propionaldehyde	C_2H_5CHO	liquid	434.2
Propionamide	$C_2H_5CONH_2$	solid	439.9
Propionic acid	$C_2H_5CO_2H$	liquid	367.2
Propionic anhydride	$(C_2H_5CO)_2O$	liquid	746.6

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Propionitrile	C_2H_5CN	liquid	456.4
n-Propyl alcohol	C_3H_7OH	liquid	480.5
Propyl amine	$C_3H_7NH_2$	liquid	558.3
n-Propylbenzene	$C_3H_7C_6H_5$	liquid	1,246.4
Propyl bromide	C_3H_7Br	vapor	497.3
Propyl carbylamine	C_3H_7NC	liquid	639.6
Propyl chloride	C_3H_7Cl	vapor	478.3
Propylene	$CH_3CH{:}CH_2$	gas	490.2
Propylene glycol	$CH_3CHOHCH_2OH$	liquid	431.0
n-Propyl iodide	C_3H_7I	liquid	514.3
n-Propyltoluene	$C_6H_4(CH_3)(C_3H_7)$—(1, 3)	liquid	1,405.4
Pseudocumene	$C_6H_3(CH_3)_3$—(1, 2, 4)	liquid	1,241.7
Pyridine	C_5H_5N	liquid	658.5
Pyrocatechol	$C_6H_4(OH)_2$	solid	684.8
Pyrogallol	$C_6H_3(OH)_3$	solid	638.7
Pyrrole	C_4H_5N	liquid	567.7
Quercitol	$C_6H_{12}O_5$	solid	704.2
Quinoline	C_9H_7N	liquid	1,123.5
Quinone	$O{:}C_6H_4{:}O$	solid	656.6
Raffinose	$C_{18}H_{32}O_{16}$	solid	2,025.5
Retene	$C_{18}H_{18}$	solid	2,306.8
Resorcinol	$C_6H_4(OH)_2$	solid	683.0
Resorcinoldimethyl ether	$(CH_3O)_2C_6H_4$	liquid	1,022.6
Rhamnose	$C_6H_{12}O_6$	solid	718.3
Safrole	$C_{10}H_{10}O_2$	liquid	1,244.1
Salicylaldehyde, *see o-Hydroxybenzaldehyde*			
* Salicylic acid	$HOC_6H_4CO_2H$—(1, 2)	solid	723.1
Sarcosine	$CH_3NHCH_2CO_2H$	solid	401.1
Sebacic acid	$(CH_2)_8(CO_2H)_2$	solid	1,297.3
Skatole	C_9H_9N	liquid	1,170.5
d-Sorbose	$C_6H_{12}O_6$	solid	668.3
Starch	$(C_6H_{10}O_5)x$	solid	4,178.8
Stearic acid	$C_{18}H_{36}O_2$	solid	2,711.8
Strychnine	$C_{21}H_{22}O_2N_2$	solid	2,685.7
Styrene	$(C_6H_5CH)_2$	liquid	1,047.1
Suberic acid	$(CH_2)_6(CO_2H)_2$	solid	985.2
Succinic acid	$(CH_2CO_2H)_2$	solid	357.1
Succinic acid nitrile	$(CH_2CN)_2$	liquid	545.7
Succinic anhydride	$(CH_2CO)_2O$	solid	369.6
Succinimide	$C_4H_5O_2N$	solid	437.9
Sucrose	$C_{12}H_{22}O_{11}$	solid	1,349.6
Sylvestrene	$C_{10}H_{16}$	liquid	1,464.7
d-Tartaric acid	$(CHOH)_2(CO_2H)_2$	solid	275.1
d, l-Tartaric acid (anhydr.)	$(CHOH)_2(CO_2H)_2$	solid	278.4
Terephthalic acid	$C_6H_4(CO_2H)_2$	solid	770.4
Terpin hydrate	$C_{10}H_{22}O_3$	solid	1,451.0
Terpineol	$C_{10}H_{18}O$	solid	1,469.5
Tetrahydrobenzene	C_6H_{10}	liquid	891.9
Tetrahydronaphthalene	$C_{10}H_{12}$	liquid	1,352.4
Tetramethylmethane	$(CH_3)_4C$	gas	842.6
Tetraphenylmethane	$(C_6H_5)_4C$	solid	3,102.4
Tetryl	$C_7H_5N_5O_8$	solid	842.3
Thebaine	$C_{19}H_{21}O_3N$	solid	2,441.3
Thiophene	C_4H_4S	liquid	670.5
Thujane	$C_{10}H_{18}$	liquid	1,506.4
Thymol	$C_{10}H_{14}O$	liquid	1,353.4
Thymol	$C_{10}H_{14}O$	solid	1,349.7
Thymoquinone	$C_{10}H_{12}O_2$	solid	1,271.3

* Recommended as a secondary thermochemical standard

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Toluene	$CH_3C_6H_5$	liquid	934.2
o-Toluic acid	$CH_3C_6H_4CO_2H$	solid	928.9
m-Toluic acid	$CH_3C_6H_4CO_2H$	solid	928.6
p-Toluic acid	$CH_3C_6H_4CO_2H$	solid	926.9
o-Toluidine	$CH_3C_6H_4NH_2$	liquid	964.3
m-Toluidine	$CH_3C_6H_4NH_2$	liquid	965.3
p-Toluidine	$CH_3C_6H_4NH_2$	solid	958.4
o-Tolunitrile	$CH_3C_6H_4CN$	liquid	1,030.3
Toluquinone	$C_7H_6O_2$	solid	803.2
Triaminotriphenyl carbinol	$(C_6H_4NH_2)_3COH$	solid	2,483.5
Tribenzyl amine	$(C_6H_5CH_2)_3N$	solid	2,762.1
Trichloracetic acid	$Cl_3C.CO_2H$	solid	92.8
Triethyl amine	$(C_2H_5)_3N$	liquid	1,036.8
Triethyl carbinol	$(C_2H_5)_3CHOH$	liquid	1,080.0
Triisoamyl amine	$[(CH_3)_2CHCH_2CH_2]_3N$	liquid	2,459.3
Triisobutyl amine	$[(CH_3)_2CHCH_2]_3N$	liquid	1,973.6
Trimethyl amine	$(CH_3)_3N$	liquid	578.6
2, 2, 3-Trimethylbutane	$(CH_3)_3C.CH(CH_3)_2$	liquid	1,147.9
Trimethyl carbinol	$(CH_3)_3COH$	liquid	629.3
Trimethylene	$CH_2CH_2CH_2$	gas	496.8
Trimethylethylene	$(CH_3)_2C:CHCH_3$	liquid	796.0
Trimethylethylene	$(CH_3)_2C:CHCH_3$	vapor	803.6
2, 2, 4-Trimethylpentane	$(CH_3)_3C.CH_2CH(CH_3)_2$	liquid	1,303.9
Trinitrobenzene	$C_6H_3(NO_2)_3$—(1, 3, 5)	solid	663.7
Trinitroglycerol	$C_3H_5(NO_3)_3$	liquid	432.4
Trinitrotoluene	$C_6H_2(CH_3)(NO_2)_3$—(1, 2, 4, 6)	solid	820.7
Triphenyl amine	$(C_6H_5)_3N$	solid	2,267.8
Triphenylbenzene	$C_6H_3(C_6H_5)_3$—(1, 3, 5)	solid	2,936.7
Triphenyl carbinol	$(C_6H_5)_3CHOH$	solid	2,340.8
Triphenylmethane	$(C_6H_5)_3CH$	solid	2,388.7
Triphenyl methyl	$(C_6H_5)_3C$	solid	2,378.5
Tyrosine	$C_9H_{11}O_3N$	solid	1,070.2
Undecylic acid	$C_{11}H_{22}O_2$	solid	1,615.9
Urea	$(NH_2)_2CO$	solid	128.6
Urethane	$NH_2CO_2C_2H_5$	solid	397.2
Uric acid	$C_5H_4O_3N_4$	solid	460.2
n-Valeric acid	$C_4H_9CO_2H$	liquid	681.6
Vanillin	$C_6H_3(OH)(OCH_3)CHO$—(1, 2, 4)	solid	914.1
o-Xylene	$(CH_3)_2C_6H_4$	liquid	1,091.7
m-Xylene	$(CH_3)_2C_6H_4$	liquid	1,088.4
p-Xylene	$(CH_3)_2C_6H_4$	liquid	1,089.1
Xylose	$C_5H_{10}O_5$	solid	561.5

HEAT OF FORMATION

For Organic Compounds

The heat of formation of a compound "A" is equal to the sum of the heats of formation of the products of combustion minus the heat of combustion (see preceding table) of the compound "A." The heat of formation of:

Free elements	0	kg-cal
CO_2 (gas)	94.38	"
$\frac{1}{2}H_2O$ (liquid from 1 H)	34.19	"
HF (dilute aqueous solution)	75.6	"
SO_2 (gas)	69.3	"
HBr (aqueous solution)	28.54	"
HCl (aqueous solution)	39.46	"
HNO_3 (aqueous solution)	49.80	"
H_2SO_4 (aqueous solution)	207.5	"

Example I

To calculate the heat of formation of methane (CH_4) where

Heat of combustion of methane = 210.8
Heat of formation of CO_2 = 94.38
Heat of formation of $\frac{1}{2}H_2O$ = 34.19

and where the combustion occurs according to the equation:

$$CH_4 + 2O_2 = CO_2 \text{ (gas)} + 2H_2O \text{ (liquid)}$$

Then the heat of formation of $CH_4 = 94.38 + 4(34.19) - 210.8 = +20.34$ kg-cal. per gram molecular weight.

Example II

To calculate the heat of formation of ethylene (C_2H_4) where

Heat of combustion of ethylene = 331.6

and the combustion occurs according to the equation:

$$C_2H_4 + 3O_2 = 2CO_2 + 2H_2O$$

The heat of formation of $C_2H_4 = 2(94.38) + 4(34.19) - 331.6 = -6.08$ kg-cal. per gram molecular weight.

Example III

To calculate the heat of formation of ethylamine ($C_2H_5NH_2$) where

Heat of combustion of ethylamine = 408.5

and the combustion occurs according to the equation:

$$C_2H_5NH_2 + 3.75O_2 = 2CO_2 + 3.5(H_2O) + N_2$$

The heat of formation of $C_2H_5NH_2 = 2(94.38) + 7(34.19) + O(N_2) - 331.6 = +96.49$ kg-cal. per gram molecular weight.

COMBUSTION CONSTANTS OF GASES

The flue products are based upon air with 21% oxygen and 79% nitrogen; flame temperatures are not corrected for dissociation; the high or gross heat value is one which would be obtained by burning in a Junker's calorimeter; it includes the heat of condensation of the water formed by combustion and assumes that all products of combustion are cooled to the initial temperature; the low or net heat value assumes that all of the products of combustion except water have been cooled to the initial temperature; the difference between the gross and the net is equal to the heat of vaporization of water at the initial temperature.

	Formula	Mol. wt.	Sp. gr. air 1	Wt. per cu. ft. dry	B.t.u. per mol. high (gross)	B.t.u. per mol. low (net)	B.t.u. per cu. ft. high (gross) 60° F. 30 in. satd. H_2O
Acetylene	C_2H_2	26.02	0.8981	0.06858	562,000	543,000	1456
Ammonia	NH_3	17.03	0.5878	0.04489	....	....	......
Benzene	C_6H_6	78.05	2.6940	0.2057	1,413,000	1,356,000	3658
Butane	C_4H_{10}	58.08	2.0047	0.15309	1,237,000	1,142,000	3204
Butylene	C_4H_8	56.06	1.9352	0.14778	1,171,000	1,095,000	3033
Carbon dioxide	CO_2	44.00	1.5188	0.11598	....	....	......
Carbon monoxide	CO	28.00	0.9665	0.07381	122,400	122,400	317.1
Ethane	C_2H_6	30.05	1.0371	0.07920	668,300	611,300	1731
Ethylene	C_2H_4	28.03	0.9676	0.07389	622,400	584,400	1613
Hydrogen	H_2	2.02	0.0695	0.00531	123,100	104,100	318.8
Hydrogen sulfide	H_2S	34.08	1.1767	0.08986	....	....	......
Methane	CH_4	16.03	0.5534	0.04226	384,000	346,000	995
Naphthalene	$C_{10}H_8$	128.06	......	......	2,219,000	2,143,000	......
Nitrogen	N_2	28.02	0.9671	0.07385	....	....	......
Oxygen	O_2	32.00	1.1046	0.08435	....	....	......
Propane	C_3H_8	44.06	1.5210	0.11615	952,000	876,000	2465
Propylene	C_3H_6	42.05	1.4513	0.11083	893,000	836,000	2313
Toluene	C_7H_8	92.06	3.1778	0.2427	1,685,000	1,609,000	4364
Xylene	C_8H_{10}	106.08	3.6616	0.27962	1,955,000	1,860,000	5064
Water	H_2O	18.02	0.6219	0.04749	....	....	......

HEAT OF COMBUSTION OF LIQUID FUELS

Fuel	B.t.u. per lb	Gram-calories per gram	Ultimate analysis					Lbs. per gallon	Specific gravity at 60° F
			C	H	S	N	O		
Alcohol, fuel or denatured	11,620	6,456	.....	.....	....	....	....	6.836	0.820
Crude oil, California	18,910	10,506	84.00	12.70	0.75	1.70	1.20	7.636	0.917
Kansas	19,130	10,628	84.15	13.00	1.90	0.45	....	7.670	0.921
Mexico	18,755	10,419	83.70	10.20	4.15	....	....	8.120	0.975
Oklahoma	19,502	10,834	85.70	13.11	0.40	0.30	....	7.236	0.869
Pennsylvania	19,505	10,836	86.06	13.88	0.06	0.00	0.00	6.769	0.813
Texas	19,460	10,811	85.05	12.30	1.75	0.70	0.00	7.286	0.875
Wyoming	19,510	10,839	.....	.....	....	....	....	7.228	0.868
Gas oil	19,200	10,667	.....	.....	....	....	....	7.184	0.863
Gasoline	20,750	11,528	84.90	14.76	0.08	....	....	6.152	0.739
Fuel oil, California	18,835	10,464	84.67	12.36	1.16	....	....	7.956	0.9554
Mexico	18,510	10,283	84.02	10.06	4.93	....	....	8.223	0.987
Mid-continent	19,376	10,764	85.62	11.98	0.35	0.50	0.60	7.428	0.892
Furnace oil	19,025	10,569	.....	.....	....	....	....	7.462	0.896
Kerosene	19,810	11,006	.....	.....	....	....	....	6.822	0.819

COMBUSTION CONSTANTS OF GASES (Continued)

	B.t.u. per cu. ft. low (net) 60° F. 30 in. satd. H_2O	B.t.u. per cu. ft. high (gross) 60° F. 30 in. dry	B.t.u. per cu. ft. low (net) 60° F. 30 in. dry	B.t.u. per cu. ft. high (gross) 32° F. 30 in.	B.t.u. per cu. ft. low (net) 32° F. 30 in.	Theoretical flame temp. deg. F.	Cu. ft. per cu. ft. fuel gas or mol. per mol. Required for combustion: Oxygen	Air
Acetylene	1396	1483	1433	1567	1514	4770	2.5	11.90
Ammonia	......	......	......	......	......	.....	.....	.....
Benzene	3509	3722	3577	3933	3774	4110	7.5	35.70
Butane	2955	3261	3010	3445	3180	3870	6.5	30.95
Butylene	2834	3087	2887	3262	3050	4030	6.0	28.58
Carbon dioxide	......	......	......	......	......	.....	.....	.....
Carbon monoxide	317.1	322.6	322.6	341.0	341.0	4475	0.5	2.38
Ethane	1582	1762	1612	1862	1703	3820	3.5	16.67
Ethylene	1514	1641	1541	1734	1631	4250	3.0	14.29
Hydrogen	269.1	324.5	274.5	343.0	290.0	4010	0.5	2.38
Hydrogen sulfide	......	......	......	......	......	.....	1.5	7.14
Methane	896	1012	912	1069	963	3750	2.0	9.52
Naphthalene	......	......	......	......	......	4100	12.0	57.10
Nitrogen	......	......	......	......	......	.....	.....	.....
Oxygen	......	......	......	......	......	.....	.....	.....
Propane	2266	2509	2309	2652	2440	3840	5.0	23.80
Propylene	2164	2354	2204	2487	2328	4090	4.5	21.43
Toluene	4165	4441	4241	4693	4481	4050	9.0	42.87
Xylene	4815	5153	4902	5446	5181	4010	10.5	50.00
Water	......	......	......	......	......	.....	.....	.....

COMBUSTION CONSTANTS OF GASES (Continued)

	Cu. ft. per cu. ft. fuel gas or mol. per mol.			Ignition temp. at atmospheric pressure				Inflammability in air at atmospheric pressure and ordinary temp	
	Flue products			In air		In oxygen			
	CO_2	H_2O	N_2	Deg. F.	Deg. C.	Deg. F.	Deg. C.	% lower limit mixture	% upper limit mixture
Acetylene	2.0	1.0	9.40	763–824	406–440	781–824	416–440	...	...
Ammonia	...	...	...	...	...	...	...	...	...
Benzene	6.0	3.0	28.20	1364	740	1224	662	1.4	5.5
Butane	4.0	5.0	24.45	...	...	...	...	...	...
Butylene	4.0	4.0	22.58	...	...	...	...	...	...
Carbon dioxide	...	...	...	...	...	...	...	...	...
Carbon monoxide	1.0	...	1.88	1191–1216	644–658	1179–1216	637–658	16.3	71.2
Ethane	2.0	3.0	13.17	968–1166	520–630	968–1166	520–630	3.3	10.6
Ethylene	2.0	2.0	11.29	1008–1018	542–547	932–966	500–519	3.4	14.1
Hydrogen	...	1.0	1.88	1076–1094	580–590	1076–1094	580–590	6.2	71.4
Hydrogen sulfide	1.0	1.0	5.64	...	...	...	...	...	...
	SO_2								
Methane	1.0	2.0	7.52	1202–1382	650–750	1033–1292	556–700	5.8	13.3
Naphthalene	10.0	4.0	45.00	...	...	...	...	...	...
Nitrogen	...	...	...	...	...	...	...	...	...
Oxygen	...	...	...	...	...	...	...	...	...
Propane	3.0	4.0	18.80	...	...	914–1058	490–570	...	...
Propylene	3.0	3.0	16.93	...	...	...	...	...	...
Toluene	7.0	4.0	33.87	1490	810	1026	552	...	...
Xylene	8.0	5.0	39.50	...	...	...	...	...	...
Water	...	...	...	...	...	...	...	...	...

HEATS OF COMBUSTION AND COMPOSITION OF MANUFACTURED AND NATURAL GASES

Products of combustion, theoretical flame temperatures, air required and B.T.U. of gas-air mixture are based upon air with 21 % oxygen and 79 % nitrogen; heat values are calculated from the table as given under "Combustion Constants of Gases;" flame temperatures are not corrected for dissociation; carburetted water gas, coal gas, coke-oven gases and oil gas contain a small amount of benzene and oxygen.

	Combustion Values								Composition								
	Theoretical flame temp. ° F.	B.T.U. per cu. ft., high (gross) 60° F., 30 in. Hg, satd. H_2O	B.T.U. per cu. ft., low (net) 60° F., 30 in. Hg, satd. H_2O	Cu. ft. air required per cu. ft. gas	Cu. ft. CO_2 per cu. ft. of gas burned	Cu. ft. H_2O per cu. ft. of gas burned	Cu. ft. of N_2 per cu. ft. of gas burned	High (gross) B.T.U. per cu. ft. gas-air mixture	% CO_2	% CO	% C_2H_6 (ethane)	% C_2H_4 (ethylene)	% H_2	% CH_4 (methane)	% N_2	% O_2	% C_3H_8 (propane)
Blast-furnace gas	2660	93	91.6	0.70	0.392	0.032	0.55	54.7	13.0	26.2	....	....	3.2	....	57.6	...	....
Blue water gas	4167	310	285	2.28	0.469	0.518	1.81	94.5	3.5	43.4	....	....	51.8	....	1.3	...	....
Carburetted water gas	4090	578	529	4.85	0.758	0.904	3.85	98.8	1.5	33.9	....	12.8	35.2	14.8	1.8	...	....
Coal gas	3910	634	560	5.50	0.573	1.282	4.36	97.5	1.1	9.0	....	6.6	47.0	34.0	2.3	...	....
Coke-oven gas	3430	536	476	4.65	0.420	1.205	4.71	95.0	1.4	5.1	....	2.9	57.4	28.5	4.2	0.5	....
Coke-oven gas	3860	600	538	5.28	0.529	1.206	4.21	95.6	2.6	6.1	....	5.2	47.9	33.9	3.7	0.6	....
Natural gas at Follansbee, W. Va.	3835	2221	1970	21.55	2.667	3.662	17.00	98.6	....	....	31.8	....	....	....	0.5	...	67.7
Natural gas, Follansbee residual	3830	1868	1711	17.97	2.188	3.182	14.21	98.5	....	....	79.4	....	....	....	0.6	...	20.0
Natural gas at McKean County, Pa.	3770	1482	1350	14.25	1.663	2.756	11.29	97.3	....	....	67.0	....	....	32.3	0.7	...	....
Natural gas at Sandusky, Ohio	3740	1047	946	10.04	1.087	2.045	7.98	94.7	0.2	....	12.5	....	....	83.5	3.8	...	....
Oil gas	3970	516	461	4.25	0.458	1.129	3.39	98.3	2.8	10.6	....	2.7	53.5	27.0	3.4	...	
Producer gas	3050	136	128	1.08	0.311	0.165	1.44	65.3	5.7	22.0	....	0.4	10.5	2.6	58.8	...	....

HEATS OF COMBUSTION AND COMPOSITION OF REPRESENTATIVE COALS

Analysis on coal "as received." First name is that of the county, second name that of the mine.

	Type	B.t.u. per pound	Ultimate analysis					Proximate analysis			
			% C	% H	% N	% O	% S	% Moisture	% Volatile matter	% Fixed carbon	% Ash
Alabama:											
Bibb, Belle Ellen	Bituminous	14,140	78.3	5.3	1.4	7.6	1.2	3.2	31.0	59.6	6.2
Jefferson, Bessemer	"	14,620	81.7	4.7	1.5	6.5	0.7	2.4	24.4	68.4	4.8
Shelby, Aldrich	"	13,650	75.0	5.2	1.0	10.0	0.8	2.3	38.6	51.9	7.2
Alaska:											
Moose Creek	"	12,150	67.6	5.3	1.9	15.9	0.3	4.7	35.5	50.9	8.9
Arkansas:											
Hartford, Central No. 10	"	13,270	77.4	4.1	1.6	5.3	1.1	2.9	19.3	67.3	10.5
Huntington, No. 6 Central	Semi-bituminous	13,700	78.7	4.4	1.6	4.4	1.9	3.2	18.1	69.7	9.0
Colorado:											
Gunnison, Somerset	Bituminous	12,630	70.6	5.5	1.5	12.7	0.4	4.3	39.7	46.7	9.3
Weld, Erie	Sub-bituminous	9,520	54.8	6.3	1.2	33.8	0.3	24.6	29.8	42.0	3.6
Illinois:											
Christian, Pana	Bituminous	10,860	59.8	5.6	1.1	19.1	3.7	13.0	37.0	39.3	10.7
Franklin, Orient	"	12,160	69.0	5.4	1.6	15.0	1.0	7.3	36.7	47.9	8.1
Williamson, Herrin	"	11,860	67.1	5.2	1.5	16.7	0.9	9.4	33.0	49.0	8.6
Indiana:											
Green, Jasonville	"	11,540	64.5	5.8	1.5	19.8	1.1	13.5	36.3	42.9	7.3
Knox, South Bruceville	"	11,540	62.3	5.5	1.0	17.1	3.2	9.5	38.3	41.4	10.9
Sullivan, Vandalia	"	11,420	63.8	5.9	1.4	20.9	1.3	14.9	34.3	44.1	6.7
Iowa:											
Lucas, Chariton	"	10,240	55.8	5.7	1.1	21.5	3.2	15.4	30.5	41.5	12.6
Polk, Altoona	"	10,240	54.7	5.5	0.8	18.8	6.2	13.9	37.0	35.2	14.0
Kansas:											
Cherokee, Stone City	"	13,080	71.8	5.2	1.2	10.2	3.3	5.1	34.5	52.2	8.3
Crawford, Edison	"	12,500	68.8	4.9	1.2	8.7	4.6	3.9	34.2	50.1	11.8
Kentucky:											
Christian, Mannington	"	11,680	....	...	...	....	3.1	9.2	33.7	46.4	10.7
Webster	"	12,500	70.4	5.1	1.6	12.6	1.1	5.4	34.9	50.4	9.3
Maryland:											
Allegany, Frostburg	Semi-bituminous	13,430	76.9	4.3	1.9	4.9	1.1	2.2	17.2	69.1	10.9
Allegany, Ocean	Semi-bituminous	14,190	81.0	4.5	1.9	4.0	1.0	1.2	17.9	73.2	7.7
Montana:											
Carbon, Washoe	Sub-bituminous	10,550	59.8	5.6	1.3	21.0	1.1	10.5	34.7	43.7	11.2
Musselshell, Roundup	"	10,690	62.0	5.6	1.0	22.7	0.7	13.6	32.9	45.5	8.1
New Mexico:											
San Juan, Farmington	Bituminous	11,630	....	...	...	....	1.3	6.9	38.1	43.0	11.9
North Dakota:											
Ward, Burlington	Lignite	6,010	37.4	6.4	0.6	45.0	0.2	36.9	24.9	27.7	10.4
Williams, Wheelock	"	5,990	35.2	7.1	0.5	47.5	1.3	42.1	25.0	24.4	8.5
Ohio:											
Columbian, New Salisbury	Bituminous	12,730	69.9	5.2	1.4	8.3	4.3	3.5	36.7	48.9	10.9
Jefferson, Yellow Creek	"	12,720	69.7	5.2	1.4	8.0	5.1	3.4	36.3	49.6	10.7
Oklahoma:											
Coal, Lehigh	"	11,260	62.8	5.0	1.5	14.5	4.3	6.6	38.6	42.9	11.9
Latimer, Degnan	"	13 630	....	...	...	....	0.9	3.7	36.8	53.8	5.6
Pittsburg, Ridgway	"	13,280	73.8	5.4	1.8	9.6	1.7	3.8	38.0	50.6	7.6

HEATS OF COMBUSTION AND COMPOSITION OF REPRESENTATIVE COALS (Continued)

	Type	B.t.u. per pound	Ultimate analysis					Proximate analysis			
			% C	% H	% N	% O	% S	% Moisture	% Volatile matter	% Fixed carbon	% Ash
Oregon:											
Coos, Beaverhill	Sub-bituminous	9,030	51.1	5.5	1.2	28.2	0.8	16.1	31.1	39.6	13.2
Pennsylvania:											
Armstrong, Montgomeryville	Cannel	10,460	56.9	4.5	1.1	5.6	3.7	1.8	32.8	37.3	28.2
Armstrong, W. Kittanning	Bituminous	13,040	71.4	5.3	1.3	9.1	3.1	3.4	35.5	51.3	9.7
Bedford, Hopewell	"	13,810	77.4	4.1	1.4	3.4	1.0	1.6	16.3	70.0	12.1
Cambria, Bakerton	Semi-bituminous	14,460	....	...	...	....	1.1	2.2	22.2	70.3	5.3
Cambria, Nanty Glo	"	14,380	....	...	...	....	1.9	2.5	20.0	71.5	6.1
Cambria, Windber	"	14,620	83.9	4.3	1.3	2.4	1.2	2.6	17.0	73.7	6.9
Jefferson, Punxsutawney	Bituminous	13,860	76.6	5.1	1.2	7.2	2.0	2.6	30.4	59.1	7.9
Somerset, Seanor	Semi-bituminous	13,740	78.5	4.3	1.2	4.5	2.5	2.4	17.3	71.4	9.0
Rhode Island:											
Providence, Cranston	Anthracite	11,620	82.4	0.5	0.1	1.8	0.9	4.5	3.0	78.7	13.8
Texas:											
Webb, Dolores	Cannel	11,070	59.3	5.8	1.2	12.7	2.1	4.4	46.0	30.5	19.0
Virginia:											
Montgomery, Blacksburg	Semi-bituminous	12,740	75.3	3.6	0.9	4.8	0.5	1.9	14.0	68.9	15.2
Pulaski, Guntan Park	Semi-anthracite	10,960	....	...	...	....	0.8	3.8	9.4	62.2	24.0
Tazewell, Pocahontas	Semi-bituminous	14,610	84.0	4.7	1.2	5.2	0.5	3.0	20.3	72.2	4.5
Wise, Josephine	Bituminous	13,270	73.7	5.1	1.6	8.8	0.9	2.6	33.8	53.6	10.0
Washington:											
Kittitas, Ellensburg	"	11,010	61.3	5.5	1.5	14.4	1.4	10.3	30.4	43.4	15.9
Thurston, Tono	Sub-bituminous	8,700	49.9	6.3	0.9	32.4	1.2	21.7	34.8	33.3	10.3
West Virginia:											
Brook, Collier	Bituminous	12,940	72.1	5.3	1.4	10.5	2.6	4.4	37.4	50.1	8.1
Grant, Bismarck	Semi-bituminous	13,590	....	...	...	....	2.7	3.0	16.7	71.0	9.3
Mineral, Emoryville	"	12,600	....	...	...	....	2.5	2.4	16.1	65.9	15.6
Ohio, Elm Grove	Bituminous	13,200	72.8	5.3	1.4	8.8	3.6	3.0	41.4	45.6	8.1
Wyoming:											
Lincoln, Elkol	Sub-bituminous	10,080	57.8	6.3	0.9	31.1	0.7	20.8	35.4	40.6	3.2
Lincoln, Green River	Bituminous	13,310	74.5	5.3	1.3	12.5	1.0	3.6	38.4	52.5	5.5

HEAT OF COMBUSTION

For Various Substances

Heat of combustion in kilogram calories per gram of substance. Products of combustion are gaseous unless stated.

Substance	Kg-cal. per gram of substance	Observer
Asphalt	9.532	Slossen & Colburn
Butter	9.200	....
Carbon, crystal to CO_2	7.859	Berthelot
Casein	5.860	....
Charcoal to CO_2	8.080	Favre & Silbermann
	8.137	Berthelot
Dynamite, 75%	1.290	Roux & Sarran
Egg white	5.700	....
Egg yolk	8.100	....
Fats, animal, mean	9.500	....
Graphite	7.901	Berthelot
Gunpowder	0.720–0.750	....
Hemoglobin	5.900	....
Hydrogen, to liquid	33.900	Mean value
Hydrogen, to liquid	34.500	Berthelot
Hydrogen, to gas	29.150	Berthelot
Oil, cotton seed	9.500	....
Oil, lard	9.200–9.400	....
Oil, olive	9.328–9.442	Stohmann
Oil, paraffin	9.800	Mohler
Oil, rape	9.489	Stohmann
Oil, sperm	10.000	Gibson
Paraffin	10.340	Stohmann
Pitch	8.400	....
Wood, beech	4.774	....
Wood, birch	4.771	....
Wood, oak	4.620	....
Wood, pine	5.085	....

TABLES SHOWING THE FUNCTIONS, USES AND COMPOSITIONS OF FOODS

Functions and Uses of Food in the Body.

Protein. — Builds and repairs tissue Albumen (white of eggs) Casein (curd of milk) Lean meat Gluten of grains **Fats.** — Are stored as fat: Fat of meats, butter, olive oil, oils of corn, wheat and other grains. **Carbohydrates.** — Are transformed into fat: Sugar, starch, etc.	All serve as fuel to yield energy in the forms of heat and muscular power.

Mineral Matter of Ash. — Shares in forming bones and assists in processes of digestion.

Phosphates of lime, potash, soda, etc.

Food is that which, taken into the body, builds tissue and yields energy.

TABLES SHOWING THE FUNCTIONS, USES AND COMPOSITIONS OF FOOD (Continued)

Dietary Standards

For a man in full vigor at moderate muscular work, per day

	Protein	Energy
	Grams	Large calories
Food eaten	100	3500
Food digested	95	3200

Mineral Matter (Required per Day)

	grams
Phosphoric acid, (P_2O_5)	3 to 4
Sulphuric acid, (SO_3)	2 to 3.5
Potassium oxide, (K_2O)	2 to 3
Sodium oxide, (Na_2O)	4 to 6
Calcium oxide, (CaO)	0.7 to 1.0
Magnesium oxide, (MgO)	0.3 to 0.5
Iron, (Fe)	0.006 to 0.012
Chlorine, (Cl)	6 to 8

These tables are compiled from charts of the United States Department of Agriculture, prepared by C. F. Langworthy, expert in charge of nutrition investigations.

Name of the food material	Protein.	Fat.	Carbohydrates.	Ash.	Water.	Fuel value lg. calories per lb.
Apple	0.4	0.5	14.2	0.3	84.6	290
Bacon	9.4	67.4	....	4.4	18.8	3030
Beef suet	4.7	81.8	....	0.3	13.2	3510
Butter	1.0	85.0	....	3.0	11.0	3410
Buckwheat	10.0	2.2	73.2	2.0	12.6	1600
Beefsteak	18.6	18.5	....	1.0	61.9	1130
Buttermilk	3.0	0.5	4.8	0.7	91.0	160
Bean, fresh shelled	9.4	0.6	29.1	2.0	58.9	740
Bean, green string	2.3	0.3	7.4	0.8	89.2	195
Bean, navy dry	22.5	1.8	59.6	3.5	12.6	1600
Banana	1.3	0.6	22.0	0.8	75.3	460
Codfish, fresh	12.8	0.4	....	1.2	82.6	325
Codfish, salt	21.5	0.3	....	24.7	53.5	410
Corn, dried	10.0	4.3	73.4	1.5	10.8	1800
Corn, green	3.1	1.1	19.7	0.7	75.4	500
Corn bread	7.9	4.7	46.3	2.2	38.9	1205
Cream cheese	25.9	33.7	2.4	3.8	34.2	1950
Cottage cheese	20.9	1.0	4.3	1.8	72.0	510
Cream	2.5	18.5	4.5	0.5	74.0	865

TABLES SHOWING THE FUNCTIONS, USES AND COMPOSITIONS OF FOODS (Continued)

NAME OF THE FOOD MATERIAL	PROTEIN	FAT	CARBO-HYDRATES	ASH	WATER	FUEL VALUE IN CALORIES PER LB.
Candy stick			96.5	0.5	3.0	1785
Celery	1.1		3.4	1.0	94.5	85
Chestnut	10.7	7.0	74.2	2.2	5.9	1875
Cocoanut, dried	6.3	57.4	31.5	1.3	3.5	3125
Dried beef	30.0	6.6		9.1	54.3	840
Egg, whole	14.8	10.5		1.0	73.7	700
Egg, white	13.0	0.2		0.6	86.2	265
Egg, yolk	16.1	33.3		1.1	49.5	1608
Fig, dried	4.3	0.3	74.2	2.4	18.8	1475
Fruit, canned	1.1	0.1	21.1	0.5	77.2	415
Grapes	1.3	1.6	19.2	0.5	77.4	450
Grape juice, unfermented	0.2		7.4	0.2	92.2	150
Herring, smoked	36.4	15.8		13.2	34.6	1355
Honey	0.4		81.2	0.2	18.2	1520
Jelly, fruit			78.3	0.7	21.0	1455
Lard		100.0				4080
Lamb chop	17.6	28.3		1.0	53.1	1540
Mackerel	18.3	7.1		1.2	73.4	645
Macaroni	3.0	1.5	15.8	1.3	78.4	415
Milk, whole	3.3	4.0	5.0	0.7	87.0	310
Milk, skimmed	3.4	0.3	5.1	0.7	90.5	165
Molasses	2.4		69.3	3.2	25.1	1290
Oat	11.8	5.0	69.2	3.0	11.0	1720
Olive oil		100.0				4080
Oyster	6.2	1.2	3.7	2.0	86.9	235
Onion	1.6	0.3	9.9	0.6	87.6	225
Pork chop	16.9	30.1		1.0	52.0	1580
Parsnip	1.6	0.5	13.5	1.4	83.0	230
Potato	2.2	0.1	18.4	1.0	78.3	385
Peanut	25.8	38.6	22.4	2.0	9.2	2500
Peanut butter	29.3	46.5	17.1	5.0	2.1	2825
Rye	12.2	1.5	73.9	1.9	10.5	1750
Rice	8.0	2.0	77.0	1.0	12.0	1720
Rolled oats, cooked	2.8	0.5	11.5	0.7	84.5	285
Raisins	2.6	3.3	76.1	3.4	14.6	1605
Smoked ham	16.1	38.8		4.8	40.3	1940
Sugar, granulated			100.0			1860
Sugar, maple			82.8	0.9	16.3	1540
Strawberry	1.0	0.6	7.4	0.6	90.4	180
Toasted bread	11.5	1.6	61.2	1.7	24.0	1420
Wheat	12.2	1.7	73.7	1.8	10.6	1750
White bread	9.2	1.3	53.1	1.1	35.3	1215
Whole wheat bread	9.7	0.9	49.7	1.3	38.4	1140
Walnut	16.6	63.4	16.1	1.4	2.5	3285

DEHYDRATION OF METALLIC SULPHATES

Metallic sulphates.	Temp. of beginning of decomposition, ° C.	Products formed.	Color of products.
$CaSO_4.2H_2O$	38	$CaSO_4.H_2O$	White
$CaSO_4.H_2O$	80	$2CaSO_4.H_2O$	White
$2CaSO_4.H_2O$	149	$CaSO_4$	White
$MgSO_4.7H_2O$	19	$MgSO_4.6H_2O$	White
$MgSO_4.6H_2O$	38	$MgSO_4.2H_2O$	White
$MgSO_4.2H_2O$	112	$MgSO_4.H_2O$	White
$MgSO_4.H_2O$	203	$MgSO_4$	White
$CdSO_4.\frac{8}{3}H_2O$	30	$CdSO_4.2H_2O$	White
$CdSO_4.2H_2O$	41	$CdSO_4.H_2O$	White
$CdSO_4.H_2O$	170	$CdSO_4$	White
$CoSO_4.7H_2O$	14	$CoSO_4.4H_2O$	Rose
$CoSO_4.4H_2O$	58	$CoSO_4.H_2O$	Lilac
$CoSO_4.H_2O$	276	$CoSO_4$	Lilac
$NiSO_4.7H_2O$	40	$NiSO_4.4H_2O$	Green
$NiSO_4.4H_2O$	106	$NiSO_4.H_2O$	Yellow
$NiSO_4.H_2O$	279	$NiSO_4$	Orange
$ZnSO_4.7H_2O$	25	$ZnSO_4.6H_2O$	White
$ZnSO_4.6H_2O$	28	$ZnSO_4.2H_2O$	White
$ZnSO_4.2H_2O$	115	$ZnSO_4.H_2O$	White
$ZnSO_4.H_2O$	225	$ZnSO_4$	White
$MnSO_4.5H_2O$	25	$MnSO_4.2H_2O$	Pale peach blossom
$MnSO_4.2H_2O$	60	$MnSO_4.H_2O$	Paler than above
$MnSO_4.H_2O$	152	$MnSO_4$	Paler than above
$CuSO_4.5H_2O$	27	$CuSO_4.3H_2O$	Blue
$CuSO_4.3H_2O$	93	$CuSO_4.H_2O$	Pale blue
$CuSO_4.H_2O$	155	$CuSO_4$	White
$Al_2(SO_4)_3.16H_2O$	51	$Al_2(SO_4)_3.13H_2O$	White
$Al_2(SO_4)_3.13H_2O$	82	$Al_2(SO_4)_3.10H_2O$	White
$Al_2(SO_4)_3.10H_2O$	97	$Al_2(SO_4)_3.7H_2O$	White
$Al_2(SO_4)_3.7H_2O$	109	$Al_2(SO_4)_3.4H_2O$	White
$Al_2(SO_4)_3.4H_2O$	180	$Al_2(SO_4)_3.H_2O$	White
$Al_2(SO_4)_3.H_2O$	316	$Al_2(SO_4)_3$	White
$FeSO_4.7H_2O$	21	$FeSO_4.4H_2O$	Light apple green
$FeSO_4.4H_2O$	80	$FeSO_4.H_2O$	White
$FeSO_4.H_2O$	406	Fe_2O_3, SO_3	Yellowish green

DECOMPOSITION OF ANHYDROUS METALLIC SULPHATES

Metallic sulphate.	Temp. at beginning of decomposition, ° C.	Temp. of energetic decomposition, ° C.	Products of decomposition.	Color of product.
$FeSO_4$	167	480	Fe_2O_3, $2SO_4$	Yellow brown
Fe_2O_3, $2SO_3$	492	560	Fe_2O_3	Red
$Bi_2(SO_4)_3$	570	639	$5Bi_2O_3$, $4(SO_3)_3$	White
$Al_2(SO_4)_3$	590	639	Al_2O_3	White
$PbSO_4$	637	705	$6PbO$, $5SO_3$	White
$CuSO_4$	653	670	$2CuO$, SO_3	Orange
$MnSO_4$	699	790	Mn_3O_4	Dark red to black
$ZnSO_4$	702	720	$3ZnO$, $2SO_3$	White
$2CuO$, SO_3	702	736	CuO	Black
$NiSO_4$	703	764	NiO	Brownish green
$CoSO_4$	720	770	CoO	Brown to black
$3ZnO$, $2SO_3$	755	767	ZnO	White
$CdSO_4$	827	846	$5CdO$, SO_3	White
$5Bi_2O_3$, $4(SO_3)_3$	870	890	Bi_2O_3(?)	Yellow
$5CdO$, SO_3	878	890	CdO	Brown
$MgSO_4$	890	972	MgO	White
Ag_2SO_4	917	925	Ag	Silver white
$6PbO$, $5SO_3$	952	962	$2PbO$, SO_3(?)	White to yellow
$CaSO_4$	1200	....	CaO	White
$BaSO_4$	1516	....	BaO	White

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

The following collections of tables gives the specific gravity, grams per liter, pounds per cubic foot, and pounds per gallon for a large number of substances in aqueous solution. The three latter quantities have been computed from the per cent of the substance in solution and the specific gravity, assuming the density of water at 4° C. as unity. The U. S. gallon, cubic foot, and pound avoirdupois equivalents were used. The degree Baumé corresponding to the specific gravity is given according to the relation,

$$\text{Bé.} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

The per cent by weight is indicated in every case.

The substances are arranged in alphabetical order. The specific gravity of alcohol solutions will be found in a separate group. Another table gives, with less detail, the specific gravity of solutions of many other substances.

Tables indicated by the symbol * have been computed on the basis of values for the specific gravity found in the International Critical Tables.

ACETIC ACID

Specific Gravity of Aqueous Acetic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $HC_2H_3O_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
.....	0.9982	0	....	....	......
.....	0.9996	1	9.996	0.6240	0.0834
0.2	1.0012	2	20.02	1.250	0.1671
0.4	1.0025	3	30.08	1.877	0.2510
0.6	1.0040	4	40.16	2.507	0.3351
0.8	1.0055	5	50.28	3.139	0.4196
1.0	1.0069	6	60.41	3.771	0.5042
1.2	1.0083	7	70.58	4.406	0.5890
1.4	1.0097	8	80.78	5.043	0.6741
1.6	1.0111	9	91.00	5.681	0.7594
1.8	1.0125	10	101.3	6.321	0.8450
2.0	1.0139	11	111.5	6.962	0.9307
2.2	1.0154	12	121.8	7.607	1.017
2.4	1.0168	13	132.2	8.252	1.103
2.6	1.0182	14	142.5	8.899	1.190
2.8	1.0195	15	152.9	9.547	1.276
3.0	1.0209	16	163.3	10.20	1.363
3.2	1.0223	17	173.8	10.85	1.450
3.3	1.0236	18	184.2	11.50	1.538
3.5	1.0250	19	194.8	12.16	1.625
3.7	1.0263	20	205.3	12.81	1.713
3.9	1.0276	21	215.8	13.47	1.801
4.1	1.0288	22	226.3	14.13	1.889
4.2	1.0301	23	236.9	14.79	1.977
4.4	1.0313	24	247.5	15.45	2.066
4.6	1.0326	25	258.2	16.12	2.154
4.7	1.0338	26	268.8	16.78	2.243
4.9	1.0349	27	279.4	17.44	2.332
5.1	1.0361	28	290.1	18.11	2.421
5.2	1.0372	29	300.8	18.78	2.510
5.4	1.0384	30	311.5	19.45	2.600
5.5	1.0395	31	322.2	20.12	2.689
5.7	1.0406	32	333.0	20.79	2.779
5.8	1.0417	33	343.8	21.46	2.869
6.0	1.0428	34	354.6	22.13	2.959
6.1	1.0438	35	365.3	22.81	3.049
6.2	1.0449	36	376.2	23.48	3.139
6.4	1.0459	37	387.0	24.16	3.229
6.5	1.0469	38	397.8	24.83	3.320
6.6	1.0479	39	408.7	25.51	3.411
6.8	1.0488	40	419.5	26.19	3.501

ACETIC ACID (Continued)

Specific Gravity of Aqueous Acetic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $HC_2H_3O_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
6.9	1.0498	41	430.4	26.87	3.592
7.0	1.0507	42	441.3	27.55	3.683
7.1	1.0516	43	452.2	28.23	3.774
7.2	1.0525	44	463.1	28.91	3.865
7.4	1.0534	45	474.0	29.59	3.956
7.5	1.0542	46	484.9	30.27	4.047
7.6	1.0551	47	495.9	30.96	4.138
7.7	1.0559	48	506.8	31.64	4.230
7.8	1.0567	49	517.8	32.32	4.321
7.9	1.0575	50	528.8	33.01	4.413
8.0	1.0582	51	539.7	33.69	4.504
8.1	1.0590	52	550.7	34.38	4.596
8.2	1.0597	53	561.6	35.06	4.687
8.3	1.0604	54	572.6	35.75	4.779
8.4	1.0611	55	583.6	36.43	4.870
8.4	1.0618	56	594.6	37.12	4.962
8.5	1.0624	57	605.6	37.80	5.054
8.6	1.0631	58	616.6	38.49	5.146
8.7	1.0637	59	627.6	39.18	5.237
8.8	1.0642	60	638.5	39.86	5.329
8.8	1.0648	61	649.5	40.55	5.420
8.9	1.0653	62	660.5	41.23	5.512
9.0	1.0658	63	671.5	41.92	5.603
9.0	1.0662	64	682.4	42.60	5.695
9.1	1.0666	65	693.3	43.28	5.786
9.1	1.0671	66	704.3	43.97	5.877
9.2	1.0675	67	715.2	44.65	5.969
9.2	1.0678	68	726.1	45.33	6.059
9.3	1.0682	69	737.1	46.01	6.151
9.3	1.0685	70	748.0	46.69	6.242
9.3	1.0687	71	758.8	47.37	6.332
9.4	1.0690	72	769.7	48.05	6.423
9.4	1.0693	73	780.6	48.73	6.514
9.4	1.0694	74	791.4	49.40	6.604
9.4	1.0696	75	802.2	50.08	6.695
9.5	1.0698	76	813.0	50.76	6.785
9.5	1.0699	77	823.8	51.43	6.875
9.5	1.0700	78	834.6	52.10	6.965
9.5	1.0700	79	845.3	52.77	7.054
9.5	1.0700	80	856.0	53.44	7.143
9.5	1.0699	81	866.6	54.10	7.232
9.5	1.0698	82	877.2	54.76	7.321
9.4	1.0696	83	887.8	55.42	7.409
9.4	1.0693	84	898.2	56.07	7.496
9.4	1.0689	85	908.6	56.72	7.582
9.3	1.0685	86	918.9	57.36	7.668
9.2	1.0680	87	929.2	58.00	7.754
9.2	1.0675	88	939.4	58.64	7.839
9.1	1.0668	89	949.5	59.27	7.923
9.0	1.0661	90	959.5	59.90	8.007
8.9	1.0652	91	969.3	60.51	8.089
8.8	1.0643	92	979.2	61.13	8.171
8.6	1.0632	93	988.8	61.73	8.252
8.5	1.0619	94	998.2	62.31	8.330
8.3	1.0605	95	1007	62.89	8.408
8.1	1.0588	96	1016	63.45	8.482
7.8	1.0570	97	1025	64.01	8.556
7.6	1.0549	98	1034	64.54	8.627
7.2	1.0524	99	1042	65.04	8.695
6.9	1.0498	100	1050	65.54	8.761

ALBUMEN

Specific Gravity of Aqueous Albumen Solutions at 15.5° C.

Bé.	Sp. gr.	Per cent Albumen	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.37	1.0026	1	10.03	0.6259	0.0837
0.77	1.0054	2	20.11	1.255	0.1678
1.12	1.0078	3	30.23	1.887	0.2523
1.85	1.0130	5	50.65	3.162	0.4227
3.66	1.0261	10	102.6	6.406	0.8563
5.32	1.0384	15	155.8	9.724	1.300
7.06	1.0515	20	210.3	13.13	1.755
8.72	1.0644	25	266.1	16.61	2.221
10.42	1.0780	30	323.4	20.19	2.699
13.12	1.0919	35	382.2	23.86	3.189
13.78	1.1058	40	442.3	27.61	3.691
15.48	1.1204	45	504.2	31.47	4.207
17.16	1.1352	50	567.6	35.43	4.737
18.90	1.1511	55	633.1	39.52	5.283

ALUMINUM CHLORIDE

Specific Gravity of Aqueous Aluminum Chloride Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $AlCl_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0075	1	10.08	0.6290	0.0841
2.3	1.0164	2	20.33	1.269	0.1696
4.8	1.0344	4	41.38	2.583	0.3453
7.3	1.0526	6	63.16	3.943	0.5271
9.6	1.0711	8	85.69	5.349	0.7151
12.0	1.0900	10	109.0	6.805	0.9096
14.3	1.1093	12	133.1	8.310	1.111
16.6	1.1290	14	158.1	9.867	1.319
18.8	1.1491	16	183.9	11.48	1.534

ALUMINUM CHLORIDE

Specific Gravity of Aluminum Chloride Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent Al_2Cl_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0072	1	10.07	0.6288	0.0841
2.1	1.0144	2	20.29	1.267	0.1693
3.1	1.0216	3	30.65	1.913	0.2558
4.1	1.0289	4	41.16	2.570	0.3437
5.0	1.0360	5	51.80	3.234	0.4323
6.0	1.0435	6	62.61	3.909	0.5225
7.0	1.0510	7	73.57	4.593	0.6140
8.0	1.0585	8	84.68	5.286	0.7067
9.0	1.0659	9	95.93	5.989	0.8006
9.9	1.0734	10	107.3	6.701	0.8958
10.9	1.0812	11	118.9	7.425	0.9925
11.9	1.0890	12	130.7	8.158	1.091
12.8	1.0968	13	142.6	8.901	1.190
13.7	1.1047	14	154.7	9.655	1.291
14.7	1.1125	15	166.9	10.42	1.393
15.6	1.1207	16	179.3	11.19	1.496
16.6	1.1290	17	191.9	11.98	1.602
17.5	1.1372	18	204.7	12.78	1.708
18.4	1.1455	19	217.6	13.59	1.816
19.3	1.1537	20	230.7	14.40	1.926
20.2	1.1623	21	244.1	15.24	2.037
21.2	1.1709	22	257.6	16.08	2.150
22.1	1.1795	23	271.3	16.94	2.264
23.0	1.1882	24	285.2	17.80	2.380
23.8	1.1968	25	299.2	18.68	2.497
24.8	1.2058	26	313.5	19.57	2.616
25.7	1.2149	27	328.0	20.48	2.737
26.5	1.2241	28	342.7	21.40	2.860
27.4	1.2331	29	357.6	22.32	2.984
28.3	1.2422	30	372.7	23.26	3.110
29.2	1.2518	31	388.1	24.23	3.238
30.1	1.2615	32	403.7	25.20	3.369
30.9	1.2712	33	419.5	26.19	3.501
31.8	1.2808	34	435.5	27.19	3.634
32.6	1.2905	35	451.7	28.20	3.769
33.5	1.3007	36	468.3	29.23	3.908
34.4	1.3109	37	485.0	30.28	4.048
35.2	1.3211	38	502.0	31.34	4.189
36.1	1.3313	39	519.2	32.41	4.333
36.9	1.3415	40	536.6	33.50	4.478
37.8	1.3522	41	554.4	34.61	4.627

ALUMINUM SULFATE

Specific Gravity of Aqueous Aluminum Sulfate Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Al_2(SO_4)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0093	1	10.09	0.6301	0.0842
2.8	1.0195	2	20.39	1.273	0.1702
5.6	1.0404	4	41.62	2.598	0.3473
8.4	1.0618	6	63.71	3.977	0.5317
11.2	1.0837	8	86.70	5.412	0.7235
13.9	1.1062	10	110.6	6.906	0.9232
16.6	1.1293	12	135.5	8.460	1.131
19.2	1.1529	14	161.4	10.08	1.347
21.8	1.1770	16	188.3	11.76	1.572
24.3	1.2017	18	216.3	13.50	1.805
26.8	1.2272	20	245.4	15.32	2.048
29.3	1.2534	22	275.7	17.21	2.301
31.7	1.2803	24	307.3	19.18	2.564
34.1	1.3079	26	340.1	21.23	2.838

Bé	Sp. gr.	Per cent $Al_2(SO_4)_3 + 18H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0093	1.948	19.66	1.227	0.1641
2.8	1.0195	3.896	39.72	2.479	0.3314
5.6	1.0404	7.791	81.06	5.060	0.6765
8.4	1.0618	11.69	124.1	7.747	1.036
11.2	1.0837	15.58	168.9	10.54	1.409
13.9	1.1062	19.48	215.5	13.45	1.798
16.6	1.1293	23.37	264.0	16.48	2.203
19.2	1.1529	27.27	314.4	19.63	2.624
21.8	1.1770	31.16	366.8	22.90	3.061
24.3	1.2017	35.06	421.3	26.30	3.516
26.8	1.2272	38.96	478.1	29.84	3.990
29.3	1.2534	42.85	537.1	33.53	4.482
31.7	1.2803	46.75	598.5	37.36	4.995
34.1	1.3079	50.64	662.4	41.35	5.528

ALUMINUM SULFATE

Specific Gravity of Aluminum Sulfate Solutions at 15° C. (Larsson)

Alum-maker's Table

Bé.	Sp. gr.	100 kg. of solution contain				
		Kg. Al_2O_3	Kg. SO_3	Kg. sulfate with 13 per cent Al_2O_3	Kg. sulfate with 14 per cent Al_2O_3	Kg. sulfate with 15 per cent Al_2O_3
0.7	1.005	0.14	0.32	1.1	1.0	0.9
1.4	1.010	0.27	0.64	2.1	2.0	1.8
2.3	1.016	0.41	0.95	3.1	2.9	2.7
3.0	1.021	0.55	1.27	4.2	3.9	3.6
3.7	1.026	0.68	1.59	5.3	4.9	4.6
4.4	1.031	0.81	1.89	6.3	5.8	5.4
5.0	1.036	0.94	2.20	7.3	6.7	6.3
5.6	1.040	1.07	2.50	8.3	7.7	7.2
6.2	1.045	1.20	2.80	9.3	8.6	8.0
6.9	1.050	1.33	3.11	10.3	9.5	8.9
7.6	1.055	1.46	3.40	11.2	10.4	9.7
8.1	1.059	1.58	3.69	12.2	11.3	10.6
8.7	1.064	1.71	3.98	13.1	12.2	11.4
9.2	1.068	1.83	4.27	14.1	13.1	12.2
9.9	1.073	1.96	4.56	15.1	14.0	13.1
10.5	1.078	2.08	4.84	16.0	14.8	13.9
11.0	1.082	2.20	5.12	16.9	15.7	14.6
11.6	1.087	2.32	5.40	17.8	16.5	15.4
12.2	1.092	2.44	5.67	18.7	17.4	16.2
12.7	1.096	2.55	5.95	19.6	18.3	17.0
13.3	1.101	2.67	6.22	20.5	19.1	17.8
13.8	1.105	2.78	6.49	21.4	19.9	18.6
14.4	1.110	2.90	6.76	22.3	20.7	19.3
14.8	1.114	3.01	7.02	23.2	21.5	20.1
15.4	1.119	3.13	7.29	24.1	22.4	20.9
15.9	1.123	3.24	7.55	24.9	23.1	21.6
16.5	1.128	3.35	7.81	25.8	23.9	22.3
16.9	1.132	3.46	8.06	26.6	24.7	23.1
17.5	1.137	3.57	8.32	27.5	25.5	23.8
17.9	1.141	3.68	8.58	28.3	26.3	24.5
18.4	1.145	3.79	8.83	29.1	27.1	25.3
18.9	1.150	3.89	9.07	30.0	27.8	26.0
19.4	1.154	4.00	9.32	30.8	28.6	26.7
19.9	1.159	4.11	9.57	31.6	29.3	27.4
20.3	1.163	4.21	9.82	32.4	30.1	28.1
20.9	1.168	4.32	10.06	33.2	30.8	28.9
21.3	1.172	4.42	10.29	34.0	31.6	29.5
21.7	1.176	4.52	10.53	34.8	32.3	30.1

ALUMINUM SULFATE (Continued)

Specific Gravity of Aluminum Sulfate Solutions at 15° C. (Larsson)

Alum-maker's Table

Bé.	Sp. gr.	100 liters of solution contain				
		Kg. Al_2O_3	Kg. SO_3	Kg. sulfate with 13 per cent Al_2O_3	Kg. sulfate with 14 per cent Al_2O_3	Kg. sulfate with 15 per cent Al_2O_3
0.7	1.005	0.14	0.33	1.1	1	0.9
1.4	1.010	0.28	0.65	2.2	2	1.9
2.3	1.016	0.42	0.98	3.2	3	2.8
3.0	1.021	0.56	1.31	4.3	4	3.7
3.7	1.026	0.70	1.63	5.4	5	4.7
4.4	1.031	0.84	1.96	6.5	6	5.6
5.0	1.036	0.98	2.28	7.5	7	6.5
5.6	1.040	1.12	2.61	8.6	8	7.5
6.2	1.045	1.26	2.94	9.7	9	8.4
6.9	1.050	1.40	3.26	10.8	10	9.3
7.6	1.055	1.54	3.59	11.8	11	10.3
8.1	1.059	1.68	3.91	12.9	12	11.2
8.7	1.064	1.82	4.24	14.0	13	12.1
9.2	1.068	1.96	4.57	15.1	14	13.1
9.9	1.073	2.10	4.89	16.2	15	14.0
10.5	1.078	2.24	5.22	17.2	16	14.9
11.0	1.082	2.38	5.55	18.3	17	15.9
11.6	1.087	2.52	5.87	19.4	18	16.8
12.2	1.092	2.66	6.20	20.5	19	17.7
12.7	1.096	2.80	6.52	21.5	20	18.7
13.3	1.101	2.94	6.85	22.6	21	19.6
13.8	1.105	3.08	7.18	23.7	22	20.5
14.4	1.110	3.22	7.50	24.8	23	21.5
14.8	1.114	3.36	7.83	25.9	24	22.4
15.4	1.119	3.50	8.16	26.9	25	23.3
15.9	1.123	3.64	8.48	28.0	26	24.3
16.5	1.128	3.78	8.81	29.1	27	25.2
16.9	1.132	3.92	9.13	30.2	28	26.1
17.5	1.137	4.06	9.46	31.2	29	27.1
17.9	1.141	4.20	9.79	32.3	30	28.0
18.4	1.145	4.34	10.11	33.4	31	28.9
18.9	1.150	4.48	10.44	34.5	32	29.9
19.4	1.154	4.64	10.76	35.5	33	30.8
19.9	1.159	4.76	11.09	36.6	34	31.7
20.3	1.163	4.90	11.42	37.7	35	32.7
20.9	1.168	5.04	11.74	38.8	36	33.6
21.3	1.172	5.18	12.07	39.9	37	34.5
21.7	1.176	5.32	12.40	40.9	38	35.5

AMMONIA

Specific Gravity of Aqueous Ammonium Hydroxide Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent NH_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
10.9	0.9939	1	9.939	0.6205	0.0829
11.5	0.9895	2	19.79	1.235	0.1652
11.7	0.9811	4	39.24	2.450	0.3275
13.9	0.9730	6	58.38	3.644	0.4872
15.1	0.9651	8	77.21	4.820	0.6443
16.2	0.9575	10	95.75	5.977	0.7991
17.3	0.9501	12	114.0	7.117	0.9515
18.5	0.9430	14	132.0	8.242	1.102
19.5	0.9362	16	149.8	9.351	1.250
20.6	0.9295	18	167.3	10.44	1.396
21.7	0.9229	20	184.6	11.52	1.540
22.8	0.9164	22	201.6	12.59	1.682
23.8	0.9101	24	218.4	13.64	1.823
24.9	0.9040	26	235.0	14.67	1.961
25.9	0.8980	28	251.4	15.70	2.098
27.0	0.8920	30	267.6	16.71	2.233

Values Determined in Sealed Tubes, at $\frac{15^\circ}{4^\circ}$ C.

Bé.	Sp. gr.	Per cent NH_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
34.9	0.849	45	382.1	23.85	3.188
38.3	0.832	50	416.0	25.97	3.472
41.8	0.815	55	448.3	27.98	3.741
45.9	0.796	60	477.6	29.82	3.985
50.4	0.776	65	504.4	31.49	4.209
55.4	0.755	70	528.5	32.99	4.410
61.0	0.733	75	549.8	34.32	4.588
66.9	0.711	80	568.8	35.51	4.747
73.5	0.688	85	584.8	36.51	4.880
80.5	0.665	90	598.5	37.36	4.995
88.1	0.642	95	609.9	38.07	5.090
96.5	0.618	100	618.0	38.58	5.157

AMMONIUM HYDROXIDE

Specific Gravity of Aqueous Solutions at 15° C.

Specific gravity	Per cent NH_3	Total NH_3 g. per liter	Specific gravity	Per cent NH_3	Total NH_3 g. per liter
1.000	0.00	0.0	0.940	15.63	146.9
0.998	0.45	4.5	0.938	16.22	152.1
0.996	0.91	9.1	0.936	16.82	157.4
0.994	1.37	13.6	0.934	17.42	162.7
0.992	1.84	18.2	0.932	18.03	168.1
0.990	2.31	22.9	0.930	18.64	173.4
0.988	2.80	27.7	0.928	19.25	178.6
0.986	3.30	32.5	0.926	19.87	184.2
0.984	3.80	37.4	0.924	20.49	189.3
0.982	4.30	42.2	0.922	21.12	194.7
0.980	4.80	47.0	0.920	21.75	200.1
0.978	5.30	51.8	0.918	22.39	205.6
0.976	5.80	56.6	0.916	23.03	210.9
0.974	6.30	61.4	0.914	23.68	216.3
0.972	6.80	66.1	0.912	24.33	221.9
0.970	7.31	70.9	0.910	24.99	227.4
0.968	7.82	75.7	0.908	25.65	232.9
0.966	8.33	80.5	0.906	26.31	238.3
0.964	8.84	85.2	0.904	26.98	243.9
0.962	9.35	89.9	0.902	27.65	249.4
0.960	9.91	95.1	0.900	28.33	255.0
0.958	10.47	100.3	0.898	29.01	260.5
0.956	11.03	105.4	0.896	29.69	266.0
0.954	11.60	110.7	0.894	30.37	271.5
0.952	12.17	115.9	0.892	31.05	277.0
0.950	12.72	121.0	0.890	31.75	282.6
0.948	13.31	126.2	0.888	32.50	288.6
0.946	13.88	131.3	0.886	33.25	294.6
0.944	14.46	136.5	0.884	34.10	301.4
0.942	15.04	141.7	0.882	34.95	308.3

AQUA AMMONIA

Authority — W. C. Ferguson

This table has been approved and adopted as a standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = \frac{140}{\text{Sp. Gr.}} - 130.$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

The coefficient of expansion for Ammonia Solutions varying with the temperature, correction must be applied according to the following table:

	Corrections to be added for each degree below 60° F.		Corrections to be subtracted for each degree above 60° F.			
Degrees Baumé	40° F.	50° F.	70° F.	80° F.	90° F.	100° F.
14	0.015 Bé.	0.017 Bé.	0.020 Bé.	0.022 Bé.	0.024 Bé.	0.026 Bé.
16	0.021 "	0.023 "	0.026 "	0.028 "	0.030 "	0.032 "
18	0.027 "	0.029 "	0.031 "	0.033 "	0.035 "	0.037 "
20	0.033 "	0.036 "	0.037 "	0.038 "	0.040 "	0.042 "
22	0.039 "	0.042 "	0.043 "	0.045 "	0.047 "	
26	0.053 "	0.057 "	0.057 "	0.059 "		

Bé.°	Sp. gr.	Per cent NH_3.	Bé.°	Sp. gr.	Per cent NH_3.
10.00	1.0000	0.00	12.25	0.9842	3.73
10.25	0.9982	0.40	12.50	0.9825	4.16
10.50	0.9964	0.80	12.75	0.9807	4.59
10.75	0.9947	1.21	13.00	0.9790	5.02
11.00	0.9929	1.62	13.25	0.9773	5.45
11.25	0.9912	2.04	13.50	0.9756	5.88
11.50	0.9894	2.46	13.75	0.9739	6.31
11.75	0.9876	2.88	14.00	0.9722	6.74
12.00	0.9859	3.30	14.25	0.9705	7.17

AQUA AMMONIA (Continued)

Be.°	Sp. Gr.	Per cent NH_3.	Be.°	Sp. gr.	Per cent NH_3.
14.50	0.9689	7.61	22.00	0.9211	21.60
14.75	0.9672	8.05	22.25	0.9195	22.08
15.00	0.9655	8.49	22.50	0.9180	22.56
15.25	0.9639	8.93	22.75	0.9165	23.04
15.50	0.9622	9.38	23.00	0.9150	23.52
15.75	0.9605	9.83	23.25	0.9135	24.01
16.00	0.9589	10.28	23.50	0.9121	24.50
16.25	0.9573	10.73	23.75	0.9106	24.99
16.50	0.9556	11.18	24.00	0.9091	25.48
16.75	0.9540	11.64	24.25	0.9076	25.97
17.00	0.9524	12.10	24.50	0.9061	26.46
17.25	0.9508	12.56	24.75	0.9047	26.95
17.50	0.9492	13.02	25.00	0.9032	27.44
17.75	0.9475	13.49	25.25	0.9018	27.93
18.00	0.9459	13.96	25.50	0.9003	28.42
18.25	0.9444	14.43	25.75	0.8989	28.91
18.50	0.9428	14.90	26.00	0.8974	29.40
18.75	0.9412	15.37	26.25	0.8960	29.89
19.00	0.9396	15.84	26.50	0.8946	30.38
19.25	0.9380	16.32	26.75	0.8931	30.87
19.50	0.9365	16.80	27.00	0.8917	31.36
19.75	0.9349	17.28	27.25	0.8903	31.85
20.00	0.9333	17.76	27.50	0.8889	32.34
20.25	0.9318	18.24	27.75	0.8875	32.83
20.50	0.9302	18.72	28.00	0.8861	33.32
20.75	0.9287	19.20	28.25	0.8847	33.81
21.00	0.9272	19.68	28.50	0.8833	34.30
21.25	0.9256	20.16	28.75	0.8819	34.79
21.50	0.9241	20.64	29.00	0.8805	35.28
21.75	0.9226	21.12			

AMMONIUM CHLORIDE

Specific Gravity of Aqueous Ammonium Chloride Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent NH_4Cl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.2	1.0013	1	10.01	0.6251	0.0836
0.6	1.0045	2	20.09	1.254	0.1677
1.5	1.0107	4	40.43	2.524	0.3374
2.4	1.0168	6	61.01	3.809	0.5091
3.2	1.0227	8	81.82	5.108	0.6828
4.0	1.0286	10	102.9	6.421	0.8584
4.8	1.0344	12	124.1	7.749	1.036
5.6	1.0401	14	145.6	9.090	1.215
6.3	1.0457	16	167.3	10.44	1.396
7.1	1.0512	18	189.2	11.81	1.579
7.8	1.0567	20	211.3	13.19	1.764
8.5	1.0621	22	233.7	14.59	1.950
9.2	1.0674	24	256.2	15.99	2.138

AMMONIUM NITRATE

Specific Gravity of Aqueous Ammonium Nitrate Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.3	1.0023	1	10.02	0.6257	0.0836
0.9	1.0064	2	20.13	1.257	0.1680
2.1	1.0147	4	40.59	2.534	0.3387
3.3	1.0230	6	61.38	3.832	0.5122
4.4	1.0313	8	82.50	5.150	0.6885
5.5	1.0397	10	104.0	6.491	0.8677
6.7	1.0482	12	125.8	7.852	1.050
7.8	1.0567	14	147.9	9.235	1.235
8.9	1.0653	16	170.4	10.64	1.422
10.0	1.0740	18	193.3	12.07	1.613
11.1	1.0828	20	216.6	13.52	1.807
12.2	1.0916	22	240.2	14.99	2.004
13.2	1.1005	24	264.1	16.49	2.204
14.3	1.1095	26	288.5	18.01	2.407
15.4	1.1186	28	313.2	19.55	2.614
16.4	1.1277	30	338.3	21.12	2.823
19.0	1.1512	35	402.9	25.15	3.362
21.6	1.1754	40	470.2	29.35	3.924
24.2	1.2003	45	540.1	33.72	4.508
26.7	1.2258	50	612.9	38.26	5.115

AMMONIUM NITRATE

Specific Gravity of Aqueous Ammonium Nitrate Solutions at 17.5° C. (Gerlach)

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0042	1	10.04	0.6269	0.0838
1.2	1.0085	2	20.17	1.259	0.1683
1.8	1.0127	3	30.38	1.897	0.2535
2.4	1.0170	4	40.68	2.540	0.3395
3.0	1.0212	5	51.06	3.188	0.4261
3.6	1.0255	6	61.53	3.841	0.5135
4.2	1.0297	7	72.08	4.500	0.6015
4.8	1.0340	8	82.72	5.164	0.6903
5.3	1.0382	9	93.44	5.833	0.7798
5.9	1.0425	10	104.3	6.508	0.8700
6.5	1.0468	11	115.1	7.188	0.9609
7.1	1.0512	12	126.1	7.875	1.053
7.6	1.0555	13	137.2	8.566	1.145
8.2	1.0599	14	148.4	9.263	1.238
8.8	1.0642	15	159.6	9.965	1.332
9 3	1.0686	16	171.0	10.67	1.427
9.9	1.0729	17	182.4	11.39	1.522
10.4	1.0773	18	193.9	12.11	1.618
10.9	1.0816	19	205.5	12.83	1.715
11.5	1.0860	20	217.2	13.56	1.813
12.0	1.0905	21	229.0	14.30	1.911
12.6	1.0950	22	240.9	15.04	2.010
13.1	1.0995	23	252.9	15.79	2.110
13.7	1.1040	24	265.0	16.54	2.211
14.2	1.1085	25	277.1	17.30	2.313
14.7	1.1130	26	289.4	18.07	2.415
15.2	1.1175	27	301.7	18.84	2.518
15.8	1.1220	28	314.2	19.61	2.622
16.3	1.1265	29	326.7	20.39	2.726
16.8	1.1310	30	339.3	21.18	2.832
17.3	1.1358	31	352.1	21.98	2.938
17.9	1.1406	32	365.0	22.79	3.046
18.4	1.1454	33	378.0	23.60	3.154
18.9	1.1502	34	391.1	24.41	3.264
19.5	1.1550	35	404.3	25.24	3.374
20.0	1.1598	36	417.5	26.07	3.484
20.5	1.1646	37	430.9	26.90	3.596
21.0	1.1694	38	444.4	27.74	3.708
21.5	1.1743	39	457.9	28.59	3.822
22.0	1.1790	40	471.6	29.44	3.936
22.5	1.1841	41	485.5	30.31	4.051
23.1	1.1892	42	499.5	31.18	4.168

AMMONIUM NITRATE (Continued)

Specific Gravity of Aqueous Ammonium Nitrate Solutions at 17.5° C. (Gerlach)

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.6	1.1942	43	513.5	32.06	4.285
24.1	1.1994	44	527.7	32.94	4.404
24.6	1.2045	45	542.0	33.84	4.523
25.1	1.2096	46	556.4	34.74	4.643
25.6	1.2147	47	570.9	35.64	4.764
26.1	1.2198	48	585.5	36.55	4.886
26.6	1.2249	49	600.2	37.47	5.009
27.1	1.2300	50	615.0	38.39	5.132
27.6	1.2353	51	630.0	39.33	5.258
28.1	1.2407	52	645.2	40.28	5.384
28.6	1.2460	53	660.4	41.23	5.511
29.1	1.2514	54	675.8	42.19	5.639
29.6	1.2567	55	691.2	43.15	5.768
30.1	1.2621	56	706.8	44.12	5.898
30.6	1.2674	57	722.4	45.10	6.029
31.1	1.2728	58	738.2	46.09	6.161
31.6	1.2781	59	754.1	47.07	6.293
32.0	1.2835	60	770.1	48.08	6.427
32.5	1.2888	61	786.2	49.08	6.561
33.0	1.2942	62	802.4	50.09	6.696
33.5	1.3005	63	819.3	51.15	6.837
34.0	1.3059	64	835.8	52.17	6.975

AMMONIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM SULFATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $(NH_4)_2SO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0041	1	10.04	0.6283	0.08379
1.5	1.0101	2	20.20	1.621	0.1686
3.1	1.0220	4	40.88	2.552	0.3412
4.7	1.0338	6	62.03	3.872	0.5176
6.3	1.0456	8	83.65	5.222	0.6981
7.9	1.0574	10	105.7	6.601	0.8824
9.4	1.0691	12	128.3	8.009	1.071
10.8	1.0808	14	151.3	9.446	1.263
12.3	1.0924	16	174.8	10.91	1.459
13.7	1.1039	18	198.7	12.40	1.658
15.0	1.1154	20	223.1	13.93	1.862
16.3	1.1269	22	247.9	15.48	2.069
17.6	1.1383	24	273.2	17.05	2.280
18.9	1.1496	26	298.9	18.66	2.494
20.1	1.1609	28	325.1	20.29	2.713
21.3	1.1721	30	351.6	21.95	2.934
24.2	1.2000	35	420.0	26.22	3.505
26.9	1.2277	40	491.1	30.66	4.098
29.5	1.2552	45	564.8	35.26	4.714
31.9	1.2825	50	641.3	40.03	5.351

AMMONIUM SULFATE

Specific Gravity of Aqueous Ammonium Sulfate Solutions at 19° C. (Schiff)

Bé.	Sp. gr.	Per cent $(NH_4)_2SO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	1	10.06	0.6278	0.0839
1.6	1.0115	2	20.23	1.263	0.1688
2.5	1.0172	3	30.52	1.905	0.2547
3.3	1.0230	4	40.92	2.555	0.3415
4.0	1.0287	5	51.44	3.211	0.4292
4.8	1.0345	6	62.07	3.875	0.5180
5.6	1.0403	7	72.82	4.546	0.6077
6.4	1.0460	8	83.68	5.224	0.6983
7.1	1.0518	9	94.66	5.909	0.7900
7.9	1.0575	10	105.8	6.602	0.8825
8.6	1.0632	11	117.0	7.301	0.9760
9.4	1.0690	12	128.3	8.008	1.071
10.1	1.0747	13	139.7	8.722	1.166
10.8	1.0805	14	151.3	9.443	1.262
11.5	1.0862	15	162.9	10.17	1.360
12.2	1.0920	16	174.7	10.91	1.458
12.9	1.0977	17	186.6	11.65	1.557
13.6	1.1035	18	198.6	12.40	1.658
14.3	1.1092	19	210.7	13.16	1.759
14.9	1.1149	20	223.0	13.92	1.861
15.6	1.1207	21	235.3	14.69	1.964
16.3	1.1265	22	247.8	15.47	2.068
16.9	1.1323	23	260.4	16.26	2.173
17.6	1.1381	24	273.1	17.05	2.279
18.2	1.1439	25	286.0	17.85	2.387
18.9	1.1496	26	298.9	18.66	2.494
19.5	1.1554	27	312.0	19.47	2.603
20.1	1.1612	28	325.1	20.30	2.713
20.8	1.1670	29	338.4	21.13	2.824
21.3	1.1724	30	351.7	21.96	2.935
21.9	1.1780	31	365.2	22.80	3.048
22.5	1.1836	32	378.8	23.64	3.161
23.1	1.1892	33	392.4	24.50	3.275
23.6	1.1948	34	406.2	25.36	3.390
24.2	1.2004	35	420.1	26.23	3.506
24.8	1.2060	36	434.2	27.10	3.623
25.3	1.2116	37	448.3	27.99	3.741
25.9	1.2172	38	462.5	28.87	3.860
26.4	1.2228	39	476.9	29.77	3.980
27.0	1.2284	40	491.4	30.67	4.101
27.5	1.2343	41	506.1	31.59	4.223
28.1	1.2402	42	520.9	32.52	4.347
28.6	1.2462	43	535.9	33.45	4.472
29.2	1.2522	44	551.0	34.40	4.598
29.8	1.2583	45	566.2	35.35	4.725
30.3	1.2644	46	581.6	36.31	4.854
30.9	1.2705	47	597.1	37.28	4.983
31.4	1.2766	48	612.8	38.25	5.114
32.0	1.2828	49	628.6	39.24	5.246
32.5	1.2890	50	644.5	40.23	5.378

ARSENIC ACID

Specific Gravity of Aqueous Arsenic Acid Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_3AsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	1	10.06	0.6278	0.0839
1.8	1.0124	2	20.25	1.264	0.1690
3.7	1.0260	4	41.04	2.562	0.3425
5.6	1.0398	6	62.39	3.895	0.5206
7.4	1.0538	8	84.30	5.263	0.7035
9.3	1.0681	10	106.8	6.668	0.8914
11.1	1.0826	12	129.9	8.110	1.084
12.9	1.0975	14	153.7	9.592	1.282
14.7	1.1128	16	178.0	11.12	1.486
16.5	1.1285	18	203.1	12.68	1.695
18.3	1.1447	20	228.9	14.29	1.911
20.2	1.1614	22	255.5	15.95	2.132
22.0	1.1785	24	282.8	17.66	2.360
23.8	1.1961	26	311.0	19.41	2.595
25.6	1.2143	28	340.0	21.23	2.837
27.4	1.2331	30	369.9	23.09	3.087
32.0	1.2829	35	449.0	28.03	3.747
36.6	1.3370	40	534.8	33.39	4.463
41.1	1.3959	45	628.2	39.21	5.242
45.7	1.4602	50	730.1	45.58	6.093
50.3	1.5304	55	841.7	52.55	7.024
54.8	1.6070	60	964.2	60.19	8.046
59.2	1.6904	65	1099	68.59	9.169
63.6	1.7811	70	1247	77.83	10.40

Bé.	Sp. gr.	Per cent As_2O_5	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	0.810	8.143	0.5083	0.0680
1.8	1.0124	1.62	16.39	1.023	0.1368
3.7	1.0260	3.24	33.23	2.074	0.2773
5.6	1.0398	4.86	50.51	3.153	0.4216
7.4	1.0538	6.48	68.26	4.261	0.5696
9.3	1.0681	8.10	86.48	5.399	0.7217
11.1	1.0826	9.72	105.2	6.566	0.8778
12.9	1.0975	11.3	124.4	7.766	1.038
14.7	1.1128	13.0	144.2	8.999	1.203
16.5	1.1285	14.6	164.5	10.27	1.373
18.3	1.1447	16.2	185.4	11.57	1.547
20.2	1.1614	17.8	206.9	12.91	1.726
22.0	1.1785	19.4	229.0	14.30	1.911
23.8	1.1961	21.1	251.8	15.72	2.101
25.6	1.2143	22.7	275.3	17.19	2.297
27.4	1.2331	24.3	299.5	18.70	2.500
32.0	1.2829	28.3	363.6	22.70	3.034
36.6	1.3370	32.4	433.0	27.03	3.614
41.1	1.3959	36.4	508.6	31.75	4.244
45.7	1.4602	40.5	591.1	36.90	4.933
50.3	1.5304	44.5	681.5	42.54	5.687
54.8	1.6070	48.6	780.7	48.74	6.515
59.2	1.6904	52.6	889.6	55.54	7.424
63.6	1.7811	56.7	1009	63.02	8.424

BARIUM CHLORIDE

Specific Gravity of Aqueous Barium Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $BaCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.3	1.0159	2	20.32	1.268	0.1696
4.8	1.0341	4	41.36	2.582	0.3452
7.3	1.0528	6	63.17	3.943	0.5272
9.8	1.0721	8	85.77	5.354	0.7158
12.2	1.0921	10	109.2	6.818	0.9114
14.7	1.1128	12	133.5	8.336	1.114
17.2	1.1342	14	158.8	9.913	1.325
19.6	1.1564	16	185.0	11.55	1.544
22.0	1.1793	18	212.3	13.25	1.771
24.5	1.2031	20	240.6	15.02	2.008
26.9	1.2277	22	270.1	16.86	2.254
29.3	1.2531	24	300.7	18.77	2.510
31.7	1.2793	26	332.6	20.76	2.776

Bé.	Sp. gr.	Per cent $BaCl_2 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.3	1.0159	2.346	23.83	1.488	0.1989
4.8	1.0341	4.692	48.52	3.029	0.4049
7.3	1.0528	7.038	74.10	4.626	0.6184
9.8	1.0721	9.384	100.6	6.281	0.8396
12.2	1.0921	11.73	128.1	7.997	1.069
14.7	1.1128	14.08	156.6	9.778	1.307
17.2	1.1342	16.42	186.3	11.63	1.554
19.6	1.1564	18.77	217.0	13.55	1.811
22.0	1.1793	21.11	249.0	15.54	2.078
24.5	1.2031	23.46	282.2	17.62	2.355
26.9	1.2277	25.81	316.8	19.78	2.644
29.3	1.2531	28.15	352.8	22.02	2.944
31.7	1.2793	30.50	390.2	24.36	3.256

CADMIUM NITRATE

Specific Gravity of Aqueous Cadmium Nitrate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Cd(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.2	1.0154	2	20.31	1.268	0.1695
4.6	1.0326	4	41.30	2.578	0.3447
6.9	1.0502	6	63.01	3.934	0.5259
9.3	1.0683	8	85.46	5.335	0.7132
11.6	1.0869	10	108.7	6.785	0.9070
13.9	1.1061	12	132.7	8.286	1.108
16.2	1.1261	14	157.7	9.842	1.316
18.6	1.1468	16	183.5	11.45	1.531
20.9	1.1682	18	210.3	13.13	1.755
23.2	1.1904	20	238.1	14.86	1.987
28.9	1.2488	25	312.2	19.50	2.605
34.5	1.3124	30	393.7	24.58	3.286
40.1	1.3822	35	483.8	30.20	4.037
45.6	1.4590	40	583.6	36.43	4.870
51.1	1.5438	45	694.7	43.37	5.797
56.4	1.6356	50	817.8	51.05	6.825

CALCIUM CHLORIDE

Specific Gravity of Aqueous Calcium Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CaCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0148	2	20.30	1.267	0.1694
4.4	1.0316	4	41.26	2.576	0.3444
6.7	1.0486	6	62.92	3.928	0.5251
9.0	1.0659	8	85.27	5.323	0.7116
11.2	1.0835	10	108.4	6.764	0.9042
13.4	1.1015	12	132.2	8.252	1.103
15.5	1.1198	14	156.8	9.787	1.308
17.7	1.1386	16	182.2	11.37	1.520
19.8	1.1578	18	208.4	13.01	1.739
21.9	1.1775	20	235.5	14.70	1.965
27.0	1.2284	25	307.1	19.17	2.563
31.9	1.2816	30	384.5	24.00	3.209
36.6	1.3373	35	468.1	29.22	3.906
41.1	1.3957	40	558.3	34.85	4.659

Bé.	Sp. gr.	Per cent $CaCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0148	3.948	40.06	2.501	0.3343
4.4	1.0316	7.896	81.46	5.085	0.6800
6.7	1.0486	11.84	124.2	7.753	1.036
9.0	1.0659	15.79	168.3	10.51	1.405
11.2	1.0835	19.74	213.9	13.35	1.785
13.4	1.1015	23.69	260.9	16.29	2.177
15.5	1.1198	27.64	309.5	19.32	2.583
17.7	1.1386	31.58	359.6	22.45	3.001
19.8	1.1578	35.53	411.4	25.68	3.433
21.9	1.1775	39.48	465.9	29.02	3.879
27.0	1.2284	49.35	606.2	37.84	5.059
31.9	1.2816	59.22	759.0	47.38	6.334
36.6	1.3373	69.09	923.9	57.68	7.710
41.1	1.3957	78.96	1102.0	68.80	9.197

CHROMIC ACID

Specific Gravity of Aqueous Chromic Acid Solutions at $\frac{15^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent CrO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.2	1.045	6	62.70	3.914	0.5232
8.2	1.060	8	84.80	5.294	0.7077
10.2	1.076	10	107.6	6.717	0.8979
12.3	1.093	12	131.2	8.188	1.095
14.4	1.110	14	155.4	9.701	1.297
16.3	1.127	16	180.3	11.26	1.505
18.4	1.145	18	206.1	12.87	1.720
20.3	1.163	20	232.6	14.52	1.941
22.2	1.181	22	259.8	16.22	2.168
24.2	1.200	24	288.0	17.98	2.403
26.2	1.220	26	317.2	19.80	2.647
28.1	1.240	28	347.2	21.67	2.897
29.9	1.260	30	378.0	23.60	3.154
34.6	1.313	35	459.6	28.69	3.835
39.2	1.371	40	548.4	34.24	4.577
44.0	1.435	45	645.8	40.31	5.389
48.7	1.505	50	752.5	46.98	6.280
53.3	1.581	55	869.6	54.28	7.257
57.8	1.663	60	997.8	62.29	8.327

CHROMIUM SULFATE

Specific Gravity of Aqueous Chromium Sulfate Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Cr_2(SO_4)_3$ (green)	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0081	1	10.08	0.6293	0.0841
2.5	1.0172	2	20.34	1.270	0.1698
5.0	1.0358	4	41.43	2.586	0.3458
7.6	1.0551	6	63.31	3.952	0.5283
10.1	1.0751	8	86.01	5.369	0.7178
12.7	1.0958	10	109.6	6.841	0.9145
15.2	1.1172	12	134.1	8.369	1.119
17.7	1.1392	14	159.5	9.956	1.331
20.2	1.1618	16	185.9	11.60	1.551
22.7	1.1851	18	213.3	13.32	1.780
25.1	1.2091	20	241.8	15.10	2.018
27.5	1.2339	22	271.5	16.95	2.265
29.9	1.2594	24	302.3	18.87	2.522
32.2	1.2856	26	334.3	20.87	2.789
34.5	1.3125	28	367.5	22.94	3.067
36.8	1.3401	30	402.0	25.10	3.355
42.3	1.4123	35	494.3	30.86	4.125
47.6	1.4893	40	595.7	37.19	4.971

Bé.	Sp. gr.	Per cent $Cr_2(SO_4)_3$ (violet)	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0091	1	10.09	0.6300	0.084
2.7	1.0191	2	20.38	1.272	0.1701
5.5	1.0395	4	41.58	2.596	0.3470
8.3	1.0604	6	63.62	3.972	0.5310
11.0	1.0817	8	86.54	5.402	0.7222
13.6	1.1034	10	110.3	6.888	0.9208
16.2	1.1257	12	135.1	8.433	1.127
18.8	1.1486	14	160.8	10.04	1.342
21.3	1.1722	16	187.6	11.71	1.565
23.8	1.1966	18	215.4	13.45	1.797
26.3	1.2218	20	244.4	15.25	2.039
28.8	1.2479	22	274.5	17.14	2.291
31.3	1.2750	24	306.0	19.10	2.554
33.7	1.3032	26	338.8	21.15	2.828
36.2	1.3325	28	373.1	23.29	3.114

CITRIC ACID

Specific Gravity of Citric Acid Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $C_6H_8O_7 + H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0074	2	20.15	1.258	0.1681
2.1	1.0149	4	40.60	2.534	0.3388
3.2	1.0227	6	61.36	3.831	0.5121
4.3	1.0309	8	82.47	5.148	0.6883
5.5	1.0392	10	103.9	6.487	0.8672
6.5	1.0470	12	125.6	7.843	1.048
7.6	1.0549	14	147.7	9.220	1.232
8.6	1.0632	16	170.1	10.62	1.420
9.7	1.0718	18	192.9	12.04	1.610
10.8	1.0805	20	216.1	13.49	1.803
11.8	1.0889	22	239.6	14.95	1.999
12.8	1.0972	24	263.3	16.44	2.198
13.9	1.1060	26	287.6	17.95	2.400
15.0	1.1152	28	312.3	19.49	2.606
16.0	1.1244	30	337.3	21.06	2.815
17.1	1.1333	32	362.7	22.64	3.026
18.1	1.1422	34	388.3	24.24	3.241
19.1	1.1515	36	414.5	25.88	3.459
20.1	1.1612	38	441.3	27.55	3.682
21.2	1.1709	40	468.4	29.24	3.909
22.3	1.1814	42	496.2	30.98	4.141
23.1	1.1899	44	523.6	32.68	4.369
24.2	1.1998	46	551.9	34.45	4.606
25.2	1.2103	48	580.9	36.27	4.848
26.2	1.2204	50	610.2	38.09	5.092
27.2	1.2307	52	640.0	39.95	5.341
28.2	1.2410	54	670.1	41.83	5.592
29.1	1.2514	56	700.8	43.75	5.848
30.2	1.2627	58	732.4	45.72	6.112
31.2	1.2738	60	764.3	47.71	6.378
32.2	1.2849	62	796.6	49.73	6.648
33.1	1.2960	64	829.4	51.78	6.922
34.1	1.3071	66	862.7	53.85	7.199

COPPER NITRATE

Specific Gravity of Aqueous Cupric Nitrate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Cu(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.5	1.032	4	41.28	2.577	0.3445
6.9	1.050	6	63.00	3.933	0.5258
9.4	1.069	8	85.52	5.339	0.7137
11.7	1.088	10	108.8	6.792	0.9080
14.0	1.107	12	132.8	8.293	1.109
16.2	1.126	14	157.6	9.841	1.316
18.6	1.147	16	183.5	11.46	1.532
20.9	1.168	18	210.2	13.12	1.754
23.1	1.189	20	237.8	14.85	1.984
28.8	1.248	25	312.0	19.48	2.604

COPPER SULFATE

Specific Gravity of Aqueous Copper Sulfate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1	10.09	0.6299	0.0842
2.7	1.019	2	20.38	1.272	0.1701
5.6	1.040	4	41.60	2.597	0.3472
8.5	1.062	6	63.72	3.978	0.5318
11.2	1.084	8	86.72	5.414	0.7237
14.0	1.107	10	110.7	6.911	0.9238
16.8	1.131	12	135.7	8.473	1.133
19.4	1.154	14	161.6	10.09	1.348
22.1	1.180	16	188.8	11.79	1.576
24.8	1.206	18	217.1	13.55	1.812

COPPER SULFATE (Continued)

Specific Gravity of Aqueous Copper Sulfate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CuSO_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1.564	15.78	0.9853	0.1317
2.7	1.019	3.129	31.88	1.990	0.2661
5.6	1.040	6.257	65.07	4.062	0.5431
8.5	1.062	9.386	99.68	6.223	0.8318
11.2	1.084	12.51	135.7	8.469	1.132
14.0	1.107	15.64	173.2	10.81	1.445
16.8	1.131	18.77	212.3	13.25	1.772
19.4	1.154	21.90	252.7	15.78	2.110
22.1	1.180	25.03	295.3	18.44	2.465
24.8	1.206	28.16	339.6	21.20	2.834

Specific Gravity of Aqueous Copper Sulfate Solutions at 18° C. (Schiff and Gerlach)

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	0.6393	6.433	0.4016	0.0537
1.8	1.0126	1.279	12.95	0.8082	0.1080
2.7	1.0190	1.918	19.54	1.220	0.1631
3.6	1.0254	2.557	26.22	1.637	0.2188
4.5	1.0319	3.196	32.98	2.059	0.2753
5.4	1.0384	3.836	39.83	2.486	0.3324
6.2	1.0450	4.475	46.76	2.919	0.3902
7.1	1.0516	5.114	53.78	3.357	0.4488
8.0	1.0582	5.753	60.88	3.801	0.5081
8.8	1.0649	6.393	68.08	4.250	0.5681
9.7	1.0716	7.032	75.35	4.704	0.6289
10.6	1.0785	7.671	82.73	5.165	0.6904
11.4	1.0854	8.311	90.20	5.631	0.7528
12.3	1.0923	8.950	97.76	6.103	0.8158
13.1	1.0993	9.589	105.4	6.581	0.8797
13.9	1.1063	10.23	113.2	7.064	0.9443
14.8	1.1135	10.87	121.0	7.554	1.010
15.6	1.1208	11.51	129.0	8.051	1.076
16.5	1.1281	12.15	137.0	8.554	1.143
17.3	1.1354	12.79	145.2	9.062	1.211
18.1	1.1427	13.42	153.4	9.577	1.280
18.9	1.1501	14.06	161.7	10.10	1.350
19.8	1.1585	14.70	170.3	10.63	1.421

COPPER SULFATE (Continued)

Specific Gravity of Aqueous Copper Sulfate Solutions at 19° C. (Schiff and Gerlach)

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
20.6	1.1659	15.34	178.9	11.17	1.493
21.5	1.1738	15.98	187.6	11.71	1.566
22.3	1.1817	16.62	196.4	12.26	1.639
23.1	1.1898	17.26	205.4	12.82	1.714
24.0	1.1980	17.90	214.4	13.39	1.790
24.8	1.2063	18.54	223.6	13.96	1.866
25.6	1.2146	19.18	232.9	14.54	1.944

Specific Gravity of Aqueous Copper Sulfate Solutions at 18° C. (Schiff and Gerlach)

Bé.	Sp. gr.	Per cent $CuSO_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	1	10.06	0.6282	0.0840
1.8	1.0126	2	20.25	1.264	0.1690
2.7	1.0190	3	30.57	1.908	0.2551
3.6	1.0254	4	41.02	2.561	0.3423
4.5	1.0319	5	51.60	3.221	0.4306
5.4	1.0384	6	62.30	3.889	0.5199
6.2	1.0450	7	73.15	4.567	0.6105
7.1	1.0516	8	84.13	5.252	0.7021
8.0	1.0582	9	95.24	5.945	0.7948
8.8	1.0649	10	106.5	6.648	0.8887
9.7	1.0716	11	117.9	7.359	0.9837
10.6	1.0785	12	129.4	8.079	1.080
11.4	1.0854	13	141.1	8.809	1.178
12.3	1.0923	14	152.9	9.546	1.276
13.1	1.0993	15	164.9	10.29	1.376
13.9	1.1063	16	177.0	11.05	1.477
14.8	1.1135	17	189.3	11.82	1.580
15.6	1.1208	18	201.7	12.59	1.684
16.5	1.1281	19	214.3	13.38	1.789
17.3	1.1354	20	227.1	14.18	1.895
18.1	1.1427	21	240.0	14.98	2.003
18.9	1.1501	22	253.0	15.80	2.112
19.8	1.1585	23	266.5	16.63	2.224
20.6	1.1659	24	279.8	17.47	2.335
21.5	1.1738	25	293.5	18.32	2.449
22.3	1.1817	26	307.2	19.18	2.564
23.1	1.1898	27	321.2	20.05	2.681
24.0	1.1980	28	335.4	20.94	2.799
24.8	1.2063	29	349.8	21.84	2.919
25.6	1.2146	30	364.4	22.75	3.041

CUPRIC CHLORIDE

Specific Gravity of Aqueous Cupric Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.4	1.017	2	20.34	1.270	0.1697
5.0	1.036	4	41.44	2.587	0.3458
7.7	1.056	6	63.36	3.955	0.5288
10.1	1.075	8	86.00	5.369	0.7177
12.7	1.096	10	109.6	6.842	0.9146
15.2	1.117	12	134.0	8.368	1.119
17.6	1.138	14	159.3	9.946	1.330
20.0	1.160	16	185.6	11.59	1.549
22.3	1.182	18	212.8	13.28	1.776
24.7	1.205	20	241.0	15.04	2.011

Specific Gravity of Aqueous Cupric Chloride Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0091	1	10.09	0.6300	0.0842
2.6	1.0182	2	20.36	1.271	0.1699
3.9	1.0273	3	30.82	1.924	0.2572
5.1	1.0364	4	41.46	2.588	0.3460
6.3	1.0455	5	52.28	3.263	0.4363
7.5	1.0548	6	63.29	3.951	0.5282
8.7	1.0641	7	74.49	4.650	0.6216
9.9	1.0734	8	85.87	5.361	0.7166
11.1	1.0827	9	97.44	6.083	0.8132
12.2	1.0920	10	109.2	6.817	0.9113
13.8	1.1049	11	121.5	7.587	1.014
15.3	1.1178	12	134.1	8.374	1.119
16.8	1.1307	13	147.0	9.176	1.227
18.2	1.1436	14	160.1	9.995	1.336
19.6	1.1565	15	173.5	10.83	1.448
21.0	1.1696	16	187.1	11.68	1.562
22.4	1.1827	17	201.1	12.55	1.678
23.7	1.1958	18	215.2	13.44	1.796
25.1	1.2089	19	229.7	14.34	1.917
26.4	1.2223	20	244.5	15.26	2.040
27.7	1.2362	21	259.6	16.21	2.166
29.0	1.2501	22	275.0	17.17	2.295

CUPRIC CHLORIDE (Continued)

Specific Gravity of Aqueous Cupric Chloride Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
30.3	1.2640	23	290.7	18.15	2.426
31.5	1.2779	24	306.7	19.15	2.559
32.8	1.2918	25	323.0	20.16	2.695
34.0	1.3058	26	339.5	21.19	2.833
35.1	1.3198	27	356.3	22.25	2.974
36.3	1.3338	28	373.4	23.31	3.117
37.4	1.3478	29	390.9	24.40	3.262
38.5	1.3618	30	408.5	25.50	3.409
39.8	1.3784	31	427.3	26.68	3.566
41.1	1.3950	32	446.4	27.87	3.725
42.3	1.4116	33	465.8	29.08	3.887
43.5	1.4287	34	485.8	30.32	4.054
44.6	1.4447	35	505.6	31.57	4.220
45.8	1.4615	36	526.1	32.85	4.391
46.9	1.4782	37	546.9	34.14	4.564
48.0	1.4949	38	568.1	35.46	4.741
49.1	1.5116	39	589.5	36.80	4.920
50.1	1.5284	40	611.4	38.17	5.102

FERRIC CHLORIDE

Specific Gravity of Aqueous Ferric Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $FeCl_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.5	1.032	4	41.28	2.577	0.3445
6.8	1.049	6	62.94	3.929	0.5253
9.1	1.067	8	85.36	5.329	0.7124
11.4	1.085	10	108.5	6.773	0.9055
13.7	1.104	12	132.5	8.270	1.106
15.9	1.123	14	157.2	9.815	1.312
18.0	1.142	16	182.7	11.41	1.525
20.2	1.162	18	209.2	13.06	1.745
22.3	1.182	20	236.4	14.76	1.973
27.5	1.234	25	308.5	19.26	2.574
32.7	1.291	30	387.3	24.18	3.232
37.8	1.353	35	473.6	29.56	3.952
42.7	1.418	40	567.2	35.41	4.733
47.4	1.485	45	668.3	41.72	5.577
51.5	1.551	50	775.5	48.41	6.472

FERRIC CHLORIDE

Specific Gravity of Aqueous Ferric Chloride Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent Fe_2Cl_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0073	1	10.07	0.6288	0.0841
2.1	1.0146	2	20.29	1.267	0.1693
3.1	1.0219	3	30.66	1.914	0.2558
4.1	1.0292	4	41.17	2.570	0.3436
5.1	1.0365	5	51.83	3.235	0.4325
6.1	1.0439	6	62.63	3.910	0.5227
7.0	1.0513	7	73.59	4.594	0.6141
8.0	1.0587	8	84.70	5.287	0.7068
9.0	1.0661	9	95.95	5.990	0.8007
9.9	1.0734	10	107.3	6.701	0.8958
10.9	1.0814	11	119.0	7.426	0.9927
11.9	1.0894	12	130.7	8.161	1.091
12.9	1.0974	13	142.7	8.906	1.191
13.8	1.1054	14	154.8	9.661	1.291
14.8	1.1134	15	167.0	10.43	1.394
15.7	1.1215	16	179.4	11.20	1.497
16.6	1.1297	17	192.0	11.99	1.603
17.6	1.1378	18	204.8	12.79	1.709
18.4	1.1458	19	217.7	13.59	1.817
19.4	1.1542	20	230.8	14.41	1.926
20.5	1.1644	21	244.5	15.26	2.041
21.6	1.1746	22	258.4	16.13	2.157
22.6	1.1848	23	272.5	17.01	2.274
23.7	1.1950	24	286.8	17.90	2.393
24.7	1.2052	25	301.3	18.81	2.514
25.7	1.2155	26	316.0	19.73	2.637
26.7	1.2258	27	331.0	20.66	2.762
27.7	1.2365	28	346.2	21.61	2.889
28.7	1.2464	29	361.5	22.56	3.016
29.6	1.2568	30	377.0	23.54	3.146
30.6	1.2673	31	392.9	24.53	3.279
31.5	1.2778	32	408.9	25.53	3.412
32.5	1.2883	33	425.1	26.54	3.548
33.4	1.2988	34	441.6	27.57	3.685
34.3	1.3093	35	458.3	28.61	3.824
35.1	1.3199	36	475.2	29.66	3.965
36.0	1.3305	37	492.3	30.73	4.108
36.9	1.3411	38	509.6	31.81	4.253
37.7	1.3517	39	527.2	32.91	4.399
38.6	1.3622	40	544.9	34.02	4.547
39.5	1.3746	41	563.6	35.18	4.703
40.5	1.3870	42	582.5	36.37	4.861

FERRIC CHLORIDE (Continued)

Specific Gravity of Aqueous Ferric Chloride Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent Fe_2Cl_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
41.4	1.3994	43	601.7	37.56	5.022
42.3	1.4118	44	621.2	38.78	5.184
43.2	1.4242	45	640.9	40.01	5.348
44.1	1.4367	46	660.9	41.26	5.515
44.9	1.4492	47	681.1	42.52	5.684
45.8	1.4617	48	701.6	43.80	5.855
46.6	1.4742	49	722.4	45.09	6.028
47.5	1.4867	50	743.4	46.41	6.203
48.4	1.5010	51	765.5	47.79	6.388
49.3	1.5153	52	788.0	49.19	6.576
50.2	1.5296	53	810.7	50.61	6.765
51.1	1.5439	54	833.7	52.05	6.957
51.9	1.5582	55	857.0	53.50	7.152
52.8	1.5729	56	880.8	54.99	7.351
53.7	1.5876	57	904.9	56.49	7.552
54.5	1.6023	58	929.3	58.02	7.755
55.3	1.6170	59	954.0	59.56	7.962
56.1	1.6317	60	979.0	61.12	8.170

FERRIC NITRATE

Specific Gravity of Aqueous Ferric Nitrate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1	10.07	0.6283	0.0840
2.1	1.0144	2	20.29	1.267	0.1693
4.3	1.0304	4	41.22	2.573	0.3440
6.5	1.0468	6	62.81	3.921	0.5242
8.7	1.0636	8	85.09	5.312	0.7101
10.9	1.0810	10	108.1	6.748	0.9021
13.1	1.0989	12	131.9	8.232	1.101
15.2	1.1172	14	156.4	9.764	1.305
17.3	1.1359	16	181.7	11.35	1.517
19.5	1.1551	18	207.9	12.98	1.735
21.6	1.1748	20	235.0	14.67	1.961
26.9	1.2281	25	307.0	19.17	2.562

FERRIC NITRATE

Specific Gravity of Aqueous Ferric Nitrate Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0080	1	10.08	0.6293	0.0841
2.3	1.0160	2	20.32	1.269	0.1696
3.4	1.0240	3	30.72	1.918	0.2564
4.5	1.0320	4	41.28	2.577	0.3445
5.6	1.0398	5	51.99	3.246	0.4339
6.5	1.0472	6	62.83	3.922	0.5244
7.5	1.0546	7	73.82	4.608	0.6161
8.5	1.0620	8	84.96	5.304	0.7090
9.4	1.0694	9	96.25	6.008	0.8032
10.4	1.0770	10	107.7	6.723	0.8988
11.4	1.0852	11	119.4	7.452	0.9962
12.4	1.0934	12	131.2	8.191	1.095
13.4	1.1016	13	143.2	8.940	1.195
14.3	1.1098	14	155.4	9.699	1.297
15.3	1.1182	15	167.7	10.47	1.400
16.3	1.1268	16	180.3	11.25	1.505
17.3	1.1354	17	193.0	12.05	1.611
18.3	1.1440	18	205.9	12.85	1.718
19.2	1.1526	19	219.0	13.67	1.828
20.1	1.1612	20	232.2	14.50	1.938
21.2	1.1712	21	246.0	15.35	2.053
22.2	1.1812	22	259.9	16.22	2.169
23.3	1.1912	23	274.0	17.10	2.286
24.3	1.2012	24	288.3	18.00	2.406
25.3	1.2110	25	302.8	18.90	2.527
26.3	1.2212	26	317.5	19.82	2.650
27.3	1.2314	27	332.5	20.76	2.775
28.2	1.2416	28	347.6	21.70	2.901
29.2	1.2518	29	363.0	22.66	3.029
30.1	1.2622	30	378.7	23.64	3.160
31.1	1.2730	31	394.6	24.64	3.293
32.1	1.2838	32	410.8	25.65	3.428
33.0	1.2946	33	427.2	26.67	3.565
33.9	1.3054	34	443.8	27.71	3.704
34.9	1.3164	35	460.7	28.76	3.845
35.8	1.3280	36	478.1	29.85	3.990
36.8	1.3396	37	495.7	30.94	4.136
37.7	1.3512	38	513.5	32.05	4.285
38.6	1.3628	39	531.5	33.18	4.435
39.5	1.3746	40	549.8	34.32	4.589
40.4	1.3864	41	568.4	35.49	4.744
41.3	1.3982	42	587.2	36.66	4.901

FERRIC NITRATE (Continued)

Specific Gravity of Aqueous Ferric Nitrate Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
42.2	1.4100	43	606.3	37.85	5.060
43.0	1.4218	44	625.6	39.05	5.221
43.9	1.4338	45	645.2	40.28	5.384
44.8	1.4465	46	665.4	41.54	5.553
45.6	1.4592	47	685.8	42.81	5.723
46.5	1.4719	48	706.5	44.11	5.896
47.3	1.4846	49	727.5	45.41	6.071
48.2	1.4972	50	748.6	46.73	6.247
49.1	1.5122	51	771.2	48.15	6.436
50.1	1.5272	52	794.1	49.58	6.627
51.0	1.5422	53	817.4	51.03	6.821
51.9	1.5572	54	840.9	52.49	7.017
52.8	1.5722	55	864.7	53.98	7.216
53.8	1.5892	56	890.0	55.56	7.427
54.7	1.6062	57	915.5	57.15	7.640
55.7	1.6232	58	941.5	58.77	7.857
56.6	1.6402	59	967.7	60.41	8.076
57.5	1.6572	60	994.3	62.07	8.298
58.5	1.6764	61	1023	63.84	8.534
59.5	1.6956	62	1051	65.63	8.773
60.4	1.7148	63	1080	67.44	9.016
61.4	1.7340	64	1110	69.28	9.261
62.3	1.7532	65	1140	71.14	9.510

FERRIC SULFATE

Specific Gravity of Aqueous Ferric Sulfate Solutions at $\frac{17.5°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Fe_2(SO_4)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.7	1.033	4	41.32	2.579	0.3448
6.9	1.050	6	63.00	3.933	0.5258
9.1	1.067	8	85.36	5.329	0.7124
11.2	1.084	10	108.4	6.767	0.9046
13.5	1.103	12	132.4	8.263	1.105
15.8	1.122	14	157.1	9.806	1.311
17.9	1.141	16	182.6	11.40	1.524
20.1	1.161	18	209.0	13.05	1.744
22.2	1.181	20	236.2	14.75	1.971
28.2	1.241	25	310.3	19.37	2.590
34.1	1.307	30	392.1	24.48	3.272
39.6	1.376	35	481.6	30.06	4.019
44.9	1.449	40	579.6	36.18	4.837
50.1	1.528	45	687.6	42.92	5.738
55.1	1.613	50	806.5	50.35	6.730
59.9	1.703	55	936.7	58.47	7.817
64.4	1.798	60	1079	67.35	9.003

FERROUS SULFATE

Specific Gravity of Aqueous Ferrous Sulfate Solutions at $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $FeSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.1	1.0007	0.2	2.001	0.1249	0.0167
0.4	1.0028	0.4	4.011	0.2504	0.0335
0.7	1.0046	0.6	6.028	0.3763	0.0503
0.9	1.0065	0.8	8.052	0.5027	0.0672
1.2	1.0085	1.0	10.09	0.6296	0.0842
2.6	1.0180	2	20.36	1.271	0.1699
5.2	1.0375	4	41.50	2.591	0.3463
7.9	1.0575	6	63.45	3.961	0.5295
10.6	1.0785	8	86.28	5.386	0.7200
13.2	1.1000	10	110.0	6.867	0.9180
15.8	1.1220	12	134.6	8.405	1.124
18.3	1.1445	14	160.2	10.00	1.337
20.8	1.1675	16	186.8	11.66	1.559
23.2	1.1905	18	214.3	13.38	1.788
25.5	1.2135	20	242.7	15.15	2.025

Bé.	Sp. gr.	Per cent $FeSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.1	1.0007	0.366	3.663	0.2287	0.0306
0.4	1.0028	0.732	7.341	0.4583	0.0613
0.7	1.0046	1.10	11.03	0.6887	0.0921
0.9	1.0065	1.46	14.74	0.9200	0.1230
1.2	1.0085	1.83	18.46	1.152	0.1540
2.6	1.0180	3.66	37.26	2.326	0.3110
5.2	1.0375	7.32	75.95	4.742	0.6339
7.9	1.0575	11.0	116.1	7.249	0.9691
10.6	1.0785	14.6	157.9	9.858	1.318
13.2	1.1000	18.3	201.3	12.57	1.680
15.8	1.1220	22.0	246.4	15.38	2.056
18.3	1.1445	25.6	293.3	18.31	2.447
20.8	1.1675	29.3	341.9	21.34	2.853
23.2	1.1905	32.9	392.2	24.48	3.273
25.5	1.2135	36.6	444.2	27.73	3.707

FLUOSILICIC ACID

Specific Gravity of Aqueous Fluosilicic Acid Solutions at 17.5° C

Sp. gr.	Per cent H_2SiF_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0080	1	10.080	0.6293	0.0841
1.0161	2	20.322	1.269	0.1696
1.0242	3	30.726	1.918	0.2564
1.0324	4	41.296	2.578	0.3446
1.0407	5	52.035	3.249	0.4342
1.0491	6	62.946	3.930	0.5253
1.0576	7	74.032	4.622	0.6178
1.0661	8	85.288	5.325	0.7117
1.0747	9	96.723	6.038	0.8072
1.0834	10	108.340	6.764	0.9041
1.0922	11	120.142	7.500	1.003
1.1011	12	132.132	8.249	1.103
1.1100	13	144.300	9.009	1.204
1.1190	14	156.660	9.780	1.307
1.1281	15	169.215	10.56	1.412
1.1373	16	181.968	11.36	1.519
1.1466	17	194.922	12.17	1.627
1.1559	18	208.062	12.99	1.736
1.1653	19	221.407	13.82	1.848
1.1748	20	234.960	14.67	1.961
1.1844	21	248.724	15.53	2.076
1.1941	22	262.702	16.40	2.192
1.2038	23	276.874	17.29	2.311
1.2136	24	291.264	18.18	2.431
1.2235	25	305.875	19.10	2.553
1.2335	26	320.710	20.02	2.676
1.2436	27	335.772	20.96	2.802
1.2537	28	351.036	21.92	2.929
1.2639	29	366.531	22.88	3.059
1.2742	30	382.260	23.86	3.190
1.2846	31	398.226	24.86	3.323
1.2951	32	414.432	25.87	3.459
1.3056	33	430.848	26.90	3.596
1.3162*	34	447.508	27.94	3.735
1.4634** at 25° C	60.78%	889.455	55.53	7.423

* F. Stolba—Jour. prakt. Chem. **90,** 193 (1864). ** C. A. Jacobson—J. Phys. Chem. **28,** 508 (1924).

FORMIC ACID

Specific Gravity of Aqueous Formic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCO_2H	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
....	0.9982	0	....	....	......
0.3	1.0019	1	10.02	0.6255	0.0836
0.6	1.0044	2	20.09	1.254	0.1676
1.0	1.0070	3	30.21	1.886	0.2521
1.3	1.0093	4	40.37	2.520	0.3369
1.6	1.0115	5	50.58	3.157	0.4221
2.0	1.0141	6	60.85	3.798	0.5078
2.4	1.0170	7	71.19	4.444	0.5941
2.8	1.0196	8	81.57	5.092	0.6807
3.1	1.0221	9	91.99	5.743	0.7677
3.5	1.0246	10	102.5	6.396	0.8551
3.8	1.0271	11	113.0	7.053	0.9429
4.2	1.0296	12	123.6	7.713	1.031
4.5	1.0321	13	134.2	8.376	1.120
4.8	1.0345	14	144.8	9.041	1.209
5.2	1.0370	15	155.6	9.711	1.298
5.5	1.0393	16	166.3	10.38	1.388
5.8	1.0417	17	177.1	11.06	1.478
6.1	1.0441	18	187.9	11.73	1.568
6.4	1.0464	19	198.8	12.41	1.659
6.8	1.0488	20	209.8	13.09	1.750
7.1	1.0512	21	220.8	13.78	1.842
7.4	1.0537	22	231.8	14.47	1.935
7.7	1.0561	23	242.9	15.16	2.027
8.0	1.0585	24	254.0	15.86	2.120
8.3	1.0609	25	265.2	16.56	2.213
8.6	1.0633	26	276.5	17.26	2.307
8.9	1.0656	27	287.7	17.96	2.401
9.3	1.0681	28	299.1	18.67	2.496
9.6	1.0705	29	310.4	19.38	2.591
9.9	1.0729	30	321.9	20.09	2.686
10.2	1.0753	31	333.3	20.81	2.782
10.5	1.0777	32	344.9	21.53	2.878
10.7	1.0800	33	356.4	22.25	2.974
11.0	1.0823	34	368.0	22.97	3.071
11.3	1.0847	35	379.6	23.70	3.168
11.6	1.0871	36	391.4	24.43	3.266
11.9	1.0895	37	403.1	25.17	3.364
12.2	1.0919	38	414.9	25.90	3.463
12.5	1.0940	39	426.7	26.64	3.561
12.7	1.0963	40	438.5	27.38	3.660
13.1	1.0990	41	450.6	28.13	3.760
13.4	1.1015	42	462.6	28.88	3.861
13.6	1.1038	43	474.6	29.63	3.961
13.9	1.1062	44	486.7	30.38	4.062
14.2	1.1085	45	498.8	31.14	4.163
14.5	1.1108	46	511.0	31.90	4.264
14.7	1.1130	47	523.1	32.66	4.365
15.0	1.1157	48	535.5	33.43	4.469
15.4	1.1185	49	548.1	34.21	4.574
15.6	1.1207	50	560.4	34.98	4.676
15.8	1.1223	51	572.4	35.73	4.777
16.0	1.1244	52	584.7	36.50	4.879
16.3	1.1269	53	597.3	37.28	4.984
16.6	1.1295	54	609.9	38.08	5.090

FORMIC ACID (Continued)

Specific Gravity of Aqueous Formic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCO_2H	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
16.9	1.1320	55	622.6	38.87	5.196
17.2	1.1342	56	635.2	39.65	5.300
17.4	1.1361	57	647.6	40.43	5.404
17.6	1.1381	58	660.1	41.21	5.509
17.8	1.1401	59	672.7	41.99	5.613
18.1	1.1424	60	685.4	42.79	5.720
18.3	1.1448	61	698.3	43.59	5.828
18.6	1.1473	62	711.3	44.41	5.936
18.8	1.1493	63	724.1	45.20	6.042
19.1	1.1517	64	737.1	46.01	6.151
19.4	1.1543	65	750.3	46.84	6.261
19.6	1.1565	66	763.3	47.65	6.370
19.8	1.1584	67	776.1	48.45	6.477
20.0	1.1604	68	789.1	49.26	6.585
20.3	1.1628	69	802.3	50.09	6.696
20.6	1.1655	70	815.9	50.93	6.808
20.8	1.1677	71	829.1	51.76	6.919
21.1	1.1702	72	842.5	52.60	7.031
21.4	1.1728	73	856.1	53.45	7.145
21.6	1.1752	74	869.6	54.29	7.257
21.8	1.1769	75	882.7	55.10	7.366
22.0	1.1785	76	895.7	55.91	7.474
22.1	1.1801	77	908.7	56.73	7.583
22.3	1.1818	78	921.8	57.55	7.693
22.5	1.1837	79	935.1	58.38	7.804
22.7	1.1860	80	948.8	59.23	7.918
22.9	1.1876	81	962.0	60.05	8.028
23.1	1.1896	82	975.5	60.90	8.141
23.3	1.1914	83	988.9	61.73	8.252
23.5	1.1929	84	1002	62.55	8.362
23.7	1.1953	85	1016	63.43	8.479
23.9	1.1976	86	1030	64.30	8.595
24.1	1.1994	87	1043	65.14	8.708
24.3	1.2012	88	1057	65.99	8.821
24.5	1.2028	89	1070	66.83	8.933
24.6	1.2044	90	1084	67.67	9.046
24.8	1.2059	91	1097	68.51	9.158
25.0	1.2078	92	1111	69.37	9.273
25.2	1.2099	93	1125	70.24	9.390
25.3	1.2117	94	1139	71.10	9.505
25.6	1.2140	95	1153	72.00	9.625
25.7	1.2158	96	1167	72.86	9.740
25.9	1.2170	97	1180	73.69	9.851
26.0	1.2183	98	1194	74.53	9.964
26.2	1.2202	99	1208	75.41	10.08
26.3	1.2212	100	1221	76.24	10.19

GLYCEROL

Specific Gravity of Aqueous Glycerol (Glycerin) Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $C_3H_8O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
....	0.9982	0	....	....	....
0.1	1.0006	1	10.01	0.6246	0.0835
0.4	1.0030	2	20.06	1.252	0.1674
0.8	1.0053	3	30.16	1.883	0.2517
1.1	1.0077	4	40.31	2.516	0.3364
1.5	1.0101	5	50.51	3.153	0.4215
1.8	1.0125	6	60.75	3.792	0.5070
2.1	1.0149	7	71.04	4.435	0.5929
2.5	1.0173	8	81.38	5.081	0.6792
2.8	1.0197	9	91.77	5.729	0.7659
3.1	1.0221	10	102.2	6.381	0.8530
3.5	1.0246	11	112.7	7.036	0.9406
3.8	1.0271	12	123.3	7.694	1.029
4.1	1.0295	13	133.8	8.355	1.117
4.5	1.0320	14	144.5	9.019	1.206
4.8	1.0345	15	155.2	9.687	1.295
5.2	1.0370	16	165.9	10.36	1.385
5.5	1.0395	17	176.7	11.03	1.475
5.8	1.0420	18	187.6	11.71	1.565
6.2	1.0445	19	198.5	12.39	1.656
6.5	1.0470	20	209.4	13.07	1.747
6.8	1.0495	21	220.4	13.76	1.839
7.2	1.0520	22	231.4	14.45	1.931
7.5	1.0545	23	242.5	15.14	2.024
7.8	1.0571	24	253.7	15.84	2.117
8.2	1.0597	25	264.9	16.54	2.211
8.5	1.0622	26	276.2	17.24	2.305
8.8	1.0648	27	287.5	17.95	2.399
9.2	1.0674	28	298.9	18.66	2.494
9.5	1.0700	29	310.3	19.37	2.590
9.8	1.0727	30	321.8	20.09	2.686
10.2	1.0753	31	333.3	20.81	2.782
10.5	1.0780	32	345.0	21.53	2.879
10.8	1.0806	33	356.6	22.26	2.976
11.2	1.0833	34	368.3	22.99	3.074
11.5	1.0860	35	380.1	23.73	3.172
11.8	1.0887	36	391.9	24.47	3.271
12.1	1.0914	37	403.8	25.21	3.370
12.5	1.0941	38	415.8	25.95	3.470
12.8	1.0968	39	427.8	26.70	3.570
13.1	1.0995	40	439.8	27.46	3.670
13.4	1.1022	41	451.9	28.21	3.771
13.8	1.1049	42	464.1	28.97	3.873
14.1	1.1075	43	476.2	29.73	3.974
14.4	1.1102	44	488.5	30.49	4.077
14.7	1.1128	45	500.8	31.26	4.179
15.0	1.1155	46	513.1	32.03	4.282
15.3	1.1182	47	525.6	32.81	4.386
15.6	1.1209	48	538.0	33.59	4.490
16.0	1.1236	49	550.6	34.37	4.595
16.3	1.1263	50	563.2	35.16	4.700
16.6	1.1290	51	575.8	35.94	4.805
16.9	1.1317	52	588.5	36.74	4.911
17.2	1.1344	53	601.2	37.53	5.017
17.5	1.1371	54	614.0	38.33	5.124

GLYCEROL (Continued)

Specific Gravity of Aqueous Glycerol (Glycerin) Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $C_3H_8O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
17.8	1.1398	55	626.9	39.13	5.232
18.1	1.1425	56	639.8	39.94	5.339
18.4	1.1452	57	652.8	40.75	5.447
18.7	1.1479	58	665.8	41.56	5.556
19.0	1.1506	59	678.9	42.38	5.665
19.3	1.1533	60	692.0	43.20	5.775
19.6	1.1560	61	705.2	44.02	5.885
19.9	1.1587	62	718.4	44.85	5.995
20.2	1.1614	63	731.7	45.68	6.106
20.5	1.1642	64	745.1	46.51	6.218
20.8	1.1670	65	758.6	47.35	6.330
21.0	1.1697	66	772.0	48.19	6.443
21.3	1.1724	67	785.5	49.04	6.555
21.6	1.1752	68	799.1	49.89	6.669
21.9	1.1780	69	812.8	50.74	6.783
22.2	1.1808	70	826.6	51.60	6.898
22.5	1.1836	71	840.4	52.46	7.013
22.8	1.1863	72	854.1	53.32	7.128
23.1	1.1890	73	868.0	54.18	7.243
23.3	1.1917	74	881.9	55.05	7.359
23.6	1.1944	75	895.8	55.92	7.476
23.9	1.1971	76	909.8	56.80	7.592
24.2	1.1998	77	923.8	57.67	7.710
24.4	1.2025	78	938.0	58.55	7.827
24.7	1.2052	79	952.1	59.44	7.945
25.0	1.2079	80	966.3	60.32	8.064
25.2	1.2106	81	980.6	61.22	8.183
25.5	1.2133	82	994.9	62.11	8.303
25.8	1.2160	83	1009	63.01	8.423
26.0	1.2187	84	1024	63.91	8.543
26.3	1.2214	85	1038	64.81	8.664
26.5	1.2241	86	1053	65.72	8.785
26.8	1.2268	87	1067	66.63	8.907
27.1	1.2294	88	1082	67.54	9.028
27.3	1.2320	89	1096	68.45	9.150
27.6	1.2347	90	1111	69.37	9.273
27.8	1.2374	91	1126	70.29	9.397
28.1	1.2401	92	1141	71.22	9.521
28.3	1.2428	93	1156	72.15	9.645
28.6	1.2455	94	1171	73.09	9.770
28.8	1.2482	95	1186	74.03	9.896
29.1	1.2508	96	1201	74.96	10.02
29.3	1.2534	97	1216	75.90	10.15
29.5	1.2559	98	1231	76.83	10.27
29.8	1.2584	99	1246	77.77	10.40
30.0	1.2609	100	1261	78.71	10.52

HYDROCHLORIC ACID

Specific Gravity of Aqueous Hydrochloric Acid Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent HCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0032	1	10.03	0.6263	0.0837
1.2	1.0082	2	20.16	1.259	0.1683
2.6	1.0181	4	40.72	2.542	0.3399
3.9	1.0279	6	61.67	3.850	0.5147
5.3	1.0376	8	83.01	5.182	0.6927
6.6	1.0474	10	104.7	6.539	0.8741
7.9	1.0574	12	126.9	7.921	1.059
9.2	1.0675	14	149.5	9.330	1.247
10.4	1.0776	16	172.4	10.76	1.439
11.7	1.0878	18	195.8	12.22	1.634
12.9	1.0980	20	219.6	13.71	1.833
14.2	1.1083	22	243.8	15.22	2.035
15.4	1.1187	24	268.5	16.76	2.241
16.6	1.1290	26	293.5	18.32	2.450
17.7	1.1392	28	319.0	19.91	2.662
18.8	1.1493	30	344.8	21.52	2.877
19.9	1.1593	32	371.0	23.16	3.096
21.0	1.1691	34	397.5	24.81	3.317
22.0	1.1789	36	424.4	26.49	3.542
23.0	1.1885	38	451.6	28.19	3.769
24.0	1.1980	40	479.2	29.92	3.999

HYDROCHLORIC ACID

Authority — W. C. Ferguson

This table has been approved and adopted as a standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}$$

Baumé Hydrometers for use with this table must be graduated by the above formula which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

10° – 15° Bé. — 1/40° Bé. or .0002 Sp. Gr. for 1° F.
15° – 22° Bé. — 1/30° Bé. or .0003 " " " 1° F.
22° – 25° Bé. — 1/28° Bé. or .00035 " " " 1° F.

Bé.°	Sp. gr.	Tw.°	Per cent HCl	Bé.°	Sp. gr.	Tw.°	Per cent HCl
1.00	1.0069	1.38	1.40	10.25	1.0761	15.22	15.22
2.00	1.0140	2.80	2.82	10.50	1.0781	15.62	15.62
3.00	1.0211	4.22	4.25	10.75	1.0801	16.02	16.01
4.00	1.0284	5.68	5.69	11.00	1.0821	16.42	16.41
5.00	1.0357	7.14	7.15	11.25	1.0841	16.82	16.81
5.25	1.0375	7.50	7.52	11.50	1.0861	17.22	17.21
5.50	1.0394	7.88	7.89	11.75	1.0881	17.62	17.61
5.75	1.0413	8.26	8.26	12.00	1.0902	18.04	18.01
6.00	1.0432	8.64	8.64	12.25	1.0922	18.44	18.41
6.25	1.0450	9.00	9.02	12.50	1.0943	18.86	18.82
6.50	1.0469	9.38	9.40	12.75	1.0964	19.28	19.22
6.75	1.0488	9.76	9.78	13.00	1.0985	19.70	19.63
7.00	1.0507	10.14	10.17	13.25	1.1006	20.12	20.04
7.25	1.0526	10.52	10.55	13.50	1.1027	20.54	20.45
7.50	1.0545	10.90	10.94	13.75	1.1048	20.96	20.86
7.75	1.0564	11.28	11.32	14.00	1.1069	21.38	21.27
8.00	1.0584	11.68	11.71	14.25	1.1090	21.80	21.68
8.25	1.0603	12.06	12.09	14.50	1.1111	22.22	22.09
8.50	1.0623	12.46	12.48	14.75	1.1132	22.64	22.50
8.75	1.0642	12.84	12.87	15.00	1.1154	23.08	22.92
9.00	1.0662	13.24	13.26	15.25	1.1176	23.52	23.33
9.25	1.0681	13.62	13.65	15.50	1.1197	23.94	23.75
9.50	1.0701	14.02	14.04	15.75	1.1219	24.38	24.16
9.75	1.0721	14.42	14.43	16.0	1.1240	24.80	24.57
10.00	1.0741	14.82	14.83	16.1	1.1248	24.96	24.73

HYDROCHLORIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HCl	Bé.°	Sp. gr.	Tw.°	Per cent HCl
16.2	1.1256	25.12	24.90	20.9	1.1684	33.68	33.12
16.3	1.1265	25.30	25.06	21.0	1.1694	33.88	33.31
16.4	1.1274	25.48	25.23	21.1	1.1703	34.06	33.50
16.5	1.1283	25.66	25.39	21.2	1.1713	34.26	33.69
16.6	1.1292	25.84	25.56	21.3	1.1722	34.44	33.88
16.7	1.1301	26.02	25.72	21.4	1.1732	34.64	34.07
16.8	1.1310	26.20	25.89	21.5	1.1741	34.82	34.26
16.9	1.1319	26.38	26.05	21.6	1.1751	35.02	34.45
17.0	1.1328	26.56	26.22	21.7	1.1760	35.20	34.64
17.1	1.1336	26.72	26.39	21.8	1.1770	35.40	34.83
17.2	1.1345	26.90	26.56	21.9	1.1779	35.58	35.02
17.3	1.1354	27.08	26.73	22.0	1.1789	35.78	35.21
17.4	1.1363	27.26	26.90	22.1	1.1798	35.96	35.40
17.5	1.1372	27.44	27.07	22.2	1.1808	36.16	35.59
17.6	1.1381	27.62	27.24	22.3	1.1817	36.34	35.78
17.7	1.1390	27.80	27.41	22.4	1.1827	36.54	35.97
17.8	1.1399	27.98	27.58	22.5	1.1836	36.72	36.16
17.9	1.1408	28.16	27.75	22.6	1.1846	36.92	36.35
18.0	1.1417	28.34	27.92	22.7	1.1856	37.12	36.54
18.1	1.1426	28.52	28.09	22.8	1.1866	37.32	36.73
18.2	1.1435	28.70	28.26	22.9	1.1875	37.50	36.93
18.3	1.1444	28.88	28.44	23.0	1.1885	37.70	37.14
18.4	1.1453	29.06	28.61	23.1	1.1895	37.90	37.36
18.5	1.1462	29.24	28.78	23.2	1.1904	38.08	37.58
18.6	1.1471	29.42	28.95	23.3	1.1914	38.28	37.80
18.7	1.1480	29.60	29.13	23.4	1.1924	38.48	38.03
18.8	1.1489	29.78	29.30	23.5	1.1934	38.68	38.26
18.9	1.1498	29.96	29.48	23.6	1.1944	38.88	38.49
19.0	1.1508	30.16	29.65	23.7	1.1953	39.06	38.72
19.1	1.1517	30.34	29.83	23.8	1.1963	39.26	38.95
19.2	1.1526	30.52	30.00	23.9	1.1973	39.46	39.18
19.3	1.1535	30.70	30.18	24.0	1.1983	39.66	39.41
19.4	1.1544	30.88	30.35	24.1	1.1993	39.86	39.64
19.5	1.1554	31.08	30.53	24.2	1.2003	40.06	39.86
19.6	1.1563	31.26	30.71	24.3	1.2013	40.26	40.09
19.7	1.1572	31.44	30.90	24.4	1.2023	40.46	40.32
19.8	1.1581	31.62	31.08	24.5	1.2033	40.66	40.55
19.9	1.1590	31.80	31.27	24.6	1.2043	40.86	40.78
20.0	1.1600	32.00	31.45	24.7	1.2053	41.06	41.01
20.1	1.1609	32.18	31.64	24.8	1.2063	41.26	41.24
20.2	1.1619	32.38	31.82	24.9	1.2073	41.46	41.48
20.3	1.1628	32.56	32.01	25.0	1.2083	41.66	41.72
20.4	1.1637	32.74	32.19	25.1	1.2093	41.86	41.99
20.5	1.1647	32.94	32.38	25.2	1.2103	42.06	42.30
20.6	1.1656	33.12	32.56	25.3	1.2114	42.28	42.64
20.7	1.1666	33.32	32.75	25.4	1.2124	42.48	43.01
20.8	1.1675	33.50	32.93	25.5	1.2134	42.68	43.40

HYDROCYANIC ACID

Specific Gravity of Aqueous Hydrocyanic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCN	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
54.4	0.759	80	607.2	37.91	5.067
56.2	0.752	82	616.6	38.49	5.146
57.9	0.745	84	625.8	39.07	5.222
59.7	0.738	86	634.7	39.62	5.297
61.5	0.731	88	643.3	40.16	5.368
63.4	0.724	90	651.6	40.68	5.438
65.3	0.717	92	659.6	41.18	5.505
66.9	0.711	94	668.3	41.72	5.577
68.9	0.704	96	675.8	42.19	5.640
70.9	0.697	98	683.1	42.64	5.700
72.6	0.691	100	691.0	43.14	5.767

Specific Gravity of Aqueous Hydrocyanic Acid Solutions at $\frac{15°}{4°}$ C.

Bé.	Sp. gr.	Per cent HCN	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
10.3	0.998	1	9.98	0.6230	0.0833
10.6	0.996	2	19.92	1.244	0.1662
11.0	0.993	4	39.72	2.480	0.3315
11.4	0.989	6	59.34	3.704	0.4952
12.3	0.984	8	78.72	4.914	0.6569
13.2	0.978	10	97.80	6.105	0.8162
14.2	0.971	12	116.5	7.274	0.9724
15.2	0.964	14	135.0	8.425	1.126
16.4	0.956	16	153.0	9.549	1.276

HYDROFLUOSILICIC ACID

Specific Gravity of Aqueous Hydrofluosilicic Acid Solutions at 17.5° C. (Stolba)

Bé.	Sp. gr.	Per cent H_2SiF_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0040	0.5	5.020	0.3134	0.0419
1.2	1.0080	1.0	10.08	0.6293	0.0841
1.7	1.0120	1.5	15.18	0.9476	0.1267
2.3	1.0161	2.0	20.32	1.269	0.1696
2.9	1.0201	2.5	25.50	1.592	0.2128
3.4	1.0242	3.0	30.73	1.918	0.2564
4.0	1.0283	3.5	35.99	2.247	0.3004
4.6	1.0324	4.0	41.30	2.578	0.3446
5.1	1.0366	4.5	46.65	2.912	0.3893
5.7	1.0407	5.0	52.04	3.248	0.4342
6.2	1.0449	5.5	57.47	3.588	0.4796
6.8	1.0491	6.0	62.95	3.930	0.5253
7.3	1.0533	6.5	68.46	4.274	0.5714
7.9	1.0576	7.0	74.03	4.622	0.6178
8.4	1.0618	7.5	79.64	4.971	0.6646
9.0	1.0661	8.0	85.29	5.324	0.7118
9.5	1.0704	8.5	90.98	5.680	0.7593
10.1	1.0747	9.0	96.72	6.038	0.8072
10.6	1.0791	9.5	102.5	6.400	0.8555
11.2	1.0834	10.0	108.3	6.763	0.9041
11.7	1.0878	10.5	114.2	7.130	0.9532
12.2	1.0922	11.0	120.1	7.500	1.003
12.8	1.0966	11.5	126.1	7.873	1.052
13.3	1.1011	12.0	132.1	8.249	1.103
13.8	1.1055	12.5	138.2	8.627	1.153
14.4	1.1100	13.0	144.3	9.008	1.204
14.9	1.1145	13.5	150.5	9.393	1.256
15.4	1.1190	14.0	156.7	9.780	1.307
16.0	1.1236	14.5	162.9	10.17	1.360
16.5	1.1281	15.0	169.2	10.56	1.412
17.0	1.1327	15.5	175.6	10.96	1.465
17.5	1.1373	16.0	182.0	11.36	1.519
18.0	1.1419	16.5	188.4	11.76	1.572
18.5	1.1466	17.0	194.9	12.17	1.627
19.0	1.1512	17.5	201.5	12.58	1.681
19.6	1.1559	18.0	208.1	12.99	1.736
20.1	1.1606	18.5	214.7	13.40	1.792
20.6	1.1653	19.0	221.4	13.82	1.848
21.1	1.1701	19.5	228.2	14.24	1.904
21.6	1.1748	20.0	235.0	14.67	1.961
22.1	1.1796	20.5	241.8	15.10	2.018
22.6	1.1844	21.0	248.7	15.53	2.076

HYDROFLUOSILICIC ACID (Continued)

Specific Gravity of Aqueous Hydrofluosilicic Acid Solutions at 17.5° C. (Stolba)

Bé.	Sp. gr.	Per cent H_2SiF_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.1	1.1892	21.5	255.7	15.96	2.134
23.6	1.1941	22.0	262.7	16.40	2.192
24.1	1.1989	22.5	269.8	16.84	2.251
24.6	1.2038	23.0	276.9	17.28	2.311
25.0	1.2087	23.5	284.0	17.73	2.370
25.5	1.2136	24.0	291.3	18.18	2.431
26.0	1.2186	24.5	298.6	18.64	2.492
26.5	1.2235	25.0	305.9	19.09	2.553
27.0	1.2285	25.5	313.3	19.56	2.614
27.5	1.2335	26.0	320.7	20.02	2.676
27.9	1.2385	26.5	328.2	20.49	2.739
28.4	1.2436	27.0	335.8	20.96	2.802
28.9	1.2486	27.5	343.4	21.44	2.865
29.3	1.2537	28.0	351.0	21.91	2.929
29.8	1.2588	28.5	358.8	22.40	2.994
30.3	1.2639	29.0	366.5	22.88	3.059
30.7	1.2691	29.5	374.4	23.37	3.124
31.2	1.2742	30.0	382.3	23.86	3.190
31.7	1.2794	30.5	390.2	24.36	3.256
32.1	1.2846	31.0	398.2	24.86	3.323
32.6	1.2898	31.5	406.3	25.36	3.391
33.0	1.2951	32.0	414.4	25.87	3.459
33.5	1.3003	32.5	422.6	26.38	3.527
34.0	1.3056	33.0	430.8	26.90	3.596
34.4	1.3109	33.5	439.2	27.41	3.665
34.8	1.3162	34.0	447.5	27.94	3.735

MAGNESIUM CHLORIDE

Specific Gravity of Aqueous Magnesium Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $MgCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0146	2	20.29	1.267	0.1693
4.4	1.0311	4	41.24	2.575	0.3442
6.6	1.0478	6	62.87	3.925	0.5247
8.8	1.0646	8	85.17	5.317	0.7107
10.9	1.0816	10	108.2	6.752	0.9026
13.1	1.0989	12	131.9	8.232	1.100
15.1	1.1164	14	156.3	9.757	1.304
17.2	1.1342	16	181.5	11.33	1.514
19.2	1.1523	18	207.4	12.95	1.731
21.1	1.1706	20	234.1	14.62	1.954
26.0	1.2184	25	304.6	19.02	2.542
30.7	1.2688	30	380.6	23.76	3.177

Bé.	Sp. gr.	Per cent $MgCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0146	4.270	43.32	2.705	0.3616
4.4	1.0311	8.540	88.06	5.497	0.7349
6.6	1.0478	12.81	134.2	8.380	1.120
8.8	1.0646	17.08	181.8	11.35	1.518
10.9	1.0816	21.35	230.9	14.42	1.927
13.1	1.0989	25.62	281.6	17.58	2.350
15.1	1.1164	29.89	333.7	20.83	2.785
17.2	1.1342	34.16	387.5	24.19	3.233
19.2	1.1523	38.43	442.8	27.65	3.696
21.1	1.1706	42.70	499.9	31.21	4.172
26.0	1.2184	53.38	650.4	40.60	5.427
30.7	1.2688	64.05	812.7	50.73	6.782

MAGNESIUM CHLORIDE

Specific Gravity of Aqueous Magnesium Chloride Solutions at 14° C. (Oudemans)

Bé.	Sp. gr.	Per cent $MgCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0033	1	10.03	0.6263	0.0837
1.1	1.0073	2	20.15	1.258	0.1681
1.6	1.0113	3	30.34	1.894	0.2532
2.2	1.0154	4	40.62	2.536	0.3390
2.8	1.0194	5	50.97	3.182	0.4254
3.3	1.0234	6	61.40	3.833	0.5124
3.9	1.0274	7	71.92	4.490	0.6002
4.4	1.0314	8	82.51	5.151	0.6886
5.0	1.0355	9	93.20	5.818	0.7777
5.5	1.0395	10	104.0	6.489	0.8675
6.0	1.0435	11	114.8	7.166	0.9579
6.6	1.0476	12	125.7	7.848	1.049
7.1	1.0517	13	136.7	8.535	1.141
7.7	1.0558	14	147.8	9.227	1.234
8.2	1.0599	15	159.0	9.925	1.327
8.7	1.0641	16	170.3	10.63	1.421
9.3	1.0682	17	181.6	11.34	1.515
9.8	1.0724	18	193.0	12.05	1.611
10.3	1.0765	19	204.5	12.77	1.707
10.8	1.0807	20	216.1	13.49	1.804
11.4	1.0849	21	227.8	14.22	1.901
11.9	1.0891	22	239.6	14.96	2.000
12.4	1.0933	23	251.5	15.70	2.098
12.9	1.0976	24	263.4	16.44	2.198
13.4	1.1018	25	275.5	17.20	2.299
13.9	1.1061	26	287.6	17.95	2.400
14.4	1.1103	27	299.8	18.71	2.502
14.9	1.1146	28	312.1	19.48	2.604
15.4	1.1189	29	324.5	20.26	2.708
15.9	1.1232	30	337.0	21.04	2.812
16.4	1.1275	31	349.5	21.82	2.917
16.9	1.1319	32	362.2	22.61	3.022
17.4	1.1363	33	375.0	23.41	3.129
17.9	1.1407	34	387.8	24.21	3.237
18.4	1.1451	35	400.8	25.02	3.345
18.9	1.1495	36	413.8	25.83	3.453
19.4	1.1540	37	427.0	26.66	3.563
19.8	1.1584	38	440.2	27.48	3.673
20.3	1.1628	39	453.5	28.31	3.784
20.8	1.1673	40	466.9	29.15	3.897
21.3	1.1718	41	480.4	29.99	4.009
21.7	1.1763	42	494.0	30.84	4.123
22.2	1.1809	43	507.8	31.70	4.238
22.7	1.1855	44	521.6	32.56	4.353
23.2	1.1901	45	535.5	33.43	4.469
23.6	1.1948	46	549.6	34.31	4.587
24.1	1.1995	47	563.8	35.19	4.705
24.6	1.2042	48	578.0	36.08	4.824

MAGNESIUM CHLORIDE (Continued)

Specific Gravity of Aqueous Magnesium Chloride Solutions at 14° C. (Oudemans)

Bé.	Sp. gr.	Per cent $MgCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0033	0.47	4.699	0.2934	0.0392
1.1	1.0073	0.94	9.436	0.5891	0.0787
1.6	1.0113	1.41	14.21	0.8871	0.1186
2.2	1.0154	1.87	19.02	1.188	0.1588
2.8	1.0194	2.34	23.87	1.490	0.1992
3.3	1.0234	2.81	28.76	1.795	0.2400
3.9	1.0274	3.28	33.68	2.103	0.2811
4.4	1.0314	3.75	38.65	2.413	0.3225
5.0	1.0355	4.22	43.65	2.725	0.3643
5.5	1.0395	4.68	48.69	3.039	0.4063
6.0	1.0435	5.15	53.76	3.356	0.4487
6.6	1.0476	5.62	58.88	3.676	0.4914
7.1	1.0517	6.09	64.04	3.998	0.5344
7.7	1.0558	6.56	69.23	4.322	0.5777
8.2	1.0599	7.03	74.46	4.649	0.6214
8.7	1.0641	7.49	79.74	4.978	0.6655
9.3	1.0682	7.96	85.05	5.310	0.7098
9.8	1.0724	8.43	90.41	5.644	0.7545
10.3	1.0765	8.90	95.80	5.980	0.7995
10.8	1.0807	9.37	101.2	6.320	0.8448
11.4	1.0849	9.84	106.7	6.661	0.8905
11.9	1.0891	10.3	112.2	7.006	0.9365
12.4	1.0933	10.8	117.8	7.352	0.9829
12.9	1.0976	11.2	123.4	7.702	1.030
13.4	1.1018	11.7	129.0	8.054	1.077
13.9	1.1061	12.2	134.7	8.409	1.124
14.4	1.1103	12.6	140.4	8.765	1.172
14.9	1.1146	13.1	146.2	9.125	1.220
15.4	1.1189	13.6	152.0	9.487	1.268
15.9	1.1232	14.1	157.8	9.862	1.317
16.4	1.1275	14.5	163.7	10.22	1.366
16.9	1.1319	15.0	169.6	10.59	1.416
17.4	1.1363	15.5	175.6	10.96	1.466
17.9	1.1407	15.9	181.7	11.34	1.516
18.4	1.1451	16.4	187.7	11.72	1.567
18.9	1.1495	16.9	193.8	12.10	1.617
19.4	1.1540	17.3	200.0	12.48	1.669
19.8	1.1584	17.8	206.2	12.87	1.721
20.3	1.1628	18.3	212.4	13.26	1.773
20.8	1.1673	18.7	218.7	13.65	1.825
21.3	1.1718	19.2	225.0	14.05	1.878
21.7	1.1763	19.7	231.4	14.45	1.931
22.2	1.1809	20.1	237.8	14.85	1.985
22.7	1.1855	20.6	244.3	15.25	2.039
23.2	1.1901	21.1	250.8	15.66	2.093
23.6	1.1948	21.5	257.4	16.07	2.148
24.1	1.1995	22.0	264.1	16.48	2.204
24.6	1.2042	22.5	270.7	16.90	2.259

MAGNESIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS MAGNESIUM SULFATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $MgSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.6	1.0186	2	20.37	1.272	0.1700
5.5	1.0392	4	41.57	2.595	0.3469
8.2	1.0602	6	63.61	3.971	0.5309
10.9	1.0816	8	86.53	5.402	0.7221
13.6	1.1034	10	110.3	6.889	0.9208
16.2	1.1256	12	135.1	8.432	1.127
18.7	1.1484	14	160.8	10.04	1.342
21.3	1.1717	16	187.5	11.70	1.564
23.3	1.1955	18	215.2	13.43	1.796
26.1	1.2198	20	244.0	15.23	2.036
28.5	1.2447	22	273.8	17.09	2.285
30.8	1.2701	24	304.8	19.03	2.544
33.1	1.2961	26	337.0	21.04	2.812

Bé.	Sp. gr.	Per cent $MgSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.6	1.0186	4.095	41.71	2.604	0.3481
5.5	1.0392	8.190	85.11	5.314	0.7103
8.2	1.0602	12.29	130.3	8.131	1.087
10.9	1.0816	16.38	177.2	11.06	1.479
13.6	1.1034	20.48	225.9	14.10	1.886
16.2	1.1256	24.57	276.6	17.27	2.308
18.7	1.1484	28.67	329.2	20.55	2.747
21.3	1.1717	32.76	383.9	23.96	3.203
23.3	1.1955	36.86	440.6	27.51	3.677
26.1	1.2198	40.95	499.5	31.18	4.169
28.5	1.2447	45.05	560.7	35.00	4.679
30.8	1.2701	49.14	624.2	38.96	5.209
33.1	1.2961	53.24	690.0	43.08	5.758

NICKEL CHLORIDE

Specific Gravity of Aqueous Nickel Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NiCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.008	1	10.08	0.6293	0.0841
2.6	1.018	2	20.36	1.271	0.1699
5.2	1.037	4	41.48	2.589	0.3462
7.8	1.057	6	63.42	3.959	0.5293
10.5	1.078	8	86.24	5.384	0.7197
13.1	1.099	10	109.9	6.861	0.9171
15.7	1.121	12	134.5	8.398	1.123
18.1	1.143	14	160.0	9.990	1.335
20.8	1.167	16	186.7	11.66	1.558
23.3	1.191	18	214.4	13.38	1.789
25.7	1.215	20	243.0	15.17	2.028
31.7	1.280	25	320.0	19.98	2.670
37.8	1.353	30	405.9	25.34	3.387

NICKEL NITRATE

Specific Gravity of Aqueous Nickel Nitrate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Ni(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.6	1.033	4	41.32	2.579	0.3448
6.9	1.050	6	63.00	3.933	0.5258
9.4	1.069	8	85.52	5.339	0.7137
11.7	1.088	10	108.8	6.792	0.9080
14.0	1.107	12	132.8	8.293	1.109
16.3	1.127	14	157.8	9.850	1.317
18.7	1.148	16	183.7	11.47	1.533
21.0	1.169	18	210.4	13.14	1.756
23.3	1.191	20	238.2	14.87	1.988
28.9	1.249	25	312.3	19.49	2.606
34.4	1.311	30	393.3	24.55	3.282
39.7	1.377	35	482.0	30.09	4.022

NICKEL SULFATE

Specific Gravity of Aqueous Nickel Sulfate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NiSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1	10.09	0.6299	0.0842
2.8	1.020	2	20.40	1.274	0.1702
5.8	1.042	4	41.68	2.602	0.3478
8.6	1.063	6	63.78	3.982	0.5323
11.4	1.085	8	86.80	5.419	0.7244
14.3	1.109	10	110.9	6.923	0.9255
17.0	1.133	12	136.0	8.488	1.135
19.8	1.158	14	162.1	10.12	1.353
22.4	1.183	16	189.3	11.82	1.580
25.1	1.209	18	217.6	13.59	1.816

NITRIC ACID

Specific Gravity of Aqueous Nitric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0036	1	10.04	0.6265	0.0838
1.3	1.0091	2	20.18	1.260	0.1684
2.1	1.0146	3	30.44	1.900	0.2540
2.9	1.0201	4	40.80	2.547	0.3405
3.6	1.0256	5	51.28	3.201	0.4279
4.4	1.0312	6	61.87	3.862	0.5163
5.2	1.0369	7	72.58	4.531	0.6057
5.9	1.0427	8	83.42	5.207	0.6961
6.7	1.0485	9	94.37	5.891	0.7875
7.5	1.0543	10	105.4	6.582	0.8798
8.2	1.0602	11	116.6	7.280	0.9732
9.0	1.0661	12	127.9	7.986	1.068
9.8	1.0721	13	139.4	8.701	1.163
10.5	1.0781	14	150.9	9.422	1.260
11.3	1.0842	15	162.6	10.15	1.357
12.0	1.0903	16	174.4	10.89	1.456
12.8	1.0964	17	186.4	11.64	1.555
13.5	1.1026	18	198.5	12.39	1.656
14.2	1.1088	19	210.7	13.15	1.758
15.0	1.1150	20	223.0	13.92	1.861
15.7	1.1213	21	235.5	14.70	1.965
16.4	1.1276	22	248.1	15.49	2.070
17.1	1.1340	23	260.8	16.28	2.177
17.9	1.1404	24	273.7	17.09	2.284
18.6	1.1469	25	286.7	17.90	2.393
19.4	1.1534	26	299.9	18.72	2.503
20.0	1.1600	27	313.2	19.55	2 614
20.7	1.1666	28	326.6	20.39	2.726
21.4	1.1733	29	340.3	21.24	2.840
22.1	1.1800	30	354.0	22.10	2.954
22.8	1.1867	31	367.9	22.97	3.070
23.5	1.1934	32	381.9	23.84	3.187
24.2	1.2002	33	396.1	24.73	3.305
24.9	1.2071	34	410.4	25.62	3.425
25.6	1.2140	35	424.9	26.53	3.546
26.2	1.2205	36	439.4	27.43	3.667
26.8	1.2270	37	454.0	28.34	3.789
27.5	1.2335	38	468.7	29.26	3.912
28.1	1.2399	39	483.6	30.19	4.035
28.7	1.2463	40	498.5	31.12	4.160
29.3	1.2527	41	513.6	32.06	4.286
29.8	1.2591	42	528.8	33.01	4.413
30.4	1.2655	43	544.2	33.97	4.541
31.0	1.2719	44	559.6	34.94	4.670
31.6	1.2783	45	575.2	35.91	4.800
32.1	1.2847	46	591.0	36.89	4.932
32.7	1.2911	47	606.8	37.88	5.064
33.2	1.2975	48	622.8	38.88	5.197
33.8	1.3040	49	639.0	39.89	5.332
34.3	1.3100	50	655.0	40.89	5.466
34.8	1.3160	51	671.2	41.90	5.601
35.3	1.3219	52	687.4	42.91	5.736
35.8	1.3278	53	703.7	43.93	5.873
36.3	1.3336	54	720.1	44.96	6.010

NITRIC ACID (Continued)

Specific Gravity of Aqueous Nitric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
36.7	1.3393	55	736.6	45.98	6.147
37.2	1.3449	56	753.1	47.02	6.285
37.6	1.3505	57	769.8	48.06	6.424
38.1	1.3560	58	786.5	49.10	6.563
38.5	1.3614	59	803.2	50.14	6.703
38.9	1.3667	60	820.0	51.19	6.843
39.3	1.3719	61	836.9	52.24	6.984
39.7	1.3769	62	853.7	53.29	7.124
40.1	1.3818	63	870.5	54.34	7.265
40.4	1.3866	64	887.4	55.40	7.406
40.8	1.3913	65	904.3	56.46	7.547
41.1	1.3959	66	921.3	57.51	7.688
41.5	1.4004	67	938.3	58.57	7.830
41.8	1.4048	68	955.3	59.63	7.972
42.1	1.4091	69	972.3	60.70	8.114
42.4	1.4134	70	989.4	61.76	8.257
42.7	1.4176	71	1006	62.83	8.399
43.0	1.4218	72	1024	63.91	8.543
43.3	1.4258	73	1041	64.98	8.686
43.6	1.4298	74	1058	66.05	8.830
43.9	1.4337	75	1075	67.13	8.973
44.1	1.4375	76	1093	68.20	9.117
44.4	1.4413	77	1110	69.28	9.262
44.7	1.4450	78	1127	70.36	9.406
44.9	1.4486	79	1144	71.44	9.550
45.1	1.4521	80	1162	72.52	9.694
45.4	1.4555	81	1179	73.60	9.839
45.6	1.4589	82	1196	74.68	9.983
45.8	1.4622	83	1214	75.76	10.13
46.1	1.4655	84	1231	76.85	10.27
46.3	1.4686	85	1248	77.93	10.42
46.5	1.4716	86	1266	79.01	10.56
46.7	1.4745	87	1283	80.08	10.71
46.8	1.4773	88	1300	81.16	10.85
47.0	1.4800	89	1317	82.23	10.99
47.2	1.4826	90	1334	83.30	11.14
47.4	1.4850	91	1351	84.36	11.28
47.5	1.4873	92	1368	85.42	11.42
47.6	1.4892	93	1385	86.46	11.56
47.8	1.4912	94	1402	87.51	11.70
47.9	1.4932	95	1419	88.56	11.84
48.0	1.4952	96	1435	89.61	11.98
48.2	1.4974	97	1452	90.67	12.12
48.4	1.5008	98	1471	91.82	12.27
48.7	1.5056	99	1491	93.05	12.44
49.2	1.5129	100	1513	94.45	12.63

NITRIC ACID

Authority — W. C. Ferguson

This table has been approved and adopted as a Standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

At 10°–20° Bé. — 1/30° Bé. or .00029 Sp. Gr. = 1° F.
20°–30° Bé. — 1/23° Bé. or .00044 " " = 1° F.
30°–40° Bé. — 1/20° Bé. or .00060 " " = 1° F.
40°–48.5° Bé. — 1/17° Bé. or .00084 " " = 1° F.

Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.	Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.
10.00	1.0741	14.82	12.86	15.25	1.1176	23.52	19.70
10.25	1.0761	15.22	13.18	15.50	1.1197	23.94	20.02
10.50	1.0781	15.62	13.49	15.75	1.1219	24.38	20.36
10.75	1.0801	16.02	13.81	16.00	1.1240	24.80	20.69
11.00	1.0821	16.42	14.13	16.25	1.1262	25.24	21.03
11.25	1.0841	16.82	14.44	16.50	1.1284	25.68	21.36
11.50	1.0861	17.22	14.76	16.75	1.1306	26.12	21.70
11.75	1.0881	17.62	15.07	17.00	1.1328	26.56	22.04
12.00	1.0902	18.04	15.41	17.25	1.1350	27.00	22.38
12.25	1.0922	18.44	15.72	17.50	1.1373	27.46	22.74
12.50	1.0943	18.86	16.05	17.75	1.1395	27.90	23.08
12.75	1.0964	19.28	16.39	18.00	1.1417	28.34	23.42
13.00	1.0985	19.70	16.72	18.25	1.1440	28.80	23.77
13.25	1.1006	20.12	17.05	18.50	1.1462	29.24	24.11
13.50	1.1027	20.54	17.38	18.75	1.1485	29.70	24.47
13.75	1.1048	20.96	17.71	19.00	1.1508	30.16	24.82
14.00	1.1069	21.38	18.04	19.25	1.1531	30.62	25.18
14.25	1.1090	21.80	18.37	19.50	1.1554	31.08	25.53
14.50	1.1111	22.22	18.70	19.75	1.1577	31.54	25.88
14.75	1.1132	22.64	19.02	20.00	1.1600	32.00	26.24
15.00	1.1154	23.08	19.36	20.25	1.1624	32.48	26.61

NITRIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.	Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.
20.50	1.1647	32.94	26.96	31.50	1.2775	55.50	43.89
20.75	1.1671	33.42	27.33	31.75	1.2804	56.08	44.34
21.00	1.1694	33.88	27.67	32.00	1.2832	56.64	44.78
21.25	1.1718	34.36	28.02	32.25	1.2861	57.22	45.24
21.50	1.1741	34.82	28.36	32.50	1.2889	57.78	45.68
21.75	1.1765	35.30	28.72	32.75	1.2918	58.36	46.14
22.00	1.1789	35.78	29.07	33.00	1.2946	58.92	46.58
22.25	1.1813	36.26	29.43	33.25	1.2975	59.50	47.04
22.50	1.1837	36.74	29.78	33.50	1.3004	60.08	47.49
22.75	1.1861	37.22	30.14	33.75	1.3034	60.68	47.95
23.00	1.1885	37.70	30.49	34.00	1.3063	61.26	48.42
23.25	1.1910	38.20	30.86	34.25	1.3093	61.86	48.90
23.50	1.1934	38.68	31.21	34.50	1.3122	62.44	49.35
23.75	1.1959	39.18	31.58	34.75	1.3152	63.04	49.83
24.00	1.1983	39.66	31.94	35.00	1.3182	63.64	50.32
24.25	1.2008	40.16	32.31	35.25	1.3212	64.24	50.81
24.50	1.2033	40.66	32.68	35.50	1.3242	64.84	51.30
24.75	1.2058	41.16	33.05	35.75	1.3273	65.46	51.80
25.00	1.2083	41.66	33.42	36.00	1.3303	66.06	52.30
25.25	1.2109	42.18	33.80	36.25	1.3334	66.68	52.81
25.50	1.2134	42.68	34.17	36.50	1.3364	67.28	53.32
25.75	1.2160	43.20	34.56	36.75	1.3395	67.90	53.84
26.00	1.2185	43.70	34.94	37.00	1.3426	68.52	54.36
26.25	1.2211	44.22	35.33	37.25	1.3457	69.14	54.89
26.50	1.2236	44.72	35.70	37.50	1.3488	69.76	55.43
26.75	1.2262	45.24	36.09	37.75	1.3520	70.40	55.97
27.00	1.2288	45.76	36.48	38.00	1.3551	71.02	56.52
27.25	1.2314	46.28	36.87	38.25	1.3583	71.66	57.08
27.50	1.2340	46.80	37.26	38.50	1.3615	72.30	57.65
27.75	1.2367	47.34	37.67	38.75	1.3647	72.94	58.23
28.00	1.2393	47.86	38.06	39.00	1.3679	73.58	58.82
28.25	1.2420	48.40	38.46	39.25	1.3712	74.24	59.43
28.50	1.2446	48.92	38.85	39.50	1.3744	74.88	60.06
28.75	1.2473	49.46	39.25	39.75	1.3777	75.54	60.71
29.00	1.2500	50.00	39.66	40.00	1.3810	76.20	61.38
29.25	1.2527	50.54	40.06	40.25	1.3843	76.86	62.07
29.50	1.2554	51.08	40.47	40.50	1.3876	77.52	62.77
29.75	1.2582	51.64	40.89	40.75	1.3909	78.18	63.48
30.00	1.2609	52.18	41.30	41.00	1.3942	78.84	64.20
30.25	1.2637	52.74	41.72	41.25	1.3976	79.52	64.93
30.50	1.2664	53.28	42.14	41.50	1.4010	80.20	65.67
30.75	1.2692	53.84	42.58	41.75	1.4044	80.88	66.42
31.00	1.2719	54.38	43.0[illegible]	42.00	1.4078	81.96	67.18
31.25	1.2747	54.94	43.44	42.25	1.4112	82.24	67.95

NITRIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.	Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.
42.50	1.4146	82.92	68.73	45.50	1.4573	91.46	79.03
42.75	1.4181	83.62	69.52	45.75	1.4610	92.20	80.04
43.00	1.4216	84.32	70.33	46.00	1.4646	92.92	81.08
43.25	1.4251	85.02	71.15	46.25	1.4684	93.68	82.18
43.50	1.4286	85.72	71.98	46.50	1.4721	94.42	83.33
43.75	1.4321	86.42	72.82	46.75	1.4758	95.16	84.48
44.00	1.4356	87.12	73.67	47.00	1.4796	95.92	85.70
44.25	1.4392	87.84	74.53	47.25	1.4834	96.68	86.98
44.50	1.4428	88.56	75.40	47.50	1.4872	97.44	88.32
44.75	1.4464	89.28	76.28	47.75	1.4910	98.20	89.76
45.00	1.4500	90.00	77.17	48.00	1.4948	98.96	91.35
45.25	1.4536	90.72	78.07	48.25	1.4987	99.74	93.13
				48.50	1.5026	100.52	95.11

OXALIC ACID

Specific Gravity of Aqueous Oxalic Acid Solutions at 17.5° C. (Gerlach)

Bé.	Sp. gr.	Per cent $H_2C_2O_4 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0035	1	10.04	0.6265	0.0837
1.0	1.0070	2	20.14	1.257	0.1681
1.5	1.0105	3	30.32	1.892	0.2530
2.0	1.0140	4	40.56	2.532	0.3385
2.5	1.0175	5	50.88	3.176	0.4246
3.0	1.0210	6	61.26	3.824	0.5112
3.5	1.0245	7	71.72	4.477	0.5985
4.0	1.0280	8	82.24	5.134	0.6863
4.4	1.0315	9	92.84	5.795	0.7747
4.9	1.0350	10	103.5	6.461	0.8637
5.4	1.0385	11	114.2	7.131	0.9533
5.8	1.0420	12	125.0	7.806	1.043
6.3	1.0455	13	135.9	8.485	1.134

Bé.	Sp. gr.	Per cent $H_2C_2O_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0035	0.71	7.166	0.4474	[illegible]
1.0	1.0070	1.43	14.38	0.8979	[illegible]
1.5	1.0105	2.14	21.65	1.351	[illegible]
2.0	1.0140	2.86	28.97	1.808	[illegible]
2.5	1.0175	3.57	36.33	2.268	[illegible]
3.0	1.0210	4.28	43.75	2.731	[illegible]
3.5	1.0245	5.00	51.21	3.197	[illegible]
4.0	1.0280	5.71	58.73	3.666	[illegible]
4.4	1.0315	6.43	66.30	4.139	[illegible]
4.9	1.0350	7.14	73.91	4.614	[illegible]
5.4	1.0385	7.86	81.58	5.093	[illegible]
5.8	1.0420	8.57	89.30	5.574	[illegible]
6.3	1.0455	9.28	97.06	6.059	[illegible]

PERCHLORIC ACID

Specific Gravity of Aqueous Perchloric Acid Solutions at $\frac{15°}{4°}$ C.*

Sp. gr.	Per cent $HClO_4$	G. per liter	Lbs. per cu. ft.	Lbs per gal.
1.005	1	10.08	.6274	.0830
1.011	2	20.22	1.262	.1687
1.023	4	40.91	2.554	.3414
1.035	6	62.09	3.876	.5181
1.047	8	83.77	5.229	.6991
1.060	10	106.0	6.615	.8843
1.073	12	128.7	8.035	1.074
1.086	14	152.0	9.490	1.268
1.100	16	175.9	10.98	1.468
1.114	18	200.4	12.51	1.673
1.128	20	225.6	14.08	1.882
1.143	22	251.4	15.69	2.098
1.158	24	277.9	17.35	2.319
1.174	26	305.2	19.06	2.547
1.190	28	333.2	20.80	2.781
1.207	30	362.0	22.60	3.021
1.224	32	391.6	24.45	3.268
1.242	34	422.2	26.36	3.523
1.260	36	453.7	28.32	3.786
1.279	38	486.2	30.35	4.057
1.298	40	519.6	32.44	4.336
1.352	45	608.4	37.98	5.078
1.410	50	705.2	44.02	5.885
1.473	55	810.2	50.58	6.762
1.538	60	922.8	57.61	7.706
1.606	65	1044	65.18	8.711
1.674	70	1172	73.17	9.777

Specific Gravity of 65 to 75% Solution at $\frac{25°}{4°}$ C.

Based on values reported by G. Frederick Smith and O. E. Goehler, Ind. and Eng. Chem. 3, 61, 1931

1.597	65.0	1038	64.79	8.661
1.603	65.5	1050	65.56	8.764
1.610	66.0	1063	66.34	8.868
1.617	66.5	1075	67.12	8.973
1.624	67.0	1088	67.91	9.078
1.630	67.5	1100	68.70	9.184
1.637	68.0	1113	69.50	9.290
1.644	68.5	1126	70.30	9.397
1.651	69.0	1139	71.10	9.504
1.657	69.5	1152	71.91	9.613
1.664	70.0	1165	72.72	9.722
1.671	70.5	1178	73.54	9.831
1.678	71.0	1191	74.36	9.940
1.684	71.5	1204	75.18	10.05
1.691	72.0	1218	76.01	10.16
1.698	72.5	1231	76.84	10.27
1.704	73.0	1244	77.68	10.38
1.711	73.5	1258	78.52	10.50
1.718	74.0	1271	79.36	10.61
1.725	74.5	1285	80.21	10.72
1.731	75.0	1298	81.06	10.84

PHOSPHORIC ACID

Specific Gravity of Aqueous Phosphoric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_3PO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0038	1	10.04	0.6266	0.0838
1.3	1.0092	2	20.18	1.260	0.1684
2.8	1.0200	4	40.80	2.547	0.3405
4.3	1.0309	6	61.85	3.861	0.5162
5.8	1.0420	8	83.36	5.204	0.6957
7.3	1.0532	10	105.3	6.575	0.8789
8.8	1.0647	12	127.8	7.976	1.066
10.3	1.0764	14	150.7	9.408	1.258
11.8	1.0884	16	174.1	10.87	1.453
13.3	1.1008	18	198.1	12.37	1.654
14.8	1.1134	20	222.7	13.90	1.858
16.3	1.1263	22	247.8	15.47	2.068
17.8	1.1395	24	273.5	17.07	2.282
19.2	1.1529	26	299.8	18.71	2.501
20.7	1.1665	28	326.6	20.39	2.726
22.2	1.1805	30	354.2	22.11	2.955
25.8	1.216	35	425.6	26.57	3.552
29.4	1.254	40	501.6	31.31	4.186
32.9	1.293	45	581.9	36.32	4.856
36.4	1.335	50	667.5	41.67	5.570
39.9	1.379	55	758.5	47.35	6.329
43.3	1.426	60	855.6	53.41	7.140
46.7	1.475	65	958.8	59.85	8.001
50.0	1.526	70	1068	66.68	8.914
53.2	1.579	75	1184	73.93	9.883
56.2	1.633	80	1306	81.55	10.90
59.2	1.689	85	1436	89.62	11.98
62.0	1.746	90	1571	98.10	13.11
63.1	1.770	92	1628	101.7	13.59
64.2	1.794	94	1686	105.3	14.07
65.3	1.819	96	1746	109.0	14.57
66.4	1.844	98	1807	112.8	15.08
67.5	1.870	100	1870	116.7	15.61

PHOSPHORIC ACID

Specific Gravity of Aqueous Phosphoric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent P_2O_5	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0038	0.72	7.271	0.4539	0.0607
1.3	1.0092	1.4	14.62	0.9128	0.1220
2.8	1.0200	2.9	29.56	1.845	0.2466
4.3	1.0309	4.3	44.81	2.797	0.3739
5.8	1.0420	5.8	60.39	3.770	0.5039
7.3	1.0532	7.2	76.29	4.763	0.6367
8.8	1.0647	8.7	92.55	5.778	0.7724
10.3	1.0764	10.1	109.2	6.815	0.9110
11.8	1.0884	11.6	126.1	7.875	1.053
13.3	1.1008	13.0	143.5	8.960	1.198
14.8	1.1134	14.5	161.3	10.07	1.346
16.3	1.1263	15.9	179.5	11.21	1.498
17.8	1.1395	17.4	198.1	12.37	1.653
19.2	1.1529	18.8	217.1	13.56	1.812
20.7	1.1665	20.3	236.6	14.77	1.975
22.2	1.1805	21.7	256.5	16.02	2.141
25.8	1.216	25.4	308.3	19.25	2.573
29.4	1.254	29.0	363.4	22.68	3.032
32.9	1.293	32.6	421.5	26.31	3.517
36.4	1.335	36.2	483.5	30.19	4.035
39.9	1.379	39.8	549.4	34.30	4.585
43.3	1.426	43.5	619.8	38.69	5.172
46.7	1.475	47.1	694.5	43.36	5.796
50.0	1.526	50.7	773.8	48.31	6.458
53.2	1.579	54.3	857.9	53.55	7.159
56.2	1.633	58.0	946.4	59.08	7.898
59.2	1.689	61.6	1040	64.92	8.679
62.0	1.746	65.2	1138	71.06	9.500
63.1	1.770	66.6	1180	73.64	9.844
64.2	1.794	68.1	1222	76.26	10.19
65.3	1.819	69.5	1265	78.97	10.56
66.4	1.844	71.0	1309	81.72	10.92
67.5	1.870	72.4	1355	84.57	11.30

POTASSIUM BROMIDE

Specific Gravity of Aqueous Potassium Bromide Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KBr	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0054	1	10.05	0.6276	0.0839
1.8	1.0127	2	20.25	1.264	0.1690
3.9	1.0275	4	41.10	2.566	0.3430
5.9	1.0426	6	62.56	3.905	0.5220
8.0	1.0581	8	84.65	5.284	0.7064
10.0	1.0740	10	107.4	6.705	0.8963
12.0	1.0903	12	130.8	8.168	1.092
14.0	1.1070	14	155.0	9.675	1.293
16.0	1.1242	16	179.9	11.23	1.501
18.0	1.1419	18	205.5	12.83	1.715
20.0	1.1601	20	232.0	14.48	1.936
22.0	1.1788	22	259.3	16.19	2.164
24.0	1.1980	24	287.5	17.95	2.399
25.9	1.2178	26	316.6	19.77	2.642
27.9	1.2383	28	346.7	21.64	2.893
29.9	1.2593	30	377.8	23.58	3.153
34.7	1.3147	35	460.1	28.73	3.840
39.5	1.3746	40	549.8	34.32	4.589

POTASSIUM CARBONATE

Specific Gravity of Aqueous Potassium Carbonate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2CO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0072	1	10.07	0.6288	0.0841
2.3	1.0163	2	20.33	1.269	0.1696
4.8	1.0345	4	41.38	2.583	0.3453
7.3	1.0529	6	63.17	3.944	0.5272
9.7	1.0715	8	85.72	5.351	0.7154
12.0	1.0904	10	109.0	6.807	0.9100
14.3	1.1096	12	133.2	8.312	1.111
16.6	1.1291	14	158.1	9.868	1.319
18.8	1.1490	16	183.8	11.48	1.534
21.0	1.1692	18	210.5	13.14	1.756

POTASSIUM CARBONATE (Continued)

Specific Gravity of Aqueous Potassium Carbonate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2CO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.1	1.1898	20	238.0	14.86	1.986
25.2	1.2107	22	266.4	16.63	2.223
27.3	1.2320	24	295.7	18.46	2.468
29.3	1.2536	26	325.9	20.35	2.720
31.3	1.2756	28	357.2	22.30	2.981
33.3	1.2979	30	389.4	24.31	3.249
38.0	1.3548	35	474.2	29.60	3.957
42.5	1.4141	40	565.6	35.31	4.720
46.8	1.4759	45	664.2	41.46	5.543
50.9	1.5404	50	770.2	48.08	6.427

POTASSIUM CHLORIDE

Specific Gravity of Aqueous Potassium Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0046	1	10.05	0.6271	0.0838
1.6	1.0110	2	20.22	1.262	0.1687
3.4	1.0239	4	40.96	2.557	0.3418
5.2	1.0369	6	62.21	3.884	0.5192
6.9	1.0500	8	84.00	5.244	0.7010
8.6	1.0633	10	106.3	6.638	0.8874
10.3	1.0768	12	129.2	8.067	1.078
12.0	1.0905	14	152.7	9.531	1.274
13.7	1.1043	16	176.7	11.03	1.475
15.4	1.1185	18	201.3	12.57	1.680
17.0	1.1328	20	226.6	14.14	1.891
18.6	1.1474	22	252.4	15.76	2.107
20.2	1.1623	24	279.0	17.41	2.328

POTASSIUM CHROME ALUM

Specific Gravity of Aqueous Potassium Chrome Alum Solutions at $\frac{15^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $K_2Cr_2(SO_4)_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.8	1.034	4	41.36	2.582	0.3452
7.2	1.052	6	63.12	3.940	0.5267
9.5	1.070	8	85.60	5.344	0.7143
11.9	1.089	10	108.9	6.798	0.9088
14.3	1.109	12	133.1	8.308	1.111
16.6	1.129	14	158.1	9.867	1.319
18.9	1.150	16	184.0	11.49	1.536
21.2	1.171	18	210.8	13.16	1.759
23.5	1.193	20	238.6	14.90	1.991
25.8	1.216	22	267.5	16.70	2.233
28.0	1.239	24	297.4	18.56	2.482
30.2	1.263	26	328.4	20.50	2.740
32.5	1.289	28	360.9	22.53	3.012
34.7	1.315	30	394.5	24.63	3.292
40.2	1.383	35	484.1	30.22	4.040
45.4	1.456	40	582.4	36.36	4.860
50.4	1.533	45	689.9	43.07	5.757
55.2	1.615	50	807.5	50.41	6.739

Bé.	Sp. gr.	Per cent $K_2Cr_2(SO_4)_4 + 24H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1.763	17.76	1.108	0.1481
2.3	1.016	3.527	35.83	2.237	0.2991
4.8	1.034	7.053	72.93	4.553	0.6087
7.2	1.052	10.58	111.30	6.948	0.9287
9.5	1.070	14.11	150.9	9.423	1.260
11.9	1.089	17.63	192.0	11.99	1.603
14.3	1.109	21.16	234.7	14.65	1.958
16.6	1.129	24.69	278.7	17.40	2.326
18.9	1.150	28.21	324.4	20.25	2.708
21.2	1.171	31.74	371.7	23.20	3.102
23.5	1.193	35.27	420.7	26.26	3.511
25.8	1.216	38.79	471.7	29.45	3.937
28.0	1.239	42.32	524.3	32.73	4.376
30.2	1.263	45.85	579.0	36.15	4.832
32.5	1.289	49.37	636.4	39.73	5.311
34.7	1.315	52.90	695.3	43.43	5.805
40.2	1.383	61.72	853.5	53.28	7.123
45.4	1.456	70.53	1026.9	64.11	8.570
50.4	1.533	79.35	1216.4	75.94	10.15
55.2	1.615	88.17	1423.9	88.89	11.88

POTASSIUM CHROMATE

Specific Gravity of Aqueous Potassium Chromate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0066	1	10.07	0.6284	0.0840
2.1	1.0147	2	20.29	1.267	0.1694
4.4	1.0311	4	41.24	2.575	0.3442
6.6	1.0477	6	62.86	3.924	0.5246
8.8	1.0647	8	85.18	5.317	0.7108
11.0	1.0821	10	108.2	6.755	0.9030
13.2	1.0999	12	132.0	8.240	1.101
15.3	1.1181	14	156.5	9.772	1.306
17.4	1.1366	16	181.9	11.35	1.518
19.5	1.1555	18	208.0	12.98	1.736
21.6	1.1748	20	235.0	14.67	1.961
23.6	1.1945	22	262.8	16.41	2.193
25.6	1.2147	24	291.5	18.20	2.433
27.6	1.2354	26	321.2	20.05	2.681
29.6	1.2566	28	351.8	21.96	2.936
31.6	1.2784	30	383.5	23.94	3.201

Specific Gravity of Potassium Chromate Solutions at 19.5° C. (Schiff)

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0080	1	10.08	0.6293	0.0841
2.3	1.0161	2	20.32	1.269	0.1696
3.4	1.0243	3	30.73	1.918	0.2564
4.6	1.0325	4	41.30	2.578	0.3447
5.7	1.0408	5	52.04	3.249	0.4343
6.8	1.0492	6	62.95	3.930	0.5254
7.9	1.0576	7	74.03	4.622	0.6178
9.0	1.0663	8	85.30	5.325	0.7119
10.1	1.0750	9	96.75	6.040	0.8074
11.2	1.0837	10	108.4	6.765	0.9044
12.3	1.0925	11	120.2	7.502	1.003
13.4	1.1014	12	132.2	8.251	1.103
14.4	1.1104	13	144.4	9.011	1.205
15.5	1.1195	14	156.7	9.784	1.308

POTASSIUM CHROMATE (Continued)

Specific Gravity of Potassium Chromate Solutions at 19.5° C. (Schiff)

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
16.5	1.1287	15	169.3	10.57	1.413
17.6	1.1380	16	182.1	11.37	1.519
18.6	1.1474	17	195.1	12.18	1.628
19.7	1.1570	18	208.3	13.00	1.738
20.7	1.1667	19	221.7	13.84	1.850
21.8	1.1765	20	235.3	14.69	1.964
22.8	1.1864	21	249.1	15.55	2.079
23.8	1.1964	22	263.2	16.43	2.197
24.8	1.2066	23	277.5	17.32	2.316
25.8	1.2169	24	292.1	18.23	2.437
26.9	1.2274	25	306.9	19.16	2.561
27.9	1.2379	26	321.9	20.09	2.686
28.9	1.2485	27	337.1	21.04	2.813
29.8	1.2592	28	352.6	22.01	2.942
30.8	1.2700	29	368.3	22.99	3.074
31.8	1.2808	30	384.2	23.99	3.207
32.8	1.2921	31	400.6	25.01	3.343
33.8	1.3035	32	417.1	26.04	3.481
34.7	1.3151	33	434.0	27.09	3.622
35.7	1.3268	34	451.1	28.16	3.765
36.7	1.3386	35	468.5	29.25	3.910
37.6	1.3505	36	486.2	30.35	4.057
38.6	1.3625	37	504.1	31.47	4.207
39.5	1.3746	38	522.3	32.61	4.359
40.4	1.3868	39	540.9	33.76	4.514
41.4	1.3991	40	559.6	34.94	4.670

POTASSIUM DICHROMATE

Specific Gravity of Aqueous Potassium Dichromate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $K_2Cr_2O_7$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.7	1.0122	2	20.24	1.264	0.1689
3.7	1.0264	4	41.06	2.563	0.3426
5.7	1.0408	6	62.45	3.898	0.5211
7.6	1.0554	8	84.43	5.271	0.7046
9.5	1.0703	10	107.0	6.682	0.8932

POTASSIUM HYDROXIDE

Specific Gravity of Aqueous Potassium Hydroxide Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KOH	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	1	10.08	0.6295	0.0841
2.5	1.0175	2	20.35	1.270	0.1698
3.8	1.0267	3	30.80	1.923	0.2570
5.0	1.0359	4	41.44	2.587	0.3458
6.3	1.0452	5	52.26	3.262	0.4361
7.5	1.0544	6	63.26	3.949	0.5280
8.7	1.0637	7	74.46	4.648	0.6214
9.9	1.0730	8	85.84	5.359	0.7164
11.0	1.0824	9	97.42	6.081	0.8130
12.2	1.0918	10	109.2	6.816	0.9111
13.3	1.1013	11	121.1	7.563	1.011
14.5	1.1108	12	133.3	8.321	1.112
15.6	1.1203	13	145.6	9.092	1.215
16.7	1.1299	14	158.2	9.875	1.320
17.8	1.1396	15	170.9	10.67	1.427
18.8	1.1493	16	183.9	11.48	1.535
19.9	1.1590	17	197.0	12.30	1.644
20.9	1.1688	18	210.4	13.13	1.756
22.0	1.1786	19	223.9	13.98	1.869
23.0	1.1884	20	237.7	14.84	1.983
24.0	1.1984	21	251.7	15.71	2.100
25.0	1.2083	22	265.8	16.59	2.218
26.0	1.2184	23	280.2	17.49	2.339
27.0	1.2285	24	294.8	18.41	2.461
27.9	1.2387	25	309.7	19.33	2.584
28.9	1.2489	26	324.7	20.27	2.710
29.8	1.2592	27	340.0	21.22	2.837
30.8	1.2695	28	355.5	22.19	2.966
31.7	1.2800	29	371.2	23.17	3.098
32.6	1.2905	30	387.2	24.17	3.231
33.6	1.3010	31	403.3	25.18	3.366
34.5	1.3117	32	419.7	26.20	3.503
35.4	1.3224	33	436.4	27.24	3.642
36.2	1.3331	34	453.3	28.30	3.783
37.1	1.3440	35	470.4	29.37	3.926
38.0	1.3549	36	487.8	30.45	4.070
38.8	1.3659	37	505.4	31.55	4.218
39.7	1.3769	38	523.2	32.66	4.366
40.5	1.3879	39	541.3	33.79	4.517
41.4	1.3991	40	559.6	34.94	4.670
42.2	1.4103	41	578.2	36.10	4.825
43.0	1.4215	42	597.0	37.27	4.982
43.8	1.4329	43	616.1	38.46	5.142
44.6	1.4443	44	635.5	39.67	5.303
45.4	1.4558	45	655.1	40.90	5.467
46.2	1.4673	46	675.0	42.14	5.633
47.0	1.4790	47	695.1	43.39	5.801
47.7	1.4907	48	715.5	44.67	5.971
48.5	1.5025	49	736.2	45.96	6.144
49.2	1.5143	50	757.2	47.27	6.319
50.0	1.5262	51	778.4	48.59	6.496
50.7	1.5382	52	799.9	49.93	6.675

POTASSIUM IODIDE

Specific Gravity of Aqueous Potassium Iodide Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KI	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0055	1	10.06	0.6277	0.0839
1.9	1.0130	2	20.26	1.265	0.1691
4.0	1.0281	4	41.12	2.567	0.3432
6.1	1.0437	6	62.62	3.909	0.5226
8.2	1.0597	8	84.78	5.292	0.7075
10.3	1.0761	10	107.6	6.718	0.8980
12.3	1.0930	12	131.2	8.188	1.095
14.4	1.1104	14	155.5	9.705	1.297
16.5	1.1284	16	180.5	11.27	1.507
18.6	1.1469	18	206.4	12.89	1.723
20.6	1.1660	20	233.2	14.56	1.946
23.7	1.1857	22	260.9	16.28	2.177
24.8	1.2060	24	289.4	18.07	2.415
26.8	1.2270	26	319.0	19.92	2.662
28.9	1.2487	28	349.6	21.83	2.918
30.9	1.2712	30	381.4	23.81	3.183
36.0	1.3308	35	465.8	29.08	3.887
41.1	1.3959	40	558.4	34.86	4.660
46.2	1.4672	45	660.2	41.22	5.510
51.2	1.5458	50	772.9	48.25	6.450
56.2	1.6327	55	898.0	56.06	7.494

POTASSIUM NITRATE

Specific Gravity of Aqueous Potassium Nitrate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0045	1	10.05	0.6271	0.0838
1.5	1.0108	2	20.22	1.262	0.1687
3.3	1.0234	4	40.94	2.556	0.3416
5.1	1.0363	6	62.18	3.882	0.5189
6.8	1.0494	8	83.95	5.241	0.7006
8.6	1.0627	10	106.3	6.634	0.8868
10.3	1.0762	12	129.1	8.062	1.078
12.0	1.0899	14	152.6	9.525	1.273
13.7	1.1039	16	176.6	11.03	1.474
15.3	1.1181	18	201.3	12.56	1.680
17.0	1.1326	20	226.5	14.14	1.890
18.6	1.1473	22	252.4	15.76	2.106
20.2	1.1623	24	279.0	17.41	2.328

POTASSIUM SULFATE

Specific Gravity of Aqueous Potassium Sulfate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	1	10.06	0.6282	0.0840
2.1	1.0145	2	20.29	1.267	0.1693
4.4	1.0310	4	41.24	2.574	0.3442
6.6	1.0477	6	62.86	3.924	0.5246
8.8	1.0646	8	85.17	5.317	0.7107
11.0	1.0817	10	108.17	6.753	0.9027

POTASSIUM TARTRATE

Specific Gravity of Aqueous Potassium Tartrate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $K_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0048	1	10.05	0.6273	0.0839
1.6	1.0114	2	20.23	1.263	0.1688
3.5	1.0248	4	40.99	2.559	0.3421
5.4	1.0383	6	62.30	3.889	0.5199
7.2	1.0519	8	84.15	5.253	0.7023
8.9	1.0657	10	106.6	6.653	0.8894
10.7	1.0798	12	129.6	8.089	1.081
12.5	1.0941	14	153.2	9.562	1.278
14.2	1.1087	16	177.4	11.07	1.480
16.0	1.1236	18	202.3	12.63	1.688
17.7	1.1387	20	227.7	14.22	1.901
19.4	1.1540	22	253.9	15.85	2.119
21.0	1.1696	24	280.7	17.52	2.343
22.7	1.1855	26	308.2	19.24	2.572
24.3	1.2017	28	336.5	21.01	2.808
26.0	1.2181	30	365.4	22.81	3.050
30.0	1.2606	35	441.2	27.54	3.682
33.9	1.3051	40	522.0	32.59	4.357
37.7	1.3516	45	608.2	37.97	5.076
41.4	1.4001	50	700.1	43.70	5.842

Bé.	Sp. gr.	Per cent $K_2C_4H_4O_6 + \frac{1}{2}H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0048	1.040	10.45	0.6522	0.0872
1.6	1.0114	2.080	21.03	1.313	0.1755
3.5	1.0248	4.159	42.62	2.661	0.3557
5.4	1.0383	6.239	64.78	4.044	0.5406
7.2	1.0519	8.319	87.50	5.462	0.7302
8.9	1.0657	10.40	110.8	6.918	0.9247
10.7	1.0798	12.48	134.7	8.411	1.124
12.5	1.0941	14.56	159.3	9.943	1.329
14.2	1.1087	16.64	184.5	11.52	1.539
16.0	1.1236	18.72	210.3	13.13	1.755
17.7	1.1387	20.80	236.8	14.78	1.976
19.4	1.1540	22.88	264.0	16.48	2.203
21.0	1.1696	24.96	291.9	18.22	2.436
22.7	1.1855	27.03	320.5	20.01	2.675
24.3	1.2017	29.12	349.9	21.84	2.920
26.0	1.2181	31.19	380.0	23.72	3.171
30.0	1.2606	36.39	458.8	28.64	3.829
33.9	1.3051	41.59	542.8	33.89	4.530
37.7	1.3516	46.79	632.4	39.48	5.278
41.4	1.4001	51.99	727.9	45.44	6.075

SODIUM ARSENATE

Specific Gravity of Aqueous Di-sodium Arsenate Solutions at $\frac{14°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2HAsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	1	10.08	0.6295	0.0841
2.5	1.0175	2	20.35	1.270	0.1698
5.1	1.0365	4	41.46	2.588	0.3460
7.7	1.0563	6	63.38	3.957	0.5289
10.3	1.0768	8	86.14	5.378	0.7189
12.9	1.0980	10	109.8	6.854	0.9163
15.5	1.1197	12	134.4	8.388	1.121
18.0	1.1419	14	159.9	9.980	1.334
20.5	1.1645	16	186.3	11.63	1.555

Bé.	Sp. gr.	Per cent Na_2HAsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	2.163	21.80	1.361	0.1819
2.5	1.0175	4.325	44.01	2.747	0.3672
5.1	1.0365	8.650	89.66	5.597	0.7482
7.7	1.0563	12.98	137.1	8.556	1.144
10.3	1.0768	17.30	186.3	11.63	1.555
12.9	1.0980	21.63	237.4	14.82	1.982
15.5	1.1197	25.95	290.6	18.14	2.425
18.0	1.1419	30.28	345.7	21.58	2.885
20.5	1.1645	34.60	402.9	25.15	3.363

SODIUM ARSENATE

Specific Gravity of Aqueous Di-sodium Arsenate Solutions at 14° C. (Schiff)

Bé.	Sp. gr.	Per cent $Na_2HAsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0042	1	10.04	0.6269	0.0838
1.2	1.0084	2	20.17	1.259	0.1683
1.8	1.0126	3	30.38	1.896	0.2535
2.4	1.0168	4	40.67	2.539	0.3394
3.0	1.0212	5	51.06	3.188	0.4261
3.6	1.0256	6	61.54	3.842	0.5135
4.2	1.0300	7	72.10	4.501	0.6017
4.8	1.0344	8	82.75	5.166	0.6906
5.4	1.0389	9	93.50	5.837	0.7803
6.0	1.0434	10	104.3	6.514	0.8707
6.6	1.0479	11	115.3	7.196	0.9619
7.2	1.0525	12	126.3	7.885	1.054
7.8	1.0571	13	137.4	8.579	1.147
8.4	1.0618	14	148.7	9.280	1.241
9.0	1.0665	15	160.0	9.987	1.335
9.6	1.0712	16	171.4	10.70	1.430
10.2	1.0759	17	182.9	11.42	1.526
10.8	1.0807	18	194.5	12.14	1.623
11.4	1.0855	19	206.2	12.88	1.721
12.0	1.0904	20	218.1	13.61	1.820
12.6	1.0953	21	230.0	14.36	1.920
13.2	1.1002	22	242.0	15.11	2.020
13.8	1.1052	23	254.2	15.87	2.121
14.4	1.1102	24	266.4	16.63	2.224
15.0	1.1153	25	278.8	17.41	2.327
15.6	1.1204	26	291.3	18.19	2.431
16.2	1.1255	27	303.9	18.97	2.536
16.8	1.1306	28	316.6	19.76	2.642
17.3	1.1358	29	329.4	20.56	2.749
17.9	1.1410	30	342.3	21.37	2.857
18.5	1.1463	31	355.4	22.18	2.965
19.1	1.1516	32	368.5	23.01	3.075
19.7	1.1569	33	381.8	23.83	3.186
20.2	1.1623	34	395.2	24.67	3.298
20.8	1.1677	35	408.7	25.51	3.411
21.4	1.1731	36	422.3	26.36	3.524
22.0	1.1786	37	436.1	27.22	3.639
22.5	1.1838	38	449.1	28.03	3.748
23.1	1.1896	39	464.0	28.96	3.872
23.7	1.1952	40	478.1	29.85	3.990

SODIUM ARSENATE

Specific Gravity of Aqueous Tri-sodium Arsenate Solutions at $\frac{17°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_3AsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0097	1	10.10	0.6303	0.0843
2.9	1.0207	2	20.41	1.274	0.1704
6.0	1.0431	4	41.72	2.605	0.3482
9.0	1.0659	6	63.95	3.992	0.5337
11.9	1.0892	8	87.14	5.440	0.7272
14.7	1.1130	10	111.3	6.948	0.9288
17.5	1.1373	12	136.5	8.520	1.1389

Bé.	Sp. gr.	Per cent Na_3AsO_4 $+12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0097	2.040	20.59	1.286	0.1719
2.9	1.0207	4.079	41.64	2.599	0.3475
6.0	1.0431	8.158	85.10	5.313	0.7102
9.0	1.0659	12.237	130.4	8.143	1.089
11.9	1.0892	16.317	177.7	11.09	1.483
14.7	1.1130	20.396	227.0	14.17	1.894
17.5	1.1373	24.4752	278.4	17.38	2.323

Specific Gravity of Aqueous Tri-sodium Arsenate Solutions at 17° C. (Schiff)

Bé.	Sp. gr.	Per cent Na_3AsO_4 $+12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0053	1	10.05	0.6276	0.0839
1.5	1.0107	2	20.21	1.262	0.1687
2.3	1.0161	3	30.48	1.903	0.2544
3.1	1.0215	4	40.86	2.551	0.3410
3.8	1.0270	5	51.35	3.206	0.4285
4.6	1.0325	6	61.95	3.867	0.5170
5.3	1.0380	7	72.66	4.536	0.6064

SODIUM ARSENATE (Continued)

Specific Gravity of Aqueous Tri-sodium Arsenate Solutions at 17° C. (Schiff)

Bé.	Sp. gr.	Per cent $Na_3AsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
6.0	1.0435	8	83.48	5.211	0.6967
6.8	1.0491	9	94.42	5.894	0.7880
7.5	1.0547	10	105.5	6.584	0.8802
8.3	1.0603	11	116.6	7.281	0.9733
9.0	1.0659	12	127.9	7.985	1.067
9.7	1.0716	13	139.3	8.697	1.163
10.4	1.0773	14	150.8	9.415	1.259
11.1	1.0830	15	162.5	10.14	1.356
11.8	1.0887	16	174.2	10.87	1.454
12.5	1.0945	17	186.1	11.62	1.553
13.2	1.1003	18	198.1	12.36	1.653
13.9	1.1061	19	210.2	13.12	1.754
14.6	1.1120	20	222.4	13.88	1.856
15.3	1.1179	21	234.8	14.66	1.959
16.0	1.1238	22	247.2	15.43	2.063

SODIUM BROMIDE

Specific Gravity of Aqueous Sodium Bromide Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NaBr	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0060	1	10.06	0.6280	0.0840
2.0	1.0139	2	20.28	1.266	0.1692
4.2	1.0298	4	41.19	2.571	0.3438
6.4	1.0462	6	62.77	3.919	0.5238
8.6	1.0631	8	85.05	5.309	0.7097
10.8	1.0803	10	108.0	6.744	0.9015
13.0	1.0981	12	131.8	8.226	1.100
15.1	1.1164	14	156.3	9.757	1.304
17.3	1.1352	16	181.6	11.34	1.516
19.4	1.1546	18	207.8	12.97	1.734
21.5	1.1745	20	234.9	14.66	1.960
23.7	1.1951	22	262.9	16.41	2.194
25.8	1.2163	24	291.9	18.22	2.436
27.9	1.2382	26	321.9	20.10	2.687
30.0	1.2608	28	353.0	22.04	2.946
32.1	1.2841	30	385.2	24.05	3.215
37.3	1.3462	35	471.2	29.41	3.932
42.4	1.4138	40	565.5	35.30	4.719

SODIUM CARBONATE

Specific Gravity of Aqueous Sodium Carbonate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2CO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0086	1	10.09	0.6296	0.0842
2.7	1.0190	2	20.38	1.272	0.1701
5.6	1.0398	4	41.59	2.596	0.3471
8.3	1.0606	6	63.64	3.973	0.5311
10.9	1.0816	8	86.53	5.402	0.7221
13.5	1.1029	10	110.3	6.885	0.9204
16.0	1.1244	12	134.9	8.423	1.126
18.5	1.1463	14	160.5	10.02	1.339

Bé.	Sp. gr.	Per cent $Na_2CO_3 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0086	2.70	27.23	1.700	0.2272
2.7	1.0190	5.40	55.02	3.435	0.4592
5.6	1.0398	10.80	112.3	7.010	0.9370
8.3	1.0606	16.20	171.8	10.72	1.434
10.9	1.0816	21.60	233.6	14.58	1.949
13.5	1.1029	27.00	297.7	18.59	2.485
16.0	1.1244	32.40	364.3	22.74	3.040
18.5	1.1463	37.80	433.3	27.05	3.616

SODIUM CHLORIDE

Specific Gravity of Aqueous Sodium Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NaCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0053	1	10.05	0.6276	0.0839
1.8	1.0125	2	20.25	1.264	0.1690
3.8	1.0268	4	41.07	2.564	0.3428
5.8	1.0413	6	62.48	3.900	0.5214
7.7	1.0559	8	84.47	5.273	0.7049
9.6	1.0707	10	107.1	6.684	0.8935
11.5	1.0857	12	130.3	8.133	1.087
13.3	1.1009	14	154.1	9.622	1.286
15.1	1.1162	16	178.6	11.15	1.490
16.9	1.1319	18	203.7	12.72	1.700
18.7	1.1478	20	229.6	14.33	1.916
20.4	1.1640	22	256.1	15.99	2.137
22.2	1.1804	24	283.3	17.69	2.364
23.9	1.1972	26	311.3	19.43	2.598

SODIUM CHROMATE

Specific Gravity of Aqueous Sodium Chromate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0074	1	10.07	0.6289	0.0841
2.3	1.0163	2	20.33	1.269	0.1696
4.8	1.0344	4	41.38	2.583	0.3453
7.3	1.0529	6	63.17	3.944	0.5272
9.7	1.0718	8	85.74	5.353	0.7156
12.1	1.0912	10	109.1	6.812	0.9106
14.5	1.1110	12	133.3	8.323	1.113
16.8	1.1312	14	158.4	9.886	1.322
19.1	1.1518	16	184.3	11.50	1.538
21.4	1.1728	18	211.1	13.18	1.762
23.6	1.1942	20	238.8	14.91	1.993
25.8	1.2160	22	267.5	16.70	2.233
27.9	1.2383	24	297.2	18.55	2.480
30.0	1.2611	26	327.9	20.47	2.736

SODIUM DICHROMATE

Specific Gravity of Aqueous Sodium Dichromate Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2Cr_2O_7$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
1.9	1.013	2	20.26	1.265	0.1691
3.8	1.027	4	41.08	2.565	0.3428
5.7	1.041	6	62.46	3.899	0.5212
7.7	1.056	8	84.48	5.274	0.7050
9.5	1.070	10	107.0	6.680	0.8929
11.2	1.084	12	130.1	8.121	1.086
12.9	1.098	14	153.7	9.596	1.283
14.6	1.112	16	177.9	11.11	1.485
16.2	1.126	18	202.7	12.65	1.691
17.8	1.140	20	228.0	14.23	1.903
19.2	1.153	22	253.7	15.84	2.117
20.6	1.166	24	279.8	17.47	2.335
22.0	1.179	26	306.5	19.14	2.558
23.5	1.193	28	334.0	20.85	2.788
24.9	1.207	30	362.1	22.60	3.022
28.4	1.244	35	435.4	27.18	3.634
31.6	1.279	40	511.6	31.94	4.269
34.5	1.312	45	590.4	36.86	4.927
37.0	1.342	50	671.0	41.89	5.600

SODIUM HYDROXIDE

Specific Gravity of Aqueous Sodium Hydroxide Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NaOH	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0095	1	10.10	0.6302	0.0842
2.9	1.0207	2	20.41	1.274	0.1704
4.5	1.0318	3	30.95	1.932	0.2583
6.0	1.0428	4	41.71	2.604	0.3481
7.4	1.0538	5	52.69	3.289	0.4397
8.8	1.0648	6	63.89	3.988	0.5332
10.2	1.0758	7	75.31	4.701	0.6284
11.6	1.0869	8	86.95	5.428	0.7256
12.9	1.0979	9	98.81	6.168	0.8246
14.2	1.1089	10	110.9	6.923	0.9254
16.8	1.1309	12	135.7	8.472	1.133
19.2	1.1530	14	161.4	10.08	1.347
21.6	1.1751	16	188.0	11.74	1.569
23.9	1.1972	18	215.5	13.45	1.798
26.1	1.2191	20	243.8	15.22	2.035
28.2	1.2411	22	273.0	17.05	2.279
30.2	1.2629	24	303.1	18.92	2.529
32.1	1.2848	26	334.0	20.85	2.788
34.0	1.3064	28	365.8	22.84	3.053
35.8	1.3279	30	398.4	24.87	3.324
37.5	1.3490	32	431.7	26.95	3.602
39.1	1.3696	34	465.7	29.07	3.886
40.7	1.3900	36	500.4	31.24	4.176
42.2	1.4101	38	535.8	33.45	4.472
43.6	1.4300	40	572.0	35.71	4.773
45.0	1.4494	42	608.7	38.00	5.080
46.3	1.4685	44	646.1	40.34	5.392
47.5	1.4873	46	684.2	42.71	5.709
48.8	1.5065	48	723.1	45.14	6.035
49.9	1.5253	50	762.7	47.61	6.364

SODIUM NITRATE

Specific Gravity of Aqueous Sodium Nitrate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NaNO_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0049	1	10.05	0.6273	0.0839
1.7	1.0117	2	20.23	1.263	0.1689
3.6	1.0254	4	41.02	2.561	0.3423
5.5	1.0392	6	62.35	3.892	0.5203
7.3	1.0532	8	84.26	5.260	0.7031
9.2	1.0674	10	106.7	6.663	0.8908
11.0	1.0819	12	129.8	8.105	1.083
12.8	1.0967	14	153.5	9.585	1.281
14.6	1.1118	16	177.9	11.11	1.485
16.4	1.1272	18	202.9	12.67	1.693
18.1	1.1429	20	228.6	14.27	1.908
19.9	1.1589	22	255.0	15.92	2.128
21.6	1.1752	24	282.0	17.61	2.354
23.3	1.1917	26	309.8	19.34	2.586
25.0	1.2085	28	338.4	21.12	2.824
26.7	1.2256	30	367.7	22.95	3.068
30.8	1.2701	35	444.5	27.75	3.710
34.9	1.3175	40	527.0	32.90	4.398
39.0	1.3683	45	615.7	38.44	5.138

SODIUM NITRITE

Specific Gravity of Aqueous Sodium Nitrite Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NaNO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0058	1	10.06	0.6279	0.0839
1.8	1.0125	2	20.25	1.264	0.1690
3.7	1.0260	4	41.04	2.562	0.3425
5.5	1.0397	6	62.38	3.894	0.5206
7.4	1.0535	8	84.28	5.261	0.7033
9.2	1.0675	10	106.8	6.664	0.8909
10.9	1.0816	12	129.8	8.103	1.083
12.7	1.0959	14	153.4	9.578	1.280
14.4	1.1103	16	177.6	11.09	1.483
16.1	1.1248	18	202.5	12.64	1.690
17.7	1.1394	20	227.9	14.23	1.902

SODIUM POTASSIUM TARTRATE

Specific Gravity of Aqueous Sodium Potassium Tartrate (Rochelle Salt) Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NaKC_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0049	1	10.05	0.6273	0.0839
1.7	1.0116	2	20.23	1.263	0.1688
3.6	1.0252	4	41.01	2.560	0.3422
5.4	1.0390	6	62.34	3.892	0.5202
7.3	1.0530	8	84.24	5.259	0.7030
9.1	1.0673	10	106.7	6.663	0.8907
11.0	1.0818	12	129.8	8.104	1.083
12.8	1.0965	14	153.5	9.583	1.281
14.5	1.1114	16	177.8	11.10	1.484
16.3	1.1265	18	202.8	12.66	1.692
18.0	1.1419	20	228.4	14.26	1.906
19.7	1.1576	22	254.7	15.90	2.125
21.4	1.1735	24	281.6	17.58	2.350
23.1	1.1896	26	309.3	19.31	2.581
24.8	1.2059	28	337.7	21.08	2.818
26.4	1.2225	30	366.8	22.90	3.061
28.0	1.2394	32	396.6	24.76	3.310
29.6	1.2566	34	427.2	26.67	3.565
31.2	1.2742	36	458.7	28.64	3.828

Bé.	Sp. gr.	Per cent $NaKC_4H_4O_6 + 4H_2O$	G. per liter	Lbs. per cu. ft.	Lb. per gal.
0.7	1.0049	1.343	13.50	0.8425	0.1127
1.7	1.0116	2.686	27.17	1.696	0.2267
3.6	1.0252	5.372	55.07	3.438	0.4596
5.4	1.0390	8.058	83.72	5.227	0.6986
7.3	1.0530	10.74	113.1	7.063	0.9441
9.1	1.0673	13.43	143.3	8.948	1.196
11.0	1.0818	16.12	174.3	10.88	1.455
12.8	1.0965	18.80	206.2	12.87	1.721
14.5	1.1114	21.49	238.8	14.91	1.993
16.3	1.1265	24.17	272.3	17.00	2.273
18.0	1.1419	26.86	306.7	19.15	2.560
19.7	1.1576	29.55	342.0	21.35	2.854
21.4	1.1735	32.23	378.2	23.61	3.157
23.1	1.1896	34.92	415.4	25.93	3.466
24.8	1.2059	37.60	453.5	28.31	3.784
26.4	1.2225	40.29	492.5	30.75	4.110
28.0	1.2394	42.98	532.6	33.25	4.445
29.6	1.2566	45.66	573.8	35.82	4.788
31.2	1.2742	48.35	616.1	38.46	5.141

SODIUM SILICATE

Specific Gravity of Aqueous Sodium Silicate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2O \div 3.9SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.4	1.046	6	62.76	3.918	0.5327
8.6	1.063	8	85.04	5.309	0.7097
10.7	1.080	10	108.0	6.742	0.9013
12.9	1.098	12	131.8	8.225	1.100
14.6	1.116	14	156.2	9.754	1.304
17.1	1.134	16	181.4	11.33	1.514
19.2	1.153	18	207.5	12.96	1.732
21.3	1.172	20	234.4	14.63	1.956
23.3	1.191	22	262.0	16.36	2.187
25.3	1.211	24	290.6	18.14	2.425
27.3	1.232	26	320.3	20.00	2.673
29.3	1.253	28	350.8	21.90	2.928
31.3	1.275	30	382.5	23.88	3.192
33.3	1.298	32	415.4	25.93	3.466

Bé.	Sp. gr.	Per cent $Na_2O \div 3.36SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.5	1.047	6	62.82	3.922	0.5243
8.9	1.065	8	85.20	5.319	0.7110
11.1	1.083	10	108.3	6.761	0.9038
13.3	1.101	12	132.1	8.248	1.103
15.5	1.120	14	156.8	9.789	1.309
17.7	1.139	16	182.2	11.38	1.521
19.9	1.159	18	208.6	13.02	1.741
22.0	1.179	20	235.8	14.72	1.968
24.2	1.200	22	264.0	16.48	2.203
26.3	1.222	24	293.3	18.31	2.447
28.4	1.244	26	323.4	20.19	2.699
30.6	1.267	28	354.8	22.15	2.961
32.6	1.290	30	387.0	24.16	3.230
34.7	1.314	32	420.5	26.25	3.509
36.7	1.339	34	455.3	28.42	3.799
38.8	1.365	36	491.4	30.68	4.101
40.9	1.393	38	529.3	33.05	4.417

SODIUM SILICATE

Specific Gravity of Aqueous Sodium Silicate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2O + $2.40SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.8	1.034	4	41.36	2.582	0.3452
7.2	1.052	6	63.12	3.940	0.5268
9.6	1.071	8	85.68	5.349	0.7150
12.0	1.090	10	109.0	6.805	0.9096
14.4	1.110	12	133.2	8.315	1.112
16.7	1.130	14	158.2	9.876	1.320
19.0	1.151	16	184.2	11.50	1.537

Bé.	Sp. gr.	Per cent Na_2O + $2.44SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
32.2	1.285	28	359.8	22.46	3.003
34.2	1.309	30	392.7	24.52	3.277
36.3	1.334	32	426.9	26.65	3.562
38.4	1.360	34	462.4	28.87	3.859
40.5	1.387	36	499.3	31.17	4.167
42.5	1.415	38	537.7	33.57	4.487
44.7	1.445	40	578.0	36.08	4.824

Bé.	Sp. gr.	Per cent Na_2O + $2.06SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.9	1.035	4	41.40	2.584	0.3455
7.4	1.054	6	63.24	3.948	0.5278
9.9	1.073	8	85.84	5.359	0.7164
12.3	1.093	10	109.3	6.823	0.9121
14.7	1.113	12	133.6	8.338	1.115
17.1	1.134	14	158.8	9.911	1.325
19.6	1.156	16	185.0	11.55	1.544
21.9	1.178	18	212.0	13.24	1.770
24.2	1.200	20	240.0	14.98	2.003

SODIUM SILICATE (Continued)

Specific Gravity of Aqueous Sodium Silicate Solutions

$T \frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2O + 2.06SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
26.4	1.223	22	269.1	16.80	2.245
28.7	1.247	24	299.3	18.68	2.498
30.9	1.271	26	330.5	20.63	2.758
33.1	1.296	28	362.9	22.65	3.028
35.2	1.321	30	396.3	24.74	3.307
37.3	1.346	32	430.7	26.89	3.594
39.2	1.371	34	466.1	29.10	3.890
41.2	1.397	36	502.9	31.40	4.197
43.1	1.423	38	540.7	33.76	4.513
45.0	1.450	40	580.0	36.21	4.840
49.6	1.520	45	684.0	42.70	5.708
54.0	1.594	50	797.0	49.75	6.651
58.3	1.673	55	920.2	57.44	7.679

Bé.	Sp. gr.	Per cent $Na_2O + 1.69SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.4	1.017	2	20.34	1.270	0.1697
5.0	1.036	4	41.44	2.587	0.3458
7.7	1.056	6	63.36	3.955	0.5288
10.4	1.077	8	86.16	5.379	0.7190
12.9	1.098	10	109.8	6.854	0.9163
15.4	1.119	12	134.3	8.383	1.121
17.9	1.141	14	159.7	9.972	1.333
20.3	1.163	16	186.1	11.62	1.553
22.7	1.186	18	213.5	13.33	1.782
25.2	1.210	20	242.0	15.11	2.020
27.5	1.234	22	271.5	16.95	2.266
29.8	1.259	24	302.2	18.86	2.522
32.1	1.284	26	333.8	20.84	2.786
34.3	1.310	28	366.8	22.90	3.061
36.6	1.337	30	401.1	25.04	3.347
38.8	1.365	32	436.8	27.27	3.645
41.0	1.394	34	474.0	29.59	3.955
43.2	1.424	36	512.6	32.00	4.278
45.4	1.456	38	553.3	34.54	4.617

SODIUM SULFATE

Specific Gravity of Aqueous Sodium Sulfate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0073	1	10.07	0.6288	0.0841
2.3	1.0164	2	20.33	1.269	0.1696
4.9	1.0348	4	41.39	2.584	0.3454
7.4	1.0535	6	63.21	3.946	0.5275
9.8	1.0724	8	85.79	5.356	0.7160
12.2	1.0915	10	109.2	6.814	0.9109
14.5	1.1109	12	133.3	8.322	1.112
16.8	1.1306	14	158.3	9.881	1.321
19.0	1.1506	16	184.1	11.49	1.536
21.2	1.1709	18	210.8	13.16	1.759
23.3	1.1915	20	238.3	14.88	1.989
25.4	1.2124	22	266.7	16.65	2.226
27.5	1.2336	24	296.1	18.48	2.471

Bé.	Sp. gr.	Per cent $Na_2SO_4 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0073	2.268	22.85	1.426	0.1907
2.3	1.0164	4.536	46.11	2.878	0.3848
4.9	1.0348	9.073	93.88	5.861	0.7835
7.4	1.0535	13.61	143.4	8.950	1.197
9.8	1.0724	18.15	194.6	12.15	1.624
12.2	1.0915	22.68	247.6	15.46	2.066
14.5	1.1109	27.22	302.4	18.88	2.523
16.8	1.1306	31.75	359.0	22.41	2.996
19.0	1.1506	36.29	417.6	26.07	3.485
21.2	1.1709	40.83	478.1	29.84	3.989
23.3	1.1915	45.36	540.5	33.74	4.511
25.4	1.2124	49.90	605.0	37.77	5.049
27.5	1.2336	54.44	671.5	41.92	5.604

SODIUM SULFATE

Specific Gravity of Aqueous Sodium Sulfate Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $Na_2SO_4 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.004	1	10.04	0.6268	0.0838
1.2	1.008	2	20.16	1.259	0.1682
1.9	1.013	3	30.39	1.897	0.2536
2.3	1.016	4	40.64	2.537	0.3392
2.8	1.020	5	51.00	3.184	0.4256
3.4	1.024	6	61.44	3.836	0.5127
4.0	1.028	7	71.96	4.492	0.6005
4.5	1.032	8	82.56	5.154	0.6890
5.0	1.036	9	93.24	5.821	0.7781
5.6	1.040	10	104.0	6.492	0.8679
6.1	1.044	11	114.8	7.169	0.9584
6.5	1.047	12	125.6	7.843	1.048
7.2	1.052	13	136.8	8.538	1.141
7.7	1.056	14	147.8	9.229	1.234
8.2	1.060	15	159.0	9.926	1.327
8.7	1.064	16	170.2	10.63	1.421
9.4	1.069	17	181.7	11.34	1.517
9.9	1.073	18	193.1	12.06	1.612
10.4	1.077	19	204.6	12.77	1.708
11.0	1.082	20	216.4	13.51	1.806
11.5	1.086	21	228.1	14.24	1.903
12.0	1.090	22	239.8	14.97	2.001
12.5	1.094	23	251.6	15.71	2.100
12.9	1.098	24	263.5	16.45	2.199
13.5	1.103	25	275.8	17.21	2.301
14.0	1.107	26	287.8	17.97	2.402
14.5	1.111	27	300.0	18.73	2.503
15.1	1.116	28	312.5	19.51	2.608
15.5	1.120	29	324.8	20.28	2.711
16.1	1.125	30	337.5	21.07	2.817

SODIUM SULFATE

Specific Gravity of Aqueous Sodium Sulfate Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent Na_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.004	0.44	4.440	0.2772	0.0371
1.2	1.008	0.88	8.916	0.5566	0.0744
1.9	1.013	1.33	13.44	0.8390	0.1122
2.3	1.016	1.77	17.97	1.122	0.1500
2.8	1.020	2.21	22.55	1.408	0.1882
3.4	1.024	2.65	27.17	1.696	0.2268
4.0	1.028	3.10	31.82	1.987	0.2656
4.5	1.032	3.54	36.51	2.279	0.3047
5.0	1.036	3.98	41.24	2.574	0.3441
5.6	1.040	4.42	45.99	2.871	0.3838
6.1	1.044	4.86	50.79	3.171	0.4238
6.5	1.047	5.31	55.56	3.469	0.4637
7.2	1.052	5.75	60.48	3.776	0.5047
7.7	1.056	6.19	65.38	4.082	0.5456
8.2	1.060	6.63	70.32	4.390	0.5868
8.7	1.064	7.08	75.29	4.700	0.6283
9.4	1.069	7.52	80.37	5.017	0.6707
9.9	1.073	7.96	85.42	5.332	0.7128
10.4	1.077	8.40	90.50	5.650	0.7552
11.0	1.082	8.85	95.70	5.974	0.7987
11.5	1.086	9.29	100.9	6.296	0.8417
12.0	1.090	9.73	106.1	6.620	0.8850
12.5	1.094	10.2	111.3	6.947	0.9287
12.9	1.098	10.6	116.5	7.275	0.9726
13.5	1.103	11.1	122.0	7.613	1.018
14.0	1.107	11.5	127.3	7.946	1.062
14.5	1.111	11.9	132.7	8.282	1.107
15.1	1.116	12.4	138.2	8.627	1.153
15.5	1.120	12.8	143.6	8.967	1.199
16.1	1.125	13.3	149.3	9.318	1.246

SODIUM SULFIDE

Specific Gravity of Aqueous Sodium Sulfide Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2S	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0098	1	10.10	0.6304	0.0843
3.0	1.0211	2	20.42	1.275	0.1704
6.1	1.0440	4	41.76	2.607	0.3485
9.1	1.0672	6	64.03	3.997	0.5344
12.1	1.0907	8	87.26	5.447	0.7282
14.9	1.1146	10	111.5	6.958	0.9302
17.7	1.1388	12	136.7	8.531	1.140
20.4	1.1634	14	162.9	10.17	1.359
23.0	1.1885	16	190.2	11.87	1.587
25.6	1.2140	18	218.5	13.64	1.824

SODIUM SULFITE

Specific Gravity of Aqueous Sodium Sulfite Solutions at $\frac{19°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2SO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0078	1	10.08	0.6291	0.0841
2.5	1.0172	2	20.34	1.270	0.1698
5.1	1.0363	4	41.45	2.588	0.3459
7.6	1.0556	6	63.34	3.954	0.5286
10.1	1.0751	8	86.01	5.369	0.7178
12.6	1.0948	10	109.5	6.835	0.9136
14.9	1.1146	12	133.8	8.350	1.116
17.2	1.1346	14	158.8	9.916	1.326
19.4	1.1549	16	184.8	11.54	1.542
21.7	1.1755	18	211.6	13.21	1.766

SODIUM SULFITE ACID (SODIUM BISULFITE)

Specific Gravity of Aqueous Sodium Acid Sulfite Solutions at 15° C.

Bé.	Sp. gr.	Per cent $NaHSO_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.008	1.6	16.13	1.007	0.1346
3.1	1.022	2.1	21.46	1.340	0.1791
5.3	1.038	3.6	37.37	2.333	0.3118
7.2	1.052	5.1	53.65	3.349	0.4477
9.2	1.068	6.5	69.42	4.334	0.5793
11.2	1.084	8.0	86.72	5.414	0.7237
13.2	1.100	9.5	104.5	6.524	0.8721
15.1	1.116	11.2	125.0	7.803	1.043
17.1	1.134	12.8	145.2	9.061	1.211
19.1	1.152	14.6	168.2	10.50	1.404
21.2	1.171	16.5	193.2	12.06	1.612
23.2	1.190	18.5	220.2	13.74	1.837
25.2	1.210	20.9	252.9	15.79	2.110
27.2	1.231	23.5	289.3	18.06	2.414
29.2	1.252	25.9	324.3	20.24	2.706
31.3	1.275	28.9	368.5	23.00	3.075
33.3	1.298	31.7	411.5	25.69	3.434
35.2	1.321	34.7	458.4	28.62	3.825
37.2	1.345	38.0	511.1	31.91	4.265

Bé.	Sp. gr.	Per cent SO_2	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.008	1.0	9.929	0.6198	0.0829
3.1	1.022	1.3	13.21	0.8248	0.1103
5.3	1.038	2.2	23.00	1.436	0.1920
7.2	1.052	3.1	33.03	2.062	0.2756
9.2	1.068	4.0	42.74	2.668	0.3566
11.2	1.084	4.9	53.39	3.333	0.4455
13.2	1.100	5.8	64.33	4.016	0.5369
15.1	1.116	6.9	76.95	4.804	0.6421
17.1	1.134	7.9	89.36	5.578	0.7457
19.1	1.152	9.0	103.5	6.464	0.8641
21.2	1.171	10.2	118.9	7.426	0.9926
23.2	1.190	11.4	135.5	8.461	1.131
25.2	1.210	12.9	155.7	9.719	1.299
27.2	1.231	14.5	178.1	11.12	1.486
29.2	1.252	15.9	199.6	12.46	1.666
31.3	1.275	17.8	226.8	14.16	1.893
33.3	1.298	19.5	253.3	15.81	2.114
35.2	1.321	21.4	282.2	17.62	2.355
37.2	1.345	23.4	314.6	19.64	2.626

SODIUM TARTRATE

Specific Gravity of Aqueous Sodium Tartrate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.8	1.0123	2	20.25	1.264	0.1690
3.8	1.0266	4	41.06	2.564	0.3427
5.7	1.0410	6	62.46	3.899	0.5212
7.6	1.0555	8	84.44	5.271	0.7047
9.5	1.0702	10	107.0	6.681	0.8931
11.4	1.0851	12	130.2	8.129	1.087
13.2	1.1002	14	154.0	9.616	1.285
15.0	1.1156	16	178.5	11.14	1.490
16.8	1.1313	18	203.6	12.71	1.699
18.6	1.1471	20	229.4	14.32	1.915
20.4	1.1633	22	255.9	15.98	2.136
22.1	1.1797	24	283.1	17.67	2.363
23.8	1.1963	26	311.0	19.42	2.596
25.5	1.2132	28	339.7	21.21	2.835

Bé.	Sp. gr.	Per cent $Na_2C_4H_4O_6 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1.186	11.92	0.7441	0.0995
1.8	1.0123	2.371	24.01	1.499	0.2003
3.8	1.0266	4.743	48.69	3.040	0.4063
5.7	1.0410	7.114	74.06	5.623	0.6180
7.6	1.0555	9.486	100.1	6.250	0.8355
9.5	1.0702	11.86	126.9	7.922	1.059
11.4	1.0851	14.23	154.4	9.638	1.288
13.2	1.1002	16.60	182.6	11.40	1.524
15.0	1.1156	18.97	211.6	13.21	1.766
16.8	1.1313	21.34	241.4	15.07	2.015
18.6	1.1471	23.71	272.0	16.98	2.270
20.4	1.1633	26.09	303.5	18.94	2.532
22.2	1.1797	28.46	335.7	20.96	2.802
23.8	1.1963	30.83	368.8	23.02	3.078
25.5	1.2132	33.20	402.8	25.14	3.361

SODIUM THIOSULFATE

Specific Gravity of Aqueous Sodium Thiosulfate (Hypo) Solutions at $\frac{20°}{4°}$ C.*

Bé	Sp. gr.	Per cent $Na_2S_2O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1	10.07	0.6283	0.0840
2.1	1.0148	2	20.30	1.267	0.1694
4.4	1.0315	4	41.26	2.576	0.3443
6.7	1.0483	6	62.90	3.927	0.5249
8.9	1.0654	8	85.23	5.321	0.7113
11.1	1.0827	10	108.3	6.759	0.9035
13.2	1.1003	12	132.0	8.243	1.102
15.3	1.1182	14	156.5	9.773	1.306
17.4	1.1365	16	181.8	11.35	1.517
19.5	1.1551	18	207.9	12.98	1.735
21.5	1.1740	20	234.8	14.66	1.959
23.5	1.1932	22	262.5	16.39	2.191
25.4	1.2128	24	291.1	18.17	2.429
27.4	1.2328	26	320.5	20.01	2.675
29.3	1.2532	28	350.9	21.91	2.928
31.2	1.2739	30	382.2	23.86	3.189
35.8	1.3273	35	464.6	29.00	3.877
40.1	1.3827	40	553.1	34.53	4.616

Bé.	Sp. gr.	Per cent $Na_2S_2O_3 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1.570	15.80	0.9863	0.1318
2.1	1.0148	3.139	31.86	1.989	0.2659
4.4	1.0315	6.279	64.77	4.043	0.5405
6.7	1.0483	9.418	98.73	6.164	0.8239
8.9	1.0654	12.56	133.8	8.352	1.117
11.1	1.0827	15.70	170.0	10.61	1.418
13.2	1.1003	18.84	207.3	12.94	1.730
15.3	1.1182	21.98	245.7	15.34	2.051
17.4	1.1365	25.12	285.4	17.82	2.382
19.5	1.1551	28.25	326.4	20.37	2.724
21.5	1.1740	31.39	368.6	23.01	3.076
23.5	1.1932	34.53	412.1	25.72	3.439
25.4	1.2128	37.67	456.9	28.52	3.813
27.4	1.2328	40.81	503.1	31.41	4.199
29.3	1.2532	43.95	550.8	34.38	4.597
31.2	1.2739	47.09	599.9	37.45	5.006
35.8	1.3273	54.94	729.2	45.52	6.085
40.1	1.3827	62.79	868.2	54.20	7.245

SODIUM THIOSULFATE

Specific Gravity of Aqueous Sodium Thiosulfate (Hypo) Solutions at 19° C. (Schiff)

Bé.	Sp. gr.	Per cent $Na_2S_2O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	0.637	6.404	0.3998	0.0534
1.5	1.0105	1.27	12.88	0.8038	0.1075
2.3	1.0158	1.91	19.41	1.212	0.1620
3.0	1.0211	2.55	26.02	1.624	0.2172
3.7	1.0264	3.19	32.69	2.041	0.2728
4.5	1.0317	3.82	39.44	2.462	0.3291
5.2	1.0370	4.46	46.24	2.887	0.3859
5.9	1.0423	5.10	53.12	3.316	0.4433
6.6	1.0476	5.73	60.07	3.750	0.5013
7.3	1.0529	6.37	67.08	4.187	0.5598
8.0	1.0584	7.01	74.17	4.630	0.6190
8.7	1.0639	7.65	81.33	5.077	0.6787
9.4	1.0695	8.28	88.58	5.529	0.7392
10.1	1.0751	8.92	95.89	5.986	0.8002
10.8	1.0807	9.56	103.3	6.447	0.8618
11.5	1.0863	10.2	110.7	6.912	0.9240
12.2	1.0919	10.8	118.3	7.382	0.9869
12.9	1.0975	11.5	125.9	7.857	1.050
13.6	1.1031	12.1	133.5	8.335	1.114
14.2	1.1087	12.7	141.3	8.819	1.179
14.9	1.1145	13.4	149.1	9.308	1.244
15.6	1.1204	14.0	157.0	9.803	1.310
16.3	1.1263	14.7	165.0	10.30	1.377
16.9	1.1322	15.3	173.1	10.81	1.445
17.6	1.1381	15.9	181.3	11.32	1.513
18.3	1.1440	16.6	189.5	11.83	1.581
18.9	1.1499	17.2	197.8	12.35	1.651
19.5	1.1558	17.8	206.2	12.87	1.721
20.2	1.1617	18.5	214.6	13.40	1.791
20.8	1.1676	19.1	223.2	13.93	1.862
21.5	1.1738	19.7	231.8	14.47	1.935
22.1	1.1800	20.4	240.6	15.02	2.008
22.8	1.1862	21.0	249.4	15.57	2.081
23.4	1.1924	21.7	258.3	16.12	2.155
24.0	1.1986	22.3	267.3	16.68	2.230
24.7	1.2048	22.9	276.3	17.25	2.306
25.3	1.2110	23.6	285.5	17.82	2.382
25.9	1.2172	24.2	294.7	18.40	2.459
26.5	1.2234	24.8	304.0	18.98	2.537
27.1	1.2297	25.5	313.4	19.56	2.615
27.7	1.2362	26.1	322.9	20.16	2.695
28.3	1.2427	26.8	332.5	20.76	2.775
28.9	1.2492	27.4	342.2	21.36	2.856
29.5	1.2558	28.0	352.0	21.98	2.938
30.1	1.2624	28.7	361.9	22.59	3.020
30.7	1.2690	29.3	371.9	23.22	3.103
31.3	1.2756	29.9	381.9	23.84	3.187
31.9	1.2822	30.6	392.1	24.48	3.272
32.5	1.2888	31.2	402.3	25.12	3.357
33.1	1.2954	31.9	412.6	25.76	3.443

SODIUM THIOSULFATE

Specific Gravity of Aqueous Sodium Thiosulfate Solutions at 19° C. (Schiff)

Bé.	Sp. gr.	Per cent $Na_2S_2O_3 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.5	1.0105	2	20.21	1.262	0.1687
2.3	1.0158	3	30.47	1.902	0.2543
3.0	1.0211	4	40.84	2.550	0.3409
3.7	1.0264	5	51.32	3.204	0.4283
4.5	1.0317	6	61.90	3.864	0.5166
5.2	1.0370	7	72.59	4.532	0.6058
5.9	1.0423	8	83.38	5.205	0.6959
6.6	1.0476	9	94.28	5.886	0.7868
7.3	1.0529	10	105.3	6.573	0.8787
8.0	1.0584	11	116.4	7.268	0.9716
8.7	1.0639	12	127.7	7.970	1.065
9.4	1.0695	13	139.0	8.680	1.160
10.1	1.0751	14	150.5	9.396	1.256
10.8	1.0807	15	162.1	10.12	1.353
11.5	1.0863	16	173.8	10.85	1.450
12.2	1.0919	17	185.6	11.59	1.549
12.9	1.0975	18	197.6	12.33	1.649
13.6	1.1031	19	209.6	13.08	1.749
14.2	1.1087	20	221.7	13.84	1.850
14.9	1.1145	21	234.0	14.61	1.953
15.6	1.1204	22	246.5	15.39	2.057
16.3	1.1263	23	259.0	16.17	2.162
16.9	1.1322	24	271.7	16.96	2.268
17.6	1.1381	25	284.5	17.76	2.374
18.3	1.1440	26	297.4	18.57	2.482
18.9	1.1499	27	310.4	19.38	2.591
19.5	1.1558	28	323.6	20.20	2.701
20.2	1.1617	29	336.9	21.03	2.811
20.8	1.1676	30	350.3	21.87	2.923
21.5	1.1738	31	363.9	22.72	3.037
22.1	1.1800	32	377.6	23.57	3.151
22.8	1.1862	33	391.4	24.44	3.267
23.4	1.1924	34	405.4	25.31	3.383
24.0	1.1986	35	419.5	26.19	3.501
24.7	1.2048	36	433.7	27.08	3.620
25.3	1.2110	37	418.1	27.97	3.739
25.9	1.2172	38	462.5	28.87	3.860
26.5	1.2234	39	477.1	29.79	3.982
27.1	1.2297	40	491.9	30.71	4.105
27.7	1.2362	41	506.8	31.64	4.230
28.3	1.2427	42	521.9	32.58	4.356
28.9	1.2492	43	537.2	33.53	4.483
29.5	1.2558	44	552.6	34.49	4.611
30.1	1.2624	45	568.1	35.46	4.741
30.7	1.2690	46	583.7	36.44	4.871
31.3	1.2756	47	599.5	37.43	5.003
31.9	1.2822	48	615.5	38.42	5.136
32.5	1.2888	49	631.5	39.42	5.270
33.1	1.2954	50	647.7	40.43	5.405

STANNIC CHLORIDE

Specific Gravity of Aqueous Stannic Chloride Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $SnCl_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.4	1.031	4	41.24	2.574	0.3442
6.5	1.047	6	62.82	3.922	0.5243
8.7	1.064	8	85.12	5.314	0.7103
10.9	1.081	10	108.1	6.748	0.9021
13.1	1.099	12	131.9	8.233	1.101
15.2	1.117	14	156.4	9.762	1.305
17.2	1.135	16	181.6	11.34	1.515
19.4	1.154	18	207.7	12.97	1.733
21.4	1.173	20	234.6	14.65	1.958
23.4	1.192	22	262.2	16.37	2.188
25.4	1.212	24	290.9	18.16	2.427
27.4	1.233	26	320.6	20.01	2.675
29.5	1.255	28	351.4	21.94	2.933
31.5	1.278	30	383.4	23.93	3.200
36.6	1.337	35	468.0	29.21	3.905
41.7	1.403	40	561.2	35.03	4.683
46.7	1.475	45	663.8	41.44	5.539
51.8	1.555	50	777.5	48.54	6.488
56.8	1.644	55	904.2	56.45	7.546
61.8	1.742	60	1045	65.25	8.722
66.7	1.851	65	1203	75.11	10.04
71.4	1.971	70	1380	86.13	11.51

Bé.	Sp. gr.	Per cent $SnCl_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1.35	13.55	0.8460	0.1131
2.1	1.015	2.69	27.32	1.705	0.2280
4.4	1.031	5.38	55.50	3.465	0.4632
6.5	1.047	8.07	84.54	5.278	0.7055
8.7	1.064	10.8	114.5	7.151	0.9560
10.9	1.081	13.5	145.5	9.082	1.214
13.1	1.099	16.1	177.5	11.08	1.481
15.2	1.117	18.8	210.4	13.14	1.756
17.2	1.135	21.5	244.4	15.26	2.039
19.4	1.154	24.2	279.5	17.45	2.333
21.4	1.173	26.9	315.8	19.71	2.635
23.4	1.192	29.6	352.9	22.03	2.945
25.4	1.212	32.3	391.5	24.44	3.267
27.4	1.233	35.0	431.4	26.93	3.600
29.5	1.255	37.7	472.9	29.52	3.946
31.5	1.278	40.4	516.0	32.21	4.306
36.6	1.337	47.1	629.7	39.31	5.255
41.7	1.403	53.8	755.2	47.15	6.303
46.7	1.475	60.6	893.2	55.78	7.454
51.8	1.555	67.3	1046	65.32	8.732
56.8	1.644	74.0	1217	75.96	10.15
61.8	1.742	80.7	1407	87.81	11.74
66.7	1.851	87.5	1619	101.1	13.51
71.4	1.971	94.2	1857	115.9	15.49

STANNOUS CHLORIDE

Specific Gravity of Aqueous Stannous Chloride Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $SnCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0068	1	10.07	0.6285	0.0840
2.1	1.0146	2	20.29	1.267	0.1693
4.3	1.0306	4	41.22	2.573	0.3440
6.5	1.0470	6	62.82	3.922	0.5243
8.7	1.0638	8	85.10	5.313	0.7102
10.9	1.0810	10	108.1	6.748	0.9021
13.0	1.0986	12	131.8	8.230	1.100
15.2	1.1167	14	156.3	9.760	1.305
17.3	1.1353	16	181.6	11.34	1.516
19.4	1.1545	18	207.8	12.97	1.734
21.5	1.1743	20	234.9	14.66	1.960
23.6	1.1948	22	262.9	16.41	2.194
25.8	1.2159	24	291.8	18.22	2.435
27.8	1.2377	26	321.8	20.09	2.686
29.9	1.2603	28	352.9	22.03	2.945
32.0	1.2837	30	385.1	24.04	3.214
37.3	1.3461	35	471.1	29.41	3.932
42.5	1.4145	40	565.8	35.32	4.722
47.7	1.4897	45	670.4	41.85	5.594
52.8	1.5729	50	786.5	49.10	6.563
57.9	1.6656	55	916.1	57.19	7.645
63.1	1.7695	60	1062	66.28	8.860
68.1	1.8865	65	1226	76.55	10.23

Bé.	Sp. gr.	Per cent $SnCl_2 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0068	1.19	11.98	0.7480	0.1000
2.1	1.0146	2.38	24.15	1.508	0.2015
4.3	1.0306	4.76	49.06	3.063	0.4094
6.5	1.0470	7.14	74.76	4.667	0.6239
8.7	1.0638	9.52	101.3	6.322	0.8452
10.9	1.0810	11.9	128.6	8.031	1.074
13.0	1.0986	14.3	156.9	9.794	1.309
15.2	1.1167	16.7	186.0	11.61	1.553
17.3	1.1353	19.0	216.2	13.49	1.804
19.4	1.1545	21.4	247.3	15.44	2.064
21.5	1.1743	23.8	279.5	17.45	2.332
23.6	1.1948	26.2	312.8	19.53	2.610
25.8	1.2159	28.6	347.3	21.68	2.898
27.8	1.2377	30.9	383.0	23.91	3.196
29.9	1.2603	33.3	419.9	26.22	3.505
32.0	1.2837	35.7	458.3	28.61	3.825
37.3	1.3461	41.7	560.7	35.00	4.679
42.5	1.4145	47.6	673.3	42.03	5.619
47.7	1.4897	53.6	797.8	49.80	6.657
52.8	1.5729	59.5	935.9	58.43	7.810
57.9	1.6656	65.5	1090	68.06	9.098
63.1	1.7695	71.4	1263	78.87	10.54
68.1	1.8865	77.4	1459	91.10	12.18

SUCROSE (CANE SUGAR)

Specific Gravity of Aqueous Sugar Solutions at $\frac{20°}{4°}$ C.

Bé.	Sp. gr.	Per cent $C_{12}H_{22}O_{11}$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
....	0.9982	0	....	......	......
0.3	1.0021	1	10.02	0.6256	0.0836
0.9	1.0060	2	20.12	1.256	0.1679
1.4	1.0099	3	30.30	1.891	0.2528
2.0	1.0139	4	40.56	2.532	0.3384
2.5	1.0179	5	50.89	3.177	0.4247
3.1	1.0219	6	61.31	3.827	0.5117
3.6	1.0259	7	71.81	4.483	0.5993
4.1	1.0299	8	82.40	5.144	0.6876
4.7	1.0340	9	93.06	5.810	0.7766
5.3	1.0381	10	103.8	6.481	0.8664
5.8	1.0423	11	114.7	7.157	0.9568
6.4	1.0465	12	125.6	7.839	1.048
7.0	1.0507	13	136.6	8.527	1.140
7.5	1.0549	14	147.7	9.220	1.232
8.1	1.0592	15	158.9	9.918	1.326
8.7	1.0635	16	170.2	10.62	1.420
9.2	1.0678	17	181.5	11.33	1.515
9.8	1.0721	18	193.0	12.05	1.611
10.3	1.0765	19	204.5	12.77	1.707
10.8	1.0810	20	216.2	13.50	1.804
11.4	1.0854	21	227.9	14.23	1.902
12.0	1.0899	22	239.8	14.97	2.001
12.5	1.0944	23	251.7	15.71	2.101
13.1	1.0990	24	263.8	16.47	2.201
13.6	1.1036	25	275.9	17.22	2.302
14.2	1.1082	26	288.1	17.99	2.404
14.7	1.1128	27	300.5	18.76	2.507
15.3	1.1175	28	312.9	19.53	2.611
15.8	1.1222	29	325.4	20.32	2.716
16.3	1.1270	30	338.1	21.11	2.821
16.9	1.1318	31	350.8	21.90	2.928
17.5	1.1366	32	363.7	22.71	3.035
18.0	1.1415	33	376.7	23.51	3.143
18.6	1.1463	34	389.8	24.33	3.253
19.1	1.1513	35	402.9	25.15	3.363
19.6	1.1562	36	416.2	25.98	3.474
20.1	1.1612	37	429.7	26.82	3.586
20.7	1.1663	38	443.2	27.67	3.698
21.2	1.1713	39	456.8	28.52	3.812
21.7	1.1764	40	470.6	29.38	3.927
22.3	1.1816	41	484.5	30.24	4.043
22.8	1.1868	42	498.4	31.12	4.160
23.3	1.1920	43	512.6	32.00	4.277
23.9	1.1972	44	526.8	32.89	4.396
24.4	1.2025	45	541.1	33.78	4.516
25.0	1.2079	46	555.6	34.69	4.637
25.5	1.2132	47	570.2	35.60	4.759
26.0	1.2186	48	584.9	36.52	4.882
26.5	1.2241	49	599.8	37.44	5.005
27.1	1.2296	50	614.8	38.38	5.131
27.6	1.2351	51	629.9	39.32	5.257
28.1	1.2406	52	645.1	40.27	5.384
28.7	1.2462	53	660.5	41.23	5.512
29.2	1.2519	54	676.0	42.20	5.641
29.7	1.2575	55	691.6	43.18	5.772
30.3	1.2632	56	707.4	44.16	5.904

SUCROSE (CANE SUGAR) (Continued)

Specific Gravity of Aqueous Sugar Solutions at $\frac{20°}{4°}$ C.

Bé.	Sp. gr.	Per cent $C_{12}H_{22}O_{11}$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
30.8	1.2690	57	723.3	45.15	6.036
31.3	1.2748	58	739.4	46.16	6.170
31.8	1.2806	59	755.6	47.17	6.305
32.3	1.2865	60	771.9	48.19	6.441
32.8	1.2924	61	788.3	49.21	6.579
33.4	1.2983	62	804.9	50.25	6.717
33.9	1.3043	63	821.7	51.30	6.857
34.4	1.3103	64	838.6	52.35	6.998
34.8	1.3163	65	855.6	53.41	7.140
35.4	1.3224	66	872.8	54.49	7.284
35.9	1.3286	67	890.1	55.57	7.428
36.4	1.3347	68	907.6	56.66	7.574
36.9	1.3409	69	925.2	57.76	7.721
37.4	1.3472	70	943.0	58.87	7.870
37.9	1.3535	71	961.0	59.99	8.019
38.4	1.3598	72	979.0	61.12	8.170
38.9	1.3661	73	997.3	62.26	8.323
39.4	1.3725	74	1016.	63.41	8.476
39.9	1.3790	75	1034.	64.56	8.631
40.4	1.3854	76	1053.	65.73	8.787
40.9	1.3920	77	1072.	66.91	8.944
41.4	1.3985	78	1091.	68.10	9.103
41.8	1.4051	79	1110.	69.29	9.263
42.2	1.4117	80	1129.	70.50	9.425
42.7	1.4184	81	1149.	71.72	9.588
43.2	1.4251	82	1169.	72.95	9.752
43.7	1.4318	83	1188.	74.19	9.917
44.2	1.4386	84	1208.	75.44	10.08
44.7	1.4454	85	1229.	76.70	10.25
45.2	1.4522	86	1249.	77.97	10.42
45.6	1.4591	87	1269.	79.25	10.59
46.1	1.4660	88	1290.	80.54	10.77
46.6	1.4730	89	1311.	81.85	10.94

SULFURIC ACID

Specific Gravity of Aqueous Sulfuric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0051	1	10.05	0.6275	0.0839
1.7	1.0118	2	20.24	1.263	0.1689
2.6	1.0184	3	30.55	1.907	0.2550
3.5	1.0250	4	41.00	2.560	0.3422
4.5	1.0317	5	51.59	3.220	0.4305
5.4	1.0385	6	62.31	3.890	0.5200
6.3	1.0453	7	73.17	4.568	0.6106
7.2	1.0522	8	84.18	5.255	0.7025
8.1	1.0591	9	95.32	5.950	0.7955
9.0	1.0661	10	106.6	6.655	0.8897
9.9	1.0731	11	118.0	7.369	0.9851
10.8	1.0802	12	129.6	8.092	1.082
11.7	1.0874	13	141.4	8.825	1.180
12.5	1.0947	14	153.3	9.567	1.279
13.4	1.1020	15	165.3	10.32	1.379
14.3	1.1094	16	177.5	11.08	1.481
15.2	1.1168	17	189.9	11.85	1.584
16.0	1.1243	18	202.4	12.63	1.689
16.9	1.1318	19	215.0	13.42	1.795
17.7	1.1394	20	227.9	14.23	1.902
18.6	1.1471	21	240.9	15.04	2.010
19.4	1.1548	22	254.1	15.86	2.120
20.3	1.1626	23	267.4	16.69	2.231
21.1	1.1704	24	280.9	17.54	2.344
21.9	1.1783	25	294.6	18.39	2.458
22.8	1.1862	26	308.4	19.25	2.574
23.6	1.1942	27	322.4	20.13	2.691
24.4	1.2023	28	336.6	21.02	2.809
25.2	1.2104	29	351.0	21.91	2.929
26.0	1.2185	30	365.6	22.82	3.051
26.8	1.2267	31	380.3	23.74	3.173
27.6	1.2349	32	395.2	24.67	3.298
28.4	1.2432	33	410.3	25.61	3.424
29.1	1.2515	34	425.5	26.56	3.551
29.9	1.2599	35	441.0	27.53	3.680
30.7	1.2684	36	456.6	28.51	3.811
31.4	1.2769	37	472.5	29.49	3.943
32.2	1.2855	38	488.5	30.49	4.077
33.0	1.2941	39	504.7	31.51	4.212
33.7	1.3028	40	521.1	32.53	4.349
34.5	1.3116	41	537.8	33.57	4.488
35.2	1.3205	42	554.6	34.62	4.628
35.9	1.3294	43	571.6	35.69	4.770
36.7	1.3384	44	588.9	36.76	4.914
37.4	1.3476	45	606.4	37.86	5.061
38.1	1.3569	46	624.2	38.97	5.209
38.9	1.3663	47	642.2	40.09	5.359
39.6	1.3758	48	660.4	41.23	5.511
40.3	1.3854	49	678.8	42.38	5.665
41.1	1.3951	50	697.6	43.55	5.821
41.8	1.4049	51	716.5	44.73	5.979
42.5	1.4148	52	735.7	45.93	6.140
43.2	1.4248	53	755.1	47.14	6.302
44.0	1.4350	54	774.9	48.37	6.467

SULFURIC ACID (Continued)

Specific Gravity of Aqueous Sulfuric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
44.7	1.4453	55	794.9	49.62	6.634
45.4	1.4557	56	815.2	50.89	6.803
46.1	1.4662	57	835.7	52.17	6.974
46.8	1.4768	58	856.5	53.47	7.148
47.5	1.4875	59	877.6	54.79	7.324
48.2	1.4983	60	899.0	56.12	7.502
48.9	1.5091	61	920.6	57.47	7.682
49.6	1.5200	62	942.4	58.83	7.865
50.3	1.5310	63	964.5	60.21	8.049
51.0	1.5421	64	986.9	61.61	8.236
51.7	1.5533	65	1010	63.03	8.426
52.3	1.5646	66	1033	64.46	8.618
53.0	1.5760	67	1056	65.92	8.812
53.7	1.5874	68	1079	67.39	9.008
54.3	1.5989	69	1103	68.87	9.207
55.0	1.6105	70	1127	70.38	9.408
55.6	1.6221	71	1152	71.90	9.611
56.3	1.6338	72	1176	73.44	9.817
56.9	1.6456	73	1201	74.99	10.02
57.5	1.6574	74	1226	76.57	10.24
58.1	1.6692	75	1252	78.15	10.45
58.7	1.6810	76	1278	79.75	10.66
59.3	1.6927	77	1303	81.37	10.88
59.9	1.7043	78	1329	82.99	11.09
60.5	1.7158	79	1355	84.62	11.31
61.1	1.7272	80	1382	86.26	11.53
61.6	1.7383	81	1408	87.90	11.75
62.1	1.7491	82	1434	89.54	11.97
62.6	1.7594	83	1460	91.16	12.19
63.0	1.7693	84	1486	92.78	12.40
63.5	1.7786	85	1512	94.38	12.62
63.9	1.7872	86	1537	95.95	12.83
64.2	1.7951	87	1562	97.49	13.03
64.5	1.8022	88	1586	99.01	13.23
64.8	1.8087	89	1610	100.5	13.43
65.1	1.8144	90	1633	101.9	13.63
65.3	1.8195	91	1656	103.4	13.82
65.5	1.8240	92	1678	104.8	14.00
65.7	1.8279	93	1700	106.1	14.19
65.8	1.8312	94	1721	107.5	14.36
65.9	1.8337	95	1742	108.7	14.54
66.0	1.8355	96	1762	110.0	14.70
66.0	1.8364	97	1781	111.2	14.87
66.0	1.8361	98	1799	112.3	15.02
65.9	1.8342	99	1816	113.4	15.15
65.8	1.8305	100	1831	114.3	15.28

TABLES OF THE MANUFACTURING CHEMISTS' ASSOCIATION

SULFURIC ACID

Authorities — W. C. Ferguson; H. P. Talbot

This table has been approved and adopted as a standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should always be printed on the scale.

66° Baumé = Sp. Gr. 1.8354.

1 cu. ft. water at 60° F. weighs 62.37 lbs. av.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

H_2SO_4 = 100 per cent.

	H_2SO_4	O. V.	60°
O. V.	93.19	100.00	119.98
60°	77.67	83.35	100.00
50°	62.18	66.72	80.06

Acids stronger than 66° Bé. should have their percentage compositions determined by chemical analysis.

Bé.°	Sp. gr.	Tw.°	Per cent H_2SO	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu. ft.	* Freezing (melting) point.
0	1.0000	0.0	0.00	62.37	0.00	0.00	32.0° F.
1	1.0069	1.4	1.02	62.80	1.09	.68	31.2 "
2	1.0140	2.8	2.08	63.24	2.23	1.41	30.5 "
3	1.0211	4.2	3.13	63.69	3.36	2.14	29.8 "
4	1.0284	5.7	4.21	64.14	4.52	2.90	28.9 "
5	1.0357	7.1	5.28	64.60	5.67	3.66	28.1 "
6	1.0432	8.6	6.37	65.06	6.84	4.45	27.2 "
7	1.0507	10.1	7.45	65.53	7.99	5.24	26.3 "
8	1.0584	11.7	8.55	66.01	9.17	6.06	25.1 "
9	1.0662	13.2	9.66	66.50	10.37	6.89	24.0 "
10	1.0741	14.8	10.77	66.99	11.56	7.74	22.8 "
11	1.0821	16.4	11.89	67.49	12.76	8.61	21.5 "
12	1.0902	18.0	13.01	68.00	13.96	9.49	20.0 "
13	1.0985	19.7	14.13	68.51	15.16	10.39	18.3 "
14	1.1069	21.4	15.25	69.04	16.36	11.30	16.6 "

* Calculated from Pickering's results, Journal of London Chemical Society, vol. 57, p. 363.

SULFURIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent H_2SO_4	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu.ft.	* Freezing (melting) point.
15	1.1154	23.1	16.38	69.57	17.58	12.23	14.7 F.
16	1.1240	24.8	17.53	70.10	18.81	13.19	12.6 "
17	1.1328	26.6	18.71	70.65	20.08	14.18	10.2 "
18	1.1417	28.3	19.89	71.21	21.34	15.20	7.7 "
19	1.1508	30.2	21.07	71.78	22.61	16.23	4.8 "
20	1.1600	32.0	22.25	72.35	23.87	17.27	+ 1.6 "
21	1.1694	33.9	23.43	72.94	25.14	18.34	− 1.8 "
22	1.1789	35.8	24.61	73.53	26.41	19.42	− 6.0 "
23	1.1885	37.7	25.81	74.13	27.69	20.53	−11 "
24	1.1983	39.7	27.03	74.74	29.00	21.68	−16 "
25	1.2083	41.7	28.28	75.36	30.34	22.87	−23 "
26	1.2185	43.7	29.53	76.00	31.69	24.08	−30 "
27	1.2288	45.8	30.79	76.64	33.04	25.32	−39 "
28	1.2393	47.9	32.05	77.30	34.39	26.58	−49 "
29	1.2500	50.0	33.33	77.96	35.76	27.88	−61 "
30	1.2609	52.2	34.63	78.64	37.16	29.22	−74 "
31	1.2719	54.4	35.93	79.33	38.55	30.58	−82 "
32	1.2832	56.6	37.26	80.03	39.98	32.00	−96 "
33	1.2946	58.9	38.58	80.74	41.40	33.42	−97 "
34	1.3063	61.3	39.92	81.47	42.83	34.90	−91 "
35	1.3182	63.6	41.27	82.22	44.28	36.41	−81 "
36	1.3303	66.1	42.63	82.97	45.74	37.95	−70 "
37	1.3426	68.5	43.99	83.74	47.20	39.53	−60 "
38	1.3551	71.0	45.35	84.52	48.66	41.13	−53 "
39	1.3679	73.6	46.72	85.32	50.13	42.77	−47 "
40	1.3810	76.2	48.10	86.13	51.61	44.45	−41 "
41	1.3942	78.8	49.47	86.96	53.08	46.16	−35 "
42	1.4078	81.6	50.87	87.80	54.58	47.92	−31 "
43	1.4216	84.3	52.26	88.67	56.07	49.72	−27 "
44	1.4356	87.1	53.66	89.54	57.58	51.56	−23 "
45	1.4500	90.0	55.07	90.44	59.09	53.44	−20 "
46	1.4646	92.9	56.48	91.35	60.60	55.36	−14 "
47	1.4796	95.9	57.90	92.28	62.13	57.33	−15 "
48	1.4948	99.0	59.32	93.23	63.65	59.34	−18 "
49	1.5104	102.1	60.75	94.20	65.18	61.40	−22 "

* Calculated from Pickering's results, Journal of London Chemical Society vol. 57, p. 363.

SULFURIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent H_2SO_4	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu.ft.	*Freezing (melting) point.
50	1.5263	105.3	62.18	95.20	66.72	63.52	−27 F.
51	1.5426	108.5	63.66	96.21	68.31	65.72	−33 "
52	1.5591	111.8	65.13	97.24	69.89	67.96	−39 "
53	1.5761	115.2	66.63	98.30	71.50	70.28	−49 "
54	1.5934	118.7	68.13	99.38	73.11	72.66	−59 "
55	1.6111	122.2	69.65	100.48	74.74	75.10	..
56	1.6292	125.8	71.17	101.61	76.37	77.60	..
57	1.6477	129.5	72.75	102.77	78.07	80.23	.. } Below −40
58	1.6667	133.3	74.36	103.95	79.79	82.95	..
59	1.6860	137.2	75.99	105.16	81.54	85.75	− 7
60	1.7059	141.2	77.67	106.40	83.35	88.68	+12.6 F
61	1.7262	145.2	79.43	107.66	85.23	91.76	27.3 "
62	1.7470	149.4	81.30	108.96	87.24	95.06	39.1 "
63	1.7683	153.7	83.34	110.29	89.43	98.63	46.1 "
64	1.7901	158.0	85.66	111.65	91.92	102.63	46.4 "
64¼	1.7957	159.1	86.33	112.00	92.64	103.75	43.6 "
64½	1.8012	150.2	87.04	112.34	93.40	104.93	41.1 "
64¾	1.8068	161.4	87.81	112.69	94.23	106.19	37.9 "
65	1.8125	162.5	88.65	113.05	95.13	107.54	33.1 "
65¼	1.8182	163.6	89.55	113.40	96.10	108.97	24.6 "
65½	1.8239	164.8	90.60	113.76	97.22	110.60	13.4 "
65¾	1.8297	165.9	91.80	114.12	98.51	112.42	− 1 "
66	1.8354	167.1	93.19	114.47	100.0	114.47	−29 "

* Calculated from Pickering's results, Journal of London Chemical Society, vol. 57, p. 363.

APPROXIMATE BOILING POINTS

50°	Bé.	295 F.
60°	"	386 "
61°	"	400 "
62°	"	415 "
63°	"	432 "
64°	"	451 "
65°	"	485 "
66°	"	538 "

Per cent 60°	Pounds 60° in 1 cu. ft.	Per cent 50°	Pounds 50° in 1 cu. ft
61.93	53.34	77.36	66.63
63.69	55.39	79.56	69.19
65.50	57.50	81.81	71.83
67.28	59.66	84.05	74.53
69.09	61.86	86.30	77.27
70.90	64.12	88.56	80.10
72.72	66.43	90.83	82.98
74.55	68.79	93.12	85.93
76.37	71.20	95.40	88.94
78.22	73.68	97.70	92.03

SULFURIC ACID (Continued)

FIXED POINTS

Sp. gr.	Per cent H_2SO_4	Sp. gr.	Per cent H_2SO_4
1.0000	.00	1.5281	62.34
1.0048	.71	1.5440	63.79
1.0347	5.14	1.5748	66.51
1.0649	9.48	1.6272	71.00
1.0992	14.22	1.6679	74.46
1.1353	19.04	1.7044	77.54
1.1736	23.94	1.7258	79.40
1.2105	28.55	1.7472	81.32
1.2513	33.49	1.7700	83.47
1.2951	38.64	1.7959	86.36
1.3441	44.15	1.8117	88.53
1.3947	49.52	1.8194	89.75
1.4307	53.17	1.8275	91.32
1.4667	56.68	1.8354	93.19
1.4822	58.14		

ALLOWANCE FOR TEMPERATURE

At 10° Bé. .029° Bé. or .00023 Sp. Gr. = 1° F.
At 20° Bé. .036° Bé. or .00034 Sp. Gr. = 1° F.
At 30° Bé. .035° Bé. or .00039 Sp. Gr. = 1° F.
At 40° Bé. .031° Bé. or .00041 Sp. Gr. = 1° F.
At 50° Bé. .028° Bé. or .00045 Sp. Gr. = 1° F.
At 60° Bé. .026° Bé. or .00053 Sp. Gr. = 1° F.
At 63° Bé. .026° Bé. or .00057 Sp. Gr. = 1° F.
At 66° Bé. .0235° Bé. or .00054 Sp. Gr. = 1° F.

Per cent 60°	Pounds 60° in 1 cu. ft.	Per cent 50°	Pounds 50° in 1 cu. ft
80.06	76.21	100.00	95.20
81.96	78.85	102.38	98.50
83.86	81.54	104.74	101.85
85.79	84.33	107.15	105.33
87.72	87.17	109.57	108.89
89.67	90.10	112.01	112.55
91.63	93.11	114.46	116.30
93.67	96.26	117.00	120.24
95.74	99.52	119.59	124.31
97.84	102.89	122.21	128.52
100.00	106.40	124.91	132.91
102.27	110.10	127.74	137.52
104.67	114.05	130.75	142.47
107.30	118.34	134.03	147.82
110.29	123.14	137.76	153.81
111.15	124.49	138.84	155.50
112.06	125.89	139.98	157.25
113.05	127.40	141.22	159.14
114.14	129.03	142.57	161.17
115.30	130.75	144.02	163.32
116.65	132.70	145.71	165.76
118.19	134.88	147.63	168.48
119.98	137.34	149.87	171.56

SULFURIC ACID, SO_3

Specific Gravity of Aqueous Sulfuric Acid Solutions at $\frac{20°}{4°}$ C. Giving SO_3 Content

Bé.	Sp. gr.	Per cent SO_3	G. per liter SO_3	Lbs. per cu. ft. SO_3	Lbs per gal. SO_3
0.7	1.0051	.8163	8.204	.5122	0.0685
1.7	1.0118	1.633	16.52	1.030	.1379
2.6	1.0184	2.449	24.94	1.557	.2082
3.5	1.0250	3.265	33.47	2.090	.2793
4.5	1.0317	4.082	42.11	2.628	.3514
5.4	1.0385	4.898	50.86	3.175	.4245
6.3	1.0453	5.714	59.73	3.729	.4984
7.2	1.0522	6.531	68.72	4.290	.5735
8.1	1.0591	7.347	77.81	4.857	.6494
9.0	1.0661	8.163	87.02	5.433	.7263
9.9	1.0731	8.979	96.32	6.015	.8042
10.8	1.0802	9.796	105.8	6.606	.8833
11.7	1.0874	10.612	115.4	7.204	.9633
12.5	1.0947	11.43	125.1	7.810	1.044
13.4	1.1020	12.24	134.9	8.424	1.126
14.3	1.1094	13.06	144.9	9.045	1.209
15.2	1.1168	13.88	155.0	9.673	1.293
16.0	1.1243	14.69	165.2	10.31	1.379
16.9	1.1318	15.51	175.5	10.95	1.465
17.7	1.1394	16.33	186.0	11.62	1.553
18.6	1.1471	17.14	196.6	12.28	1.641
19.4	1.1548	17.96	207.4	12.95	1.731
20.3	1.1626	18.78	218.3	13.62	1.821
21.1	1.1704	19.59	229.3	14.32	1.913
21.9	1.1783	20.41	240.5	15.01	2.007
22.8	1.1862	21.22	251.8	15.71	2.101
23.6	1.1942	22.04	263.2	16.43	2.197
24.4	1.2023	22.86	274.8	17.16	2.293
25.2	1.2104	23.67	286.5	17.89	2.391
26.0	1.2185	24.49	298.4	18.63	2.491
26.8	1.2267	25.31	310.4	19.38	2.590
27.6	1.2349	26.12	322.6	20.14	2.692
28.4	1.2432	26.94	334.9	20.91	2.795
29.1	1.2515	27.75	347.3	21.68	2.899
29.9	1.2599	28.57	360.0	22.47	3.003
30.7	1.2684	29.39	372.7	23.27	3.111
31.4	1.2769	30.20	385.7	24.07	3.219
32.2	1.2855	31.02	398.8	24.89	3.328
33.0	1.2941	31.84	412.0	25.72	3.438
33.7	1.3028	32.65	425.4	26.45	3.550
34.5	1.3116	33.47	439.0	27.40	3.664
35.2	1.3205	34.29	452.7	28.26	3.778
35.9	1.3294	35.10	466.6	29.13	3.894
36.7	1.3384	35.92	480.7	30.01	4.011
37.4	1.3476	36.73	495.0	30.91	4.131
38.1	1.3569	37.55	509.5	31.81	4.252
38.9	1.3663	38.37	524.2	32.73	4.375
39.6	1.3758	39.18	539.1	33.66	4.499
40.3	1.3854	40.00	554.1	34.50	4.624
41.1	1.3951	40.82	569.5	35.55	4.752
41.8	1.4049	41.63	584.9	36.51	4.881
42.5	1.4148	42.45	600.6	37.49	5.012
43.2	1.4248	43.26	616.4	38.48	5.144
44.0	1.4350	44.08	632.6	39.49	5.279
44.7	1.4453	44.90	648.9	40.51	5.415
45.4	1.4557	45.71	665.5	41.54	5.553

SULFURIC ACID SO_3 (Continued)

Specific Gravity of Aqueous Sulfuric Acid Solutions at $\frac{20°}{4°}$ C. Giving SO_3 Content

Bé.	Sp. gr.	Per cent SO_3	G. per liter SO_3	Lbs. per cu. ft. SO_3	Lbs. per gal. SO_3
46.1	1.4662	46.53	682.2	42.59	5.693
46.8	1.4768	47.35	699.2	43.65	5.835
47.5	1.4875	48.16	716.4	44.73	5.979
48.2	1.4983	48.98	733.9	45.81	6.124
48.9	1.5091	49.80	751.5	46.91	6.271
49.6	1.5200	50.61	769.3	48.02	6.420
50.3	1.5310	51.43	787.3	49.15	6.571
51.0	1.5421	52.24	805.6	50.29	6.723
51.7	1.5533	53.06	824.5	51.45	6.878
52.3	1.5646	53.88	843.3	52.62	7.035
53.0	1.5760	54.69	862.0	53.81	7.193
53.7	1.5874	55.51	880.8	55.01	7.353
54.3	1.5989	56.33	900.4	56.22	7.516
55.0	1.6105	57.14	920.0	57.45	7.680
55.6	1.6221	57.96	940.4	58.69	7.846
56.3	1.6338	58.77	960.0	59.95	8.014
56.9	1.6456	59.59	980.4	61.22	8.180
57.5	1.6574	60.41	1001	62.51	8.359
58.1	1.6692	61.22	1022	63.80	8.530
58.7	1.6810	62.04	1043	65.10	8.702
59.3	1.6927	62.86	1064	66.42	8.882
59.9	1.7043	63.67	1085	67.75	9.053
60.5	1.7158	64.49	1106	69.08	9.233
61.1	1.7272	65.31	1128	70.42	9.412
61.6	1.7383	66.12	1149	71.75	9.592
62.1	1.7491	66.94	1171	73.09	9.771
62.6	1.7594	67.75	1192	74.42	9.951
63.0	1.7693	68.57	1213	75.74	10.12
63.5	1.7786	69.39	1234	77.04	10.30
63.9	1.7872	70.20	1255	78.33	10.47
64.2	1.7951	71.02	1275	79.58	10.64
64.5	1.8022	71.84	1295	80.82	10.80
64.8	1.8087	72.65	1314	82.04	10.96
65.1	1.8144	73.47	1333	83.18	11.13
65.3	1.8195	74.28	1352	84.41	11.28
65.5	1.8240	75.10	1370	85.55	11.43
65.7	1.8279	75.92	1388	86.61	11.58
65.8	1.8312	76.73	1405	87.75	11.72
65.9	1.8337	77.55	1422	88.73	11.87
66.0	1.8355	78.37	1438	89.79	12.00
66.0	1.8364	79.18	1454	90.77	12.14
66.0	1.8361	80.00	1468	91.67	12.26
65.9	1.8342	80.82	1482	92.57	12.37
65.8	1.8305	81.63	1495	93.31	12.47

TANNIC ACID

Specific Gravity of Aqueous Tannic Acid Solutions at 15° C. (Trammer)

Bé.	Sp. gr.	Per cent $C_{14}H_{10}O_9$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0040	1.0	10.04	0.6268	0.0838
0.6	1.0044	1.0	11.05	0.6897	0.0922
0.7	1.0048	1.2	12.06	0.7527	0.1006
0.8	1.0052	1.3	13.07	0.8158	0.1091
0.8	1.0056	1.4	14.08	0.8789	0.1175
0.9	1.0060	1.5	15.09	0.9420	0.1259
0.9	1.0064	1.6	16.10	1.005	0.1344
1.0	1.0068	1.7	17.12	1.068	0.1428
1.0	1.0072	1.8	18.13	1.132	0.1513
1.1	1.0076	1.9	19.14	1.195	0.1598
1.2	1.0080	2.0	20.16	1.259	0.1682
1.2	1.0084	2.1	21.18	1.322	0.1767
1.3	1.0088	2.2	22.19	1.385	0.1852
1.3	1.0092	2.3	23.21	1.449	0.1937
1.4	1.0096	2.4	24.23	1.513	0.2022
1.4	1.0100	2.5	25.25	1.576	0.2107
1.5	1.0104	2.6	26.27	1.640	0.2192
1.5	1.0108	2.7	27.29	1.704	0.2278
1.6	1.0112	2.8	28.31	1.768	0.2363
1.7	1.0116	2.9	29.34	1.831	0.2448
1.7	1.0120	3.0	30.36	1.895	0.2534
1.8	1.0124	3.1	31.38	1.959	0.2619
1.8	1.0128	3.2	32.41	2.023	0.2705
1.9	1.0132	3.3	33.44	2.087	0.2790
1.9	1.0136	3.4	34.46	2.151	0.2876
2.0	1.0140	3.5	35.49	2.216	0.2962
2.1	1.0144	3.6	36.52	2.280	0.3048
2.1	1.0148	3.7	37.55	2.344	0.3133
2.2	1.0152	3.8	38.58	2.408	0.3219
2.2	1.0156	3.9	39.61	2.473	0.3305
2.3	1.0160	4.0	40.64	2.537	0.3392
2.3	1.0164	4.1	41.67	2.601	0.3478
2.4	1.0168	4.2	42.71	2.666	0.3564
2.5	1.0172	4.3	43.74	2.731	0.3650
2.5	1.0176	4.4	44.77	2.795	0.3737
2.6	1.0180	4.5	45.81	2.860	0.3823
2.6	1.0184	4.6	46.85	2.924	0.3909
2.7	1.0188	4.7	47.88	2.989	0.3996
2.7	1.0192	4.8	48.92	3.054	0.4083
2.8	1.0196	4.9	49.96	3.119	0.4169
2.8	1.0200	5.0	51.00	3.184	0.4256
5.6	1.0401	10.0	104.0	6.493	0.8680

TARTARIC ACID

Specific Gravity of Aqueous Tartaric Acid (d) Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $H_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0045	1	10.05	0.6271	0.0838
1.3	1.0090	2	20.18	1.260	0.1684
2.6	1.0179	4	40.72	2.542	0.3398
3.9	1.0273	6	61.64	3.848	0.5144
5.2	1.0371	8	82.97	5.179	0.6924
6.5	1.0469	10	104.7	6.535	0.8737
7.8	1.0565	12	126.8	7.915	1.058
9.0	1.0661	14	149.3	9.317	1.246
10.3	1.0761	16	172.2	10.75	1.437
11.5	1.0865	18	195.6	12.21	1.632
12.8	1.0969	20	219.4	13.70	1.831
14.0	1.1072	22	243.6	15.21	2.033
15.2	1.1175	24	268.2	16.74	2.238
16.5	1.1282	26	293.3	18.31	2.448
17.7	1.1393	28	319.0	19.91	2.662
19.0	1.1505	30	345.2	21.55	2.880
20.2	1.1615	32	371.7	23.20	3.102
21.3	1.1726	34	398.7	24.89	3.327
22.5	1.1840	36	426.2	26.61	3.557
23.8	1.1959	38	454.4	28.37	3.792
25.0	1.2078	40	483.1	30.16	4.032
26.1	1.2198	42	512.3	31.98	4.275
27.3	1.2317	44	541.9	33.83	4.523
28.5	1.2441	46	572.3	35.73	4.776
29.6	1.2568	48	603.3	37.66	5.034
30.8	1.2696	50	634.8	39.63	5.298
32.0	1.2828	52	667.1	41.64	5.567
33.1	1.2961	54	699.9	43.69	5.841
34.3	1.3093	56	733.2	45.77	6.119

ZINC CHLORIDE

Specific Gravity of Aqueous Zinc Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $ZnCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.4	1.0167	2	20.33	1.269	0.1697
4.9	1.0350	4	41.40	2.584	0.3455
7.3	1.0532	6	63.19	3.945	0.5274
9.7	1.0715	8	85.72	5.351	0.7154
11.0	1.0819	10	108.2	6.754	0.9029
14.2	1.1085	12	133.0	8.304	1.110
16.4	1.1275	14	157.9	9.854	1.317
18.6	1.1468	16	183.5	11.45	1.531
20.7	1.1665	18	210.0	13.11	1.752
22.8	1.1866	20	237.3	14.82	1.980
27.9	1.2380	25	309.5	19.32	2.583
32.8	1.2928	30	387.8	24.21	3.237
37.8	1.3522	35	473.3	29.54	3.950
42.7	1.4173	40	566.9	35.39	4.731
47.6	1.4890	45	670.1	41.83	5.592
52.5	1.5681	50	784.1	48.95	6.543
57.4	1.655	55	910.3	56.82	7.596
62.1	1.749	60	1049	65.51	8.757
66.7	1.851	65	1203	75.11	10.05
71.1	1.962	70	1373	85.74	11.46

ZINC CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS ZINC CHLORIDE SOLUTIONS AT $\frac{60°}{60°}$ F. (WHITNEY, HARTLE, SAKRYD)

Bé.	Sp. gr.	Per cent $ZnCl_2$	Weight of 1 cu. ft. in lbs.	Lbs. $ZnCl_2$ in 1 cu. ft.	Per cent 50 per cent $ZnCl_2$	Lbs. 50 per cent $ZnCl_2$ in 1 cu. ft.
0	1.0000	0	62.37	0	0	0
1	1.0069	.76	62.80	.4773	1.52	.9546
2	1.0140	1.53	63.24	.9676	3.06	1.9352
3	1.0211	2.29	63.69	1.4585	4.58	2.9170
4	1.0284	3.05	64.14	1.9563	6.10	3.9126
5	1.0357	3.81	64.60	2.4613	7.62	4.9226
6	1.0432	4.63	65.06	3.0123	9.26	6.0246
7	1.0507	5.45	65.53	3.5714	10.90	7.1428
8	1.0584	6.27	66.01	4.1388	12.54	8.2776
9	1.0662	7.09	66.50	4.7149	14.18	9.4298
10	1.0741	7.91	66.99	5.2980	15.82	10.5978
11	1.0821	8.78	67.49	5.9256	17.56	11.8512
12	1.0902	9.65	68.00	6.5620	19.30	13.1240
13	1.0985	10.52	68.51	7.2073	21.04	14.4146
14	1.1069	11.39	69.04	7.8637	22.78	15.7274
15	1.1154	12.26	69.57	8.5293	24.52	17.0586
16	1.1240	13.21	70.10	9.2602	26.42	18.5204
17	1.1328	14.15	70.65	9.9970	28.30	19.9940
18	1.1417	15.10	71.21	10.7527	30.20	21.5054
19	1.1508	16.04	71.78	11.5135	32.08	23.0270
20	1.1600	16.98	72.35	12.2850	33.96	24.5700
21	1.1694	17.96	72.94	13.1000	35.92	26.2000
22	1.1789	18.94	73.53	13.9266	37.88	27.8532
23	1.1885	19.92	74.13	14.7667	39.84	29.5334
24	1.1983	20.90	74.74	15.6207	41.80	31.2414
25	1.2083	21.88	75.36	16.4888	43.76	32.9776
26	1.2185	22.88	76.00	17.3888	45.76	34.7776
27	1.2288	23.88	76.64	18.3016	47.76	36.6032
28	1.2393	24.89	77.30	19.2400	49.78	38.4800
29	1.2500	25.89	77.96	20.1838	51.78	40.3676
30	1.2609	26.90	78.64	21.1542	53.80	42.3084
31	1.2719	27.91	79.33	22.1410	55.82	44.2820
32	1.2832	28.91	80.03	23.1367	57.82	46.2734
33	1.2946	29.92	80.74	24.1574	59.84	48.3148
34	1.3063	30.93	81.47	25.1987	61.86	50.3974
35	1.3182	31.93	82.22	26.2528	63.86	52.5056
36	1.3303	32.94	82.97	27.3303	65.88	54.6606
37	1.3426	33.95	83.74	28.4297	67.90	56.8594
38	1.3551	34 96	84.52	29.5482	69.92	59.0964
39	1.3679	35.97	85.32	30.6896	71.94	61.3792
40	1.3810	36.98	86.13	31.8509	73.96	63.7018
41	1.3942	38.02	86.96	33.0622	76.04	66.1244
42	1.4078	39.05	87.80	34.2859	78.10	68.5718
43	1.4216	40.09	88.67	35.5478	80.18	71.0956
44	1.4356	41.12	89.54	36.8188	82.24	73.6376
45	1.4500	42.16	90.44	38.1295	84.32	76.2590
46	1.4646	43.21	91.35	39.4723	86.42	78.9446
47	1.4796	44.26	92.28	40.8431	88.52	81.6862
48	1.4948	45.32	93.23	42.2518	90.64	84.5036
49	1.5104	46.37	94.20	43.6805	92.74	87.3610
50	1.5263	47.43	95.20	45.1534	94.86	90.3068
51	1.5426	48.48	96.21	46.6426	96.96	93.2852
52	1.5591	49.54	97.24	48.1727	99.08	96.3454

ZINC CHLORIDE (Continued)

Specific Gravity of Aqueous Zinc Chloride Solutions at $\frac{60°}{60°}$ F. (Whitney, Hartle, Sakryd)

Bé.	Sp. gr.	Per cent $ZnCl_2$	Weight of 1 cu. ft. in lbs.	Lbs. $ZnCl_2$ in 1 cu. ft.	Per cent 50 per cent $ZnCl_2$	Lbs. 50 per cent $ZnCl_2$ in 1 cu. ft.
53	1.5761	50.60	98.30	49.7398	101.20	99.4796
54	1.5934	51.66	99.38	51.3397	103.32	102.6794
55	1.6111	52.72	100.48	52.9731	105.44	105.9462
56	1.6292	53.80	101.61	54.6662	107.60	109.3324
57	1.6477	54.88	102.77	56.4002	109.76	112.8004
58	1.6667	55.97	103.95	58.1808	111.94	116.3616
59	1.6860	57.06	105.16	60.0043	114.12	120.0086
60	1.7059	58.15	106.40	61.8716	116.30	123.7432
61	1.7262	59.23	107.66	63.7670	118.46	127.5340
62	1.7470	60.30	108.96	65.7029	120.60	131.4058
63	1.7683	61.37	110.29	67.6850	122.74	135.3700
64	1.7901	62.44	111.65	69.7143	124.88	139.4286
65	1.8125	63.52	113.05	71.8094	127.04	143.6188
66	1.8354	64.68	114.47	74.0392	129.36	148.0784
67	1.8590	65.85	115.95	76.3531	131.70	152.7062
68	1.8831	67.02	117.45	78.7150	134.04	157.4300
69	1.9079	68.19	119.90	81.1461	136.38	162.2922
70	1.9333	69.36	120.58	83.6343	138.72	167.2696

FIXED POINTS*

Bé.	Sp. gr.	Per cent $ZnCl_2$
5.08	1.0363	3.88
10.16	1.0754	8.05
15.35	1.1184	12.59
20.35	1.1633	17.32
25.14	1.1707	22.02
30.00	1.2609	26.90
35.07	1.3190	32.00
40.15	1.3829	37.14
44.99	1.4499	42.15
50.14	1.5285	47.58
55.05	1.6120	52.77
60.13	1.7085	58.29
65.11	1.8150	63.65
70.05	1.9345	69.42

APPROXIMATE ALLOWANCE FOR TEMPERATURE

$$\left.\begin{array}{lll} \text{At } 5° \text{ Bé.} & = 0.024° \text{ Bé.} \\ \text{“ } 10° \text{ “} & = 0.029° \text{ “} \\ \text{“ } 15° \text{ “} & = 0.029° \text{ “} \\ \text{“ } 20° \text{ “} & = 0.033° \text{ “} \\ \text{“ } 25° \text{ “} & = 0.033° \text{ “} \\ \text{“ } 30° \text{ “} & = 0.033° \text{ “} \\ \text{“ } 35° \text{ “} & = 0.033° \text{ “} \\ \text{“ } 40° \text{ “} & = 0.033° \text{ “} \\ \text{“ } 45° \text{ “} & = 0.033° \text{ “} \\ \text{“ } 50° \text{ “} & = 0.030° \text{ “} \\ \text{“ } 55° \text{ “} & = 0.028° \text{ “} \\ \text{“ } 60° \text{ “} & = 0.027° \text{ “} \\ \text{“ } 65° \text{ “} & = 0.027° \text{ “} \\ \text{“ } 70° \text{ “} & = 0.024° \text{ “} \end{array}\right\} \text{For each } 1° \text{ Fahrenheit}$$

* The percentage composition on all fixed points were determined by actual chemical analysis, both Zinc and Chlorine being determined.

ZINC NITRATE

Specific Gravity of Aqueous Zinc Nitrate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Zn(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.2	1.0154	2	20.31	1.268	0.1695
4.5	1.0322	4	41.29	2.577	0.3446
6.9	1.0496	6	62.98	3.931	0.5256
9.2	1.0675	8	85.40	5.331	0.7127
11.5	1.0859	10	108.6	6.779	0.9062
13.8	1.1048	12	132.6	8.276	1.106
16.0	1.1244	14	157.4	9.827	1.314
18.3	1.1445	16	183.1	11.43	1.528
20.6	1.1652	18	209.7	13.09	1.750
22.8	1.1865	20	237.3	14.81	1.980
28.3	1.2427	25	310.7	19.39	2.593
33.7	1.3029	30	390.9	24.40	3.262
39.0	1.3678	35	478.7	29.89	3.995
44.2	1.4378	40	575.1	35.90	4.799
49.2	1.5134	45	681.0	42.51	5.683
54.1	1.5944	50	797.2	49.77	6.653

ZINC NITRATE

Specific Gravity of Aqueous Zinc Nitrate Solutions at 17.5° (Franz)

Bé.	Sp. gr.	Per cent $Zn(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0099	1	10.10	0.6305	0.0843
2.8	1.0198	2	20.40	1.273	0.1702
4.2	1.0297	3	30.89	1.928	0.2578
5.5	1.0396	4	41.58	2.596	0.3470
6.9	1.0496	5	52.48	3.276	0.4380
8.1	1.0590	6	63.54	3.967	0.5303
9.3	1.0684	7	74.79	4.669	0.6241
10.5	1.0778	8	86.22	5.383	0.7196
11.6	1.0872	9	97.85	6.108	0.8166
12.8	1.0968	10	109.7	6.847	0.9153
14.0	1.1070	11	121.8	7.602	1.016
15.2	1.1172	12	134.1	8.369	1.119
16.4	1.1274	13	146.6	9.149	1.223
17.5	1.1376	14	159.3	9.942	1.329
18.6	1.1476	15	172.1	10.75	1.437
19.9	1.1586	16	185.4	11.57	1.547
21.0	1.1696	17	198.8	12.41	1.659
22.2	1.1806	18	212.5	13.27	1.773
23.3	1.1916	19	226.4	14.13	1.889
24.4	1.2024	20	240.5	15.01	2.007
25.6	1.2147	21	255.1	15.92	2.129
26.8	1.2270	22	269.9	16.85	2.253
28.0	1.2393	23	285.0	17.79	2.379
29.1	1.2516	24	300.4	18.75	2.507
30.3	1.2640	25	316.0	19.73	2.637
31.4	1.2766	26	331.9	20.72	2.770
32.5	1.2892	27	348.1	21.73	2.905
33.6	1.3018	28	364.5	22.75	3.042
34.7	1.3144	29	381.2	23.80	3.181
35.7	1.3268	30	398.0	24.85	3.322
36.8	1.3396	31	415.3	25.92	3.466
37.8	1.3524	32	432.8	27.02	3.612
38.8	1.3652	33	450.5	28.12	3.760
39.8	1.3780	34	468.5	29.25	3.910
40.7	1.3906	35	486.7	30.38	4.062
41.7	1.4039	36	505.4	31.55	4.218
42.7	1.4172	37	524.4	32.73	4.376
43.6	1.4305	38	543.6	33.93	4.536
44.6	1.4438	39	563.1	35.15	4.699
45.5	1.4572	40	582.9	36.39	4.864
46.4	1.4707	41	603.0	37.64	5.032
47.3	1.4844	42	623.4	38.92	5.203
48.2	1.4981	43	644.2	40.21	5.376
49.1	1.5118	44	665.2	41.53	5.551
50.0	1.5258	45	686.6	42.86	5.730
50.9	1.5403	46	708.5	44.23	5.913
51.7	1.5548	47	730.8	45.62	6.098
52.6	1.5693	48	753.3	47.02	6.286
53.4	1.5838	49	776.1	48.45	6.476
54.3	1.5984	50	799.2	49.89	6.669

ZINC SULFATE

Specific Gravity of Aqueous Zinc Sulfate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $ZnSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.7	1.0190	2	20.38	1.272	0.1701
5.6	1.0403	4	41.61	2.598	0.3473
8.5	1.0620	6	63.72	3.978	0.5318
11.3	1.0842	8	86.74	5.415	0.7238
14.0	1.1071	10	110.7	6.911	0.9239
16.8	1.1308	12	135.7	8.471	1.132
19.5	1.1553	14	161.7	10.10	1.350
22.2	1.1806	16	188.9	11.79	1.576

Bé.	Sp. gr.	Per cent $ZnSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.7	1.0190	3.562	36.30	2.266	0.3030
5.6	1.0403	7.125	74.12	4.627	0.6185
8.5	1.0620	10.69	113.5	7.085	0.9472
11.3	1.0842	14.25	154.5	9.645	1.289
14.0	1.1071	17.81	197.2	12.31	1.646
16.8	1.1308	21.37	241.7	15.09	2.017
19.5	1.1533	24.94	288.1	17.99	2.404
22.2	1.1806	28.50	336.5	21.00	2.808

ZINC SULFATE

Specific Gravity of Aqueous Zinc Sulfate Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $ZnSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
1.9	1.013	2	20.26	1.265	0.1691
2.7	1.019	3	30.57	1.908	0.2551
3.4	1.024	4	40.96	2.557	0.3418
4.1	1.029	5	51.45	3.212	0.4294
4.9	1.035	6	62.10	3.877	0.5182
5.7	1.041	7	72.87	4.549	0.6081
6.5	1.047	8	83.76	5.229	0.6990
7.3	1.053	9	94.77	5.916	0.7909
8.1	1.059	10	105.9	6.611	0.8838
9.0	1.066	11	117.3	7.320	0.9786
9.9	1.073	12	128.8	8.038	1.075
10.6	1.079	13	140.3	8.757	1.171
11.4	1.085	14	151.9	9.483	1.268
12.1	1.091	15	163.7	10.22	1.366
12.8	1.097	16	175.5	10.96	1.465
13.5	1.103	17	187.5	11.71	1.565
14.4	1.110	18	199.8	12.47	1.667
15.1	1.116	19	212.0	13.24	1.770
16.0	1.124	20	224.8	14.03	1.876
16.7	1.130	21	237.3	14.81	1.980
17.5	1.137	22	250.1	15.62	2.087
18.1	1.143	23	262.9	16.41	2.194
18.9	1.150	24	276.0	17.23	2.303
19.7	1.157	25	289.3	18.06	2.414
20.4	1.164	26	302.6	18.89	2.526
21.2	1.171	27	316.2	19.74	2.639
22.0	1.179	28	330.1	20.61	2.755
22.6	1.185	29	343.7	21.45	2.868
23.5	1.193	30	357.9	22.34	2.987
24.2	1.200	31	372.0	23.22	3.104
25.1	1.209	32	386.9	24.15	3.229
25.8	1.216	33	401.3	25.05	3.349
26.5	1.224	34	416.2	25.98	3.473
27.2	1.231	35	430.9	26.90	3.560
28.1	1.240	36	446.4	27.87	3.725
28.6	1.246	37	461.0	28.78	3.847
29.5	1.255	38	476.9	29.77	3.980
30.2	1.263	39	492.6	30.75	4.111
30.9	1.271	40	508.4	31.74	4.243
31.7	1.280	41	524.8	32.76	4.380
32.4	1.288	42	541.0	33.77	4.514
33.0	1.295	43	556.9	34.76	4.647
33.8	1.304	44	573.8	35.82	4.788
34.3	1.310	45	589.5	36.80	4.920
35.2	1.320	46	607.2	37.91	5.067
36.0	1.330	47	625.1	39.02	5.217
36.6	1.337	48	641.8	40.06	5.356
37.3	1.346	49	659.5	41.17	5.504
37.8	1.353	50	676.5	42.23	5.646
38.5	1.362	51	694.6	43.36	5.797
39.2	1.370	52	712.4	44.47	5.945
39.9	1.380	53	731.4	45.66	6.104
40.7	1.390	54	750.6	46.86	6.264
41.4	1.399	55	769.5	48.03	6.421
41.9	1.406	56	787.4	49.15	6.571
42.6	1.416	57	807.1	50.39	6.736
43.2	1.425	58	826.5	51.60	6.897
44.0	1.435	59	846.7	52.85	7.065
44.7	1.445	60	867.0	54.12	7.235

ZINC SULFATE (Continued)

Specific Gravity of Aqueous Zinc Sulfate Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $ZnSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	0.56	5.648	0.3526	0.0471
1.9	1.013	1.12	11.37	0.7101	0.0949
2.7	1.019	1.68	17.16	1.071	0.1432
3.4	1.024	2.25	23.00	1.436	0.1919
4.1	1.029	2.81	28.89	1.803	0.2411
4.9	1.035	3.37	34.86	2.177	0.2910
5.7	1.041	3.93	40.91	2.554	0.3414
6.5	1.047	4.49	47.03	2.936	0.3924
7.3	1.053	5.05	53.21	3.322	0.4440
8.1	1.059	5.61	59.46	3.712	0.4962
9.0	1.066	6.18	65.83	4.110	0.5494
9.9	1.073	6.74	72.29	4.513	0.6033
10.6	1.079	7.30	78.75	4.916	0.6572
11.4	1.085	7.86	85.28	5.324	0.7117
12.0	1.091	8.42	91.88	5.736	0.7667
12.8	1.097	8.98	98.54	6.152	0.8224
13.5	1.103	9.54	105.3	6.572	0.8786
14.4	1.110	10.1	112.2	7.003	0.9361
15.1	1.116	10.7	119.0	7.432	0.9935
16.0	1.124	11.2	126.2	7.879	1.053
16.7	1.130	11.8	133.2	8.317	1.112
17.5	1.137	12.4	140.4	8.767	1.172
18.1	1.143	12.9	147.6	9.214	1.232
18.9	1.150	13.5	155.0	9.673	1.293
19.7	1.157	14.0	162.4	10.14	1.355
20.4	1.164	14.6	169.9	10.61	1.418
21.2	1.171	15.2	177.5	11.08	1.481
22.0	1.179	15.7	185.3	11.57	1.547
22.6	1.185	16.3	192.9	12.04	1.610
23.5	1.193	16.8	200.9	12.54	1.677
24.2	1.200	17.4	208.9	13.04	1.743
25.1	1.209	18.0	217.2	13.56	1.813
25.8	1.216	18.5	225.3	14.06	1.880
26.5	1.224	19.1	233.6	14.59	1.950
27.2	1.231	19.7	241.9	15.10	2.019
28.1	1.240	20.2	250.6	15.65	2.092
28.6	1.246	20.8	258.8	16.16	2.160
29.5	1.255	21.3	267.7	16.71	2.234
30.2	1.263	21.9	276.5	17.26	2.308
30.9	1.271	22.5	285.4	17.82	2.382
31.7	1.280	23.0	294.6	18.39	2.459
32.4	1.288	23.6	303.7	18.96	2.535
33.0	1.295	24.1	312.6	19.52	2.609
33.8	1.304	24.7	322.1	20.11	2.688
34.3	1.310	25.3	331.0	20.66	2.762
35.2	1.320	25.8	340.9	21.28	2.845
36.0	1.330	26.4	350.9	21.91	2.929
36.6	1.337	26.9	360.3	22.49	3.007
37.3	1.346	27.5	370.3	23.12	3.090
37.8	1.353	28.1	379.8	23.71	3.170
38.5	1.362	28.6	390.0	24.35	3.254
39.2	1.370	29.2	400.0	24.97	3.338
39.9	1.380	29.8	410.6	25.63	3.427
40.7	1.390	30.3	421.4	26.31	3.517
41.4	1.399	30.9	432.0	26.97	3.605
41.9	1.406	31.4	442.0	27.60	3.689
42.6	1.416	32.0	453.1	28.29	3.782
43.2	1.425	32.6	464.0	28.97	3.872
44.0	1.435	33.1	475.3	29.67	3.967
44.7	1.445	33.7	486.8	30.39	4.062

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

The Specific Gravity of Aqueous Solutions Expressed in Grams of the Substance Shown by the Formula per 100 Grams of the Aqueous Solution

Per cent by weight	$AgNO_3$ $20°/4°$ C.	$Al(NO_3)_3$ $18°/4°$ C.	$AuCl_3$ $15°/4°$ C.	$Ba(C_2H_3O_2)_2$ $18°/4°$ C.	$BaBr_2$ $20°/4°$ C.
1	1.0070	1.0065	1.0060	1.0059	......
2	1.0154	1.0144	1.0132	1.0133	1.0156
3	......	......	......	......	......
4	1.0327	1.0305	1.0281	1.0282	1.0335
5	......	......	......	......	......
6	1.0506	1.0469	1.0434	1.0433	1.0519
7	......	......	......	......	......
8	1.0690	1.0638	1.0591	1.0587	1.0710
9	......	......	......	......	......
10	1.0882	1.0811	1.0750	1.0745	1.0907
11	......	......	......	......	......
12	1.1080	1.0989	......	1.0908	1.1111
13	......	......	......	......	......
14	1.1284	1.1171	......	1.1075	1.1323
15	......	......	......	......	......
16	1.1495	1.1357	......	1.1246	1.1543
17	......	......	......	......	......
18	1.1715	1.1549	......	1.1421	1.1770
19	......	......	......	......	......
20	1.1942	1.1745	......	1.1599	1.2006
21	......	......	......	......	......
22	......	1.1946	......	1.1782	......
23	......	......	......	......	......
24	......	1.2153	......	1.1970	......
25	1.2545	......	......	......	1.2634
26	......	1.2365	......	1.2161	.....
27	......	......	......	......	.....
28	......	1.2582	......	1.2356	......
29	......	......	......	......	......
30	1.3205	1.2805	......	1.2554	1.3325
31	......	......	......	......	......
32	......	1.3036	......	......	......
33	......	......	......	......	......
34	......	......	......	......	......
35	1.3931	......	......	1.3069	1.4087
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	1.4743	......	......	1.3608	1.4926
42	......	......	......	......	......
44	......	......	......	......	......
45	1.565	......	......	......	......
46	......	......	......	......	......
48	......	......	......	......	......
50	1.668	......	......	......	......
55	1.786	......	......	......	......
60	1.916	......	......	......	......
65	......	......	......	......	......
70	2.2333	......	......	......	......
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	BaI_2 $\frac{20°}{4°}$ C.	$Ba(NO_3)_2$ $\frac{18°}{4°}$ C.	$C_{12}H_{22}O_{11}$ Sucrose $\frac{20°}{4°}$ C.	$CaBr_2$ $\frac{20°}{4°}$ C.	$Ca(C_2H_3O_2)_2$ $\frac{18°}{4°}$ C.
1	......	......	1.0021	......	1.0043
2	1.0154	1.0151	1.0060	1.0152	1.0100
3	......	......	1.0099	......	......
4	1.0331	1.0320	1.0139	1.0326	1.0215
5	......	......	1.0179	......	......
6	1.0513	1.0494	1.0219	1.0504	1.0331
7	......	......	1.0259	......	......
8	1.0701	1.0674	1.0299	1.0688	1.0447
9	......	......	1.0340	......	......
10	1.0896	......	1.0381	1.0877	1.0563
11	......	......	1.0423	......	......
12	1.1099	......	1.0465	1.1071	1.0679
13	......	......	1.0507	......	......
14	1.1308	......	1.0549	1.1272	1.0795
15	......	......	1.0592	......	......
16	1.1525	......	1.0635	1.1480	1.0912
17	......	......	1.0678	......	......
18	1.1750	......	1.0722	1.1696	1.1029
19	......	......	1.0765	......	......
20	1.1984	......	1.0810	1.1919	1.1146
21	......	......	1.0854	......	......
22	......	......	1.0899	......	1.1263
23	......	......	1.0944	......	......
24	......	......	1.0990	......	......
25	1.2610	......	1.1036	1.2499	......
26	......	......	1.1082	......	......
27	......	......	1.1128	......	......
28	......	......	1.1175	......	......
29	......	......	1.1222	......	......
30	1.3289	......	1.1270	1.3125	......
31	......	......	1.1317	......	......
32	......	......	1.1366	......	......
33	......	......	1.1415	......	......
34	......	......	1.1464	......	......
35	1.404	......	1.1513	1.381	......
36	......	......	1.1563	......	......
37	......	......	1.1612	......	......
38	......	......	1.1663	......	......
39	......	......	1.1713	......	......
40	1.490	......	1.1765	1.457	......
42	......	......	1.1868	......	......
44	......	......	1.1973	......	......
45	1.587	......	1.2025	1.541	......
46	......	......	1.2079	......	......
48	......	......	1.2186	......	......
50	1.698	......	1.2296	1.635	......
55	1.825	......	1.2575	......	......
60	1.970	......	1.2865	......	......
65	......	......	1.3163	......	......
70	......	......	1.3472	......	......
75	......	......	1.3790	......	......
80	......	......	1.4117	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	CaI_2 $\frac{20°}{4°}$ C	$Ca(NO_3)_2$ $\frac{18°}{4°}$ C.	$CdBr_2$ $\frac{20°}{4°}$ C.	$CdCl_2$ $\frac{20°}{4°}$ C.	CdI_2 $\frac{20°}{4°}$ C.
1	......	......	......	......	......
2	1.0150	1.0137	1.0158	1.0159	1.0153
3	......	......	......	......	......
4	1.0323	1.0291	1.0339	1.0339	1.0328
5	......	......	......	......	......
6	1.0500	1.0448	1.0524	1.0524	1.0507
7	......	......	......	......	......
8	1.0683	1.0608	1.0714	1.0715	1.0690
9	......	......	......	......	......
10	1.0873	1.0771	1.0910	1.0912	1.0879
11	......	......	......	......	......
12	1.1069	1.0937	1.1112	1.1115	1.1075
13	......	......	......	......	......
14	1.1273	1.1106	1.1322	1.1324	1.1278
15	......	......	......	......	......
16	1.1485	1.1279	1.1540	1.1540	1.1489
17	......	......	......	......	......
18	1.1703	1.1455	1.1766	1.1762	1.1709
19	......	......	......	......	......
20	1.1928	1.1636	1.2000	1.1992	1.1937
21	......	......	......	......	......
22	......	......	......	......	......
23	......	......	......	......	......
24	......	......	......	......	......
25	1.2530	1.2106	1.2605	1.2604	1.2546
26	......	......	......	......	......
27	......	......	......	......	......
28	......	......	......	......	......
29	......	......	......	......	......
30	1.3195	1.260	1.3286	1.3273	1.3219
31	......	......	......	......	......
32	......	......	......	......	......
33	......	......	......	......	......
34	......	......	......	......	......
35	1.3928	1.311	1.4049	1.4010	1.3967
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	1.4734	1.365	1.4902	1.4833	1.4801
42	......	......	......	......	......
44	......	......	......	......	......
45	......	1.422	......	1.5748	1.5726
46	......	......	......	......	......
48	......	......	......	......	......
50	......	......	......	1.6762	......
55	......	......	......	......	......
60	......	......	......	......	......
65	......	......	......	......	......
70	......	......	......	......	......
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$CdSO_4$ $\frac{18°}{4°}$ C.	$CoCl_2$ $\frac{20°}{4°}$ C.	$Co(NO_3)_2$ $\frac{20°}{4°}$ C.	HBr $\frac{20°}{4°}$ C.	$HClO_4$ $\frac{15°}{4°}$ C.
1	1.0086	1.0073	1.0064	1.0053	1.0050
2	1.0182	1.0165	1.0145	1.0124	1.0109
3	......	......	......	......	......
4	1.0383	1.0350	1.0315	1.0269	1.0228
5	......	......	......	......	......
6	1.0590	1.0538	1.0485	1.0417	1.0348
7	......	......	......	......	......
8	1.0803	1.0735	1.0660	1.0568	1.0471
9	......	......	......	......	......
10	1.1023	1.0940	1.084	1.0723	1.0597
11	......	......	......	......	......
12	1.1250	1.1150	1.103	1.0883	1.0726
13	......	......	......	......	......
14	1.1485	1.1365	1.122	1.1048	1.0859
15	......	......	......	......	......
16	1.1729	1.1585	1.142	1.1219	1.0995
17	......	......	......	......	......
18	1.1982	1.1815	1.163	1.1396	1.1135
19	......	......	......	......	......
20	1.2243	1.2050	1.184	1.1579	1.1279
21	......	......	......	......	......
22	......	......	......	1.1767	1.1428
23	......	......	......	......	......
24	......	......	......	1.1961	1.1581
25	1.2940	......	1.239	......	......
26	......	......	......	1.2161	1.1738
27	......	......	......	......	......
28	......	......	......	1.2367	1.1900
29	......	......	......	......	......
30	1.3714	......	1.299	1.2580	1.2067
31	......	......	......	......	......
32	......	......	......	......	1.2239
33	......	......	......	......	......
34	......	......	......	......	1.2418
35	1.4551	......	......	1.3150	......
36	......	......	......	......	1.2603
37	......	......	......	......	......
38	......	......	......	......	1.2794
39	......	......	......	......	......
40	1.5470	......	......	1.3772	1.2991
42	......	......	......	......	......
44	......	......	......	......	......
45	......	......	......	1.4446	1.3521
46	......	......	......	......	......
48	......	......	......	......	......
50	......	......	......	1.5173	1.4103
55	......	......	......	1.5953	1.4733
60	......	......	......	1.6787	1.5389
65	......	......	......	1.7675	1.6059
70	......	......	......	......	1.6736
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	HF $\frac{20°}{4°}$ C.	HI $\frac{20°}{4°}$ C.	HIO_3 $\frac{18°}{4°}$ C.	HIO_4 $\frac{17°}{4°}$ C.	H_2O_2 $\frac{18°}{4°}$ C.
1	......	1.0054	1.0071	1.0076	1.0022
2	......	1.0127	1.0157	1.0165	1.0058
3	......	......	......	......	......
4	......	1.0277	1.0334	1.0349	1.0131
5	1.017	......	......	......	......
6	......	1.0431	1.0517	1.0539	1.0204
7	......	......	......	......	......
8	......	1.0589	1.0706	1.0737	1.0277
9	......	......	......	......	......
10	1.035	1.0751	1.0900	1.0944	1.0351
11	......	......	......	......	......
12	......	1.0918	1.1100	1.1161	1.0425
13	......	......	......	......	......
14	......	1.1091	1.1306	1.1388	1.0499
15	1.053	......	......	......	......
16	......	1.1270	1.1519	1.1623	1.0574
17	......	......	......	......	......
18	......	1.1456	1.1740	1.1865	1.0649
19	......	......	......	......	......
20	1.070	1.1649	1.1969	1.2116	1.0725
21	......	......	......	......	......
22	......	1.1850	1.2206	1.2376	1.0802
23	......	......	......	......	......
24	......	1.2059	1.2450	1.2647	1.0880
25	1.086	......	......	......	......
26	......	1.2277	1.2700	1.2931	1.0959
27	......	......	......	......	......
28	......	1.2503	1.2956	1.3230	1.1040
29	......	......	......	......	......
30	1.101	1.2737	1.3218	1.3545	1.1122
31	......	......	......	......	......
32	......	......	......	1.3875	......
33	......	......	......	......	......
34	......	......	......	......	......
35	1.116	1.3357	1.3900	......	1.1327
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	1.130	1.4029	1.4640	......	1.1536
42	......	......	......	......	......
44	......	......	......	......	......
45	1.143	1.4755	......	......	1.1749
46	......	......	......	......	......
48	......	......	......	......	......
50	1.155	......	......	......	1.1966
55	......	......	......	......	1.2188
60	......	......	......	......	1.2416
65	......	......	......	......	1.2652
70	......	......	......	......	1.2897
75	......	......	......	......	1.3149
80	......	......	......	......	1.3406

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	H_2SeO_4 $\frac{20°}{4°}$ C.	$HgCl_2$ $\frac{20°}{4°}$ C.	$KC_2H_3O_2$ $\frac{18°}{4°}$ C.	$KBrO_3$ $\frac{20°}{4°}$ C.	$KClO_3$ $\frac{20°}{4°}$ C.
1	1.0059	1.0065	1.0038	1.0056	1.0045
2	1.0136	1.0150	1.0089	1.0131	1.0109
3	......	1.0236	......	1.0206	1.0174
4	1.0291	1.0323	1.0191	1.0282	1.0241
5	......	1.0411	......	1.0359	......
6	1.0447	......	1.0293	......	......
7	......	......	......	......	......
8	1.0605	......	1.0395	......	......
9	......	......	......	......	......
10	1.0766	......	1.0497	......	......
11	......	......	......	......	......
12	1.0931	......	1.0599	......	......
13	......	......	......	......	......
14	1.1101	......	1.0703	......	......
15	......	......	......	......	......
16	1.1276	......	1.0808	......	......
17	......	......	......	......	......
18	1.1455	......	1.0914	......	......
19	......	......	......	......	......
20	1.1639	......	1.1022	......	......
21	......	......	......	......	......
22	1.1829	......	1.1131	......	......
23	......	......	......	......	......
24	1.2026	......	1.1241	......	......
25	......	......	......	......	......
26	1.2229	......	1.1353	......	......
27	......	......	......	......	......
28	1.2438	......	1.1466	......	......
29	......	......	......	......	......
30	1.2653	......	1.1579	......	......
31	......	......	......	......	......
32	1.2874	......	......	......	......
33	......	......	......	......	......
34	1.3101	......	......	......	......
35	......	......	1.1868	......	......
36	1.3334	......	......	......	......
37	......	......	......	......	......
38	1.3573	......	......	......	......
39	......	......	......	......	......
40	1.3819	......	1.2162	......	......
42	......	......	......	......	......
44	1.4073	......	......	......	......
45	1.4336	......	1.2460	......	......
46	1.4609	......	......	......	......
48	1.4892	......	......	......	......
50	1.5186	......	1.2761	......	......
55	......	......	1.3065	......	......
60	1.6850	......	1.3372	......	......
65	......	......	......	......	......
70	1.8870	......	......	......	......
75	......	......	......	......	......
80	2.1220	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	KF $\frac{18°}{4°}$ C.	$KHSO_4$ $\frac{20°}{4°}$ C.	$K_3Fe(CN)_6$ $\frac{20°}{4°}$ C.	$K_4Fe(CN)_6$ $\frac{20°}{4°}$ C.	KIO_3 $\frac{20°}{4°}$ C.
1	1.0072	1.0051	1.0034	1.0051	1.0068
2	1.0159	1.0120	1.0090	1.0119	1.0155
3	......	......	......	......	1.0243
4	1.0334	1.0260	1.0201	1.0256	......
5	......	......	......	......	......
6	1.0512	1.0403	1.0314	1.0395	......
7	......	......	......	......	......
8	1.0693	1.0549	1.0427	1.0536	......
9	......	......	......	......	......
10	1.0877	1.0698	1.0542	1.0678	......
11	......	......	......	......	......
12	1.1064	1.0850	1.0656	1.0823	......
13	......	......	......	......	......
14	1.1254	1.1004	1.0774	1.0971	......
15	......	......	......	......	......
16	1.1448	1.1161	1.0890	1.1120	......
17	......	......	......	......	......
18	1.1646	......	1.1010	......	......
19	......	......	......	......	......
20	1.1847	......	1.1130	.....	......
21	......	......	......	......	......
22	1.2052	......	......	......	......
23	......	......	......	......	......
24	1.2260	......	......	......	......
25	......	......	......	......	......
26	1.2471	......	......	......	......
27	......	......	......	......	......
28	......	......	......	......	......
29	......	......	......	......	......
30	......	......	......	......	......
31	......	......	......	......	......
32	......	......	......	......	......
33	......	......	......	......	......
34	......	......	......	......	......
35	......	......	......	......	......
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	......	......	......	......	......
42	......	......	......	......	......
44	......	......	......	......	......
45	......	......	......	......	......
46	......	......	......	......	......
48	......	......	......	......	......
50	......	......	......	......	......
55	......	......	......	......	......
60	......	......	......	......	......
65	......	......	......	......	......
70	......	......	......	......	......
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	LiBr $\frac{20°}{4°}$ C.	LiCl $\frac{20°}{4°}$ C.	LiI $\frac{20°}{4°}$ C.	Li_2SO_4 $\frac{20°}{4°}$ C.	$MgBr_2$ $\frac{20°}{4°}$ C.
1	1.0055	1.0041	1.0056	1.0068	......
2	1.0128	1.0099	1.0131	1.0155	1.0151
3	......	......	......	......	......
4	1.0277	1.0215	1.0284	1.0329	1.0324
5	......	......	......	......	......
6	1.0429	1.0330	1.0442	1.0505	1.0501
7	......	......	......	......	......
8	1.0585	1.0444	1.0604	1.0684	1.0683
9	......	......	......	......	......
10	1.0746	1.0559	1.0771	1.0863	1.0871
11	......	......	......	......	......
12	1.0910	1.0675	1.0943	1.1044	1.1065
13	......	......	......	......	......
14	1.1079	1.0792	1.1120	1.1228	1.1265
15	......	......	......	......	......
16	1.1253	1.0910	1.1303	1.1411	1.1471
17	......	......	......	......	......
18	1.1432	1.1029	1.1492	1.1599	1.1683
19	......	......	......	......	......
20	1.1616	1.1150	1.1688	1.1789	1.1903
21	......	......	......	......	......
22	1.1806	1.1274	1.1890	1.1984	......
23	......	......	......	......	......
24	1.2002	1.1399	1.2099	1.2182	......
25	......	......	......	......	1.2482
26	1.2205	1.1527	1.2315	......	......
27	......	......	......	......	......
28	1.2414	1.1658	1.2540	......	......
29	......	......	......	......	......
30	1.2629	1.1791	1.2772	......	1.3110
31	......	......	......	......	......
32	......	......	......	......	......
33	......	......	......	......	......
34	......	......	......	......	......
35	1.3204	......	1.3393	......	1.3790
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	1.3836	......	1.4078	......	1.452
42	......	......	......	......	......
44	......	......	......	......	......
45	1.4535	......	1.4840	......	1.5320
46	......	......	......	......	......
48	......	......	......	......	......
50	......	......	1.5692	......	......
55	......	......	1.6654	......	......
60	......	......	1.7748	......	......
65	......	......	......	......	......
70	......	......	......	......	......
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	MgI_2 $\frac{20°}{4°}$ C.	$Mg(NO_3)_2$ $\frac{20°}{4°}$ C.	$MnBr_2$ $\frac{18°}{4°}$ C.	$MnCl_2$ $\frac{18°}{4°}$ C.
1	......	......	1.0071	1.0069
2	1.0149	1.0132	1.0157	1.0153
3	......	......	......	......
4	1.0321	1.0285	1.0332	1.0324
5	......	......	......	......
6	1.0498	1.0441	1.0511	1.0498
7	......	......	......	......
8	1.0680	1.0600	1.0695	1.0676
9	......	......	......	......
10	1.0869	1.0762	1.0886	1.0859
11	......	......	......	......
12	1.1065	1.0928	1.1083	1.1046
13	......	......	......	......
14	1.1268	1.1098	1.1287	1.1238
15	......	......	......	......
16	1.1478	1.1272	1.1498	1.1435
17	......	......	......	......
18	1.1695	1.1449	1.1716	1.1638
19	......	......	......	......
20	1.1920	1.1630	1.1942	1.1846
21	......	......	......	......
22	......	1.1815	1.2176	1.2061
23	......	......	......	......
24	......	1.2004	1.2419	1.2283
25	1.2519	......	......	......
26	......	......	1.2672	1.2511
27	......	......	......	......
28	......	......	1.2934	1.2746
29	......	......	......	......
30	1.3180	......	1.3206	1.2988
31	......	......	......	......
32	......	......	1.3489	......
33	......	......	......	......
34	......	......	......	......
35	1.3914	......	......	......
36	......	......	......	......
37	......	......	......	......
38	......	......	......	......
39	......	......	......	......
40	1.4730	......	......	......
42	......	......	......	......
44	......	......	......	......
45	......	......	......	......
46	......	......	......	......
48	......	......	......	......
50	......	......	......	......
55	......	......	......	......
60	......	......	......	......
65	......	......	......	......
70	......	......	......	......
75	......	......	......	......
80	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$Mn(NO_3)_2$ $\frac{18° C.}{4°}$	$MnSO_4$ $\frac{20° C.}{4°}$	NH_4Br $\frac{25° C.}{4°}$	$NH_4C_2H_3O_2$ $\frac{25° C.}{4°}$
1	1.0063	1.0080	1.0027	0.9992
2	1.0140	1.0178	1.0084	1.0013
3	......	......	......	......
4	1.0298	1.0378	1.0198	1.0055
5	......	......	......	......
6	1.0459	1.0583	1.0314	1.0096
7	......	......	......	......
8	1.0624	1.0794	1.0432	1.0136
9	......	......	......	......
10	1.0794	1.1012	1.0552	1.0176
11	......	......	......	......
12	1.0969	1.1236	1.0674	1.0216
13	......	......	......	......
14	1.1149	1.1467	1.0799	1.0255
15	......	......	......	......
16	1.1333	1.1705	1.0927	1.0294
17	......	......	......	......
18	1.1522	1.1950	1.1058	1.0331
19	......	......	......	......
20	1.1717	......	1.1191	1.0368
21	......	......	......	......
22	1.1918	......	1.1327	1.0404
23	......	......	......	......
24	1.2125	......	1.1466	1.0439
25	......	......	......	......
26	1.2338	......	1.1608	1.0473
27	......	......	......	......
28	1.2557	......	1.1753	1.0507
29	......	......	......	......
30	1.2781	......	1.1901	1.0540
31	......	......	......	......
32	......	......	1.2053	......
33	......	......	......	......
34	......	......	1.2209	......
35	1.3367	......	......	1.0618
36	......	......	1.2369	......
37	......	......	......	......
38	......	......	1.2533	......
39	......	......	......	......
40	1.3993	......	1.2702	1.0691
42	......	......	......	......
44	......	......	......	......
45	1.4662	......	......	1.0760
46	......	......	......	......
48	......	......	......	......
50	1.5378	......	......	......
55	1.6146	......	......	......
60	......	......	......	......
65	......	......	......	......
70	......	......	......	......
75	......	......	......	......
80	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	NH_4I $\frac{18°}{4°}$ C.	N_2H_4 $\frac{15°}{4°}$ C.	NH_2OH $\frac{20°}{4°}$ C.	$NaBrO_3$ $\frac{18°}{4°}$ C.
1	1.0050	1.0002	1.0002	1.0064
2	1.0114	1.0013	1.0023	1.0143
3	......	......	......	......
4	1.0244	1.0034	1.0065	1.0305
5	......	......	......	......
6	1.0377	1.0056	1.0107	1.0471
7	......	......	......	......
8	1.0513	1.0077	1.0149	1.0641
9	......	......	......	......
10	1.0652	1.0099	1.0192	1.0816
11	......	......	......	......
12	1.0795	1.0121	1.0235	1.0996
13	......	......	......	......
14	1.0942	1.0143	1.0278	1.1182
15	......	......	......	......
16	1.1093	1.0164	1.0322	1.1373
17	......	......	......	......
18	1.1248	1.0186	1.0366	1.1569
19	......	......	......	......
20	1.1407	1.0207	1.0410	1.1771
21	......	......	......	......
22	1.1570	1.0228	1.0454	1.1979
23	......	......	......	......
24	1.1737	1.0248	1.0499	1.2193
25	......	......	......	......
26	1.1908	1.0267	1.0545	......
27	......	......	......	......
28	1.2084	1.0286	1.0591	......
29	......	......	......	......
30	1.2265	1.0305	1.0637	......
31	......	......	......	......
32	......	......	......	......
33	......	......	......	......
34	......	......	......	......
35	1.2745	1.0350	1.0755	......
36	......	......	......	......
37	......	......	......	......
38	......	......	......	......
39	......	......	......	......
40	1.3264	1.0380	1.0875	......
42	......	......	......	......
44	......	......	......	......
45	1.3823	1.0420	1.0997	......
46	......	......	......	......
48	......	......	......	......
50	......	1.0440	1.1122	......
55	......	1.0460	1.1249	......
60	......	1.0470	......	......
65	......	1.0470	......	......
70	......	1.0460	......	......
75	......	1.0430	......	......
80	......	1.0400	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$NaC_2H_3O_2$ $20° C. \frac{}{4°}$	$NaClO_4$ $18° \frac{}{4°} C.$	$Ni(NO_3)_2$ $18° \frac{}{4°} C.$	$Pb(C_2H_3O_2)_2$ $18° \frac{}{4°} C.$
1	1.0033	1.0051	1.0070	1.0061
2	1.0084	1.0116	1.0155	1.0137
3	......	......	......	......
4	1.0186	1.0247	1.0330	1.0290
5	......	......	......	......
6	1.0289	1.0381	1.0508	1.0446
7	......	......	......	......
8	1.0392	1.0517	1.0693	1.0605
9	......	......	......	......
10	1.0495	1.0656	1.0882	1.0768
11	......	......	......	......
12	1.0598	1.0798	1.1076	1.0936
13	......	......	......	......
14	1.0702	1.0943	1.1277	1.1109
15	......	......	......	......
16	1.0807	1.1090	1.1484	1.1283
17	......	......	......	......
18	1.0913	1.1241	1.1696	1.1473
19	......	......	......	......
20	1.1021	1.1396	1.1914	1.1663
21	......	......	......	......
22	1.1130	1.1554	......	1.1860
23	......	......	......	......
24	1.1240	1.1717	......	1.2063
25	......	......	1.2493	......
26	1.1351	1.1883	......	1.2273
27	......	......	......	......
28	1.1462	1.2053	......	1.2489
29	......	......	......	......
30	......	1.2227	1.3114	1.2711
31	......	......	......	......
32	......	1.2407	......	......
33	......	......	......	......
34	......	1.2591	......	......
35	......	......	1.3777	1.3304
36	......	1.2779	......	......
37	......	......	......	......
38	......	1.2969	......	......
39	......	......	......	......
40	......	......	......	1.3994
42	......	......	......	......
44	......	......	......	......
45	......	......	......	......
46	......	......	......	......
48	......	......	......	......
50	......	......	......	......
55	......	......	......	......
60	......	......	......	......
65	......	......	......	......
70	......	......	......	......
75	......	......	......	......
80	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$Pb(NO_3)_2$ $\frac{18°}{4°}$ C.	SO_2 $\frac{15.5°}{4°}$ C	$SrBr_2$ $\frac{20°}{4°}$ C.	$SrCl_2$ $\frac{20°}{4°}$ C.
1	1.0074	1.0040	......	......
2	1.0163	1.0091	1.0157	1.0161
3	......	......	......	......
4	1.0344	1.0191	1.0337	1.0344
5	......	......	......	......
6	1.0529	1.0292	1.0522	1.0532
7	......	......	......	......
8	1.0720	1.0393	1.0712	1.0726
9	......	......	......	......
10	1.0918	1.0493	1.0907	1.0925
11	......	......	......	......
12	1.1123	......	1.1109	1.1130
13	......	......	......	......
14	1.1336	......	1.1317	1.1341
15	......	......	......	......
16	1.1557	......	1.1532	1.1558
17	......	......	......	......
18	1.1789	......	1.1757	1.1781
19	......	......	......	......
20	1.2030	......	1.1992	1.2010
21	......	......	......	......
22	1.2277	......	......	......
23	......	......	......	......
24	1.2529	......	......	......
25	......	......	1.2620	1.2600
26	1.2783	......	......	......
27	......	......	......	......
28	1.3037	......	......	......
29	......	......	......	......
30	1.3289	......	1.3300	1.3250
31	......	......	......	......
32	......	......	......	......
33	......	......	......	......
34	......	......	......	......
35	......	......	1.4050	1.3960
36	......	......	......	......
37	......	......	......	......
38	......	......	......	......
39	......	......	......	......
40	......	......	1.4890	......
42	......	......	......	......
44	......	......	......	......
45	......	......	1.5830	......
46	......	......	......	......
48	......	......	......	......
50	......	......	1.6860	......
55	......	......	......	......
60	......	......	......	......
65	......	......	......	......
70	......	......	......	......
75	......	......	......	......
80	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	SrI_2 $\frac{20°}{4°}$ C.	$Sr(NO_3)_2$ $\frac{20°}{4°}$ C.	$ZnBr_2$ $\frac{20°}{4°}$ C.	ZnI_2 $\frac{20°}{4°}$ C.
1	......	......	......	......
2	1.0154	1.0150	1.0167	1.016
3	......	......	......	......
4	1.0331	1.0310	1.0354	1.034
5	......	......	......	......
6	1.0513	1.0480	1.0544	1.053
7	......	......	......	......
8	1.0701	1.0650	1.0738	1.072
9	......	......	......	......
10	1.0896	1.0830	1.0935	1.091
11	......	......	......	......
12	1.1099	1.1010	1.1135	1.111
13	......	......	......	......
14	1.1308	1.1190	1.1338	1.131
15	......	......	......	......
16	1.1526	1.1380	1.1544	1.152
17	......	......	......	......
18	1.1753	1.1580	1.1753	1.174
19	......	......	......	......
20	1.1990	1.179	1.1965	1.197
21	......	......	......	......
22	......	......	......	......
23	......	......	......	......
24	......	......	......	......
25	1.2608	1.233	1.2543	1.258
26	......	......	......	......
27	......	......	......	......
28	......	......	......	......
29	......	......	......	......
30	1.3295	1.290	1.3170	1.325
31	......	......	......	......
32	......	......	......	......
33	......	......	......	......
34	......	......	......	......
35	1.4058	1.352	1.3859	1.398
36	......	......	......	......
37	......	......	......	......
38	......	......	......	......
39	......	......	......	......
40	1.4904	1.419	1.4620	1.478
42	....	......	......	......
44	......	......	......	......
45	1.5844	......	1.5470	1.566
46	......	......	......	......
48	......	......	......	......
50	......	......	1.6430	1.663
55	......	......	1.7500	1.770
60	......	......	1.8690	1.893
65	......	......	2.0020	2.036
70	......	......	......	2.202
75	......	......	......	2.393
80	......	......	......	......

ETHYL ALCOHOL

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Giving the specific gravity at 15.56° C. referred to water at the same temperature. To reduce to specific gravity referred to water at 4° C. multiply by 0.99908.
(U. S. Department of Agriculture.)

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
1.00000	0.00	0.00	0.00	0.99431	3.90	3.12	3.10
0.99984	0.10	0.08	0.08	0.99417	4.00	3.20	3.18
0.99968	0.20	0.16	0.16	0.99403	4.10	3.28	3.26
0.99953	0.30	0.24	0.24	0.99390	4.20	3.36	3.34
0.99937	0.40	0.32	0.32	0.99376	4.30	3.44	3.42
0.99923	0.50	0.40	0.40	0.99363	4.40	3.52	3.50
0.99907	0.60	0.48	0.48	0.99349	4.50	3.60	3.58
0.99892	0.70	0.56	0.56	0.99335	4.60	3.68	3.66
0.99877	0.80	0.64	0.64	0.99322	4.70	3.76	3.74
0.99861	0.90	0.71	0.71	0.99308	4.80	3.84	3.81
0.99849	1.00	0.79	0.79	0.99295	4.90	3.92	3.89
0.99834	1.10	0.87	0.87	0.99281	5.00	4.00	3.97
0.99819	1.20	0.95	0.95	0.99268	5.10	4.08	4.05
0.99805	1.30	1.03	1.03	0.99255	5.20	4.16	4.13
0.99790	1.40	1.11	1.11	0.99241	5.30	4.24	4.21
0.99775	1.50	1.19	1.19	0.99228	5.40	4.32	4.29
0.99760	1.60	1.27	1.27	0.99215	5.50	4.40	4.37
0.99745	1.70	1.35	1.35	0.99202	5.60	4.48	4.44
0.99731	1.80	1.43	1.43	0.99189	5.70	4.56	4.52
0.99716	1.90	1.51	1.51	0.99175	5.80	4.64	4.60
0.99701	2.00	1.59	1.59	0.99162	5.90	4.72	4.68
0.99687	2.10	1.67	1.66	0.99149	6.00	4.80	4.76
0.99672	2.20	1.75	1.74	0.99136	6.10	4.88	4.84
0.99658	2.30	1.83	1.82	0.99123	6.20	4.96	4.92
0.99643	2.40	1.91	1.90	0.99111	6.30	5.05	5.00
0.99629	2.50	1.99	1.98	0.99098	6.40	5.13	5.08
0.99615	2.60	2.07	2.06	0.99085	6.50	5.21	5.16
0.99600	2.70	2.15	2.14	0.99072	6.60	5.29	5.24
0.99586	2.80	2.23	2.22	0.99059	6.70	5.37	5.32
0.99571	2.90	2.31	2.30	0.99047	6.80	5.45	5.40
0.99557	3.00	2.39	2.38	0.99034	6.90	5.53	5.48
0.99543	3.10	2.47	2.46	0.99021	7.00	5.61	5.56
0.99529	3.20	2.55	2.54	0.99009	7.10	5.69	5.64
0.99515	3.30	2.64	2.62	0.98996	7.20	5.77	5.72
0.99501	3.40	2.72	2.70	0.98984	7.30	5.86	5.80
0.99487	3.50	2.80	2.78	0.98971	7.40	5.94	5.88
0.99473	3.60	2.88	2.86	0.98959	7.50	6.02	5.96
0.99459	3.70	2.96	2.94	0.98947	7.60	6.10	6.04
0.99445	3.80	3.04	3.02	0.98934	7.70	6.18	6.11

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.98922	7.80	6.26	6.19	0.98435	12.00	9.67	9.52
0.98909	7.90	6.34	6.27	0.98424	12.10	9.75	9.60
0.98897	8.00	6.42	6.35	0.98413	12.20	9.83	9.68
0.98885	8.10	6.50	6.43	0.98402	12.30	9.92	9.76
0.98873	8.20	6.58	6.51	0.98391	12.40	10.00	9.84
0.98861	8.30	6.67	6.59	0.98381	12.50	10.08	9.92
0.98849	8.40	6.75	6.67	0.98370	12.60	10.16	10.00
0.98837	8.50	6.83	6.75	0.98359	12.70	10.24	10.07
0.98825	8.60	6.91	6.83	0.98348	12.80	10.33	10.15
0.98813	8.70	6.99	6.91	0.98337	12.90	10.41	10.23
0.98801	8.80	7.07	6.99	0.98326	13.00	10.49	10.31
0.98789	8.90	7.15	7.07	0.98315	13.10	10.57	10.39
0.98777	9.00	7.23	7.14	0.98305	13.20	10.65	10.47
0.98765	9.10	7.31	7.22	0.98294	13.30	10.74	10.55
0.98754	9.20	7.39	7.30	0.98283	13.40	10.82	10.63
0.98742	9.30	7.48	7.38	0.98273	13.50	10.90	10.71
0.98730	9.40	7.56	7.46	0.98262	13.60	10.98	10.79
0.98719	9.50	7.64	7.54	0.98251	13.70	11.06	10.87
0.98707	9.60	7.72	7.62	0.98240	13.80	11.15	10.95
0.98695	9.70	7.80	7.70	0.98230	13.90	11.23	11.03
0.98683	9.80	7.88	7.78	0.98219	14.00	11.31	11.11
0.98672	9.90	7.96	7.85	0.98209	14.10	11.39	11.19
0.98660	10.00	8.04	7.93	0.98198	14.20	11.47	11.27
0.98649	10.10	8.12	8.01	0.98188	14.30	11.56	11.35
0.98637	10.20	8.20	8.09	0.98177	14.40	11.64	11.43
0.98626	10.30	8.29	8.17	0.98167	14.50	11.72	11.51
0.98614	10.40	8.37	8.25	0.98156	14.60	11.80	11.59
0.98603	10.50	8.45	8.33	0.98146	14.70	11.88	11.67
0.98592	10.60	8.53	8.41	0.98135	14.80	11.97	11.75
0.98580	10.70	8.61	8.49	0.98125	14.90	12.05	11.82
0.98569	10.80	8.70	8.57	0.98114	15.00	12.13	11.90
0.98557	10.90	8.78	8.65	0.98104	15.10	12.21	11.98
0.98546	11.00	8.86	8.73	0.98093	15.20	12.29	12.06
0.98535	11.10	8.94	8.81	0.98083	15.30	12.38	12.14
0.98524	11.20	9.02	8.89	0.98073	15.40	12.46	12.22
0.98513	11.30	9.11	8.97	0.98063	15.50	12.54	12.30
0.98502	11.40	9.19	9.05	0.98052	15.60	12.62	12.37
0.98491	11.50	9.27	9.13	0.98042	15.70	12.70	12.45
0.98479	11.60	9.35	9.21	0.98032	15.80	12.79	12.53
0.98468	11.70	9.43	9.29	0.98021	15.90	12.87	12.61
0.98457	11.80	9.51	9.36	0.98011	16.00	12.95	12.69
0.98446	11.90	9.59	9.44	0.98001	16.10	13.03	12.77

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.97991	16.20	13.12	12.85	0.97568	20.40	16.59	16.18
0.97980	16.30	13.20	12.93	0.97558	20.50	16.67	16.26
0.97970	16.40	13.29	13.01	0.97547	20.60	16.75	16.34
0.97960	16.50	13.37	13.09	0.97537	20.70	16.84	16.42
0.97950	16.60	13.45	13.17	0.97527	20.80	16.92	16.50
0.97940	16.70	13.53	13.25	0.97517	20.90	17.01	16.58
0.97929	16.80	13.62	13.33	0.97507	21.00	17.09	16.66
0.97917	16.90	13.70	13.41	0.97497	21.10	17.17	16.74
0.97909	17.00	13.78	13.49	0.97487	21.20	17.26	16.82
0.97899	17.10	13.86	13.57	0.97477	21.30	17.34	16.90
0.97889	17.20	13.94	13.65	0.97467	21.40	17.43	16.98
0.97879	17.30	14.03	13.73	0.97457	21.50	17.51	17.06
0.97869	17.40	14.11	13.81	0.97446	21.60	17.59	17.14
0.97859	17.50	14.19	13.89	0.97436	21.70	17.67	17.22
0.97848	17.60	14.27	13.96	0.97426	21.80	17.76	17.30
0.97838	17.70	14.35	14.04	0.97416	21.90	17.84	17.38
0.97828	17.80	14.44	14.12	0.97406	22.00	17.92	17.46
0.97818	17.90	14.52	14.20	0.97396	22.10	18.00	17.54
0.97808	18.00	14.60	14.28	0.97386	22.20	18.09	17.62
0.97798	18.10	14.68	14.36	0.97375	22.30	18.17	17.70
0.97788	18.20	14.77	14.44	0.97365	22.40	18.26	17.78
0.97778	18.30	14.85	14.52	0.97355	22.50	18.34	17.86
0.97768	18.40	14.94	14.60	0.97345	22.60	18.42	17.94
0.97758	18.50	15.02	14.68	0.97335	22.70	18.51	18.02
0.97748	18.60	15.10	14.76	0.97324	22.80	18.59	18.10
0.97738	18.70	15.18	14.84	0.97314	22.90	18.68	18.18
0.97728	18.80	15.27	14.92	0.97304	23.00	18.76	18.26
0.97718	18.90	15.38	15.00	0.97294	23.10	18.84	18.33
0.97708	19.00	15.43	15.08	0.97283	23.20	18.92	18.41
0.97698	19.10	15.51	15.15	0.97273	23.30	19.01	18.49
0.97688	19.20	15.59	15.23	0.97263	23.40	19.09	18.57
0.97678	19.30	15.68	15.31	0.97253	23.50	19.17	18.65
0.97668	19.40	15.76	15.39	0.97242	23.60	19.25	18.73
0.97658	19.50	15.84	15.47	0.97232	23.70	19.34	18.18
0.97648	19.60	15.93	15.55	0.97222	23.80	19.42	18.88
0.97638	19.70	16.01	15.63	0.97211	23.90	19.51	18.96
0.97628	19.80	16.09	15.71	0.97201	24.00	19.59	19.04
0.97618	19.90	16.18	15.79	0.97191	24.10	19.67	19.12
0.97608	20.00	16.26	15.87	0.97180	24.20	19.76	19.20
0.97598	20.10	16.34	15.95	0.97170	24.30	19.84	19.28
0.97588	20.20	16.42	16.03	0.97159	24.40	19.93	19.36
0.97578	20.30	16.51	16.10	0.97149	24.50	20.01	19.44

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.97139	24.60	20.09	19.52	0.96681	28.80	23.64	22.85
0.97128	24.70	20.18	19.60	0.96669	28.90	23.72	22.93
0.97118	24.80	20.26	19.68	0.96658	29.00	23.81	23.01
0.97107	24.90	20.35	19.76	0.96646	29.10	23.89	23.09
0.97097	25.00	20.43	19.84	0.96635	29.20	23.98	23.17
0.97086	25.10	20.51	19.92	0.96623	29.30	24.06	23.25
0.97076	25.20	20.60	20.00	0.96611	29.40	24.15	23.33
0.97065	25.30	20.68	20.08	0.96600	29.50	24.23	23.41
0.97055	25.40	20.77	20.16	0.96587	29.60	24.32	23.49
0.97044	25.50	20.85	20.24	0.96576	29.70	24.40	23.57
0.97033	25.60	20.93	20.32	0.96564	29.80	24.49	23.65
0.97023	25.70	21.02	20.40	0.96553	29.90	24.57	23.73
0.97012	25.80	21.10	20.47	0.96541	30.00	24.66	23.81
0.97001	25.90	21.19	20.55	0.96529	30.10	24.74	23.89
0.96991	26.00	21.27	20.63	0.96517	30.20	24.83	23.97
0.96980	26.10	21.35	20.71	0.96505	30.30	24.91	24.04
0.96969	26.20	21.44	20.79	0.96493	30.40	25.00	24.12
0.96959	26.30	21.52	20.87	0.96481	30.50	25.08	24.20
0.96949	26.40	21.61	20.95	0.96469	30.60	25.17	24.28
0.96937	26.50	21.69	21.03	0.96457	30.70	25.25	24.36
0.96926	26.60	21.77	21.11	0.96445	30.80	25.34	24.44
0.96915	26.70	21.86	21.19	0.96433	30.90	25.42	24.52
0.96905	26.80	21.94	21.27	0.96421	31.00	25.51	24.60
0.96894	26.90	22.03	21.35	0.96409	31.10	25.60	24.68
0.96883	27.00	22.11	21.43	0.96396	31.20	25.68	24.76
0.96872	27.10	22.20	21.51	0.96384	31.30	25.77	24.84
0.96861	27.20	22.28	21.59	0.96372	31.40	25.85	24.92
0.96850	27.30	22.37	21.67	0.96360	31.50	25.94	25.00
0.96839	27.40	22.45	21.75	0.96347	31.60	26.03	25.08
0.96828	27.50	22.54	21.83	0.96335	31.70	26.11	25.16
0.96816	27.60	22.62	21.90	0.96323	31.80	26.20	25.24
0.96805	27.70	22.71	21.98	0.96310	31.90	26.28	25.32
0.96794	27.80	22.79	22.06	0.96298	32.00	26.37	25.40
0.96783	27.90	22.88	22.14	0.96285	32.10	26.46	25.48
0.96772	28.00	22.96	22.22	0.96273	32.20	26.54	25.56
0.96761	28.10	23.04	22.30	0.96260	32.30	26.63	25.64
0.96749	28.20	23.13	22.38	0.96248	32.40	26.71	25.71
0.96738	28.30	23.21	22.45	0.96235	32.50	26.80	25.79
0.96726	28.40	23.30	22.53	0.96222	32.60	26.89	25.87
0.96715	28.50	23.38	22.61	0.96210	32.70	26.97	25.95
0.96704	28.60	23.47	22.69	0.96197	32.80	27.06	26.03
0.96692	28.70	23.55	22.77	0.96185	32.90	27.14	26.11

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.96172	33.00	27.23	26.19	0.95603	37.20	30.88	29.52
0.96159	33.10	27.32	26.27	0.95589	37.30	30.96	29.60
0.96146	33.20	27.40	26.35	0.95574	37.40	31.05	29.68
0.96133	33.30	27.49	26.43	0.95560	37.50	31.14	29.76
0.96120	33.40	27.57	26.51	0.95545	37.60	31.23	29.84
0.96108	33.50	27.66	26.59	0.95531	37.70	31.32	29.92
0.96095	33.60	27.75	26.67	0.95516	37.80	31.40	30.00
0.96082	33.70	27.83	26.75	0.95502	37.90	31.49	30.08
0.96069	33.80	27.92	26.82	0.95487	38.00	31.58	30.16
0.96056	33.90	28.00	26.90	0.95472	38.10	31.67	30.24
0.96043	34.00	28.09	26.98	0.95457	38.20	31.76	30.32
0.96030	34.10	28.18	27.06	0.95442	38.30	31.85	30.40
0.96016	34.20	28.26	27.14	0.95427	38.40	31.94	30.48
0.96003	34.30	28.35	27.22	0.95413	38.50	32.03	30.56
0.95990	34.40	28.43	27.30	0.95398	38.60	32.12	30.64
0.95977	34.50	28.52	27.38	0.95383	38.70	32.20	30.72
0.95963	34.60	28.61	27.46	0.95368	38.80	32.29	30.79
0.95950	34.70	28.70	27.54	0.95353	38.90	32.37	30.87
0.95937	34.80	28.78	27.62	0.95338	39.00	32.46	30.95
0.95923	34.90	28.87	27.70	0.95323	39.10	32.55	31.03
0.95910	35.00	28.96	27.78	0.95307	39.20	32.64	31.11
0.95896	35.10	29.05	27.86	0.95292	39.30	32.72	31.18
0.95883	35.20	29.13	27.94	0.95277	39.40	32.81	31.26
0.95869	35.30	29.22	28.02	0.95262	39.50	32.90	31.34
0.95855	35.40	29.30	28.09	0.95246	39.60	32.99	31.42
0.95842	35.50	29.38	28.17	0.95231	39.70	33.08	31.50
0.95828	35.60	29.48	28.25	0.95216	39.80	33.17	31.58
0.95814	35.70	29.57	28.33	0.95200	39.90	33.27	31.66
0.95800	35.80	29.65	28.41	0.95185	40.00	33.35	31.74
0.95787	35.90	29.74	28.49	0.95169	40.10	33.44	31.82
0.95773	36.00	29.83	28.57	0.95154	40.20	33.53	31.90
0.95759	36.10	29.92	28.65	0.95138	40.30	33.61	31.98
0.95745	36.20	30.00	28.73	0.95122	40.40	33.70	32.06
0.95731	36.30	30.09	28.81	0.95107	40.50	33.79	32.14
0.95717	36.40	30.17	28.88	0.95091	40.60	33.88	32.22
0.95703	36.50	30.26	28.96	0.95075	40.70	33.97	32.30
0.95688	36.60	30.35	29.04	0.95059	40.80	34.06	32.38
0.95674	36.70	30.44	29.12	0.95044	40.90	34.15	32.46
0.95660	36.80	30.52	29.20	0.95028	41.00	34.24	32.54
0.95646	36.90	30.61	29.29	0.95012	41.10	34.33	32.62
0.95632	37.00	30.70	29.36	0.94996	41.20	34.42	32.70
0.95618	37.10	30.79	29.44	0.94980	41.30	34.50	32.78

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.94964	41.40	34.59	32.86	0.94258	45.60	38.39	36.19
0.94948	41.50	34.68	32.93	0.94241	45.70	38.48	36.26
0.94932	41.60	34.77	33.01	0.94223	45.80	38.57	36.34
0.94916	41.70	34.86	33.09	0.94206	45.90	38.66	36.42
0.94900	41.80	34.95	33.17	0.94188	46.00	38.75	36.50
0.94884	41.90	35.04	33.25	0.94170	46.10	38.84	36.58
0.94868	42.00	35.13	33.33	0.94152	46.20	38.93	36.66
0.94852	42.10	35.22	33.41	0.94134	46.30	39.03	36.74
0.94835	42.20	35.31	33.49	0.94116	46.40	39.12	36.82
0.94810	42.30	35.40	33.57	0.94098	46.50	39.21	36.90
0.94802	42.40	35.49	33.65	0.94080	46.60	39.30	36.98
0.94786	42.50	35.58	33.73	0.94062	46.70	39.39	37.06
0.94770	42.60	35.67	33.81	0.94044	46.80	39.49	37.13
0.94753	42.70	35.76	33.89	0.94026	46.90	39.58	37.21
0.94737	42.80	35.85	33.97	0.94008	47.00	39.67	37.29
0.94720	42.90	35.94	34.04	0.93990	47.10	39.76	37.37
0.94704	43.00	36.03	34.12	0.93971	47.20	39.85	37.45
0.94687	43.10	36.12	34.20	0.93953	47.30	39.95	37.53
0.94670	43.20	36.21	34.28	0.93934	47.40	40.04	37.61
0.94654	43.30	36.30	34.36	0.93916	47.50	40.13	37.69
0.94637	43.40	36.39	34.44	0.93898	47.60	40.22	37.77
0.94620	43.50	36.48	34.52	0.93879	47.70	40.32	37.85
0.94603	43.60	36.57	34.60	0.93861	47.80	40.41	37.93
0.94586	43.70	36.66	34.68	0.93842	47.90	40.51	38.01
0.94570	43.80	36.75	34.76	0.93824	48.00	40.60	38.09
0.94553	43.90	36.84	34.84	0.93805	48.10	40.69	38.17
0.94536	44.00	36.93	34.91	0.93786	48.20	40.78	38.25
0.94519	44.10	37.02	34.99	0.93768	48.30	40.88	38.33
0.94502	44.20	37.11	35.07	0.93749	48.40	40.97	38.41
0.94484	44.30	37.21	35.15	0.93730	48.50	41.06	38.49
0.94467	44.40	37.30	35.23	0.93711	48.60	41.15	38.57
0.94450	44.50	37.39	35.31	0.93692	48.70	41.24	38.65
0.94433	44.60	37.48	35.39	0.93679	48.80	41.34	38.72
0.94416	44.70	37.57	35.47	0.93655	48.90	41.43	38.80
0.94398	44.80	37.66	35.55	0.93636	49.00	41.52	38.88
0.94381	44.90	37.76	35.63	0.93617	49.10	41.61	38.96
0.94364	45.00	37.84	35.71	0.93598	49.20	41.71	39.04
0.94346	45.10	37.93	35.79	0.93578	49.30	41.80	39.12
0.94329	45.20	38.02	35.87	0.93559	49.40	41.90	39.20
0.94311	45.30	38.12	35.95	0.93540	49.50	41.99	39.28
0.94294	45.40	38.21	36.03	0.93521	49.60	42.08	39.36
0.94276	45.50	38.30	36.11	0.93502	49.70	42.18	39.44

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.93482	49.80	42.27	39.52	0.8773	75.00	....	....
0.93463	49.90	42.37	39.60	0.8747	76.00	....	....
0.9344	50.00	...*	....	0.8721	77.00	....	....
0.9325	51.00	....	....	0.8694	78.00	....	....
0.9305	52.00	....	....	0.8667	79.00	....	....
0.9285	53.00	....	....	0.8639	80.00	....	....
0.9264	54.00	....	....	0.8611	81.00	....	....
0.9244	55.00	....	....	0.8583	82.00	....	....
0.9222	56.00	....	....	0.8554	83.00	....	....
0.9201	57.00	....	....	0.8525	84.00	....	....
0.9180	58.00	....	....	0.8496	85.00	....	....
0.9158	59.00	....	....	0.8465	86.00	....	....
0.9136	60.00	....	....	0.8435	87.00	....	....
0.9113	61.00	....	....	0.8404	88.00	....	....
0.9091	62.00	....	....	0.8372	89.00	....	....
0.9068	63.00	....	....	0.8339	90.00	....	....
0.9044	64.00	....	....	0.8306	91.00	....	....
0.9021	65.00	....	....	0.8272	92.00	....	....
0.8997	66.00	....	....	0.8236	93.00	....	....
0.8974	67.00	....	....	0.8199	94.00	....	....
0.8949	68.00	....	....	0.8161	95.00	....	....
0.8925	69.00	....	....	0.8121	96.00	....	....
0.8900	70.00	....	....	0.8079	97.00	....	....
0.8876	71.00	....	....	0.8035	98.00	....	....
0.8850	72.00	....	....	0.7989	99.00	....	....
0.8825	73.00	....	....	0.7939	100.00	....	....
0.8799	74.00	....	....	......	......	....	....

* For specific gravity of mixtures by weight see following table.

ETHYL ALCOHOL

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Weight

The table gives the specific gravity at the temperature indicated referred to water at 4° C.

(U. S. Bureau of Standards.)

Per cent alcohol by weight.	15° C.	20° C.	25° C.	Per cent alcohol by weight.	15° C.	20° C.	25° C.
0	0.99913	0.99824	0.99708	51	0.91566	0.91164	0.90758
1	0.99725	0.99636	0.99521	52	0.91344	0.90940	0.90533
2	0.99543	0.99453	0.99338	53	0.91120	0.90715	0.90307
3	0.99366	0.99274	0.99159	54	0.90895	0.90488	0.90079
4	0.99197	0.99102	0.98984	55	0.90670	0.90262	0.89851
5	0.99033	0.98936	0.98815	56	0.90443	0.90034	0.89622
6	0.98877	0.98776	0.98651	57	0.90215	0.89805	0.89392
7	0.98726	0.98620	0.98491	58	0.89987	0.89576	0.89162
8	0.98581	0.98470	0.98336	59	0.89758	0.89346	0.88931
9	0.98442	0.98325	0.98185	60	0.89528	0.89115	0.88700
10	0.98307	0.98185	0.98038	61	0.89297	0.88883	0.88467
11	0.98176	0.98047	0.97893	62	0.89066	0.88651	0.88234
12	0.98049	0.97913	0.97752	63	0.88834	0.88418	0.88000
13	0.97925	0.97781	0.97612	64	0.88601	0.88185	0.87766
14	0.97803	0.97651	0.97474	65	0.88368	0.87950	0.87530
15	0.97683	0.97522	0.97336	66	0.88134	0.87716	0.87295
16	0.97563	0.97393	0.97199	67	0.87899	0.87480	0.87058
17	0.97444	0.97264	0.97061	68	0.87664	0.87244	0.86821
18	0.97324	0.97134	0.96922	69	0.87428	0.87008	0.86583
19	0.97203	0.97003	0.96782	70	0.87192	0.86770	0.86344
20	0.97080	0.96870	0.96640	71	0.86954	0.86532	0.86105
21	0.96956	0.96736	0.96497	72	0.86716	0.86292	0.85864
22	0.96829	0.96599	0.96352	73	0.86477	0.86052	0.85622
23	0.96699	0.96459	0.96203	74	0.86237	0.85812	0.85380
24	0.96566	0.96317	0.96052	75	0.85997	0.85570	0.85137
25	0.96430	0.96171	0.95897	76	0.85755	0.85328	0.84893
26	0.96289	0.96021	0.95739	77	0.85513	0.85084	0.84648
27	0.96145	0.95868	0.95577	78	0.85270	0.84840	0.84403
28	0.95997	0.95711	0.95412	79	0.85026	0.84595	0.84157
29	0.95845	0.95550	0.95244	80	0.84781	0.84349	0.83909
30	0.95688	0.95385	0.95071	81	0.84534	0.84101	0.83660
31	0.95526	0.95215	0.94894	82	0.84286	0.83852	0.83410
32	0.95360	0.95042	0.94713	83	0.84037	0.83602	0.83159
33	0.95191	0.94865	0.94529	84	0.83786	0.83350	0.82906
34	0.95017	0.94684	0.94342	85	0.83534	0.83097	0.82652
35	0.94839	0.94499	0.94152	86	0.83279	0.82842	0.82396
36	0.94657	0.94311	0.93957	87	0.83022	0.82583	0.82137
37	0.94471	0.94119	0.93760	88	0.82762	0.82323	0.81876
38	0.94282	0.93924	0.93560	89	0.82500	0.82060	0.81613
39	0.94089	0.93725	0.93356	90	0.82235	0.81795	0.81348
40	0.93893	0.93524	0.93151	91	0.81966	0.81527	0.81080
41	0.93694	0.93320	0.92943	92	0.81694	0.81255	0.80808
42	0.93491	0.93113	0.92732	93	0.81418	0.80979	0.80534
43	0.93286	0.92904	0.92519	94	0.81138	0.80700	0.80256
44	0.93078	0.92693	0.92305	95	0.80854	0.80417	0.79974
45	0.92868	0.92480	0.92088	96	0.80564	0.80129	0.79689
46	0.92655	0.92264	0.91870	97	0.80271	0.79838	0.79400
47	0.92441	0.92047	0.91650	98	0.79972	0.79541	0.79106
48	0.92225	0.91828	0.91429	99	0.79668	0.79240	0.78809
49	0.92006	0.91608	0.91207	100	0.79358	0.78933	0.78507
50	0.91787	0.91386	0.90983	.....	....	....	....

ETHYL ALCOHOL

Specific Gravity of Aqueous Solutions Referred to Water at the Same Temperature

Per cent alcohol	Sp. gr. $\frac{15°}{15°}$ C.	Sp. gr. $\frac{20°}{20°}$ C.	Sp. gr. $\frac{25°}{25°}$ C.	Per cent alcohol	Sp. gr. $\frac{15°}{15°}$ C.	Sp. gr. $\frac{20°}{20°}$ C.	Sp. gr. $\frac{25°}{25°}$ C.
0	1.00000	1.00000	1.00000	51	0.91635	0.91322	0.91026
1	0.99812	0.99813	0.99811	52	0.91412	0.91097	0.90799
2	0.99629	0.99629	0.99627	53	0.91189	0.90872	0.90571
3	0.99451	0.99451	0.99447	54	0.90964	0.90645	0.90343
4	0.99281	0.99279	0.99274	55	0.90738	0.90418	0.90113
5	0.99118	0.99113	0.99106	56	0.90512	0.90191	0.89883
6	0.98963	0.98955	0.98945	57	0.90285	0.89962	0.89654
7	0.98815	0.98802	0.98788	58	0.90058	0.89733	0.89423
8	0.98670	0.98653	0.98634	59	0.89830	0.89502	0.89191
9	0.98528	0.98505	0.98481	60	0.89601	0.89271	0.88959
10	0.98390	0.98361	0.98330	61	0.89371	0.89040	0.88725
11	0.98256	0.98221	0.98184	62	0.89139	0.88807	0.88491
12	0.98126	0.98084	0.98039	63	0.88907	0.88574	0.88256
13	0.97999	0.97948	0.97897	64	0.88674	0.88339	0.88020
14	0.97875	0.97816	0.97757	65	0.88441	0.88104	0.87783
15	0.97754	0.97687	0.97619	66	0.88207	0.87869	0.87547
16	0.97637	0.97560	0.97484	67	0.87971	0.87632	0.87309
17	0.97518	0.97431	0.97346	68	0.87736	0.87396	0.87071
18	0.97398	0.97301	0.97207	69	0.87500	0.87158	0.86833
19	0.97276	0.97169	0.97065	70	0.87263	0.86920	0.86593
20	0.97152	0.97036	0.96922	71	0.87025	0.86680	0.86352
21	0.97028	0.96901	0.96778	72	0.86785	0.86440	0.86110
22	0.96902	0.96763	0.96630	73	0.86545	0.86200	0.85869
23	0.96773	0.96624	0.96481	74	0.86304	0.85958	0.85626
24	0.96642	0.96483	0.96329	75	0.86063	0.85716	0.85383
25	0.96508	0.96339	0.96176	76	0.85822	0.85473	0.85140
26	0.96371	0.96190	0.96018	77	0.85579	0.85230	0.84895
27	0.96228	0.96037	0.95856	78	0.85336	0.84985	0.84650
28	0.96080	0.95880	0.95689	79	0.85092	0.84740	0.84404
29	0.95927	0.95717	0.95520	80	0.84846	0.84494	0.84157
30	0.95769	0.95551	0.95345	81	0.84599	0.84245	0.83909
31	0.95607	0.95381	0.95168	82	0.84350	0.83997	0.83659
32	0.95440	0.95207	0.94986	83	0.84101	0.83747	0.83408
33	0.95269	0.95028	0.94802	84	0.83850	0.83496	0.83156
34	0.95094	0.94847	0.94613	85	0.83598	0.83242	0.82902
35	0.94915	0.94662	0.94422	86	0.83343	0.82987	0.82646
36	0.94732	0.94473	0.94227	87	0.83086	0.82729	0.82389
37	0.94546	0.94281	0.94031	88	0.82826	0.82469	0.82128
38	0.94355	0.94086	0.93830	89	0.82564	0.82207	0.81865
39	0.94161	0.93886	0.93626	90	0.82299	0.81942	0.81600
40	0.93964	0.93684	0.93421	91	0.82030	0.81674	0.81331
41	0.93764	0.93479	0.93212	92	0.81759	0.81401	0.81060
42	0.93559	0.93272	0.93001	93	0.81484	0.81127	0.80785
43	0.93352	0.93062	0.92787	94	0.81205	0.80848	0.80507
44	0.93143	0.92849	0.92571	95	0.80922	0.80567	0.80225
45	0.92933	0.92636	0.92355	96	0.80636	0.80280	0.79939
46	0.92721	0.92421	0.92137	97	0.80344	0.79988	0.79648
47	0.92506	0.92204	0.91917	98	0.80045	0.79688	0.79349
48	0.92291	0.91986	0.91697	99	0.79739	0.79383	0.79045
49	0.92075	0.91766	0.91475	100	0.79429	0.79074	0.78736
50	0.91856	0.91546	0.91251	....	....	....	....

ETHYL ALCOHOL

Density of aqueous solutions at 20°C in g/ml. The concentration is expressed as per cent by weight.

Per cent		.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	0.99	823	804	785	766	748	729	710	692	673	655
1		636	618	599	581	562	544	525	507	489	471
2		453	435	417	399	381	363	345	327	310	292
3		275	257	240	222	205	188	171	154	137	120
4		103	087	070	053	037	020	003	*987	*971	*954
5	0.98	938	922	906	890	874	859	843	827	811	796
6		780	765	749	734	718	703	688	673	658	642
7		627	612	597	582	567	553	538	523	508	493
8		478	463	449	434	419	404	389	374	360	345
9		331	316	301	287	273	258	244	229	215	201
10		187	172	158	144	130	117	103	089	075	061
11		047	033	019	006	*992	*978	*964	*951	*937	*923
12	0.97	910	896	883	869	855	842	828	815	801	788
13		775	761	748	735	722	709	696	683	670	657
14		643	630	617	604	591	578	565	552	539	526
15		514	501	488	475	462	450	438	425	412	400
16		387	374	361	349	336	323	310	297	284	272
17		259	246	233	220	207	194	181	168	155	142
18		129	116	103	089	076	063	050	037	024	010
19	0.96	997	984	971	957	944	931	917	904	891	877
20		864	850	837	823	810	796	783	769	756	742
21		729	716	702	688	675	661	647	634	620	606
22		592	578	564	551	537	523	509	495	481	467
23		453	439	425	411	396	382	368	354	340	326
24		312	297	283	269	254	240	225	211	196	182
25		168	153	139	124	109	094	080	065	050	035
26		020	005	*990	*975	*959	*944	*929	*914	*898	*883
27	0.95	867	851	836	820	805	789	773	757	742	726
28		710	694	678	662	646	630	613	597	581	565
29		548	532	516	499	483	466	450	433	416	400
30		382	365	349	332	315	298	281	264	247	230
31		212	195	178	161	143	126	108	091	074	056
32		038	020	003	*985	*967	*950	*932	*914	*896	*878
33	0.94	860	842	824	806	788	770	752	734	715	697
34		679	660	642	624	605	587	568	550	531	512
35		494	475	456	438	419	400	382	363	344	325
36		306	287	268	249	230	211	192	172	153	134
37		114	095	075	056	036	017	*997	*978	*958	*939
38	0.93	919	899	879	859	840	820	800	780	760	740
39		720	700	680	660	640	620	599	579	559	539
40		518	498	478	458	437	417	396	376	356	335
41		314	294	273	253	232	212	191	170	149	129
42		107	086	065	044	023	002	*981	*960	*939	*918
43	0.92	897	876	855	834	812	791	770	749	728	707
44		685	664	642	621	600	579	557	536	515	493
45		472	450	429	408	386	365	343	322	300	279
46		257	236	214	193	171	150	128	106	085	063
47		041	019	*997	*976	*954	*932	*910	*889	*867	*845
48	0.91	823	801	780	758	736	714	692	670	648	626
49		604	582	560	538	516	494	472	450	428	406
50		384	361	339	317	295	272	250	228	206	183

ETHYL ALCOHOL (Continued)

Per cent		.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
50	0.91	384	361	339	317	295	272	250	228	206	183
51		160	138	116	093	071	049	026	004	*981	*959
52	0.90	936	914	891	869	846	824	801	779	756	734
53		711	689	666	644	621	598	576	553	531	508
54		485	463	440	417	395	372	349	327	304	281
55		258	236	213	190	167	145	122	099	076	054
56		031	008	*985	*962	*939	*917	*894	*871	*848	*825
57	0.89	803	780	757	734	711	688	665	643	620	597
58		574	551	528	505	482	459	436	413	390	367
59		344	321	298	275	252	229	206	183	160	137
60		113	090	067	044	021	*998	*975	*951	*928	*905
61	0.88	882	859	836	812	789	766	743	720	696	673
62		650	626	603	580	557	533	510	487	463	440
63		417	393	370	347	323	300	277	253	230	206
64		183	160	136	113	089	066	042	019	*995	*972
65	0.87	948	925	901	878	854	831	807	784	760	737
66		713	689	666	642	619	595	572	548	524	501
67		477	454	430	406	383	359	336	312	288	265
68		241	218	194	170	147	123	099	075	052	028
69		004	*981	*957	*933	*909	*885	*862	*838	*814	*790
70	0.86	766	742	718	694	671	647	623	599	575	551
71		527	503	479	455	431	407	383	359	335	311
72		287	263	239	215	191	167	143	119	095	071
73		047	022	*998	*974	*950	*926	*902	*878	*854	*830
74	0.85	806	781	757	733	709	685	661	636	612	588
75		564	540	515	491	467	443	419	394	370	346
76		322	297	273	249	225	200	176	152	128	103
77		079	055	031	006	*982	*958	*933	*909	*884	*860
78	0.84	835	811	787	762	738	713	689	664	640	615
79		590	566	541	517	492	467	443	418	393	369
80		344	319	294	270	245	220	196	171	146	121
81		096	072	047	022	*997	*972	*947	*923	*898	*873
82	0.83	848	823	798	773	748	723	698	674	649	624
83		599	574	549	523	498	473	448	423	398	373
84		348	323	297	272	247	222	196	171	146	120
85		095	070	044	019	*994	*968	*943	*917	*892	*866
86	0.82	840	815	789	763	738	712	686	660	635	609
87		583	557	531	505	479	453	427	401	375	349
88		323	297	271	245	219	193	167	140	114	088
89		062	035	009	*983	*956	*930	*903	*877	*850	*824
90	0.81	797	770	744	717	690	664	637	610	583	556
91		529	502	475	448	421	394	366	339	312	285
92		257	230	203	175	148	120	093	066	038	010
93	0.80	983	955	928	900	872	844	817	789	761	733
94		705	677	649	621	593	565	537	509	480	452
95		424	395	367	338	310	281	253	224	195	166
96		138	109	080	051	022	*993	*963	*934	*905	*875
97	0.79	846	816	787	757	727	698	668	638	608	578
98		547	517	487	456	426	396	365	335	305	274
99		243	213	182	151	120	089	059	028	*997	*966
100	0.78	934									

METHYL ALCOHOL

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Giving the specific gravity at 15°C referred to water at 4°C.

(Calculated from values by Doroshevski and Rozhdestvenski, Dittmar and Fawsitt.)

Per cent alcohol by weight	Per cent alcohol by volume	Specific gravity	Per cent alcohol by weight	Per cent alcohol by volume	Specific gravity
1	1.25	0.99727	51	58.74	0.91653
2	2.50	0.99543	52	59.76	0.91451
3	3.75	0.99370	53	60.77	0.91248
4	4.99	0.99198	54	61.78	0.91044
5	6.22	0.99029	55	62.78	0.90839
6	7.45	0.98864	56	63.78	0.90631
7	8.68	0.98701	57	64.77	0.90421
8	9.91	0.98547	58	65.75	0.90210
9	11.13	0.98394	59	66.73	0.89996
10	12.35	0.98241	60	67.69	0.89781
11	13.56	0.98093	61	68.65	0.89563
12	14.77	0.97945	62	69.61	0.89341
13	15.98	0.97802	63	70.55	0.89117
14	17.18	0.97660	64	71.49	0.88890
15	18.38	0.97518	65	72.42	0.88662
16	19.58	0.97377	66	73.34	0.88433
17	20.77	0.97237	67	74.26	0.88203
18	21.96	0.97096	68	75.17	0.87971
19	23.15	0.96955	69	76.08	0.87739
20	24.33	0.96814	70	76.98	0.87507
21	25.51	0.96673	71	77.86	0.87271
22	26.69	0.96533	72	78.75	0.87033
23	27.86	0.96392	73	79.62	0.86792
24	29.03	0.96251	74	80.48	0.86546
25	30.19	0.96108	75	81.34	0.86300
26	31.35	0.95963	76	82.18	0.86051
27	32.51	0.95817	77	83.02	0.85801
28	33.66	0.95668	78	83.86	0.85551
29	34.81	0.95518	79	84.68	0.85300
30	35.95	0.95366	80	85.50	0.85048
31	37.09	0.95213	81	86.31	0.84794
32	38.22	0.95056	82	87.11	0.84536
33	39.35	0.94896	83	87.90	0.84274
34	40.48	0.94734	84	88.68	0.84009
35	41.59	0.94570	85	89.45	0.83742
36	42.71	0.94404	86	90.21	0.83475
37	43.82	0.94237	87	90.97	0.83207
38	44.92	0.94067	88	91.72	0.82937
39	46.02	0.93894	89	92.46	0.82667
40	47.11	0.93720	90	93.19	0.82396
41	48.20	0.93543	91	93.92	0.82124
42	49.28	0.93365	92	94.63	0.81849
43	50.35	0.93185	93	95.33	0.81568
44	51.42	0.93001	94	96.02	0.81285
45	52.49	0.92815	95	96.70	0.80999
46	53.54	0.92627	96	97.37	0.80713
47	54.60	0.92436	97	98.04	0.80428
48	55.64	0.92242	98	98.70	0.80143
49	56.68	0.92048	99	99.35	0.79859
50	57.71	0.91852	100	100.00	0.79577

METHYL ALCOHOL

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Giving the specific gravity at 15.6° C. referred to water at the same temperature. To reduce to specific gravity of water at 4°C. multiply by 0.99908.

(Techn. Hogskolan, Stockholm.)

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
1.0000	0.00	0.00	0.9950	2.72	3.48	0.9900	5.72	7.13
0.9999	0.06	0.07	0.9949	2.78	3.55	0.9899	5.78	7.21
0.9998	0.11	0.13	0.9948	2.84	3.62	0.9898	5.85	7.28
0.9997	0.17	0.20	0.9947	2.89	3.70	0.9897	5.91	7.36
0.9996	0.22	0.27	0.9946	2.95	3.77	0.9896	5.97	7.44
0.9995	0.28	0.33	0.9945	3.01	3.84	0.9895	6.04	7.52
0.9994	0.33	0.40	0.9944	3.07	3.91	0.9894	6.10	7.59
0.9993	0.39	0.47	0.9943	3.13	3.98	0.9893	6.16	7.67
0.9992	0.44	0.53	0.9942	3.18	4.06	0.9892	6.23	7.75
0.9991	0.50	0.60	0.9941	3.24	4.13	0.9891	6.29	7.82
0.9990	0.55	0.67	0.9940	3.30	4.20	0.9890	6.36	7.90
0.9989	0.61	0.73	0.9939	3.36	4.27	0.9889	6.42	7.98
0.9988	0.66	0.80	0.9938	3.42	4.35	0.9888	6.48	8.05
0.9987	0.72	0.86	0.9937	3.48	4.42	0.9887	6.55	8.13
0.9986	0.77	0.93	0.9936	3.53	4.49	0.9886	6.61	8.21
0.9985	0.83	1.00	0.9935	3.59	4.57	0.9885	6.67	8.29
0.9984	0.88	1.06	0.9934	3.65	4.64	0.9884	6.74	8.36
0.9983	0.94	1.13	0.9933	3.71	4.71	0.9883	6.80	8.44
0.9982	0.99	1.20	0.9932	3.77	4.79	0.9882	6.86	8.52
0.9981	1.05	1.26	0.9931	3.83	4.89	0.9881	6.93	8.59
0.9980	1.10	1.33	0.9930	3.89	4.94	0.9880	6.99	8.67
0.9979	1.15	1.40	0.9929	3.94	5.01	0.9879	7.06	8.75
0.9978	1.20	1.47	0.9928	4.00	5.08	0.9878	7.12	8.83
0.9977	1.26	1.54	0.9927	4.06	5.16	0.9877	7.19	8.90
0.9976	1.31	1.62	0.9926	4.12	5.23	0.9876	7.25	8.98
0.9975	1.36	1.69	0.9925	4.18	5.30	0.9875	7.32	9.06
0.9974	1.41	1.76	0.9924	4.24	5.38	0.9874	7.38	9.14
0.9973	1.46	1.83	0.9923	4.29	5.45	0.9873	7.45	9.22
0.9972	1.52	1.90	0.9922	4.35	5.52	0.9872	7.51	9.29
0.9971	1.57	1.97	0.9921	4.41	5.60	0.9871	7.58	9.37
0.9970	1.62	2.05	0.9920	4.47	5.67	0.9870	7.64	9.45
0.9969	1.67	2.12	0.9919	4.53	5.74	0.9869	7.71	9.53
0.9968	1.72	2.19	0.9918	4.60	5.82	0.9868	7.77	9.61
0.9967	1.78	2.26	0.9917	4.66	5.89	0.9867	7.84	9.68
0.9966	1.83	2.33	0.9916	4.72	5.96	0.9866	7.90	9.76
0.9965	1.88	2.40	0.9915	4.78	6.04	0.9865	7.97	9.84
0.9964	1.93	2.47	0.9914	4.85	6.11	0.9864	8.03	9.92
0.9963	1.98	2.55	0.9913	4.91	6.18	0.9863	8.10	10.00
0.9962	2.04	2.62	0.9912	4.97	6.25	0.9862	8.16	10.07
0.9961	2.09	2.69	0.9911	5.03	6.33	0.9861	8.23	10.15
0.9960	2.14	2.76	0.9910	5.10	6.40	0.9860	8.29	10.23
0.9959	2.20	2.83	0.9909	5.16	6.47	0.9859	8.35	10.31
0.9958	2.26	2.90	0.9908	5.22	6.55	0.9858	8.42	10.38
0.9957	2.31	2.98	0.9907	5.28	6.62	0.9857	8.48	10.47
0.9956	2.37	3.05	0.9906	5.35	6.69	0.9856	8.55	10.55
0.9955	2.43	3.12	0.9905	5.41	6.77	0.9855	8.61	10.63
0.9954	2.49	3.19	0.9904	5.47	6.84	0.9854	8.68	10.71
0.9953	2.55	3.26	0.9903	5.53	6.91	0.9853	8.74	10.79
0.9952	2.60	3.34	0.9902	5.60	6.98	0.9852	8.81	10.87
0.9951	2.66	3.41	0.9901	5.66	7.06	0.9851	8.87	10.95

METHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
0.9850	8.94	11.03	0.9796	12.55	15.46	0.9742	16.43	20.09
0.9849	9.00	11.10	0.9795	12.62	15.55	0.9741	16.51	20.17
0.9848	9.06	11.18	0.9794	12.69	15.63	0.9740	16.58	20.26
0.9847	9.13	11.26	0.9793	12.76	15.72	0.9739	16.65	20.35
0.9846	9.19	11.34	0.9792	12.83	15.80	0.9738	16.72	20.43
0.9845	9.26	11.42	0.9791	12.90	15.89	0.9737	16.79	20.52
0.9844	9.32	11.50	0.9790	12.97	15.97	0.9736	16.86	20.60
0.9843	9.39	11.58	0.9789	13.04	16.06	0.9735	16.93	20.69
0.9842	9.45	11.66	0.9788	13.11	16.14	0.9734	17.00	20.77
0.9841	9.52	11.74	0.9787	13.18	16.23	0.9733	17.07	20.86
0.9840	9.58	11.82	0.9786	13.25	16.31	0.9732	17.14	20.94
0.9839	9.65	11.90	0.9785	13.32	16.40	0.9731	17.21	21.03
0.9838	9.72	11.98	0.9784	13.39	16.48	0.9730	17.28	21.11
0.9837	9.78	12.06	0.9783	13.46	16.57	0.9729	17.35	21.20
0.9836	9.85	12.14	0.9782	13.53	16.65	0.9728	17.42	21.28
0.9835	9.92	12.23	0.9781	13.60	16.74	0.9727	17.49	21.37
0.9834	9.99	12.31	0.9780	13.67	16.82	0.9726	17.56	21.45
0.9833	10.06	12.39	0.9779	13.74	16.91	0.9725	17.63	21.54
0.9832	10.12	12.47	0.9778	13.82	16.99	0.9724	17.70	21.62
0.9831	10.19	12.55	0.9777	13.89	17.08	0.9723	17.77	21.71
0.9830	10.26	12.63	0.9776	13.96	17.16	0.9722	17.84	21.79
0.9829	10.33	12.71	0.9775	14.03	17.25	0.9721	17.91	21.88
0.9828	10.40	12.79	0.9774	14.11	17.33	0.9720	17.98	21.96
0.9827	10.46	12.87	0.9773	14.18	17.42	0.9719	18.05	22.05
0.9826	10.53	12.95	0.9772	14.25	17.50	0.9718	18.12	22.13
0.9825	10.60	13.04	0.9771	14.32	17.59	0.9717	18.19	22.22
0.9824	10.67	13.12	0.9770	14.40	17.68	0.9716	18.26	22.30
0.9823	10.74	13.20	0.9769	14.47	17.76	0.9715	18.33	22.39
0.9822	10.80	13.28	0.9768	14.54	17.85	0.9714	18.40	22.47
0.9821	10.87	13.36	0.9767	14.61	17.93	0.9713	18.47	22.56
0.9820	10.94	13.44	0.9766	14.69	18.02	0.9712	18.54	22.64
0.9819	11.01	13.52	0.9765	14.76	18.10	0.9711	18.61	22.73
0.9818	11.07	13.61	0.9764	14.83	18.19	0.9710	18.68	22.82
0.9817	11.14	13.69	0.9763	14.90	18.27	0.9709	18.75	22.90
0.9816	11.21	13.78	0.9762	14.98	18.36	0.9708	18.82	22.99
0.9815	11.27	13.86	0.9761	15.05	18.44	0.9707	18.89	23.07
0.9814	11.34	13.94	0.9760	15.12	18.53	0.9706	18.96	23.16
0.9813	11.41	14.03	0.9759	15.19	18.62	0.9705	19.03	23.24
0.9812	11.47	14.11	0.9758	15.27	18.70	0.9704	19.10	23.33
0.9811	11.54	14.20	0.9757	15.34	18.79	0.9703	19.17	23.41
0.9810	11.61	14.28	0.9756	15.41	18.88	0.9702	19.24	23.50
0.9809	11.67	14.36	0.9755	15.49	18.96	0.9701	19.31	23.58
0.9808	11.74	14.45	0.9754	15.56	19.05	0.9700	19.38	23.67
0.9807	11.80	14.53	0.9753	15.63	19.14	0.9699	19.45	23.75
0.9806	11.87	14.62	0.9752	15.70	19.22	0.9698	19.52	23.84
0.9805	11.94	14.70	0.9751	15.78	19.31	0.9697	19.59	23.92
0.9804	12.00	14.78	0.9750	15.95	19.40	0.9696	19.66	24.00
0.9803	12.07	14.87	0.9749	15.92	19.48	0.9695	19.73	24.09
0.9802	12.14	14.95	0.9748	16.00	19.56	0.9694	19.80	24.17
0.9801	12.20	15.04	0.9747	16.07	19.65	0.9693	19.87	24.25
0.9800	12.27	15.12	0.9746	16.14	19.74	0.9692	19.94	24.34
0.9799	12.34	15.21	0.9745	16.22	19.83	0.9691	20.01	24.42
0.9798	12.41	15.29	0.9744	16.29	19.91	0.9690	20.09	24.51
0.9797	12.48	15.38	0.9743	16.36	20.00	0.9689	20.16	24.59

METHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
0.9688	20.23	24.67	0.9668	21.63	26.35	0.9648	23.03	27.99
0.9687	20.30	24.76	0.9667	21.70	26.43	0.9647	23.10	28.07
0.9686	20.37	24.84	0.9666	21.77	26.52	0.9646	23.17	28.18
0.9685	20.44	24.92	0.9665	21.84	26.60	0.9645	23.24	28.24
0.9684	20.51	25.01	0.9664	21.91	26.68	0.9644	23.31	28.32
0.9683	20.58	25.09	0.9663	21.98	26.77	0.9643	23.38	28.40
0.9682	20.65	25.17	0.9662	22.05	26.85	0.9642	23.45	28.48
0.9681	20.72	25.26	0.9661	22.12	26.94	0.9641	23.52	28.56
0.9680	20.79	25.34	0.9660	22.19	27.02	0.9640	23.59	28.64
0.9679	20.86	25.42	0.9659	22.26	27.10	0.9639	23.66	28.72
0.9678	20.93	25.51	0.9658	22.38	27.18	0.9638	23.75	28.80
0.9677	21.00	25.59	0.9657	22.40	27.26	0.9637	23.80	28.88
0.9676	21.07	25.68	0.9656	22.47	27.34	0.9636	23.88	28.96
0.9675	21.14	25.76	0.9655	22.54	27.43	0.9635	23.95	29.04
0.9674	21.21	25.84	0.9654	22.61	27.51	0.9634	24.02	29.11
0.9673	21.28	25.95	0.9653	22.68	27.59	0.9633	24.09	29.19
0.9672	21.33	26.01	0.9652	22.75	27.67	0.9632	24.16	29.27
0.9671	21.42	26.10	0.9651	22.82	27.75	0.9631	24.23	29.36
0.9670	21.49	26.18	0.9650	22.89	27.83	0.9630	24.31	29.43
0.9669	21.56	26.26	0.9649	22.96	27.91	0.9629	24.38	29.51

IMMERSION REFRACTOMETER READINGS OF METHYL AND ETHYL ALCOHOLS AT 20°C

By Leach and Lythgoe. Jour. Am. Chem. Soc. 27, 964 (1905)

% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol	% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol	% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol
0	14.5	14.5	35	35.8	75.8	70	33.0	100.0
1	14.8	16.0	36	36.3	76.9	71	32.3	100.2
2	15.4	17.6	37	36.8	78.0	72	31.7	100.4
3	16.0	19.1	38	37.3	79.1	73	31.1	100.6
4	16.6	20.7	39	37.7	80.2	74	30.4	100.8
5	17.2	22.3	40	38.1	81.3	75	29.7	101.0
6	17.8	24.1	41	38.4	82.3	76	29.0	101.0
7	18.4	25.9	42	38.8	83.3	77	28.3	100.9
8	19.0	27.8	43	39.2	84.2	78	27.6	100.9
9	19.6	29.6	44	39.3	85.2	79	26.8	100.8
10	20.2	31.4	45	39.4	86.2	80	26.0	100.7
11	20.8	33.2	46	39.5	87.0	81	25.1	100.6
12	21.4	35.0	47	39.6	87.8	82	24.3	100.5
13	22.0	36.9	48	39.7	88.7	83	23.6	100.4
14	22.6	38.7	49	39.8	89.5	84	22.8	100.3
15	23.2	40.5	50	39.8	90.3	85	21.8	100.1
16	23.9	42.5	51	39.7	91.1	86	20.8	99.8
17	24.5	44.5	52	39.6	91.8	87	19.7	99.5
18	25.2	46.5	53	39.6	92.4	88	18.6	99.2
19	25.8	48.5	54	39.5	93.0	89	17.3	98.9
20	26.5	50.5	55	39.4	93.6	90	16.1	98.6
21	27.1	52.4	56	39.2	94.1	91	14.9	98.3
22	27.8	54.3	57	39.0	94.7	92	13.7	97.8
23	28.4	56.3	58	38.6	95.2	93	12.4	97.2
24	29.1	58.2	59	38.3	95.7	94	11.0	96.4
25	29.7	60.1	60	37.9	96.2	95	9.6	95.7
26	30.3	61.9	61	37.5	96.7	96	8.2	94.9
27	30.9	63.7	62	37.0	97.1	97	6.7	94.0
28	31.6	65.5	63	36.5	97.5	98	5.1	93 0
29	32.2	67.2	64	36.0	98.0	99	3.5	92.0
30	32.8	69.0	65	35.5	98.3	100	2.0	91.0
31	33.5	70.4	66	35.0	98.7			
32	34.1	71.7	67	34.5	99.1			
33	34.7	73.1	68	34.0	99.4			
34	35.2	74.4	69	33.5	99.7			

Calculation of the percentage of ethyl and methyl alcohols in a mixture with water, assuming a distillate to have a sp. gr. of 0.97917 $\frac{15.56°}{15.56°}$ and a refraction of 30.0 at 20° on the immersion refractometer. — From the tables of sp. gr. for these alcohols the density is found to correspond to 13.70% and 12.83% by weight of ethyl and methyl alcohol respectively; from the table above, the refractometer readings corresponding to 13.70% ethyl and methyl alcohol are 38.16 and 22.42 respectively. Then $(38.16 - 30.0) / (38.16 - 22.42) \times 100 = 51.8\%$, or 51.8% of the alcohol in the distillate is methyl alcohol.

$(12.83 \times 0.518) + 13.70 \times (1 - 0.518) = 13.25$ which is the % by weight of the mixed alcohols in the distillate, of which 13.25×0.518 or 6.86% is methyl alcohol and $13.25 \times (1 - 0.518)$ or 6.39% is ethyl alcohol.

DENSITY AND SPECIFIC GRAVITY OF GASES AND VAPORS

Name	Formula	Density g/l 0°C 760 mm	Density lbs./ft.^{3} 32°F, 1 atm.	Specific gravity Air = 1	Specific gravity O_2 = 1
Acetylene	C_2H_2	1.173	0.07323	0.9073	0.8208
Air	....	1.2929	.08071	1.0000	0.9047
Ammonia	NH_3	0.7710	.04813	0.5963	0.5395
Argon	A	1.7837	.11135	1.3796	1.2482
Arsenic fluoride	AsF_5	7.71*	.481*	5.96*	5.40*
Arsenic hydride	AsH_3	3.484*	.2175*	2.695*	2.438*
Boron fluoride	BF_3	2.99*	.187*	2.31*	2.09*
Butane (*n*)	C_4H_{10}	2.5190†	.15725†	2.0854†	1.8868†
Butane, *iso-*	C_4H_{10}	2.673	.1669	2.067	1.870
Carbon dioxide	CO_2	1.9769	.12341	1.5290	1.3834
Carbon monoxide	CO	1.2504	.07806	0.9671	0.8750
Carbon oxysulfide	COS	2.72	.170	2.10	1.90
Chlorine	Cl_2	3.214	.2006	2.486	2.249
Chlorine dioxide	ClO_2	3.09[11]	.193[11]	2.39[11]	2.16[11]
Chlorine monoxide	Cl_2O	3.89	.243	3.01	2.72
Cyanogen	C_2N_2	2.335*	.1458*	1.806*	1.634*
Dimethylamine	$(CH_3)_2NH$	1.966[17]	.1227[17]	1.521[17]	1.376[17]
Ethane	C_2H_6	1.3566	.08469	1.0493	0.9493
Ethylene	C_2H_4	1.2604	.07868	0.9749	0.8820
Fluorine	F_2	1.696	.1059	1.312	1.187
Germanium hydride (digermane)	Ge_2H_6	6.74[20]	.421[20]	5.21[20]	4.72[20]
Germanium tetrahydride	GeH_4	3.420	.2135	2.645	2.393
Helium	He	0.17847	.01114	0.13804	0.12489
Hydrogen	H_2	0.08988	.005611	0.06952	0.06290
Hydrogen bromide	HBr	3.6445	.2275	2.8189	2.5503
Hydrogen chloride	HCl	1.6392	.10233	1.2678	1.1471
Hydrogen iodide	HI	5.7891	.3614	4.4776	4.0510
Hydrogen selenide	H_2Se	3.670	.229	2.839	2.568
Hydrogen sulfide	H_2S	1.539	.09608	1.190	1.077
Hydrogen telluride	H_2Te	5.81	.363	4.49	4.07
Krypton	Kr	3.708	.2315	2.868	2.595
Methane	CH_4	0.7168	.04475	0.5544	0.5016
Methylamine	CH_3NH_2	1.396	.08715	1.080	0.9769
Methyl chloride	CH_3Cl	2.3076	.1441	1.7848	1.6148
Methyl ether	$(CH_3)_2O$	2.1098	.1317	1.6318	1.4764
Methyl fluoride	CH_3F	1.5452	.09646	1.1951	1.0813
Neon	Ne	0.90035	.05621	0.69638	0.63004
Nitric oxide	NO	1.3402	.08367	1.0366	0.9378
Nitrogen	N_2	1.25055	.07807	0.96724	0.87510
Nitrogen (atm.)	....	1.2568	.07846	0.9721	0.8795
Nitrosyl chloride	NOCl	2.992	.1868	2.314	2.094
Nitrosyl fluoride	NOF	2.176*	.1358*	1.683*	1.523*
Nitrous oxide	N_2O	1.9778	.1235	1.5297	1.3840
Nitroxyl chloride	NO_2Cl	2.57*	.160*	1.99*	1.798*
Nitroxyl fluoride	NO_2F	2.90	.181	2.24	2.03
Oxygen	O_2	1.42904	.08921	1.10527	1.0000
Ozone	O_3	2.144	.1338	1.658	1.500
Phosphine	PH_3	1.5294	.09548	1.1829	1.0702
Phosphorus fluoride	PF_3	3.907*	.2439*	3.022*	2.734*
Phosphorus oxyfluoride	POF_3	4.8	.30	3.7	3.4
Phosphorus pentafluoride	PF_5	5.81	.363	4.494	4.066
Propane	C_3H_8	2.020	.1261	1.562	1.414

* Temperature not stated, probably 20°C.

† Both butane and air at 710 mm.

DENSITY AND SPECIFIC GRAVITY OF GASES AND VAPORS (Continued)

Name	Formula	Density g/l 0°C 760 mm	Density lbs./ft.^{3} 32°F, 1 atm.	Specific gravity Air = 1	Specific gravity O_2 = 1
Radon	Ra	9.73	.607	7.526	6.809
Silicane, chloro-	SiH_3Cl	3.03	.189	2.34	2.12
Silicane, chloromethyl	SiH_2ClCH_3	3.64	.227	2.82	2.55
Silicane, dichloromethyl	$SiHCl_2CH_3$	5.3	.33	4.1	3.7
Silicane, dimethyl	$SiH_2(CH_3)_2$	2.73	.170	2.11	1.91
Silicane, methyl	SiH_3CH_3	2.08	.130	1.61	1.46
Silicane, trifluoro-	$SiHF_3$	3.86	.241	2.99	2.70
Silicon fluoride	SiF_4	4.684	.2924	3.623	3.278
Silicon hexahydride	Si_2H_6	2.85	.178	2.204	1.994
Silicon tetrahydride	SiH_4	1.44	.0899	1.114	1.008
Stibine (15°C, 754 mm)	SbH_3	5.30	.331	4.10	3.71
Sulfur dioxide	SO_2	2.9269	.1827	2.2638	2.0482
Sulfur fluoride	SF_6	6.50*	.406*	5.03*	4.55*
Sulfuric oxyfluoride	SO_2F_2	3.72*	.232*	2.88*	2.60*
Trimethylamine	$(CH_3)_3N$	2.580	.1611	1.996	1.805
Trimethyl boron	$(CH_3)_3B$	2.52	.157	1.95	1.76
Tungsten fluoride	WF_6	12.9	.805	9.98	9.03
Xenon	Xe	5.851	.3653	4.525	4.094

* Temperature not stated, probably 20°C.

DENSITY OF ELEMENTS

The density is given in grams per cubic centimeter and pounds per cubic foot at the temperature stated. Where no temperature is given ordinary atmospheric temperature is understood.

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
Aluminum, hard drawn	20	2.699	168.5	Edwards, 1925
liquid	659	2.382	148.7	Moorman, 1921
Antimony, vacuo-distilled	20	6.618	413.1	Kahlbaum, 1902
compressed	20	6.691	417.7	Kahlbaum, 1902
amorphous	.....	6.22	388.3	Herard
Argon, liquid	−183	1.3845	86.4	Baly-Donnan
	−189	1.4233	88.9	Baly-Donnan
Arsenic, metallic	15	5.73	357.7	Lashchenko, 1922
amorphous, brown—black	.....	3.70	231.0	Guenther [1908
yellow	18	2.0	124.9	Erdmann & Reppert,
Barium	.....	3.78	236.0	Guntz
	25	3.5	218.5	Biltz & Hüttig, 1920
Bismuth, electrolytic	.....	9.747	608.5	Classen, 1890 [1912
	20	9.80	611.8	Johnston & Adams,
vacuo-distilled	20	9.781	610.6	Kahlbaum, 1902
liquid	271	10.00	624.3	Vincentini-Omodei
	271	10.24	639.25	Plüss, 1915
solid	271	9.67	603.7	Vincentini-Omodei
Boron, crystal	.....	2.535	158.3	Wigand
amorphous	.....	2.45	152.9	Moissan
Bromine, liquid	.....	3.12	194.8	Richards-Stull
Cadmium, cast	20	8.648	539.9	Egerton & Lee, 1923
wrought	.....	8.67	541.2	
vacuo-distilled	20	8.648	539.9	Kahlbaum, 1902
solid	318	8.37	522.5	Vincentini-Omodei
liquid	318	7.99	498.8	Vincentini-Omodei
	349	7.94	495.7	Arpi, 1914
Caesium	20	1.873	116.9	Richards-Brink
Calcium	.....	1.54	96.1	Brink
Carbon, crystal	.....	3.52	219.7	Wigand
graphite	.....	2.25	140.5	Wigand
Cerium, electrolytic	.....	6.79	423.9	Muthmann-Weiss
pure	.....	6.9	430.7	Muthmann-Weiss
Chlorine, liquid	−33.6	1.507	94.1	Drugman-Ramsay
Chromium	.....	6.52–73	407.0–420.1	
pure	20	6.92	432.0	Moissan
	.....	7.1	443.2	Richards, 1907
Cobalt	21	8.71	543.7	Tilden [1915
	.....	8.9	555.6	Kalmus & Harper,
Columbium	15	8.4	524.4	Muthmann-Weiss
Copper, cast	.....	8.30–95	518.1–558.7	
annealed	20	8.89	555.0	Dellinger, 1911
wrought	.....	8.85–95	552.5–558.7	
hard-drawn	20	8.89	555.0	Dellinger, 1911
vacuo-distilled	20	8.9326	557.6	Kahlbaum, 1902
compressed	20	8.9376	558.0	Kahlbaum, 1902

DENSITY OF ELEMENTS (Continued)

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
liquid	.....	8.217	513.0	Roberts-Wrightson
Erbium	.....	4.77(?)	298.0	St. Meyer
Fluorine, liquid	−200	1.14	71.2	Moissan-Dewar
Gallium	25	5.903	369.1	Bur. of Stand., 1934
Germanium	20	5.46	340.9	Winkler [1913
Glucinum (Beryllium)	20	1.84	114.9	Fichter & Jablczynski,
Gold, cast	.....	19.3	1204.8	
cold rolled	20	19.296	1204.6	Rose, 1912
wrought	.....	19.33	1206.7	[1905
drawn annealed	20	19.26	1202.3	Kahlbaum & Sturm,
vacuo-distilled	20	18.88	1178.6	Kahlbaum, 1902
compressed	20	19.27	1203.0	Kahlbaum, 1902
Helium, liquid	−269	0.15	9.4	Onnes
Hydrogen, liquid	−252	0.07	4.4	Dewar, 1904
Indium	.....	7.28	454.5	Richards
Iridium	17	22.42	1399.6	Deville-Debray
Iodine	20	4.94	308.4	Richards-Stull
Iron, pure	.....	7.85–88	490.1–491.9	[1924
electrolytic, rolled	20	7.90	493.2	Tritton & Hanson,
gray cast	.....	7.03–13	438.9–445.1	
white cast	.....	7.58–73	473.2–482.6	
wrought	.....	7.80–90	486.9–493.2	
liquid	.....	6.88	429.5	Roberts-Austen
steel	.....	7.60–80	474.4–486.9	
Krypton, liquid	−146	2.16	134.8	Ramsay-Travers
Lanthanum	.....	6.15	383.9	Muthmann-Weiss
Lead, vacuo-distilled	20	11.342	708.0	Kahlbaum, 1902
compressed	20	11.347	708.4	Kahlbaum, 1902
solid	325	11.005	687.0	Vincentini-Omodei
liquid	325	10.645	664.5	Vincentini-Omodei
	400	10.597	661.5	Day, Sosman, 1914
	850	10.078	629.1	Day, Sosman, 1914
Lithium	20	0.534	33.3	Richards-Brink, 1907
Magnesium	.....	1.741	108.7	Voigt
Manganese	.....	7.42	463.2	Prelinger
Mercury, liquid	0	13.596	848.8	Regnault, Volkmann
	20	13.546	845.6	
	−38.8	13.690	854.6	Vincentini-Omodei
solid	−38.8	14.193	886.0	Vincentini-Omodei
	−188	14.383	897.9	Dewar, 1902
Molybdenum	.....	9.01	562.5	Moissan
	.....	10.2	636.8	Fink, 1910
Neodymium	.....	6.96	434.5	Muthmann-Weiss
Nickel	.....	8.60–90	536.9–555.6	
Nitrogen, liquid	−195	0.81	50.6	Baly-Donnan, 1902
	−205	0.854	53.3	Baly-Donnan, 1902
Osmium	.....	22.5	1404.6	Deville-Debray
Oxygen, liquid	−184	1.14	71.2	
Palladium	.....	12.16	759.1	Richards-Stull
Phosphorus, white	.....	1.83	114.2	
red	.....	2.20	137.3	
metallic	15	2.34	146.1	Hittorf
Platinum	20	21.37	1334.1	Richards-Stull
Potassium	20	0.87	54.3	Richards-Brink, 1907
solid	62.1	0.851	53.1	Vincentini-Omodei
liquid	62.1	0.83	51.8	Vincentini-Omodei
Praesodymium	.....	6.475	404.2	Muthmann-Weiss
Rhodium	.....	12.44	776.6	Holborn-Henning
Rubidium	20	1.532	95.6	Richards-Brink, 1907
Ruthenium	0	12.06	752.9	Toby
Samarium	.....	7.7–8	480.7–486.9	Muthmann-Weiss

DENSITY OF ELEMENTS (Continued)

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
Selenium	.....	4.3–8	268.4–299.6	
Silicon, crystal	20	2.42	151.1	Richards-Stull-Brink
amorphous	15	2.35	146.7	Vigoroux
Silver, cast	.....	10.42–53	650.5–657.4	
wrought	.....	10.6	661.7	
vacuo-distilled	20	10.492	655.0	Kahlbaum, 1902
compressed	20	10.503	655.7	Kahlbaum, 1902
liquid	.....	9.51	593.7	Wrightson
Sodium	20	0.9712	60.6	Richards-Brink, 1907
solid	97.6	0.9519	59.4	Vincentini-Omodei
liquid	97.6	0.9287	58.0	Vincentini-Omodei
solid	−188	1.0066	62.8	Dewar
Strontium	.....	2.50–58	156.1–161.1	Matthiessen
Sulfur	.....	2.0–1	124.9–131.1	
liquid	.....	1.811	112.1	Vincentini-Omodei
Tantalum	.....	16.6	1036.3	
Tellurium, crystal	.....	6.25	390.2	
amorphous	20	6.02	375.8	Beljankin
Thallium	.....	11.86	740.4	Richards-Stull [1925
Thorium	.....	11.3–11.7	705.4–730.4	Rentschler, Marden,
Tin, white cast	.....	7.29	455.1	Matthiessen
wrought	.....	7.30	455.7	
crystallized	.....	6.97–7.18	435.1–448.2	
solid	226	7.184	448.5	Vincentini-Omodei
liquid	226	6.99	436.4	Vincentini-Omodei
gray	.....	5.8	362.1	
Titanium	18	4.5	280.9	Mixter
Tungsten	.....	18.6–19.1	1161.1–1192.4	
Uranium	13	18.7	1167.4	Zimmermann
Vanadium	.....	5.69	355.3	Ruff-Martin
	20	5.96	372.1	Hull, 1922
Xenon, liquid	−109	3.52	219.7	Ramsay-Travers
Yttrium	.....	3.80	237.2	St. Meyer
Zinc, cast	.....	7.04–16	439.5–447.0	
wrought	.....	7.19	448.9	
vacuo-distilled	20	6.92	432.0	Kahlbaum, 1902
compressed	20	7.13	445.1	Kahlbaum, 1902
liquid	.....	6.48	404.5	Roberts-Wrightson
Zirconium	.....	6.44	402.0	

DENSITY OF ALLOYS

The density is given in grams per cubic centimeter at ordinary atmospheric temperatures.

Alloy.	Composition.	g./cm.^{3}	Pounds per cu. ft.
Aluminum and copper	10 Al, 90 Cu	7.69	480.06
	5 Al, 95 Cu	8.37	522.51
	3 Al, 97 Cu	8.69	542.49
Aluminum and zinc..	91 Al, 9 Zn	2.80	174.80
Bell metal..........	78 Cu, 22 Zn	8.70	543.11
Bismuth, lead and tin	53 Bi, 40 Pb, 7 Sn	10.56	659.23

DENSITY OF ALLOYS (Continued)

Alloy.	Composition.	g/cm.³	Pounds per cu. ft.
Brass, yellow....	70 Cu, 30 Zn cast	8.44	526.88
	rolled	8.56	534.38
	drawn	8.70	543.11
red...........	90 Cu, 10 Zn..............	8.60	536.87
white..........	50 Cu, 50 Zn..............	8.20	511.01
Bronze..........	90 Cu, 10 Sn(gun metal)	8.78	548.11
	85 Cu, 15 Sn	8.89	554.98
	80 Cu, 20 Sn	8.74	545.61
	75 Cu, 25 Sn	8.83	551.23
Cadmium and tin	32 Cd, 68 Sn	7.70	480.69
Constantan......	60 Cu, 40 Ni	8.88	554.35
German silver....	26.3 Cu, 36.6 Zn, 36.8 Ni	8.30	518.14
	52 Cu, 26 Zn, 22 Ni	8.45	527.51
	59 Cu, 30 Zn, 11 Ni	8.34	520.64
	63 Cu, 30 Zn, 6 Ni	8.30	518.14
Gold and copper	98 Au, 2 Cu	18.84	1176.12
	96 Au, 4 Cu	18.36	1146.16
	94 Au, 6 Cu	17.95	1120.56
	92 Au, 8 Cu	17.52	1093.72
	90 Au, 10 Cu	17.16	1071.25
	88 Au, 12 Cu	16.81	1049.40
	86 Au, 14 Cu	16.47	1028.17
Invar...........	63.8 Fe, 36 Ni, 0.2 C	8.00	499.42
Lead and tin.....	87.5 Pb, 12.5 Sn	10.60	661.73
	84 Pb, 16 Sn	10.33	644.87
	77.8 Pb, 22.2 Sn	10.05	627.39
	63.7 Pb, 36.3 Sn	9.43	588.69
	46.7 Pb, 53.3 Sn	8.73	544.99
	30.5 Pb, 69.5 Sn	8.24	514.40
Magnalium......	90 Al, 10 Mg	2.50	156.07
	70 Al, 30 Mg	2.00	124.85
Manganese bronze	95 Cu, 5 Mn	8.80	549.36
Manganin.......	84 Cu, 12 Mn, 4 Ni	8.50	530.63
Monel metal.....	71 Ni, 27 Cu, 2 Fe	8.90	555.60
Nickelin.........	....	8.77	547.48
Phosphor bronze	79.7 Cu, 10 Sn, 9.5 Sb, 0.8 P	8.80	549.36
Platinum and iridium.......	90 Pt, 10 Ir	21.62	1349.67
	85 Pt, 15 Ir	21.62	1349.67
	66.67 Pt, 33.33 Ir	21.87	1365.28
	5 Pt, 95 Ir	22.38	1397.12
Speculum metal..	67 Cu, 33 Sn	8.60	536.87
Steel...........	99 Fe, 1 C	7.83	488.80
manganese.....	86 Fe, 13 Mn, 1 C	7.81	487.55
Wood's metal....	50 Bi, 25 Pb, 12.5 Cd, 12.5 Sn	10.56	659.23

DENSITY OF VARIOUS SOLIDS

The approximate density of various solids at ordinary atmospheric temperature.

(Selected principally from the Smithsonian Tables.)

Substance.	Grams per cu. cm.	Pounds per cu. ft.
Agate	2.5–2.7	156–168
Alabaster, carbonate	2.69–2.78	168–173
sulphate	2.26–2.32	141–245
Albite	2.62–2.65	163–165
Amber	1.06–1.11	66–69
Amphoboles	2.9–3.2	180–200
Anorthite	2.74–2.76	171–172
Asbestos	2.0–2.8	125–175
Asphalt	1.1–1.5	69–94
Basalt	2.4–3.1	150–190
Beeswax	0.96–0.97	60–61
Beryl	2.69–2.7	168
Biotite	2.7–3.1	170–190
Bone	1.7–2.0	106–125
Brick	1.4–2.2	87–137
Butter	0.86–0.87	53–54
Calamine	4.1–4.5	255–280
Calcspar	2.6–2.8	162–175
Caoutchouc	0.92–0.99	57–62
Celluloid	1.4	87
Cement, set	2.7–3.0	170–190
Chalk	1.9–2.8	118–175
Charcoal, oak	0.57	35
pine	0.28–0.44	18–28
Cinnabar	8.12	507
Clay	1.8–2.6	122–162
Coal, anthracite	1.4–1.8	87–112
bituminous	1.2–1.5	75–94
Cocoa butter	0.89–0.91	56–57
Coke	1.0–1.7	62–105
Copal	1.04–1.14	65–71
Cork	0.22–0.26	14–16
Corundum	3.9–4.0	245–250
Diamond	3.01–3.52	188–220
Dolomite	2.84	177
Ebonite	1.15	72
Emery	4.0	250
Epidote	3.25–3.50	203–218
Feldspar	2.55–2.75	159–172
Flint	2.63	164
Fluorite	3.18	198
Galena	7.3–7.6	460–470
Gamboge	1.2	75
Garnet	3.15–4.3	197–268
Gas carbon	1.88	117
Gelatine	1.27	80
Glass, common	2.4–2.8	150–175
flint	2.9–5.9	180–370
Glue	1.27	80
Granite	2.64–2.76	165–172
Graphite	2.30–2.72	144–170
Gum arabic	1.3–1.4	80–85
Gypsum	2.31–2.33	144–145
Hematite	4.9–5.3	306–330
Hornblende	3.0	187
Ice	0.917	57.2
India rubber	0.91–0.93	57–58
Ivory	1.83–1.92	114–120
Leather, dry	0.86	54
Lime, slaked	1.3–1.4	81–87
Limestone	2.68–2.76	167–171
Magnetite	4.9–5.2	306–324
Malachite	3.7–4.1	231–256
Marble	2.6–2.8	160–177
Meerschaum	0.99–1.28	62–80
Mica	2.6–3.2	165–200
Muscovite	2.76–3.00	172–225
Ochre	3.5	218
Opal	2.2	137
Paper	0.7–1.15	44–72
Paraffin	0.87–0.91	54–57
Peat	0.84	52
Pitch	1.07	67
Porcelain	2.3–2.5	143–156
Porphyry	2.6–2.9	162–181
Pyrite	4.95–5.1	309–318
Quartz	2.65	165
Resin	1.07	67
Rock salt	2.18	136
Sandstone	2.14–2.36	134–147
Serpentine	2.50–2.65	156–165
Silica, fused transparent	2.21	142
translucent	2.07	133
Slag	2.0–3.9	125–240
Slate	2.6–3.3	162–205
Soapstone	2.6–2.8	162–175
Starch	1.53	95
Sugar	1.61	100
Talc	2.7–2.8	168–174
Tallow	0.91–0.97	57–60
Tar	1.02	66
Topaz	3.5–3.6	219–223

DENSITY OF VARIOUS SOLIDS (Continued)

Substance.	Grams per cu. cm.	Pounds per cu. ft.	Substance.	Grams per cu. cm.	Pounds per cu. ft.
Tourmaline	3.0–3.2	190–200	lignum vitæ....	1.17–1.33	73–83
Wax sealing......	1.8	117	locust..........	0.67–0.71	42–44
Wood (seasoned)			logwood........	0.91	57
alder...........	0.42–0.68	26–42	mahogany		
apple...........	0.66–0.84	41–52	Honduras....	0.66	41
ash.............	0.65–0.85	40–53	Spanish......	0.85	53
bamboo........	0.31–0.40	19–25	maple..........	0.62–0.75	39–47
basswood......	0.32–0.59	20–37	oak............	0.60–0.90	37–56
beech..........	0.70–0.90	43–56	pear............	0.61–0.73	38–48
blue gum......	1.00	62	pine, pitch......	0.83–0.85	52–53
birch...........	0.51–0.77	32–48	white........	0.35–0.50	22–31
box............	0.95–1.16	59–72	yellow.......	0.37–0.60	23–37
butternut......	0.38	24	plum...........	0.66–0.78	41–49
cedar...........	0.49–0.57	30–35	poplar..........	0.35–0.50	22–31
cherry.........	0.70–0.90	43–56	satinwood......	0.95	59
dogwood.......	0.76	47	spruce..........	0.48–0.70	30–44
ebony..........	1.11–1.33	69–83	sycamore.......	0.40–0.60	24–37
elm............	0.54–0.60	34–37	teak, Indian....	0.66–0.88	41–55
hickory........	0.60–0.93	37–47	African.......	0.98	61
holly..........	0.76	47	walnut.........	0.64–0.70	40–43
juniper.........	0.56	35	water gum.....	1.00	62
larch...........	0.50–0.56	31–35	willow.........	0.40–0.60	24–37

For the specific gravity of *alloys* see Composition and Physical Properties of Alloys.

For the specific gravity of the *elements* see Physical Constants of the Elements.

For specific gravity of *inorganic compounds* see Physical Constants of Inorganic Compounds.

For specific gravity of *organic compounds* see Physical Constants of Organic Compounds.

For specific gravity of *minerals* see Physical Constants of Common Minerals.

DENSITY OF WATER

The temperature of maximum density for pure water, free from air = **3°.98** C.

The density at this temperature = **0.999973** g/cm³.
The density of water at 3.98° C is 1.000000 g/ml.

(International Bureau of Weights and Measures, 1910.)

DENSITY OF VARIOUS LIQUIDS

(Selected from Smithsonian Tables.)

Liquid.	Grams per cu.cm.	Pounds per cu.ft.	Temp. °C.
Acetone	0.792	49.4	0°
Alcohol, ethyl	0.791	49.4	0
methyl	0.810	50.5	0
Benzene	0.899	56.1	0
Carbolic acid	0.950–0.965	59.2–60.2	15
Chloroform	1.480	92.3	18
Ether	0.736	45.9	0
Gasoline	0.66–0.69	41.0–43.0	..
Glycerine	1.260	78.6	0
Milk	1.028–1.035	64.2–64.6	..
Naphtha, wood	0.848–0.810	52.9–50.5	0
Naphtha, petroleum ether	0.665	41.5	15
Oils:			
castor	0.969	60.5	15
cocoanut	0.925	57.7	15
cotton seed	0.926	60.2	16
creosote	1.040–1.100	64.9–68.6	15
linseed, boiled	0.942	58.8	15
olive	0.918	57.3	15
turpentine	0.873	54.2	16
Sea water	1.025	64.0	15

DENSITY OF ALCOHOL

DENSITY OF ETHYL ALCOHOL IN GRAMS PER CUBIC CENTIMETER, COMPUTED FROM MENDELEJEFF'S FORMULA

(Selected from Smithsonian Tables.)

Temp. °C.	0	1	2	3	4
0	.80625	.80541	.80457	.80374	.80290
10	.79788	.79704	.79620	.79535	.79451
20	.78945	.78860	.78775	.78691	.78606
30	.78097	.78012	.77927	.77841	.77756

Temp. °C.	5	6	7	8	9
0	.80207	.80123	.80039	.79956	.79872
10	.79367	.79283	.79198	.79114	.79029
20	.78522	.78437	.78352	.78267	.78182
30	.77671	.77585	.77500	.77414	.77329

HYDROMETERS AND DENSITY UNITS

Alcoholometer. — For testing alcoholic solutions; the scale shows the per cent of alcohol by volume; 0°–100° is the per cent.

Ammoniameter. — For testing ammonia solutions; scale 0°–40°; to convert to sp. gr. multiply by 3 and deduct from 1000.

Barktrometer or *Barkometer.* — For testing tanning liquor; scale 0°–80° Bk; the number to the right of the decimal point of the sp. gr. is the degree Bk; thus, 1.025 sp. gr. is 25° Bk.

Baumé. — There are two kinds in use; heavy Bé, for liquids heavier than water and light Bé for liquids lighter than water. In the former, 0° corresponds to a sp. gr. 1.000 (water at 4°C.) and 66° corresponds to a sp. gr. 1.842; in the lighter than water scale, 0° Bé is equivalent to the gravity of a 10% solution of sodium chloride and 60° Bé corresponds to a sp. gr. of 0.745. For Baumé degrees on the scale of densities greater than unity, the following equation gives the means of conversion:

$$\text{Sp. gr.} = \frac{m}{m - d} \quad \text{where } \begin{aligned} m &= 145 \text{ (in the United States)} \\ m &= 144 \text{ (old scale used in Holland)} \\ m &= 146.78 \text{ (New scale or Gerlach scale)} \\ d &= \text{Baumé reading} \end{aligned}$$

Beck's Hydrometer has 0° corresponding to sp. gr. 1.000 and 30° to sp. gr. 0.850; equal divisions on the scale are continued as far as required in both directions.

Brix Saccharometer or *Balling Saccharometer* shows directly the per cent of sugar (sucrose) by weight at the temperature indicated on the instrument, usually 17.5°C.; i.e., degrees Brix is the per cent sugar.

Cartier's Hydrometer floats in water at the 10° scale division and at 30° corresponds to 32° Bé.

Oleometer. — For vegetable and sperm oils; scale 50°–0° corresponds to sp. gr. 0.870–0.970.

Soxhlet's Lactometer, for determining the density of milk, has a scale from 25° (sp. gr. 1.025) to 35° (sp. gr. 1.035) divided into suitable scale divisions.

Twaddell Hydrometers have the scale so arranged that the reading multiplied by 5 and added to 1000 gives the sp. gr. with reference to water as 1000; it is always used for densities greater than water.

HYDROMETER CONVERSION TABLES

Showing the Relation between Density (C. G. S.) and Degrees Baumé for Densities less than Unity.

Density.	Degrees Baumé.				
	.00	.01	.02	.03	.04
0.60	103.33	99.51	95.81	92.22	88.75
.70	70.00	67.18	64.44	61.78	59.19
.80	45.00	42.84	40.73	38.68	36.67
.90	25.56	23.85	22.17	20.54	18.94
1.00	10.00	.....	.....	.....	.....

Density.	Degrees Baumé.				
	.05	.06	.07	.08	.09
0.60	85.38	82.12	78.95	75.88	72.90
.70	56.67	54.21	51.82	49.49	47.22
.80	34.71	32.79	30.92	29.09	27.30
.90	17.37	15.83	14.33	12.86	11.41
1.00	......	.....	.....	.....	.....

HYDROMETER CONVERSION TABLES
(Continued)

Showing the Relation between Density (C. G. S.) and the Baumé and Twaddell Scales for Densities above Unity.

Density.	Degrees Baumé.	Degrees Twaddell.	Density.	Degrees Baumé.	Degrees Twaddell.
1.00	0.00	0	1.41	42.16	82
1.01	1.44	2	1.42	42.89	84
1.02	2.84	4	1.43	43.60	86
1.03	4.22	6	1.44	44.31	88
1.04	5.58	8	1.45	45.00	90
1.05	6.91	10	1.46	45.68	92
1.06	8.21	12	1.47	46.36	94
1.07	9.49	14	1.48	47.03	96
1.08	10.74	16	1.49	47.68	98
1.09	11.97	18	1.50	48.33	100
1.10	13.18	20	1.51	48.97	102
1.11	14.37	22	1.52	49.60	104
1.12	15.54	24	1.53	50.23	106
1.13	16.68	26	1.54	50.84	108
1.14	17.81	28	1.55	51.45	110
1.15	18.91	30	1.56	52.05	112
1.16	20.00	32	1.57	52.64	114
1.17	21.07	34	1.58	53.23	116
1.18	22.12	36	1.59	53.80	118
1.19	23.15	38	1.60	54.38	120
1.20	24.17	40	1.61	54.94	122
1.21	25.16	42	1.62	55.49	124
1.22	26.15	44	1.63	56.04	126
1.23	27.11	46	1.64	56.58	128
1.24	28.06	48	1.65	57.12	130
1.25	29.00	50	1.66	57.65	132
1.26	29.92	52	1.67	58.17	134
1.27	30.83	54	1.68	58.69	136
1.28	31.72	56	1.69	59.20	138
1.29	32.60	58	1.70	59.71	140
1.30	33.46	60	1.71	60.20	142
1.31	34.31	62	1.72	60.70	144
1.32	35.15	64	1.73	61.18	146
1.33	35.98	66	1.74	61.67	148
1.34	36.79	68	1.75	62.14	150
1.35	37.59	70	1.76	62.61	152
1.36	38.38	72	1.77	63.08	154
1.37	39.16	74	1.78	63.54	156
1.38	39.93	76	1.79	63.99	158
1.39	40.68	78	1.80	64.44	160
1.40	41.43	80	....	.....	...

ABSOLUTE DENSITY OF WATER

Density in Grams per Cubic Centimeter, Computed from the Relative Values by Thiesen, Scheel and Disselhorst (1900), and the Absolute Value at 3°.98 C. by the International Bureau of Weights and Measures (1910).

Degrees	0	1	2	3	4	5	6	7	8	9
0	0.999841	847	854	860	866	872	878	884	889	895
1	900	905	909	914	918	923	927	930	934	938
2	941	944	947	950	953	955	958	960	962	964
3	965	967	968	969	970	971	972	972	973	973
4	973	973	973	972	972	972	970	969	968	966
5	965	963	961	959	957	955	952	950	947	944
6	941	938	935	931	927	924	920	916	911	907
7	902	898	893	888	883	877	872	866	861	855
8	849	843	837	830	824	817	810	803	796	789
9	781	774	766	758	751	742	734	726	717	709
10	700	691	682	673	664	654	645	635	625	615
11	605	595	585	574	564	553	542	531	520	509
12	498	486	475	463	451	439	427	415	402	390
13	377	364	352	339	326	312	299	285	272	258
14	244	230	216	202	188	173	159	144	129	114
15	099	084	069	054	038	023	007	*991	*975	*959
16	0.998943	926	910	893	877	860	843	826	809	792
17	774	757	739	722	704	686	668	650	632	613
18	595	576	558	539	520	501	482	463	444	424
19	405	385	365	345	325	305	285	265	244	224
20	203	183	162	141	120	099	078	056	035	013
21	0.997992	970	948	926	904	882	860	837	815	792
22	770	747	724	701	678	655	632	608	585	561
23	538	514	490	466	442	418	394	369	345	320
24	296	271	246	221	196	171	146	120	095	069
25	044	018	*992	*967	*941	*914	*888	*862	*836	*809
26	0.996783	756	729	703	676	649	621	594	567	540
27	512	485	457	429	401	373	345	317	289	261
28	232	204	175	147	118	089	060	031	002	*973
29	0.995944	914	885	855	826	796	766	736	706	676
30	646	616	586	555	525	494	464	433	402	371

RELATIVE DENSITY AND VOLUME OF WATER

The mass of one cubic centimeter of water at 4° C is taken as unity.
The values given are numerically equal to the absolute density in grams per milliliter.

(Smithsonian Tables, compiled from Various Authors.)

Temp. ° C.	Density.	Volume.	Temp. ° C.	Density.	Volume
−10	0.99815	1.00186	+35	0.99406	1.00598
−9	843	157	36	371	633
−8	869	131	37	336	669
−7	892	108	38	299	706
−6	912	088	39	262	743
−5	0.99930	1.00070	40	0.99224	1.00782
−4	945	055	41	186	821
−3	958	042	42	147	861
−2	970	031	43	107	901
−1	979	021	44	066	943
+0	0.99987	1.00013	45	0.99025	1.00985
1	993	007	46	0.98982	1.01028
2	997	003	47	940	072
3	999	001	48	896	116
4	1.00000	1.00000	49	852	162
5	0.99999	1.00001	50	0.98807	1.01207
6	997	003	51	762	254
7	993	007	52	715	301
8	988	012	53	669	349
9	981	019	54	621	398
10	0.99973	1.00027	55	0.98573	1.01448
11	963	037	60	324	705
12	952	048	65	059	979
13	940	060	70	0.97781	1.02270
14	927	073	75	489	576
15	0.99913	1.00087	80	0.97183	1.02899
16	897	103	85	0.96865	1.03237
17	880	120	90	534	590
18	862	138	95	192	959
19	843	157	100	0.95838	1.04343
20	0.99823	1.00177	110	0.9510	1.0515
21	802	198	120	0.9434	1.0601
22	780	221	130	0.9352	1.0693
23	756	244	140	0.9264	1.0794
24	732	268	150	0.9173	1.0902
25	0.99707	1.00294	160	0.9075	1.1019
26	681	320	170	0.8973	1.1145
27	654	347	180	0.8866	1.1279
28	626	375	190	0.8750	1.1429
29	597	405	200	0.8628	1.1590
30	0.99567	1.00435	210	0.850	1.177
31	537	466	220	0.837	1.195
32	505	497	230	0.823	1.215
33	473	530	240	0.809	1.236
34	440	563	250	0.794	1.259

DENSITY AND VOLUME OF MERCURY

Based on the Density of Mercury at 0° C. by Thiesen and Scheel (1898)

(Selected from Smithsonian Tables.)

Temp. ° C.	Mass in gr. per cu.cm.	Vol. of 1 gr. in cu.cms.	Temp. ° C.	Mass in gr. per cu.cm.	Vol. in 1 gr. in cu.cms.
−10	13.6202	0.0734205	30°	13.5217	0.0739552
−9	6177	4338	31	5193	9686
−8	6152	4472	32	5168	9820
−7	6128	4606	33	5144	9953
−6	6103	4739	34	5119	40087
−5	13.6078	0.0734873	35	13.5095	0.0740221
−4	6053	5006	36	5070	0354
−3	6029	5140	37	5046	0488
−2	6004	5273	38	5021	0622
—1	5979	5407	39	4997	0756
0	13.5955	0.0735540	40	13.4973	0.0740891
1	5930	5674	50	4729	2229
2	5906	5808	60	4486	3569
3	5881	5941	70	4244	4910
4	5856	6075	80	4003	6252
5	13.5832	0.0736209	90	13.3762	0.0747594
6	5807	6342	100	3522	8939
7	5782	6476	110	3283	50285
8	5758	6610	120	3044	1633
9	5733	6744	130	2805	2982
10	13.5708	0.0736877	140	13.2567	0.0754334
11	5684	7011	150	2330	5688
12	5659	7145	160	2093	7044
13	5634	7278	170	1856	8402
14	5610	7412	180	1620	9764
15	13.5585	0.0737546	190	13.1384	0.0761128
16	5561	7680	200	1148	2495
17	5536	7813	210	0913	3865
18	5512	7947	220	0678	5239
19	5487	8081	230	0443	6616
20	13.5462	0.0738215	240	13.0209	0.0767996
21	5438	8348	250	12.9975	9381
22	5413	8482	260	9741	70769
23	5389	8616	270	9507	2161
24	5364	8750	280	9273	3558
25	13.5340	0.0738883	290	12.9039	0.0774958
26	5315	9017	300	8806	6364
27	5291	9151	310	8572	7774
28	5266	9285	320	8339	9189
29	5242	9419	330	8105	80609
30	13.5217	0.0739552	340	12.7872	0.0782033
			350	7638	3464
			360	7405	4900

DENSITY OF MOIST AIR

The density of dry air may be determined by computation from the general relation $D = D_0(T_0/T)(P/P_0)$ where D_0 represents a known density at absolute temperature T_0 and pressure P_0 and D, the density at absolute temperature T and pressure P.

The density of **moist** air may be determined by a similar relation: $D = 1.2929\ (273.13/T)\ [(B - 0.3783e)/760]$ where T is the absolute temperature; B, the barometric pressure in mm, and e the vapor pressure of the moisture in the air in mm. The density will then be the product of two terms, each of which may be found by use of the tables which follow.

The **first factor,** $1.2929\ (273.13/T)$, may be found directly in Table I for various temperatures. For convenience, temperatures are given in the table in °C although the values of the factor have been computed with absolute temperatures. The tabular values actually represent the density of dry air at various temperatures and 760 mm pressure.

The **second factor,** $[(B - 0.3783e)/760]$, must be obtained in two steps: **First**—the numerator of the expression is obtained by subtracting $0.3783e$ from the barometric pressure. The quantity $0.3783e$ may be found directly from the dew point in Table II. If the wet and dry bulb thermometer readings are known e may be found in the table Reduction of Psychrometric Observations given in the section Hygrometric and Barometric Tables. $0.3783e$ may then be found by calculation or read from the table. **Second**—the value of the whole factor for any value of $B - 0.3783e$ may be obtained from Table III.

The product of the above two factors will give the required density in g/l.

To facilitate obtaining **approximate values** of the density for ordinary pressures and temperatures, a table of products is given which may be entered with the temperature in °C and the corrected (for moisture) value of the barometric pressure in mm to obtain density.

As an illustration of the use of the tables, let it be desired to find the density of air for a barometric pressure of 750 mm, a dew point of 10° C, and air temperature of 20° C.

From the dew point, the value of $0.3783e$ is found in Table II to be 3.48 mm. $750 - 3.48 = 746.52$, the corrected pressure. The pressure factor for this value found in Table III by interpolation is 0.98226.

The temperature factor from Table I is 1.2047.

$$1.2047 \times 0.98224 = 1.1833 \text{ g/l.}$$

To obtain the value directly from Table IV, enter it for 20° C and 746.5 mm which gives by interpolation 1.183 g/l.

TABLE I

$(1.2929 \times 273.13/T)$

(Besides being a necessary part of the determination of the density of moist air, the values in this table are actually the density of dry air in g/l at 760 mm pressure for various temperatures.)

Temp. °C	0	1	2	3	4	5	6	7	8	9
−50	1.5 826	897	969	*042	*115	*189	*264	*339	*415	*491
−40	1.5 147	213	278	345	412	479	547	616	686	756
−30	1.4 524	584	645	706	767	829	892	955	*019	*083
−20	1.3 951	*006	*062	*118	*175	*232	*289	*347	*406	*465
−10	1.3 420	472	523	575	628	680	734	787	841	896
− 0	1.2 929	977	*024	*073	*121	*170	*219	*269	*319	*370
+ 0	1.2 929	882	835	789	742	697	651	606	561	517
10	1.2 472	428	385	342	299	256	214	171	130	088
20	1.2 047	006	*965	*925	*885	*845	*805	*766	*727	*688
30	1.1 649	611	573	535	498	460	423	387	350	314
40	1.1 277	242	206	170	135	100	065	031	*996	*962
50	1.0 928	895	861	828	795	762	729	697	664	632
60	1.0 600	569	537	506	475	444	413	382	352	322

TABLE II

Vapor Pressure—Value of 0.3783*e*

Dew point °C	Vap. press. *e* mm (ice)	0.3783*e*	Dew point °C	Vap. press. *e* mm (water)	0.3783*e*	Dew point °C	Vap. press. *e* mm (water)	0.3783*e*
−50	0.029	0.01	**0**	4.58	1.73	**30**	31.86	12.05
−45	.054	.02	1	4.92	1.86	31	33.74	12.76
−40	.096	.04	2	5.29	2.00	32	35.70	13.51
−35	.169	.06	3	5.68	2.15	33	37.78	14.29
−30	.288	.11	4	6.10	2.31	34	39.95	15.11
−25	0.480	0.18	**5**	6.54	2.47	**35**	42.23	15.98
−24	.530	.20	6	7.01	2.65	36	44.62	16.88
−23	.585	.22	7	7.51	2.84	37	47.13	17.83
−22	.646	.24	8	8.04	3.04	38	49.76	18.82
−21	.712	.27	9	8.61	3.26	39	52.51	19.86
−20	0.783	0.30	**10**	9.21	3.48	**40**	55.40	20.96
−19	.862	.33	11	9.85	3.73	41	58.42	22.10
−18	.947	.36	12	10.52	3.98	42	61.58	23.30
−17	1.041	.39	13	11.24	4.25	43	64.89	24.55
−16	1.142	.43	14	11.99	4.54	44	68.35	25.86
−15	1.252	0.47	**15**	12.79	4.84	**45**	71.97	27.23
−14	1.373	.52	16	13.64	5.16	46	75.75	28.66
−13	1.503	.57	17	14.54	5.50	47	79.70	30.15
−12	1.644	.62	18	15.49	5.86	48	83.83	31.71
−11	1.798	.68	19	16.49	6.24	49	88.14	33.34
−10	1.964	0.74	**20**	17.55	6.64	**50**	92.6	35.03
− 9	2.144	.81	21	18.66	7.06	51	97.3	36.81
− 8	2.340	.89	22	19.84	7.51	52	102.2	38.66
− 7	2.550	.96	23	21.09	7.98	53	107.3	40.59
− 6	2.778	1.05	24	22.40	8.47	54	112.7	42.63
− 5	3.025	1.14	**25**	23.78	9.00	**55**	118.2	44.72
− 4	3.291	1.24	26	25.24	9.55	56	124.0	46.91
− 3	3.578	1.35	27	26.77	10.13	57	130.0	49.18
− 2	3.887	1.47	28	28.38	10.74	58	136.3	51.56
− 1	4.220	1.60	29	30.08	11.38	59	142.8	54.02
0	4.580	1.73	**30**	31.86	12.05	**60**	149.6	56.59

TABLE III

Pressure Factor.—[(*B* − 0.3783*e*)/760]

The figures in the body of the table give values of the whole term $(B - 0.3783e)/760$] for various values of the numerator $(B - 0.3783e)$ expressed at the left and top.

Press. mm corr.	0	1	2	3	4	5	6	7	8	9
80	.10526	.10658	.10789	.10921	.11053	.11184	.11316	.11447	.11579	.11711
90	.11842	.11974	.12105	.12237	.12368	.12500	.12632	.12763	.12895	.13026
100	.13158	.13289	.13421	.13553	.13684	.13816	.13947	.14079	.14211	.14342
110	.14474	.14605	.14737	.14868	.15000	.15132	.15263	.15395	.15526	.15658
120	.15789	.15921	.16053	.16184	.16316	.16447	.16579	.16711	.16842	.16974
130	.17105	.17237	.17368	.17500	.17632	.17763	.17895	.18026	.18158	.18289
140	.18421	.18553	.18684	.18816	.18947	.19079	.19211	.19342	.19474	.19605
150	.19737	.19868	.20000	.20132	.20263	.20395	.20526	.20658	.20789	.20921
160	.21053	.21184	.21316	.21447	.21579	.21711	.21842	.21974	.22105	.22237
170	.22368	.22500	.22632	.22763	.22895	.23026	.23158	.23289	.23421	.23553
180	.23684	.23816	.23947	.24079	.24211	.24342	.24474	.24605	.24737	.24868
190	.25000	.25132	.25263	.25395	.25526	.25658	.25789	.25921	.26053	.26184
200	.26316	.26447	.26579	.26711	.26842	.26974	.27105	.27237	.27368	.27500
210	.27632	.27763	.27895	.28026	.28158	.28289	.28421	.28553	.28684	.28816
220	.28947	.29079	.29211	.29342	.29474	.29605	.29737	.29868	.30000	.30132
230	.30263	.30395	.30526	.30658	.30789	.30921	.31053	.31184	.31316	.31447
240	.31579	.31711	.31842	.31974	.32105	.32237	.32368	.32500	.32632	.32763
250	.32895	.33026	.33158	.33289	.33421	.33553	.33684	.33816	.33947	.34079
260	.34211	.34342	.34474	.34605	.34737	.34868	.35000	.35132	.35263	.35395
270	.35526	.35658	.35789	.35921	.36053	.36184	.36316	.36447	.36579	.36711
280	.36842	.36974	.37105	.37237	.37368	.37500	.37632	.37763	.37895	.38026
290	.38158	.38289	.38421	.38553	.38684	.38816	.38947	.39079	.39211	.39342
300	.39474	.39605	.39737	.39868	.40000	.40132	.40263	.40395	.40526	.40658
310	.40789	.40921	.41053	.41184	.41316	.41447	.41579	.41711	.41842	.41974
320	.42105	.42237	.42368	.42500	.42632	.42763	.42895	.43026	.43158	.43289
330	.43421	.43553	.43684	.43816	.43947	.44079	.44211	.44342	.44474	.44605
340	.44737	.44868	.45000	.45132	.45263	.45395	.45526	.45658	.45789	.45921
350	.46053	.46184	.46316	.46447	.46579	.46711	.46842	.46974	.47105	.47237
360	.47368	.47500	.47632	.47763	.47895	.48026	.48158	.48289	.48421	.48553
370	.48684	.48816	.48947	.49079	.49211	.49342	.49474	.49605	.49737	.49868
380	.50000	.50132	.50263	.50395	.50526	.50658	.50789	.50921	.51053	.51184
390	.51316	.51447	.51579	.51711	.51842	.51974	.52105	.52237	.52368	.52500
400	.52632	.52763	.52895	.53026	.53158	.53289	.53421	.53553	.53684	.53816
410	.53947	.54079	.54211	.54342	.54474	.54605	.54737	.54868	.55000	.55132
420	.55263	.55395	.55526	.55658	.55789	.55921	.56053	.56184	.56316	.56447
430	.56579	.56711	.56842	.56974	.57105	.57237	.57368	.57500	.57632	.57763
440	.57895	.58026	.58158	.58289	.58421	.58553	.58684	.58816	.58947	.59079
450	.59211	.59342	.59474	.59605	.59737	.59868	.60000	.60132	.60263	.60395
460	.60526	.60658	.60789	.60921	.61053	.61184	.61316	.61447	.61579	.61711
470	.61842	.61974	.62105	.62237	.62368	.62500	.62632	.62763	.62895	.63026
480	.63158	.63289	.63421	.63553	.63684	.63816	.63947	.64079	.64211	.64342
490	.64474	.64605	.64737	.64868	.65000	.65132	.65263	.65395	.65526	.65658
500	.65790	.65921	.66053	.66184	.66316	.66447	.66579	.66711	.66842	.66974
510	.67105	.67237	.67368	.67500	.67632	.67763	.67895	.68026	.68158	.68290
520	.68421	.68553	.68684	.68816	.68947	.69079	.69211	.69342	.69474	.69605
530	.69737	.69868	.70000	.70132	.70263	.70395	.70526	.70658	.70790	.70921
540	.71053	.71184	.71316	.71447	.71579	.71711	.71842	.71974	.72105	.72237

TABLE III (Continued)

Press. mm corr.	0	1	2	3	4	5	6	7	8	9
550	.72368	.72500	.72632	.72763	.72895	.73026	.73158	.73290	.73421	.73553
560	.73684	.73816	.73947	.74079	.74211	.74342	.74474	.74605	.74737	.74868
570	.75000	.75132	.75263	.75395	.75526	.75658	.75790	.75921	.76053	.76184
580	.76316	.76447	.76579	.76711	.76842	.76974	.77105	.77237	.77368	.77500
590	.77632	.77763	.77895	.78026	.78158	.78290	.78421	.78553	.78684	.78816
600	.78947	.79079	.79211	.79342	.79474	.79605	.79737	.79868	.80000	.80132
610	.80263	.80395	.80526	.80658	.80790	.80921	.81053	.81184	.81316	.81447
620	.81579	.81711	.81842	.81974	.82105	.82237	.82368	.82500	.82632	.82763
630	.82895	.83026	.83158	.83290	.83421	.83553	.83684	.83816	.83947	.84079
640	.84211	.84342	.84474	.84605	.84737	.84868	.85000	.85132	.85263	.85395
650	.85526	.85658	.85790	.85921	.86053	.86184	.86316	.86447	.86579	.86711
660	.86842	.86974	.87105	.87237	.87368	.87500	.87632	.87763	.87895	.88026
670	.88158	.88290	.88421	.88553	.88684	.88816	.88947	.89079	.89211	.89342
680	.89474	.89605	.89737	.89868	.90000	.90132	.90263	.90395	.90526	.90658
690	.90790	.90921	.91053	.91184	.91316	.91447	.91579	.91711	.91842	.91974
700	.92105	.92237	.92368	.92500	.92632	.92763	.92895	.93026	.93158	.93290
710	.93421	.93553	.93684	.93816	.93947	.94079	.94211	.94342	.94474	.94605
720	.94737	.94868	.95000	.95132	.95263	.95395	.95526	.95658	.95790	.95921
730	.96053	.96184	.96316	.96447	.96579	.96711	.96842	.96974	.97105	.97237
740	.97368	.97500	.97632	.97763	.97895	.98026	.98158	.98290	.98421	.98553
750	.98684	.98816	.98947	.99079	.99211	.99342	.99474	.99605	.99737	.99868
760	1.0000	1.0013	1.0026	1.0039	1.0053	1.0066	1.0079	1.0092	1.0105	1.0118
770	1.0132	1.0145	1.0158	1.0171	1.0184	1.0197	1.0211	1.0224	1.0237	1.0250
780	1.0263	1.0276	1.0289	1.0303	1.0316	1.0329	1.0342	1.0355	1.0368	1.0382
790	1.0395	1.0408	1.0421	1.0434	1.0447	1.0461	1.0474	1.0487	1.0500	1.0513

TABLE IV

Density of Moist Air

Values in the body of the table give the density of moist air in g/l for a limited range of temperatures and corrected pressure values ($B - 0.3783e$) The latter may be obtained by use of Table II.

°C	600	610	620	630	640	650	660	670	680	690
5	1.0024	1.0191	1.0358	1.0525	1.0692	1.0859	1.1026	1.1193	1.1361	1.1528
6	.99876	1.0154	1.0321	1.0487	1.0654	1.0820	1.0986	1.1153	1.1319	1.1486
7	.99521	1.0118	1.0284	1.0450	1.0616	1.0781	1.0947	1.1113	1.1279	1.1445
8	.99165	1.0082	1.0247	1.0412	1.0578	1.0743	1.0908	1.1074	1.1239	1.1404
9	.98818	1.0047	1.0211	1.0376	1.0541	1.0705	1.0870	1 1035	1.1199	1.1364
10	.98463	1.0010	1.0175	1.0339	1.0503	1.0667	1.0831	1.0995	1.1159	1.1323
11	.98115	.99751	1.0139	1.0302	1.0466	1.0629	1.0793	1.0956	1.1120	1.1283
12	.97776	.99406	1.0104	1.0267	1.0430	1.0592	1.0755	1.0918	1.1081	1.1244
13	.97436	.99061	1.0068	1.0231	1.0393	1.0556	1.0718	1.0880	1.1043	1.1205
14	.97097	.98715	1.0033	1.0195	1.0357	1.0519	1.0681	1.0843	1.1004	1.1166
15	.96757	.98370	.99983	1.0160	1.0321	1.0482	1.0643	1.0805	1.0966	1.1127
16	.96426	.98033	.99641	1.0125	1.0286	1.0446	1.0607	1.0768	1.0928	1.1089
17	.96086	.97688	.99290	1.0089	1.0249	1.0409	1.0570	1.0730	1.0890	1.1050
18	.95763	.97359	.98955	1.0055	1.0215	1.0374	1.0534	1.0694	1.0853	1.1013
19	.95431	.97022	.98613	1.0020	1.0179	1.0338	1.0497	1.0656	1.0816	1.0975

TABLE IV (Continued)

°C	600	610	620	630	640	650	660	670	680	690
20	.95107	.96693	.98278	.99864	1.0145	1.0303	1.0462	1.0620	1.0779	1.0937
21	.94784	.96364	.97944	.99524	1.0110	1.0294	1.0426	1.0584	1.0742	1.0900
22	.94460	.96035	.97609	.99184	1.0076	1.0233	1.0391	1.0548	1.0706	1.0863
23	.94144	.95714	.97283	.98852	1.0042	1.0199	1.0356	1.0513	1.0670	1.0827
24	.93829	.95393	.96957	.98521	1.0008	1.0165	1.0321	1.0478	1.0634	1.0790
25	.93513	.95072	.96630	.98189	.99748	1.0131	1.0286	1.0442	1.0598	1.0754
26	.93197	.94750	.96304	.97858	.99411	1.0096	1.0252	1.0407	1.0562	1.0718
27	.92889	.94437	.95986	.97534	.99083	1.0063	1.0218	1.0373	1.0528	1.0682
28	.92581	.94124	.95668	.97211	.98754	1.0030	1.0184	1.0338	1.0493	1.0647
29	.92273	.93811	.95350	.96888	.98426	.99963	1.0150	1.0304	1.0458	1.0612
30	.91965	.93498	.95031	.96564	.98097	.99629	1.0116	1.0270	1.0423	1.0576
31	.91665	.93193	.94721	.96249	.97777	.99304	1.0083	1.0236	1.0389	1.0542
32	.91365	.92888	.94411	.95934	.97457	.98979	1.0050	1.0203	1.0355	1.0507
33	.91065	.92583	.94101	.95619	.97137	.98654	1.0017	1.0169	1.0321	1.0473
34	.90773	.92286	.93800	.95313	.96826	.98338	.99851	1.0136	1.0288	1.0439
35	.90473	.91981	.93490	.94998	.96506	.98013	.99521	1.0103	1.0254	1.0405

°C	700	710	720	730	740	750	760	770	780	790
5	1.1695	1.1862	1.2029	1.2196	1.2363	1.2530	1.2697	1.2864	1.3031	1.3198
6	1.1652	1.1819	1.1985	1.2152	1.2318	1.2485	1.2651	1.2817	1.2984	1.3150
7	1.1611	1.1777	1.1943	1.2108	1.2274	1.2440	1.2606	1.2772	1.2938	1.3104
8	1.1569	1.1735	1.1900	1.2065	1.2230	1.2396	1.2561	1.2726	1.2892	1.3057
9	1.1529	1.1694	1.1858	1.2023	1.2188	1.2352	1.2517	1.2682	1.2846	1.3011
10	1.1487	1.1651	1.1816	1.1980	1.2144	1.2308	1.2472	1.2636	1.2800	1.2964
11	1.1447	1.1610	1.1774	1.1937	1.2101	1.2264	1.2428	1.2592	1.2755	1.2919
12	1.1407	1.1570	1.1733	1.1896	1.2059	1.2222	1.2385	1.2548	1.2711	1.2874
13	1.1368	1.1530	1.1692	1.1855	1.2017	1.2180	1.2342	1.2504	1.2667	1.2829
14	1.1328	1.1490	1.1652	1.1814	1.1975	1.2137	1.2299	1.2461	1.2623	1.2784
15	1.1288	1.1450	1.1611	1.1772	1.1933	1.2095	1.2256	1.2417	1.2579	1.2740
16	1.1250	1.1410	1.1571	1.1732	1.1893	1.2053	1.2214	1.2375	1.2535	1.2696
17	1.1210	1.1370	1.1530	1.1691	1.1851	1.2011	1.2171	1.2331	1.2491	1.2651
18	1.1172	1.1332	1.1492	1.1651	1.1811	1.1970	1.2130	1.2290	1.2449	1.2609
19	1.1134	1.1293	1.1452	1.1611	1.1770	1.1929	1.2088	1.2247	1.2406	1.2565
20	1.1096	1.1254	1.1413	1.1572	1.1730	1.1888	1.2047	1.2206	1.2364	1.2522
21	1.1058	1.1216	1.1374	1.1532	1.1690	1.1848	1.2006	1.2164	1.2322	1.2480
22	1.1020	1.1178	1.1335	1.1493	1.1650	1.1808	1.1965	1.2122	1.2280	1.2437
23	1.0984	1.1140	1.1297	1.1454	1.1611	1.1768	1.1925	1.2082	1.2239	1.2396
24	1.0947	1.1103	1.1259	1.1416	1.1572	1.1729	1.1885	1.2041	1.2198	1.2354
25	1.0910	1.1066	1.1222	1.1377	1.1533	1.1689	1.1845	1.2001	1.2157	1.2313
26	1.0873	1.1028	1.1184	1.1339	1.1494	1.1650	1.1805	1.1960	1.2116	1.2271
27	1.0837	1.0992	1.1147	1.1302	1.1456	1.1611	1.1766	1.1921	1.2076	1.2230
28	1.0801	1.0955	1.1110	1.1264	1.1418	1.1573	1.1727	1.1881	1.2036	1.2190
29	1.0765	1.0919	1.1073	1.1227	1.1380	1.1534	1.1688	1.1842	1.1996	1.2149
30	1.0729	1.0883	1.1036	1.1189	1.1342	1.1496	1.1649	1.1802	1.1956	1.2109
31	1.0694	1.0847	1.1000	1.1153	1.1305	1.1458	1.1611	1.1764	1.1917	1.2069
32	1.0659	1.0812	1.0964	1.1116	1.1268	1.1421	1.1573	1.1725	1.1878	1.2030
33	1.0624	1.0776	1.0928	1.1080	1.1231	1.1383	1.1535	1.1687	1.1839	1.1990
34	1.0590	1.0742	1.0893	1.1044	1.1195	1.1347	1.1498	1.1649	1.1801	1.1952
35	1.0555	1.0706	1.0857	1.1008	1.1158	1.1309	1.1460	1.1611	1.1762	1.1912

DENSITY OF DRY AIR

AT THE TEMPERATURE t, AND UNDER THE PRESSURE H CM. OF MERCURY, THE DENSITY OF AIR

$$=\frac{0.001293}{1+0.00367\,t}\,\frac{H}{76}.$$

(From Miller's Laboratory Physics, Ginn & Co, publishers, by permission.)

t	Pressure H in Centimeters. 72.0	73.0	74.0	75.0	76.0	77.0
°						
10	0.001182	0.001198	0.001215	0.001231	0.001247	0.001264
11	178	193	210	227	243	259
12	173	190	206	222	239	255
13	169	186	202	218	234	251
14	165	181	198	214	230	246
15	0.001161	0.001177	0.001193	0.001210	0.001226	0.001242
16	157	173	189	205	221	238
17	153	169	185	201	217	233
18	149	165	181	197	213	229
19	145	161	177	193	209	225
20	0.001141	0.001157	0.001173	0.001189	0.001205	0.001221
21	137	153	169	185	201	216
22	134	149	165	181	197	212
23	130	145	161	177	193	208
24	126	142	157	173	189	204
25	0.001122	0.001138	0.001153	0.001169	0.001185	0.001200
26	118	134	149	165	181	196
27	115	130	146	161	177	192
28	111	126	142	157	173	188
29	107	123	138	153	169	184
30	0.001104	0.001119	0.001134	0.001150	0.001165	0.001180

Proportional Parts.

cm.	17	16	15
0.1	2	2	1
0.2	3	3	3
0.3	5	5	4
0.4	7	6	6
0.5	8	8	7
0.6	10	10	9
0.7	12	11	10
0.8	14	13	12
0.9	15	14	13

DENSITY OF SATURATED VAPORS AT THE TEMPERATURE OF NORMAL EBULLITION

Vapor.	Temp. ° C.	Density.
Acetic acid	118.5	0.00315
Benzene	80.2	0.00275
Chloroform	61.2	0.00443
Ether	34.6	0.00311
Ethyl alcohol	78.3	0.00164
Methyl alcohol	64.7	0.00121
Water	100.0	0.000596

DENSITY OF GASES IN LIQUID AND SOLID FORM

Temperatures marked * are the temperatures of normal ebullition

Gas	Liquid Temp. °C	Liquid D g/cm³	Solid Temp. °C	Solid D g/cm³	Observer
Acetylene	− 23.5	0.52	.....	....	Mathias, 1909
	+ 30.3	0.40	.....	....	....
Air (20.9 % oxygen)	−147	0.92	.....	....	....
Ammonia	− 10.7	0.65	.....	....	Andreeff, 1859
	+ 16.3	0.61	.....	....	Andreeff, 1859
Argon	−187*	1.41	−233	1.65	Baly & Donnan, 1902
Carbon dioxide	− 60	1.19	− 79	1.53	Behn, 1910
	+ 20	0.77	.....	....	Amagat
Carbon monoxide	−190*	0.79	.....	....	....
	− 68	0.86	.....	....	Baly & Donnan
Chlorine	− 33.6*	1.56	.....	1.9	Knietsch, 1890
Chlorine	+ 20	1.41	.....	....	Knietsch, 1890
Ethane	− 88	0.546	.....	....	....
Ethylene	−102	0.566	.....	....	....
Ethylene	− 21	0.41	.....	....	Cailletet & Mathias, 1886
Ethylene	+ 10	0.21	.....	....	....
Fluorine	−187*	1.11	.....	1.3	....
Helium	−269*	0.122	.....	....	Kamerling-Onnes & Perrier, 1910
Hydrogen	−253*	0.07	−260	0.076	Dewar, 1904
Hydrogen chloride	− 85.8	1.194	.....	....	....
Hydrogen fluoride	+ 13.6	0.988	.....	....	....
Hydrogen phosphide (phosphine)	− 90	0.746	.....	....	....
Hydrogen sulfide	− 61	0.86	.....	....	....
Krypton	−146	2.6	.....	2.(?)	....
Methane	−164	0.415	.....	....	....
Methyl chloride	+ 18	0.920	.....	....	....
Neon	−245.9*	1.204	.....	1.0	....
Nitrogen	−196*	0.804	−253	1.03	Dewar, 1904
Nitrous oxide	− 20	1.0	.....	....	Cailletet & Mathias
Nitrous oxide	+ 17	0.80	.....	....	Villard, 1897
Oxygen	−123	0.89	.....	....	Cailletet & Hautefeuille, 1881
	−182.7*	1.14	−253	−1.41	Kamerling-Onnes & Perrier, 1910
	−205	1.25	.....	....	Baly & Donnan
Ozone, O_3	−183	1.71	.....	....	....
Sulfur dioxide	− 10*	1.46	.....	....	Pierre
	+ 20	1.38	.....	....	Cailletet & Mathias
Xenon	−109.1*	3.06	.....	2.7(?)	....

ELASTIC CONSTANTS FOR SOLIDS

The following table gives values for the yield point (or elastic limit, indicated by e.), ultimate tensile strength Young's modulus and the modulus of rigidity in kg/mm². The Brinell hardness number is also given, representing the ratio of load in kilograms on a sphere used to indent material to the spherical area of the indentation in square millimeters.

YIELD POINT, TENSILE STRENGTH, BRINELL HARDNESS

Material	Yield point Kg/mm²	Yield point Lbs./in.²	Ultimate tensile strength Kg/mm²	Ultimate tensile strength Lbs./in.²	Brinell hardness number
		×10³		×10³	
Aluminum 99.97, annealed	....	....	5.96	8.48	16
99.5, cast	....	....	7.95	11.31	....
hot rolled	10.2	14.51	11.34	16.13	....
cold "	13.2	18.77	14.71	20.92	....
99.3, rolled	....	....	19.7–24.6	28.02–34.99	39

ELASTIC CONSTANTS FOR SOLIDS (Continued)

Yield Point, Tensile Strength, Brinell Hardness (Continued)

Material	Yield point		Ultimate tensile strength		Brinell hardness number
	Kg/mm²	Lbs./in.²	Kg/mm²	Lbs./in.²	
Aluminum-copper		$\times 10^3$		$\times 10^3$	
Cu .93, cold rolled	18.1	25.74	20.4	29.01	....
Cu 1.9 " drawn	22.1	31.43	23.62	33.59	....
Cu 4.97 cast	8.2	11.66	10.6	15.08	....
cold drawn	25	35.6	27.9	39.68	....
Cu 8.08, cast	10.2	14.51	11.65	16.57	....
cold drawn	24.3	34.56	25.9	36.84	....
Aluminum-iron Fe 11, rolled	....	....	12.6	17.92	44
Aluminum-magnesium Mg 6, rolled	....	....	28.4	40.39	69
Aluminum-manganese Mn 8, rolled	....	....	15	21.33	50
Aluminum-nickel Ni 10, rolled	....	....	16.5	23.47	53
Aluminum-zinc					
Zn 11%, hard drawn	14.3	20.34	15.4	21.90	....
20.15% " "	24.8	35.27	40.4	57.46	....
26.05% " "	34.7	49.35	42.2	60.02	....
Aluminum-zinc-copper Zn 23.48, Cu 2.67	31.7	45.09	46.6	66.28	....
Ambrac Ni 20, Zn 5	53 e.	75.4 e.	60	85.3	160
"30%" Ni 30, Zn 5	67 e.	95.3 e.	74	105.3	190
Antimony (wire)	....	....	1.1	1.56	....
Arsenic	....	....	....	....	147
Brass, *see* Cu-Zn					
Bronze, *see* Cu-Sn					
Cadmium, cast	....	....	8.5	12.09	21–24
Calcium, cast	....	....	6	8.5	42
Cerium	....	....	....	....	28
Chromel A, rolled hot Ni 82.5, Cr 15, Fe 1	42–56	59.7– 79.7	74–88	105.3–125.2	175–210
Chromel B, rolled hot Ni 77.5, Cr 20, Fe 1	49–63	69.7– 89.6	77–91	109.5–129.4	180–220
Chromel C, Ni 61, Cr 12, Fe 25, cast	28–42	39.8– 59.7	35–49	49.8– 69.7	130–180
rolled hot	35–49	49.8– 69.7	63–77	89.6–109.5	180–200
Chromium	....	....	....	....	91
Cobalt, annealed	....	....	26.0	37	48
cast	....	....	24	34.1	124
drawn	....	....	68	96.7	....
electrolytic	....	....	....	....	270–311
Constantan, Ni 55, Cu 43.9, Mn 1, C .1, annealed	14–21 e	19.9– 29.9e.	42–49	59.7– 69.7	100–120
cold rolled	21–88 e.	29.9–125.2e.	49–99	69.7–140.8	120–300
Copper, rolled	....	....	22.77	32.39	....
99.5 sheet "hard"	....	....	28.1	39.97	....
wire, hard drawn	....	....	34.5–47.1	49–67	....
" annealed	....	....	22.5–24.6	32–35	....
Copper-aluminum (aluminum bronze)					
Al 1.06, hard rolled	10.9	15.50	25	35.6	....
Al 4.05 " "	17.8	25.32	37.5	53.34	....
Al 9.9 " "	23.3	33.14	60.0	85.34	210
quenched	65.9	93.73	85.4	121.46	....
Al 11.73, hard rolled	19.9	28.30	53.3	75.81	269

ELASTIC CONSTANTS FOR SOLIDS (Continued)

Yield Point, Tensile Strength, Brinell Hardness (Continued)

Material	Yield point Kg/mm²	Yield point Lbs./in.²	Ultimate tensile strength Kg/mm²	Ultimate tensile strength Lbs./in.²	Brinell hardness number
Copper-aluminum-nickel		$\times 10^3$		$\times 10^3$	
Al 5.34, Ni 7.34, cold rolled	81.1	115.35	84.1	119.62	180
Al 6.93, Ni 5.62, cold rolled	87.2	124.02	89.0	126.58	......
Copper-nickel (nickel-silver)					
Ni 10, Zn 25, hard	......	......	63	89.6	......
Ni 15, Zn 28 "	......	......	67	95.3	......
Ni 25, Zn 20 "	......	......	77	109.5	208
Copper-tin					
Sn 4, cast and annealed	......	......	22.9	32.57	......
Sn 10 " " "	......	......	30.4	43.24	......
Sn 19 " " "	......	......	38.7	55.04	......
Sn 25 " " "	......	......	17.7	25.17	......
Copper-zinc (brass)					
Zn 10, rolled hard	......	......	39	55.5	120
Zn 20 " "	......	......	47	66.8	145
Zn 30 " "	47	66.8	47	66.8	145
Zn 40	39	55.5	47	66.8	150
Zn 50	......	......	16	22.8	95
Cupro-nickel Ni 15, hard	......	......	49	69.7	......
soft	......	......	32	45.5	......
Ni 25 "	13 e.	18.5 e.	37	52.6	......
Delta metal	14.1 e.	20 e.	36.6	52	......
Duralumin, cold rolled Al + Cu 3.5–5.5, Mn .5–.8, Mg .5	54	76.8	62.0	88.18	125
Gold, cast	......	......	17.6	25	......
pure, hard drawn	......	......	25	35.6	......
Au 90, Cu 10	......	......	45.8	65.1	......
Gun metal	......	......	17.6–35.2	25–50	......
Indium	......	......	......	......	1
Iridium, cast	......	......	......	......	172
Iron, cast	3.5–4.2e.	5–6 e.	10.5–12.7	15–18	......
electrolytic, annealed	143	203.4	29.5	41.96	77
drawn	78	110.9	80.0	113.78	......
wrought	14.8–18.3e.	21–26e.	29.5–36.6	42–52	......
Lanthanum	......	......	......	......	37
Lead, cast	......	......	1.25	1.78	4.2
rolled	......	......	2.1	3.0	......
Lead-antimony Sb 4.5	......	......	4.50	6.4	......
Sb 9.9	......	......	5.39	7.67	......
Lead-tin Sn 33.3	......	......	7.63	10.85	......
Sn 50 (soft solder)	......	......	7.1	10.1	18
Magnesium, cast	......	......	10.7–14	15.22–19.9	......
drawn, annealed	8–13	11.4–18.5	18–22	25.6–31.3	29.4
Magnesium-aluminum Al 8 Dowmetal A, cast	......	......	21.8	31.01	60
Magnesium-Al-Cu-Cd					
Al 8.3, Cu 2, Cd 1, Zn .5, Mn .2, Dowmetal D	......	......	15.5	22.05	58
Al 8, Cu 1, Cd 1, Dowmetal R	......	......	16.5	23.47	54
Magnesium-cadmium Cd 5.5, drawn	12.4	17.64	20.6	29.30	51.9
Magnesium-copper Cu 12.7, drawn	21.9	31.2	24.6	34.99	......

ELASTIC CONSTANTS FOR SOLIDS (Continued)

Yield Point, Tensile Strength, Brinell Hardness (Continued)

Material	Yield point Kg/mm²	Yield point Lbs./in.²	Ultimate tensile strength Kg/mm²	Ultimate tensile strength Lbs./in.²	Brinell hardness number
Magnesium-silicon Si 1.2, drawn	22.2	$\times 10^3$ 31.58	29	$\times 10^3$ 41.3	....
Magnesium-zinc-Al Zn 3, Al .5, cold drawn	....	....	32	45.5	....
Manganese-bronze	21.1e.	30e	45.7–59.8	65–85	....
Molybdenum, drawn	....	....	180–222	256.0–315.8	147
Monel metal, Ni 68.4, Cu 29, Fe 2, Mn .3, C .2, Si .1, cast	21– 28e.	29.9– 39.8e.	46– 56	65.4– 79.6	110–130
cold drawn or rolled	28–105e.	39.8–149.3e.	53–120	75.4–170.7	130–300
Nickel 99%, cast	14– 21	19.9– 29.9	35–49	49.8– 69.7	90–110
rolled cold	25–105	35.6–149.3	53–120	75.4–170.7	110–300
Nickel-iron C<.01					
Ni 1	....	....	42.1	59.88	....
Ni 5	....	....	51	72.5	....
Ni 10	....	....	62.8	89.32	....
Ni 18	....	....	127.7	181.63	....
Ni 25	....	....	73.3	104.25	....
Ni 50	....	....	76.3	108.52	....
Nickel-manganese Mn 3	....	....	52.1	74.10	....
Mn 9.24	....	....	58.9	83.77	....
Palladium, drawn	....	....	38	54.0	49
Phosphor-bronze Cu + Sn 3.77, P .16, drawn	41.7	59.31	56	79.6	....
Platinum, annealed	....	....	24.6	35	....
pure, drawn	....	....	34	48.4	64
Platinum-iridium, hard-worked					
Ir 10	....	....	....	....	220
Ir 20	....	....	100	142.2	330
Ir 30	....	....	140	199.1	400
Platinum-rhodium Rh 10	....	....	....	....	90
Potassium	....	....	....	....	.037
Praseodymium	....	....	....	....	25
Rhodium, cast	....	....	....	....	139
Ruthenium, cast	....	....	....	....	220
Silver, cast	....	....	28.1	40	....
hard drawn	....	....	31–36	44 -51.2	....
Silver-copper Cu 7.5 (sterling silver) cast	12.8	18.21	22.2	31.58	60
hard drawn	....	....	43	61.2	....
Ag 75, Cu 25, hard drawn	....	....	91.4	130	....
Sodium	....	....	....	....	.07
Steel, castings	25.3– 27.4e.	36– 39e.	50.6– 54.8	72– 78	....
forgings	26.0– 31.6e.	37– 45e.	52.7– 63.3	75– 90	....
hard	24.6– 28.1e.	35– 40e.	49.2– 56.2	70– 80	....
medium	21.1– 24.6e.	30– 35e.	42.2– 49.2	60– 70	....
mild	17.6– 21.1e.	25– 30e.	35.2– 42.2	50– 60	16.0
spring, tempered	77.3–119.5e.	110–170e.	91.4–140.6	130–200	....
" untempered	35.2– 47.1e.	50– 67e.	71.0– 94.9	101–135	....
Steel-C					
C .08, annealed	....	....	32.5	46.22	120
quenched	....	....	49.0	69.69	....
.38, annealed	28.1	39.97	50.6	71.97	....
.49 "	....	....	49	69.7	....
.71 "	....	....	78.4	111.51	217
quenched	....	....	129	183.5	....

ELASTIC CONSTANTS FOR SOLIDS (Continued)

Yield Point, Tensile Strength, Brinell Hardness (Continued)

Material	Yield point		Ultimate tensile strength		Brinell hardness number
	Kg/mm²	Lbs./in.²	Kg/mm²	Lbs./in.²	
Steel-C (Continued)		×10³		×10³	
C 1.00, quenched	....	....	150	213.3	402
1.40, annealed	....	....	68.6	97.57	202
quenched	....	....	131.9	187.60	460
Steel-Cr, quenched Cr 2, C .5, Mn .24	....	....	176.6	251.18	454
Steel-Cr-U, quenched, Cr .78, U .17, C .36, Mn .53, Si .25	143.4	203.96	170	241.8	....
—Cr-V, quenched. Cr 1.45, V .19, C .46, Mn .45, Si .18	140.9	200.40	169	240.4	444
—Cu, cold drawn, Cu .3, C .72, Mn .83, Si .03	....	....	207.6	295.27	....
—Mn, forged Mn 8.68, C 1.27, Si .19	....	....	123.4	175.51	....
—Ni, Ni 1.76, C .26, cast	....	....	67.5	96.01	....
Ni 2.73, C .37, cast and forged	....	....	66.3	94.30	....
Ni 3.59, C .20, quenched	....	....	138	196.3	354
—Ni-Cr, quenched, Ni 3.7–4.1, Cr .9, C .38, Mn .7, Si .15	106.5	151.47	194	275.9	....
—Ni-Cr-U, quenched, Ni 1.63, Cr .61, U .20, C .36, Mn .78, Si .47	150	213.3	175	248.9	....
—Ni-Cu, quenched, Ni 2.55, Cu .6, C .46, Mn .82, Si 1.3	196	278.8	230.5	327.84	555
—Ni-U, quenched, Ni 3.15, U .40, C .57, Mn .62, Si .58	183	260.3	209	297.3	....
—Ni-V, quenched, Ni 3.15, V .32, C .6, Mn .79, Si 1.3	194.2	276.21	241.3	343.20	627
—Ti, low carbon, quenched, Ti 2.57, C .135, Mn .31, P .01, S .017, Si .14	45.2	64.29	66.2	94.16	143
—Ti, high carbon, quenched, Ti 8.71, C .65, Mn .45, P .016, S .011, Si .163	80.3	114.21	132.5	188.45	477
—U, quenched, U 2.20, C .25, Mn .65, Si .30	145	206.2	160.6	228.42	....
—U, quenched, tempered, U .29, C .54, Mn .61	181	257.4	197	280.2	....
—U, quenched, U .53, C .72, Mn .54, Si .75	197	280.2	233	331.4	....
—V, rolled, V .8, C 1.04, Mn .05, Si .1	92.6	131.70	132.2	188.03	....
Tantalum	....	....	93	132.3	....
Thorium	....	....	56.3	80.08	....
Tin, hard drawn	....	....	7.0	10	....
rolled	....	....	2.5	3.56	....
Tin-antimony-copper bearing alloy Sb 11, Cu 11	....	....	11.5	16.36	37
Tobin bronze	35.9–39.4e.	51–56e.	46.4–56.2	66–80	....
Tungsten, drawn	....	....	420	597.4	....
Zinc, rolled	9	12.8	12–30	17.1–42.7	....

ELASTIC CONSTANTS FOR SOLIDS (Continued)

Young's Modulus and Modulus of Rigidity (Torsional)

Material	Young's modulus		Modulus of rigidity	
	Dynes/cm²	Lbs./in.²	Dynes/cm²	Lbs./in.²
	$\times 10^{11}$	$\times 10^{6}$	$\times 10^{11}$	$\times 10^{6}$
Aluminum, cast	5.6 –7.7	8–11	....	....
rolled	6.82–7.0	9.7–10	....	....
99.3, rolled	6.96	10.10	2.37	3.44
Aluminum-bronze, forged				
Cu 90, Al 10	11.81	16.8	....	....
Aluminum-iron Fe 11, rolled	6.67	9.67	....	....
Aluminum-magnesium				
Mg 6, rolled	6.18	8.96	....	....
Aluminum-manganese				
Mn 8, rolled	6.47	9.39	....	....
Aluminum-nickel Ni 10, rolled	6.47	9.39	....	....
Ambrac (Ni 20)	13.14	19.06	....	....
Antimony (wire)	7.80	11.31	1.98	2.87
Brass, cold rolled	9.02	13.09	3.53	5.12
Cadmium, cast	6.93	10.06	2.40	3.48
Constantan	14.51–15.89	21.05–23.04	....	....
Copper, rolled	12.06–12.85	17.49–18.63	4.24	6.14
wire, hard drawn	10.19–12.0	14.5–17	....	....
Cupro-nickel	8.24	11.95	....	....
Delta metal	7.73	11	....	....
Duralumin, cold rolled				
Al + Cu 3 5–5.5, Mn .5–.8, Mg .5	6.89	10.00	2.75	3.98
Gold, pure, hard drawn	7.85	11.38	....	....
Gun metal	7.0	10	....	....
Iridium, cast	5.17 (d)	7.50 (d)	....	....
Iron, cast	8.4– 9.8	12–14	....	....
electrolytic	20.6	29.9	....	....
wrought	18.3–20.4	26–29	....	....
Iron-cobalt Fe 70, Co 30	21.33	30.94	....	....
Lead, rolled	1.47– 1.67	2.13– 2.42	0.54	0.78
Magnesium, drawn, annealed	4.18	6.06	1.67	2.42
Magnesium-aluminum				
Al 8 Dowmetal A, cast	4.18	6.06	....	....
Monel metal	16.48–17.95	23.89–26.03	6.18–6.86	8.96– 9.96
Nickel	20.01–21.38	29.01–31.01	7.06–7.55	10.24–10.95
Nickel-iron C<.01				
Ni 5	21.28	30.86	....	....
Ni 18	17.36 (19% Ni)	25.17	....	....
Ni 25	18.14 (26% Ni)	26.31	....	....
Palladium, drawn	11.77	17.07	4.41	6.40
Platinum, pure, drawn	16.67	24.18	6.42	9.32
Platinum-rhodium Rh 10	....	....	6.47	9.39
Rhodium, cast	29.42 (d)	42.67 (d)	....	....
Silver, hard drawn	7.75	11.24	2.60	3.77
Steel-C				
C .08 annealed	....	....	7.79	11.31
drawn	19.22	27.88	....	....
.38 annealed	20.01	29.01	8.11	11.76
.67 "	19.61	28.45	8.04	11.66
Tantalum	18.6	27.0	....	....
Tin, rolled	3.92–5.39	5.69–7.82	1.67	2.42
Tobin bronze	3.2	4.5	....	....
Tungsten, drawn	35.5	51.49	14.81	21.48
Zinc, rolled	7.8–10.20	11.4–14.79	2.9–3.73	4.3–5.40

COMPRESSIBILITY OF LIQUIDS

Contraction in unit volume per atmosphere.

Liquid.	Temp. °C.	Pressures in atmospheres.	Coefficient.	Observer.
Acetone	0.	1–500	82×10^{-6}	Amagat, 1893
	0.	500–1000	59.	"
	0.	1000–1500	47.	"
	99.5	8.94–36.5	276.	"
Amyl alcohol	17.7	8	90.5	Röntgen, 1891
Benzene C_6H_6	12.9	0.4–18	87.	Suchodski, 1910
	34.9	2–18	100.	"
	99.9	4.5–19	190.	"
Butyl alcohol	17.4	8	90.	Röntgen
Carbon disulphide	0.	1–500	66.	Amagat, 1893
	49.2	1000–1500	51.	"
Carbon tetrachloride	20.	100–200	90.7	Richards, 1907
Chlorobenzene	13.	0.4–18	67.	Suchodski, 1910
	35.	0.4–18	77.	"
	100.	0.4–18	127.	"
Chloroform	0.	....	101.	Grimaldi, 1887
	20.	....	128.	"
	40.	....	162.	"
	60.	....	204.	"
	100.	8–9	211.	Amagat
	100.	19–34	206.	"
	20.	1–98	94.	Richards & Stall, 1904
	20.	98.7–197.4	89.	Richards & Stall, 1904
	20.	197.4–296.1	80.	Richards & Stall, 1904
Ether	12.2	0.4–17.5	163.	Suchodski, 1910
	34.8	2–19	207.	"
	63.	8.6–34.3	293.	Amagat, 1893
	78.5	8.6–34.3	363.	"
	99.	8.6–36.5	523.	"
Ethyl acetate	13.3	8.1–37.4	104.	"
Ethyl alcohol	28.	150–400	81.	Barus, 1890
	65.	150–400	100.	"
	100.	150–400	132.	"
	185.	150–400	245.	"
	310.	150–400	1530.	"
	28.	150–200	86.	"
	100.	150–200	168.	"
	310.	150–200	4200.	"

COMPRESSIBILITY OF LIQUIDS (Continued)

Contraction in unit volume per atmosphere.

Liquid.	Temp. °C.	Pressures in atmospheres.	Coefficient.	Observer.
Ethyl alcohol:				
	0.	1–50	$96. \times 10^{-6}$	Amagat, 1893
	20.	1–50	112.	"
	40.	1–50	125.	"
	0.	100–200	85.	"
	0.	300–400	73.	"
	0.	500–600	64.	"
	0.	900–1000	52.	"
Ethyl bromide.	10.1	1–500	89.6	Amagat
	10.1	500–1000	63.4	"
	13.7	0.4–18.5	113.	Suchodski, 1910
	35.	2–19	138.	"
Ethyl chloride.	0.	1–500	103.	Amagat, 1893
	0.	500–1000	69.2	"
	11.	8.5–34.2	138.	"
	62.	12.7–32.8	255.	"
	99.	12.8–34.5	495.	"
Ethyl iodide...	10.6	1–500	73.8	Amagat
		500–1000	56.2	"
Fluor-benzene.	13.9	0.4–18	88.	Suchodski, 1910
	35.3	0.4–18	103.	"
	99.7	4.3–18.5	190.	"
Glycerine.....	14.9	1–10	22.	De Metz, 1890
Mercury......	0.	....	3.92	Amagat
	15.	100–200	3.76	Richards, 1907
Methyl acetate	14.3	8.1–37.5	97.	Amagat
	99.	8.3–37	250.	"
Methyl alcohol	0.	1–500	79.4	"
	0.	500–1000	58.3	"
	14.7	8.5–371	104.	"
	100.	8.7–37.3	221.	"
Nitric acid....	20.3	1–32	338.	....
Palmitic acid..	65.	20–100	88.	Barus, 1890
	100.	20–100	99.	"
Paraffine......	64.	20–100	84.	"
	100.	20–100	107.	"
Oil, almond...	17.	....	55.	Quincke
olive.......	20.5	....	63.	"
turpentine...	19.7	....	79.	"
Toluene.......	10.	1–5.25	79.	DeHeen, 1885
	100.	1–5.25	150.	" "
Xylene.......	10.	1–5.25	74.	" "
	100.	1–5.25	132.	"

COMPRESSIBILITY OF LIQUIDS (Continued)

Contraction in unit volume per atmosphere.

Liquid.	Temp. °C.	Pressures in atmospheres.	Coefficient.	Observer.
Water........	0.	1–25	52.5×10^{-6}	Amagat, 1893
	10.	1–25	50.0	"
	20.	1–25	49.1	"
	0.	25–50	51.6	"
	10.	25–50	49.2	"
	20.	25–50	47.6	"
	0.	100–200	49.2	"
	10.	100–200	46.1	"
	20.	100–200	44.2	"
	50.	100–200	42.5	"
	100.	100–200	46.8	"
	0.	500–1000	41.6	"
	0.	1000–1500	35.8	"
	0.	1500–2000	32.4	"
	0.	2000–2500	29.2	"
	0.	2500–3000	26.1	"

ELASTIC CONSTANTS FOR GASES

For short ranges of pressure, at a constant temperature, the volume of a gas is inversely proportional to the pressure or pressure $\times$volume = a constant. (Boyle's Law.)

For high pressures, the table below shows the relative volumes at various temperatures. The volume at 0° C. and 76 cm. pressure (1 atmosphere) being taken as 1,000,000.

(From Smithsonian Tables.)

Atm.	Oxygen.			Air.		
	0°	99°.5	199°.5	0°	99°.4	200°.4
100	9265	......	......	9730		
200	4570	7000	9095	5050	7360	9430
300	3208	4843	6283	3658	5170	6622
400	2629	3830	4900	3036	4170	5240
500	2312	3244	4100	2680	3565	4422
600	2115	2867	3570	2450	3180	3883
700	1979	2610	3202	2288	2904	3502
800	1879	2417	2929	2168	2699	3219
900	1800	2268	2718	2070	2544	3000
1000	1735	2151	......	1992	2415	2828

Atm.	Nitrogen.			Hydrogen.		
	0°	99°.5	199°.6	0°	99°.3	200°.5
100	9910					
200	5195	7445	9532	5690	7567	9420
300	3786	5301	6715	4030	5286	6520
400	3142	4265	5331	3207	4147	5075
500	2780	3655	4515	2713	3462	4210
600	2543	3258	3973	2387	3006	3627
700	2374	2980	3589	2149	2680	3212
800	2240	2775	3300	1972	2444	2900
900	2149	2616	3085	1832	2244	2657
1000	2068	......	......	1720	2093	

COEFFICIENT OF FRICTION

(From Rankine's Compilation, 1858; Smithsonian Tables.)

Materials.	Coefficient of friction.	Angle of repose in degrees.
Wood on wood, dry	.25–.50	14.0–26.5
Wood on wood, soapy	.20	11.5
Metals on oak, dry	.50–.60	26.5–31.0
Metals on oak, wet	.24–.26	13.5–14.5
Metals on oak, soapy	.20	11.5
Metals on elm, dry	.20–.25	11.5–14.0
Hemp on oak, dry	.53	28.0
Hemp on oak, wet	.33	18.5
Leather on oak	.27–.38	15.0–19.5
Leather on metals, dry	.56	29.5
Leather on metals, wet	.36	20.0
Leather on metals, greasy	.23	13.0
Leather on metals, oily	.15	8.5
Metals on metals, dry	.15–.20	8.5–11.5
Metals on metals, wet	.3	16.5
Smooth surfaces occasionally greased	.07–.08	4.0–4.5
Smooth surfaces continually greased	.05	3.0
Smooth surfaces, best results	.03–.036	1.75–2.0
Steel on agate, dry	.20	11.5
Steel on agate, oiled	.107	6.1
Iron on stone	.30–.70	16.7–35.0
Wood on stone	about .40	22.0
Masonry and brick work, dry	.60–.70	33.0–35.0
Masonry and brick work, damp mortar	.74	36.5
Masonry on dry clay	.51	27.0
Masonry on moist clay	.33	18.25
Earth on earth	.25–1.00	14.0–45.0
Earth on earth, dry sand, clay and mixed earth	.38–.75	21.0–37.0
Earth on earth, damp clay	1.00	45.0
Earth on earth, wet clay	.31	17.0
Earth on earth, shingle and gravel	.81–1.11	39.0–48.0

RESISTANCE TO CRUSHING FOR VARIOUS MATERIALS

Approximate values in pounds per square inch.

Material.	Resistance to crushing in lbs. per sq. in.	Material.	Resistance to crushing in lbs. per sq.in.
Brick:		Granite	9700–34000
soft burned	3000–6000	Limestone	6000–25000
hard burned	4500–6500	Marble	7600–20700
vitrified	8500–25000	Sandstone	2400–29300
Brownstone	7300–23600	Tufa	7700–11600
Concrete	800–3800		

TENSILE STRENGTH OF METALS

(Selected from Smithsonian Tables.)

Given in pounds per square inch. The values can be considered only as approximations.

Metal.	Tensile Strength in lbs. per sq. in.
Aluminum wire	30000–40000
Brass wire	50000–150000
Bronze wire, phosphor, hard drawn	110000–140000
Bronze wire, silicon, hard drawn	95000–115000
Bronze	60000–75000
Cobalt, cast	33000
Copper wire, hard drawn	60000–70000
German silver	40000–50000
Gold wire	20000
Iron, cast	13000–33000
Iron wire, hard drawn	80000–120000
Iron wire, annealed	50000–60000
Lead, cast or drawn	2600–3300
Magnesium, hard drawn	33000
Monel metal, cold drawn	80000–100000
Nickel, hard drawn	155000
Palladium	39000
Platinum wire	50000
Silver wire	42000
Steel	80000–330000
Steel wire, maximum	460000
Steel, specially treated nickel steel	250000
Steel, piano wire, 0.033 in. diam	357000–390000
Steel, piano wire, 0.051 in. diam	325000–337000
Tantalum	130000
Tin, cast or drawn	4000–5000
Tungsten, hard drawn	590000
Zinc, cast	7000–13000
Zinc, drawn	22000–30000

MODULUS OF RUPTURE. TRANSVERSE TESTS FOR VARIOUS WOODS

(Smithsonian Tables.)

Material.	Modulus, lbs. per sq.in.	Material.	Modulus, lbs. per sq.in.
Ash, white	10,800	Maple, sugar	16,500
Basswood	8,340	Maple, white	14,640
Beech	16,200	Oak, red	11,400
Cedar, red	11,800	Oak, white	13,100
Cedar, white	6,300	Pine, white	7,900
Cypress, bald	7,900	Pine, red	9,100
Elm, white	10,300	Poplar	9,400
Fir, red	13,270	Spruce, pine	10,000
Hemlock	9,480	Walnut, black	11.900
Hickory, pignut	18,700		

HARDNESS

Scale of Hardness

1 Talc	4 Fluorite	8 Topaz
2 Rock salt or gypsum	5 Apatite	9 Corundum
3 Calcite	6 Feldspar	10 Diamond
	7 Quartz	

Hardness of Materials

Agate	6–7	Indium	1.2
Alabaster	1.7	Iridium	6–6.5
Alum	2–2.5	Iridosmium	7
Aluminum	2–2.9	Iron	4–5
Alundum	9+	Kaolinite	2.0–2.5
Amber	2–2.5	Lead	1.5
Andalusite	7.5	Lithium	0.6
Anthracite	2.2	Loess (0°)	0.3
Antimony	3.0–3.3	Magnesium	2.0
Apatite	5	Magnetite	6
Aragonite	3.5	Manganese	5.0
Arsenic	3.5	Marble	3–4
Asbestos	5	Meerschaum	2–3
Asphalt	1–2	Mica	2.8
Augite	6	Opal	4–6
Barite	3.3	Orthoclase	6
Bell-metal	4	Osmium	7.0
Beryl	7.8	Palladium	4.8
Bismuth	2.5	Phosphorus	0.5
Boric acid	3	Phosphorbronze	4
Boron	9.5	Platinum	4.3
Brass	3–4	Plat-iridium	6.5
Cadmium	2.0	Potassium	0.5
Calamine	5	Pumice	6
Calcite	3	Pyrite	6.3
Calcium	1.5	Quartz	7
Carbon	10.0	Rock salt (halite)	2
Carborundum	9–10	Ross' metal	2.5–3.0
Cesium	0.2	Rubidium	0.3
Chromium	9.0	Ruthenium	6.5
Copper	2.5–3	Selenium	2.0
Corundum	9	Serpentine	3–4
Diamond	10	Silicon	7.0
Diatomaceous earth	1–1.5	Silver	2.5–7
Dolomite	3.5–4	Silver chloride	1.3
Emery	7–9	Sodium	0.4
Feldspar	6	Steel	5–8.5
Flint	7	Stibnite	2
Fluorite	4	Strontium	1.8
Galena	2.5	Sulfur	1.5–2.5
Gallium	1.5	Talc	1
Garnet	6.5–7	Tellurium	2.3
Glass	4.5–6.5	Tin	1.5–1.8
Gold	2.5–3	Topaz	8
Graphite	0.5–1	Tourmaline	7.3
Gypsum	1.6–2	Wax (0°)	0.2
Hematite	6	Wood's metal	3
Hornblende	5.5	Zinc	2.5

SURFACE TENSION

Compiled by T. Fraser Young and William D. Harkins

Meaning of Symbols

γ = the surface tension in dynes per centimeter.

$\Delta\gamma$ = the surface tension of a solution minus the surface tension of the pure solvent.

-- air, means that the liquid was in contact with air (saturated with its own vapor).

-- vapor, means that the liquid was in contact with its own vapor.

-- N_2 and -- H_2 have corresponding meanings.

-- also designates the surface between a pair of liquids at which the interfacial tension was determined.

% = weight % of the solute (i. e. the organic substance).

f = gram formula weights per 1000 grams of solvent (i. e. water).

°C = degrees Centigrade.

°K = degrees Kelvin or Absolute. Temperature in °C = Temperature in °K − 273.1.

M.P., at the melting point.

k_E = the Eötvös Constant, in erg mole $^{-\frac{2}{3}}$ degree $^{-1}$.

$$-k_E = \frac{d\,\Gamma}{d\,t} = \frac{d\,(M/d)^{\frac{2}{3}}\,\gamma}{d\,t}$$

where $\Gamma = \gamma\,(M/d)^{\frac{2}{3}}$

M = mass of one gram formula weight of the substance

d = density of the substance.

LIQUIDS AGAINST AIR

Substance	°C	Surface tension, γ	°C	Surface tension, γ	k_E
Acetic acid	20	27.6	50	24.7	......
Acetone	20	23.7	60	18.6	1.9
Benzene	20	28.88	50	25.0	2.22
Benzophenone	20	45.1	50	41.8	2.9
n-Butyric acid	20	26.8	50	24.0	......
Carbon tetrachloride	20	26.8	50	23.1	2.21
Chlorobenzene	20	33.2	50	29.6	2.2
Chloroform	20	27.1	60	21.7	2.1
Cyclohexane	20	25.3	....	....	......
Ethyl acetate	20	23.9	50	20.2	2.3
Ethyl alcohol	20	22.3	50	19.8	......
Ethyl ether	20	17.0	..	....	2.25
n-Hexane	20	18.4	40	16.3	......
Methyl alcohol	20	22.6	50	20.1	......
n-Octane	20	21.8	60	17.9	2.3
n-Octyl alcohol	20	27.5	..	....	......
Phenol	20	40.9	50	37.7	1.85
n-Propylamine	20	22.4	45	19.4	1.9
Toluene	20	28.43	50	25.0	2.2
Triphenyl-phosphine	45.7	42.0	95.9	36.9	3.3
Tristearin	60	29.6	130	24.7	5.5

Water.—See special table below.

LIQUIDS AGAINST THEIR VAPORS

Formula	°C	γ	°C	γ	k_E
Cl_2 - -vapor	20.	18.	50.	13.	......
CO_2 - -vapor	−25.	9.1	20.	1.2	......
N_2O_4 - -vapor	1.6	31.	19.8	28.	2.2
NH_3 - -vapor	11.1	23.	59.0	13.	1.3
PCl_3 - -vapor	20.	29.1	50.	25.2	2.2
Substance	**°K**	**γ**	**°K**	**γ**	**k_E**
Hydrogen - -vapor	14.68	2.882	20.40	1.912	1.36
Neon - -vapor	24	5.90	28	4.45	2.0
Nitrogen - -vapor	70.0	10.5	90.0	6.2	2.0
Oxygen - -vapor	70.0	18.3	90.0	13.2	1.9

WATER AGAINST AIR

°C	γ	°C	γ	°C	γ	°C	γ
−8	77.0	10	74.22	25	71.97	60	66.18
−5	76.4	15	73.49	30	71.18	70	64.4
0	75.6	18	73.05	40	69.56	80	62.6
5	74.9	20	72.75	50	67.91	100	58.9

METALS

Substance	Temp. °C	γ	Substance	Temp. °C	γ
Bismuth..- -H_2	400	375	Mercury..- -air	20	465
Lead.....- -H_2	400	445	Tin......- -H_2	400	520

FUSED SALTS

AgCl....- -air	452	126	NaCl....- -N_2	996	100
	573	113	$NaNO_3$..- -N_2	559	106
$BiCl_3$....- -N_2	331	58	Na_2SO_4..- -N_2	990	188
$CaCl_2$....- -air	M.P.	152			
KCl.....- -N_2	986	82			

INTERFACIAL TENSION

Surface Tension at the Interface Between Two Liquids

(Each liquid saturated with the other)

Liquids	Temp. °C	γ	Liquids	Temp. °C	γ
Benzene- - Mercury.........	20	357.	Water- -Heptylic acid.......	20	7.0
Ethyl ether- -Mercury......	20	379.	Water- -n-Hexane......	20	51.1
Water- - Benzene..........	20	35.00	Water- -Mercury..........	20	375.
Water- -Carbon tetrachloride..	20	45.	Water- -n-Octane......	20	50.8
Water- -Ethyl ether.........	20	10.7	Water- -n-Octyl alcohol.......	20	8.5

AQUEOUS SOLUTIONS AGAINST AIR

INORGANIC

(f = gram formula weights per 1000 grams of solvent.)

For the following aqueous solutions the values of $\Delta\gamma$ are given. $\Delta\gamma$ is the difference between the surface tension of the solution and that of the solvent at the same temperature. Positive values of $\Delta\gamma$ mean that the surface tension of the solution is greater than that of the solvent. Negative values, the reverse. For convenience in computing the surface tension, the current accepted value for the surface tension of water at the stated temperature is given in the second column.

Formula	°C (γH_2O)		$\Delta\gamma$ for concentrations indicated							
$CaCl_2$	25	f	.1	.5	1.0	2.0	3.0	5.0	11.2	
	(71.97)	$\Delta\gamma$	.35	1.5	3.2	6.9	11.0	18.4	35.	
HCl	20	f		.5	1.0	2.0	4.0	6.0	9.0	17.7
	(72.75)	$\Delta\gamma$		-.2	-.3	-.5	-.9	-1.3	-2.2	-7.
NH_4OH	18	f		.5	1.0	1.5	3.0	6.0	15.0	34.0
	(73.05)	$\Delta\gamma$		-1.4	-2.4	-3.1	-5.2	-7.8	-12.0	-16.0
HNO_3	20	f		.7	1.5	2.8			8.5	
	(72.75)	$\Delta\gamma$		-.6	-1.1	-1.8			-4.	
KCl	20	f	.1	.5	1.0	2.0	3.0	4.0	4.4	
	(72.75)	$\Delta\gamma$	.16	.70	1.4	2.8	4.2	5.5	6.0	

Formula	°C (γH_2O)		$\Delta\gamma$ for concentrations indicated							
KOH	18	f		.5	1.0	2.0	3.8			
	(73.05)	$\Delta\gamma$		.9	1.8	3.5	6.7			
$MgCl_2$	20	f	.1	.5	1.0	2.0	3.0	3.65		
	(72.75)	$\Delta\gamma$	.32	1.52	3.0	6.4	10.2	13.0		
$MgSO_4$	20	f	.1	.5	1.0	2.0	2.7			
	(72.75)	$\Delta\gamma$	.26	1.03	2.1	4.6	6.5			
NaBr	20	f		.5	1.0	1.5	2.9			
	(72.75)	$\Delta\gamma$		.7	1.3	2.0	3.8			
NaCl	20	f	.1	.5	1.0	2.0	3.0	5.0	6.0	
	(72.75)	$\Delta\gamma$	.17	.82	1.64	3.3	4.9	8.2	9.8	
Na_2CO_3	20	f	.25	.5	1.0	1.5				
	(72.75)	$\Delta\gamma$	.7	1.3	2.7	4.0				
$NaNO_3$	20	f	.1	.5	1.0	2.0	3.0	5.0	7.0	12.2
	(72.75)	$\Delta\gamma$	.12	.60	1.2	2.4	3.5	5.6	7.5	11.3
NaOH	18	f		.7	1.5			5.0	11.0	14.0
	(73.05)	$\Delta\gamma$		1.3	2.8			10.0	23.	28.
Na_2SO_4	20	f	.2	.5	1.0					
	(72.75)	$\Delta\gamma$	.5	1.4	2.7					

AQUEOUS SOLUTIONS AGAINST AIR

ORGANIC

Substance	°C		Surface tension for concentrations indicated							
Acetic acid	30	%	1.000	2.475	5.001	10.01	30.09	49.96	69.91	100.00
		γ	68.0	64.4	60.1	54.6	43.6	38.4	34.3	26.6
Acetone	25	%	5.00	10.00	20.00	25.00	50.00	75.0	95.0	100.00
		γ	55.5	48.9	41.1	38.3	30.4	26.8	24.2	23.0
n-Butyric acid	25	%	.14	.31	1.05	3.83	8.6	25.	79.	100.
		γ	69.	65.	56.	42.	33.	28.	27.	26.
Ethyl alcohol	30	%	.979	2.143	4.994	10.39	25.00	50.00	75.06	100.00
		γ	66.1	61.6	54.2	45.9	34.1	27.5	24.7	21.5
Glycerol	18	%	5.0	10.0	15.0	20.0	30.0	50.0	85.0	100.0
		γ	72.9	72.9	72.7	72.4	72.	70.	66.	63.
Methyl alcohol	30	%	1.011	2.500	4.997	9.994	25.00	50.00	75.00	100.00
		γ	68.4	65.3	61.0	54.6	43.0	32.9	27.1	21.8
Phenol	20	%	.024	.047	.118	.471	.941	1.881	3.76	5.62
		γ	72.6	72.2	71.3	66.5	61.1	54.0	46.0	42.3
Propionic acid	25	%	.988	1.91	5.84	9.8	21.7	49.8	73.9	100.0
		γ	64.	60.	49.	44.	36.	32.	30.	26.
Sucrose	25	%	10.0	20.0	30.0	40.0	55.0			
		γ	72.5	73.0	73.4	74.1	75.7			

VISCOSITY

The coefficient of viscosity of a substance is defined as the tangential force per unit area of either of two horizontal planes at unit distance apart, one of which is fixed, while the other moves with unit velocity, the space being filled with the substance.

In the case of a liquid flowing slowly through a long tube of small diameter, the volume V of liquid which escapes in a time t is given by the equation,

$$V = \frac{\pi p r^4}{8 l \eta} t$$

where p is the difference in pressure between the two ends of the tube; r, its radius; l, its length and η, the coefficient of viscosity. (Law of Poiseuille.)

A more complete equation is now generally used:

$$\eta = \frac{\pi d g r^4 t}{8Q(l + \lambda)}\left(h - \frac{mv^2}{g}\right)$$

where η is the coefficient of viscosity; d, the density in gm./cm^3; r, the radius and l the length of the tube in cm.; Q, the volume in cm.^{3} discharged in t sec.; λ a correction to the length of the tube; h, the average head in cm.; m, the coefficient of the kinetic energy correction, mv^2/g; g, the acceleration due to gravity in cm./sec.^{2}; v, the mean velocity in cm./sec. See Technologic Papers of the Bureau of Standards 100 and 112, 1917 and 1918 for a full discussion.

The coefficient of viscosity is expressed in dyne-seconds per cm.^{2} or poises.

Specific viscosity is the ratio of the coefficient of viscosity of any substance to that of water at 0° C. or other specified temperature.

VISCOSITY OF WATER

Temperature C	Coefficient of Viscosity C. G. S.			Specific Viscosity Hosking 1909
	Thorpe-Rodger 1894	Hosking 1909	Bingham and Jackson, 1917	
0	0.01778	0.01793	0.01792	1.000
5	.01510	.01522	.01519	.849
10	.01303	.01310	.01308	.730
15	.01134	.01142	.01140	.637
20	.01002	.01006	.01005	.561
25	.00891	.00893	.00894	.498
30	.00798	.00800	.00801	.446
35	.00720	.00724	.00723	.404
40	.00654	.00657	.00656	.367

VISCOSITY OF WATER (Continued)

Temperature C	Coefficient of Viscosity C. G. S. Thorpe-Rodger 1894	Hosking 1909	Bingham and Jackson, 1917	Specific Viscosity Hosking 1909
45	.00597	.00600	.00599	.335
50	.00548	.00550	.00549	.307
55	.00506	.00508	.00506	.283
60	.00468	.00469	.00469	.262
65	.00436	.00436	.00436	.243
70	.00406	.00406	.00406	.226
75	.00380	.00380	.00380	.212
80	.00356	.00356	.00357	.199
85	.00335	.00335	.00336	.187
90	.00316	.00316	.00317	.176
95	.00299	.00300	.00299	.167
100	.00283	.00284 *	.00284	.158
124	......	......	......	.124 *
153	.00181 *	......	......	.101 *

* Values by Haas, 1894.

VISCOSITY OF WATER BELOW 0° C.

White-Twining, 1914

Temperature	Coefficient of Viscosity	Temperature	Coefficient of Viscosity
0° C.	0.01798	−7.23	0.02341
−2.10	.01930	−8.48	.02458
−4.70	.02121	−9.30	.02549
−6.20	.02250		

VISCOSITY OF LIQUIDS

Coefficient of viscosity of liquids including elements, organic and inorganic compounds, and mixtures. C. G. S. units.

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
Acetaldehyde........	20	0.0022	Mussell-Thole-Dunstan, 1912
Acetanilide..........	130	.0190	Thorpe-Rodger, 1894
Acetic acid..........	20	.01219	Thorpe-Rodger, 1894
	40	.00901	Thorpe-Rodger, 1894
	60	.00700	Thorpe-Rodger, 1894
	80	.00560	Thorpe-Rodger, 1894
	100	.00457	Thorpe-Rodger, 1894
	0	.0238	Faust, 1912

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. °C.	Coefficient of viscosity.	Observer.
Acetic acid:	18	.0130	Faust, 1912
	41	.0100	Faust, 1912
	59	.0070	Faust, 1912
	70	.0060	Faust, 1912
	100	.0043	Faust, 1912
anhydride........	0	.0124	Faust, 1912
	18	.0090	Faust, 1912
	100	.0049	Faust, 1912
Acetone............	20	.0033	Thorpe-Rodger, 1894
	—13	.0047	Faust, 1912
	—10	.00450	Faust, 1912
	0	.00395	Faust, 1912
	14.5	.00330	Faust, 1912
	19	.00303	Faust, 1912
	35	.00278	Faust, 1912
	41	.00280	Faust, 1912
Air, liquid.........	......	.0033	Forch, 1900
	—192.3	.00172	Verschaffelt, 1917
Alcohol. See *Ethyl alcohol.*			
Allyl alcohol.......	0	.02144	Thorpe-Rodger, 1894
	20	.01361	Thorpe-Rodger, 1894
	40	.00911	Thorpe-Rodger, 1894
	60	.00642	Thorpe-Rodger, 1894
	80	.00470	Thorpe-Rodger, 1894
amine...........	130	.00506	Mussell-Thole-Dunstan, 1921
Ammonia, NH_3.....	—33.5	.00266	Fitzgerald, 1912
Amyl acetate......	10	.0106	Pribram-Handl, 1912
	20	.0089	Pribram-Handl, 1912
	30	.0077	Pribram-Handl, 1912
	40	.0065	Pribram-Handl, 1912
Aniline............	20	.0440	Wijkander, 1897
	30	.0319	Wijkander, 1897
	40	.0241	Wijkander, 1897
	50	.0189	Wijkander, 1897
	0	.0865	Faust, 1912
Anisol.............	20	.0111	Gartenmeister
Benzene....... ...	0	.00902	Thorpe-Rodger, 1894
	20	.00649	Thorpe-Rodger, 1894
	40	.00492	Thorpe-Rodger, 1894
	60	.00390	Thorpe-Rodger, 1894
	80	.00327	Thorpe-Rodger, 1894
	0	.00850	Faust, 1912
	19.4	.00619	Faust, 1912
	50	.00418	Faust, 1912
Benzylamine.......	25	.0159	Mussell-Thole-Dunstan, 1912
Benzylaniline.......	130	.0120	Mussell-Thole-Dunstan, 1912
Bismuth	285	.0161	Plüss, 1915
	365	.0146	Plüss, 1915
Bromine...........	16	.010	Thorpe-Rodger, 1894
Butyl alcohol......	0	.05185	Thorpe-Rodger, 1894
	20	.02947	Thorpe-Rodger, 1894
	40	.01780	Thorpe-Rodger, 1894
	60	.01136	Thorpe-Rodger, 1894
	80	.00762	Thorpe-Rodger, 1894
	100	.00534	Thorpe-Rodger, 1894
Butyric acid.......	0	.02284	Thorpe-Rodger, 1894
	20	.01538	Thorpe-Rodger, 1894
	40	.01117	Thorpe-Rodger, 1894
	60	.00853	Thorpe-Rodger, 1894
	80	.00678	Thorpe-Rodger, 1894
	100	.00545	Thorpe-Rodger, 1894

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. °C.	Coefficient of viscosity.	Observer.
	20	.0163	Gartenmeister, 1890
	40	.0118	Gartenmeister, 1890
	60	.0102	Gartenmeister, 1890
Carbon dioxide, liquid	0	.00099	Warburg-Babo, 1882
	10	.00085	Warburg-Babo, 1882
	20	.00071	Warburg-Babo, 1882
	30	.00053	Warburg-Babo, 1882
pressure, 59 atm.	20	.000697	Phillips, 1912
pressure, 72 atm.	30	.000458	Phillips, 1912
disulphide........	—13	.00514	Faust, 1912
	—10	.00495	Faust, 1912
	0	.00429	Faust, 1912
	0	.00429	Thorpe-Rodger, 1894
	20	.00367	Thorpe-Rodger, 1894
	40	.00319	Thorpe-Rodger, 1894
tetrachloride.....	20	.0096	Thorpe-Rodger, 1894
Chloroform........	0	.00700	Thorpe-Rodger, 1894
	20	.00564	Thorpe-Rodger, 1894
	40	.00466	Thorpe-Rodger, 1894
	—13	.00855	Faust, 1912
	0	.00715	Faust, 1912
	19	.00615	Faust, 1912
	39	.00500	Faust, 1912
Carbolic acid. See *phenol.*			
Copal lac..........	22	4.80	Metz, 1903
Diethylamine.......	25	.00346	Kournakoff-Zemczuzny, 1912
	25	.00367	Mussell-Thole-Dunstan, 1912
Diethylaniline......	25	.0195	Mussell-Thole-Dunstan, 1912
Dimethylaniline....	25	.01285	Mussell-Thole-Dunstan, 1912
Dimethyl-α-naphthylamine......	130	.00868	Mussell-Thole-Dunstan, 1912
Dimethyl-β-naphthylamine......	130	.00952	Mussell-Thole-Dunstan, 1912
Diphenylamine.....	130	.0104	Mussell-Thole-Dunstan, 1912
Ether (diethyl-).....	0	.00286	Thorpe-Rodger, 1894
	6.7	.00276	Thorpe-Rodger, 1894
	10	.00258	Thorpe-Rodger, 1894
	20	.00234	Thorpe-Rodger, 1894
	30	.00212	Thorpe-Rodger, 1894
	25	.00226	Baker, 1912
	0	.00300	Faust, 1912
	14	.00250	Faust, 1912
	32	.00215	Faust, 1912
Ethyl acetate......	10	.0051	Pribram-Handl, 1878
	20	.0044	Pribram-Handl, 1878
	40	.0035	Pribram-Handl, 1878
alcohol..........	0	.01770	Thorpe-Rodger, 1894
	10	.01449	Thorpe-Rodger, 1894
	20	.01192	Thorpe-Rodger, 1894
	30	.00990	Thorpe-Rodger, 1894
	40	.00827	Thorpe-Rodger, 1894
	50	.00698	Thorpe-Rodger, 1894
	60	.00591	Thorpe-Rodger, 1894
	25	.010786	Kernot-Pomilio, 1912
aniline...........	25	.0204	Mussell-Thole-Dunstan, 1912
bromide..........	20	.00392	Thorpe-Rodger, 1894
formate..........	20	.00402	
iodide...........	20	.00583	
malate...........	24.7	.03016	Thole, 1912
Ethylene bromide...	0	.02435	Thorpe-Rodger, 1894
	20	.01716	Thorpe-Rodger, 1894

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. °C.	Coefficient of viscosity.	Observer.
Ethylene bromide	40	.01280	Thorpe-Rodger, 1894
	70	.00895	Thorpe-Rodger, 1894
chloride	0	.01128	Thorpe-Rodger, 1894
	20	.00833	Thorpe-Rodger, 1894
	70	.00470	Thorpe-Rodger, 1894
Eugenol	25	.06931	Dunstan-Hilditch, 1912
Formic acid	10	.02262	Gartenmeister, 1890
	20	.01804	Gartenmeister, 1890
	30	.01465	Gartenmeister, 1890
	40	.01224	Gartenmeister, 1890
	50	.01025	Gartenmeister, 1890
Glucose	83	1600.	Tammann, 1899
	67	27000.	Tammann, 1899
Glycerine	2.8	42.20	Schöttner, 1878
	8.1	25.18	Schöttner, 1878
	14.3	13.87	Schöttner, 1878
	20.3	8.30	Schöttner, 1878
Glycerine	26.5	4.94	Schöttner, 1878
Glycol	0	.0218	Arrhenius
Heptane	0	.00519	Thorpe-Rodger, 1894
	20	.00410	Thorpe-Rodger, 1894
	40	.00344	Thorpe-Rodger, 1894
	60	.00276	Thorpe-Rodger, 1894
Hexane	0	.00397	Thorpe-Rodger, 1894
	20	.00320	Thorpe-Rodger, 1894
	40	.00264	Thorpe-Rodger, 1894
	60	.00221	Thorpe-Rodger, 1894
Hydrogen	liq.	.00011	Verschaffelt, 1917
Isoamyl-amine	25	.00724	Mussell-Thole-Dunstan, 1912
Isobutyl-amine	25	.00553	Mussell-Thole-Dunstan, 1912
Isobutyric acid	20	1.318	Thorpe-Rodger, 1894
Isoeugenol	25	.2672	Dunstan-Hilditch, 1912
Isoheptane	0	.00477	Thorpe-Rodger, 1894
	20	.00379	Thorpe-Rodger, 1894
	40	.00309	Thorpe-Rodger, 1894
Isohexane	0	.00371	Thorpe-Rodger, 1894
	20	.00300	Thorpe-Rodger, 1894
	40	.00247	Thorpe-Rodger, 1894
Isopentane	0	.00273	Thorpe-Rodger, 1894
	20	.00223	Thorpe-Rodger, 1894
Isoquinoline	25	.0357	Mussell-Thole-Dunstan, 1912
Isosafrol	25	.03981	Dunstan-Hilditch, 1912
Menthol	34.9	.069	Heydweiller
Mercury	—20	.0184	Koch, 1881
	0	.0170	Koch, 1881
	20	.0157	Koch, 1881
	100	.0122	Koch, 1881
	200	.01015	Koch, 1881
	300	.00928	Koch, 1881
	0	.01661	Plüss, 1915
	20	.01547	Plüss, 1915
	34	.01476	Plüss, 1915
	98	.01263	Plüss, 1915
	193	.01079	Plüss, 1915
	299	.00975	Plüss, 1915
Methyl acetate	0	.00478	
alcohol	0	.00813	Thorpe-Rodger, 1894
	20	.00591	Thorpe-Rodger, 1894
	40	.00450	Thorpe-Rodger, 1894
	60	.00349	Thorpe-Rodger, 1894
amine	0	.00236	Fitzgerald, 1912
aniline	25	.0200	Kournakoff-Zemczuzny, 1912

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
Methyl aniline.....	25	.0202	Mussell-Thole-Dunstan, 1912
iodide............	0	.00594	
	20	.00487	
	40	.00409	
Nitric acid.........	0	.02275	
	10	.01770	
Octane............	0	.00703	Thorpe-Rodger, 1894
	20	.00538	Thorpe-Rodger, 1894
	40	.00428	Thorpe-Rodger, 1894
Oil, castor.........	10	24.2	Kahlbaum-Raber, 1918
	20	9.86	Kahlbaum-Raber, 1918
	30	4.51	Kahlbaum-Raber, 1918
	40	2.31	Kahlbaum-Raber, 1918
	100	.169	Kahlbaum-Raber, 1918
cylinder, filtered..	37.8	2.406	Archbutt-Deeley, 1912
	100	.187	Archbutt-Deeley, 1912
dark...........	37.8	4.221	Archbutt-Deeley, 1912
	100	.240	Archbutt-Deeley, 1912
linseed..........	30	.331	White, 1912
	50	.176	White, 1912
	90	.071	White, 1912
machine, light....	15.6	1.138	Archbutt-Deeley, 1912
	37.8	.342	Archbutt-Deeley, 1912
	100	.049	Archbutt-Deeley, 1912
heavy.........	15.6	6.606	Archbutt-Deeley, 1912
	37.8	1.274	Archbutt-Deeley, 1912
olive............	10	1.38	Higgins, 1914
	20	.840	Higgins, 1914
	40	.363	Higgins, 1914
	70	.124	Higgins, 1914
rape.............	0	25.3	Meyer
	10	3.85	Meyer
	20	1.63	Meyer
	30	.96	Meyer
soya bean.......	30	.406	White, 1912
	50	.206	White, 1912
	90	.078	White, 1912
sperm...........	15.6	.420	Archbutt-Deeley, 1912
	37.8	.185	Archbutt-Deeley, 1912
	100	.046	Archbutt-Deeley, 1912
Pentane...........	0	.00283	Thorpe-Rodger, 1894
	20	.00232	Thorpe-Rodger, 1894
Phenol............	18.3	.127	Scarpa, 1903
	90	.0126	Scarpa, 1903
Potassium bromide	745	.0148	Lorenz, 1912
	775	.0134	Lorenz, 1912
	805	.0119	Lorenz, 1912
nitrate	334	.021	
	358	.017	
	333	.0297	Lorenz, 1912
	418	.0200	Lorenz, 1912
Propionic acid......	10	.0125	Rellstab, 1868
	20	.0107	Rellstab, 1868
	40	.0080	Rellstab, 1868
Propyl acetate.....	10	.0066	Pribram-Handl, 1879
	20	.0059	Pribram-Handl, 1879
	40	.0044	Pribram-Handl, 1879
alcohol....	0	.03882	Thorpe-Rodger, 1894
	20	.02255	Thorpe-Rodger, 1894
	40	.01403	Thorpe-Rodger, 1894
	60	.00919	Thorpe-Rodger, 1894
	80	.00628	Thorpe-Rodger, 1894

VISCOSITY OF LIQUIDS (Continued)

Liquid.	Temp. ° C.	Coefficient of viscosity.	Observer.
Propyl aldehyde....	10	.0047	Thorpe-Rodger, 1894
	20	.0041	Thorpe-Rodger, 1894
	40	.0033	Thorpe-Rodger, 1894
bromide.........	0	.00645	Thorpe-Rodger, 1894
	20	.00517	Thorpe-Rodger, 1894
	40	.00291	Thorpe-Rodger, 1894
chloride..........	0	.00436	Thorpe-Rodger, 1894
	20	.00352	Thorpe-Rodger, 1894
	40	.00291	Thorpe-Rodger, 1894
Salicylic acid.......	10	.0320	Rellstab, 1868
	20	.0271	Rellstab, 1868
	40	.0181	Rellstab, 1868
Sodium bromide....	762	.0142	Lorenz, 1912
	780	.0128	Lorenz, 1912
chloride..........	841	.0130	Lorenz, 1912
	896	.0101	Lorenz, 1912
	924	.0097	Lorenz, 1912
nitrate...........	308	.02919	Lorenz, 1912
	348	.02439	Lorenz, 1912
	398	.01977	Lorenz, 1912
	418	.01828	Lorenz, 1912
Sugar.............	124.6	1900	Tammann, 1899
	109	28000	Tammann, 1899
Sulphur............	86	.22	Rotinjanz, 1908
	100	.16	Rotinjanz, 1908
	110	.12	Rotinjanz, 1908
	170	320	Rotinjanz, 1908
	180	550	Rotinjanz, 1908
	187	560	Rotinjanz, 1908
	200	500	Rotinjanz, 1908
	300	24	Rotinjanz, 1908
	340	6.2	Rotinjanz, 1908
	380	2.5	Rotinjanz, 1908
	420	1.13	Rotinjanz, 1908
	448	.80	Rotinjanz, 1908
Sulphur dioxide, liquid	—33.5	.005508	Fitzgerald, 1912
	—10.5	.004285	Fitzgerald, 1912
	0.1	.003936	Fitzgerald, 1912
Sulphuric acid......	20	.22	Graham, 1849
	11.2	.31953	Poiseuille
Toluene...........	0	.00768	Thorpe-Rodger, 1894
	20	.00586	Thorpe-Rodger, 1894
	40	.00466	Thorpe-Rodger, 1894
	60	.00381	Thorpe-Rodger, 1894
Turpentine.........	0	.0225	Glaser
	10	.0178	Glaser
	2	.0149	Glaser
	30	.0127	Glaser
Turpentine, Venice	17.3	1300	Landenburg, 1906
Xylene (xylol)·			
ortho............	0	.01102	Thorpe-Rodger, 1894
	20	.00807	Thorpe-Rodger, 1894
	40	.00623	Thorpe-Rodger, 1894
meta	0	.00802	Thorpe-Rodger, 1894
	20	.00615	Thorpe-Rodger, 1894
	40	.00491	Thorpe-Rodger, 1894
para..............	20	.00643	Thorpe-Rodger, 1894
	40	.00508	Thorpe Rodger, 1894
Zinc..	380	.0168	Plüss, 1915
	357	.0142	Plüss, 1915
	389	.0131	Plüss, 1915

VISCOSITY OF GASES

Coefficient of viscosity of gases and vapors. C. G. S. units.

Gas or vapor.	Temp. C.	Coefficient of viscosity.	Observer.
Acetic acid, vap......	119.1	107.0×10^{-6}	Meyer-Schumann, 1881
Acetone, vap.........	0	72.5	Puluj, 1874
	18	78.0	Puluj, 1874
Air.................	—21.5	157.3	Puluj, 1874
	0	170.5	Puluj, 1874
	197.3	253.8	Puluj, 1874
	272.4	284.0	Puluj, 1874
	340	304.0	Puluj, 1874
	0	167.9	Schumann, 1884
	10	172.4	Schumann, 1884
	20	178.0	Schumann, 1884
	30	183.6	Schumann, 1884
	40	189.6	Schumann, 1884
	60	202.2	Schumann, 1884
	80	215.3	Schumann, 1884
	100	219.0	Schumann, 1884
	—24.4	163.9	Breitenbach, 1901
	0	173.3	Breitenbach, 1901
	15	180.7	Breitenbach, 1901
	99.1	220.3	Breitenbach, 1901
	182.4	255.9	Breitenbach, 1901
	302.0	299.3	Breitenbach, 1901
	15	181.0	Markowski, 1904
	99.6	221.0	Markowski, 1904
	0	171.0	Hogg, 1905
	0	170.0	Grindlay-Gibson, 1908
	0	171.0	Fisher, 1909
	20.2	181.2	Gilchrist
	23	184.0	"Probable value," Millikan, 1913
	0	172.4	Vogel, 1914
Alcohol. See *ethyl*, *methyl*, etc.			
Ammonia............	0	96	Graham, 1846
	20	108	Graham, 1846
Argon...............	0	210.4	Schultz, 1901
	14.7	220.8	Schultz, 1901
	17.8	224.1	Schultz, 1901
	99.7	273.3	Schultz, 1901
	183.7	322.1	Schultz, 1901
Benzene, vapor.......	0	68.9	Schumann, 1884
	19	79.2	Schumann, 1884
	70.1	100.7	Schumann, 1884
	100	117.6	Schumann, 1884
Bromine, vapor......	285.9	151.1	Rankine, 1914
	338.8	170.5	Rankine, 1914
	372.8	188.5	Rankine, 1914
	412.8	207.9	Rankine, 1914
	452.8	227.3	Rankine, 1914
	493.4	248.0	Rankine, 1914
Bromoform, vapor....	151.2	253.0	Steudel, 1882
Butyl alcohol			
normal vapor	116.9	143	Steudel, 1882
tertiary vapor....	82.9	160	Steudel, 1882
chloride, normal vapor	78	149.5	Steudel, 1882
iodide, vapor.......	130	202	Steudel, 1882
Butyric acid, vapor ..	161.7	130.0	Meyer-Schumann, 1881
Carbon dioxide.......	0	141.4	Graham, 1846
	20	160.0	Graham, 1846
	20	161.4	Maxwell, 1860

VISCOSITY OF GASES (Continued)

Gas or vapor.	Temp. C.	Coefficient of viscosity.	Observer.
Carbon dioxide.......	20	160.0	Mayer-Springmuhl, 1873
	—21	129.4	Breitenbach, 1901
	0	139.0	Breitenbach, 1901
	15	145.7	Breitenbach, 1901
	99.1	186.1	Breitenbach, 1901
	182.4	222.1	Breitenbach, 1901
	302.0	268.2	Breitenbach, 1901
	12.6	145.0	Roberts, 1912
pressure, 1 atm....	20	148.0	Phillips, 1912
	30	153	Phillips, 1912
	32	155	Phillips, 1912
	35	156	Phillips, 1912
	40	157	Phillips, 1912
pressure, 20 atm...	20	156	Phillips, 1912
pressure, 40 atm...	20	166	Phillips, 1912
pressure, 50 atm...	20	177	Phillips, 1912
pressure, 56 atm...	20	186	Phillips, 1912
disulphide, vapor...	16.9	92.4	Puluj, 1874
monoxide..........	0	163.0	Graham, 1846
	20	184.0	Graham, 1846
	—149.2	86.9	Zimmer, 1912
	—78.9	128.7	Zimmer, 1912
	—42.3	148.3	Zimmer, 1912
	0.0	168.9	Zimmer, 1912
	11.4	174.9	Zimmer, 1912
tetrachloride, vapor	76.7	195.0	Steudel, 1882
Chlorine.............	0	128.7	Graham, 1846
	20	147.0	Graham, 1846
	12.7	129.7	Rankine, 1912
	99.1	168.8	Rankine, 1912
Chloroform, vapor....	0	95.9	Puluj, 1874
	17.4	102.9	Puluj, 1874
	0	99.0	Breitenbach, 1901
	17.4	103	Breitenbach, 1901
	61	189	Breitenbach, 1901
Cyanogen............	0	94.8	Graham, 1846
	20	107.0	Graham, 1846
Ether (diethyl-), vapor	0	68.9	Puluj, 1874
	16.1	73.2	Puluj, 1874
	36.5	79.3	Puluj, 1874
Ethyl acetate, vapor...	77.1	152.0	Meyer-Schumann, 1881
alcohol, vapor......	0	87.4	Puluj, 1874
	16.8	88.5	Puluj, 1874
	78.4	142.0	Steudel, 1882
bromide, vapor.....	38.4	186.5	Steudel, 1882
butyrate, vapor.....	119.8	160.0	Meyer-Schumann, 1881
chloride, vapor.....	0	93.5	Graham, 1846
	20	105.0	Graham, 1846
	16.4	94.1	Obermayer, 1875
	53.5	105.0	Obermayer, 1875
	157.3	144.0	Obermayer, 1875
formate, vapor.....	53.7	156.0	Meyer-Schumann, 1881
iodide, vapor.......	72.3	216.0	Steudel, 1882
Ethylene.............	0	96.6	Graham, 1846
	20	109.0	Graham, 1846
	—21.2	89.1	Breitenbach, 1901
	15	101.6	Breitenbach, 1901
	99.3	127.8	Breitenbach, 1901
	182.4	153.0	Breitenbach, 1901
	302.6	182.6	Breitenbach, 1901
	—75.7	69.9	Zimmer, 1912
	—44.1	76.9	Zimmer, 1912

VISCOSITY OF GASES (Continued)

Gas or vapor.	Temp. C.	Coefficient of viscosity.	Observer.
Ethylene	—38.6	78.5	Zimmer, 1912
	0	90.7	Zimmer, 1912
	13.8	95.4	Zimmer, 1912
bromide, vapor	131.6	221.0	Steudel, 1882
chloride, vapor	83.5	168.0	Steudel, 1882
Helium	0	189.1	Schultz, 1901
	15.3	196.9	Schultz, 1901
	66.6	234.8	Schultz, 1901
	184.6	269.9	Schultz, 1901
Hydrogen	W 20	93.0	Graham, 1846
	15.3	89.2	Obermayer, 1877
	15.9	92.9	Puluj, 1878
	20	97.0	Maxwell, 1868
	15	97.0	Rossander, 1900
	—20.6	81.9	Breitenbach, 1901
	15	88.9	Breitenbach, 1901
	99.2	105.9	Breitenbach, 1901
	182.4	121.5	Breitenbach, 1901
	302.0	139.2	Breitenbach, 1901
	12.3	86.4	Roberts, 1912
	0	86.7	Jeans, 1916
Hydrogen sulphide	0	115.4	Graham, 1846
	20	130.0	Graham, 1846
Iodine, vapor	124	184.3	Rankine, 1915
	247	240.1	Rankine, 1915
Isobutyl acetate, vapor	16.1	76.4	Schumann, 1884
	116.4	155.0	Schumann, 1884
alcohol, vapor	108.4	144.5	Steudel, 1882
bromide, vapor	92.3	179.5	Steudel, 1882
butyrate, vapor	156.9	167.0	Meyer-Schumann, 1881
chloride, vapor	68.5	150.0	Steudel, 1882
iodide, vapor	120	204.7	Steudel, 1882
Isopropyl alcohol, vapor	82.8	162.0	Steudel, 1882
bromide, vapor	60	176.0	Steudel, 1882
chloride, vapor	37	148.5	Steudel, 1882
iodide, vapor	89.3	201.5	Steudel, 1882
Krypton	15	246	Rankine, 1910
Mercury, vapor	0	183	Koch, 1883
	300	532	Koch, 1883
	380	656	Koch, 1883
Methane	0	104.0	Graham, 1846
	20	120.1	Graham, 1846
Methyl acetate, vapor	57.3	152.0	Meyer-Schumann, 1881
alcohol, vapor	66.8	135.0	Steudel, 1882
chloride	0	102.5	Graham, 1846
	20	116.0	Graham, 1846
	—15.3	93.6	Breitenbach, 1901
	15	105.2	Breitenbach, 1901
	99.1	138.4	Breitenbach, 1901
	182.4	170.6	Breitenbach, 1901
	302.0	213.9	Breitenbach, 1901
iodide, vapor	44	232	Steudel, 1882
Neon	15	312	Rankine, 1910
Nitrogen	0	163.5	Graham, 1846
	20	184.0	Graham, 1846
	—21.5	156.3	Obermayer, 1875
	10.9	170.7	Obermayer, 1875
	53.5	189.4	Obermayer, 1875
Nitric oxide	0	164.5	Graham, 1846
	20	186.0	Graham, 1846
Nitrous oxide	0	140.8	Graham, 1846
	20	160.0	Graham, 1846

VISCOSITY OF GASES (Continued)

Gas or vapor.	Temp. C.	Coefficient of viscosity.	Observer.
Nitrous oxide	—21.5	124.9	Obermayer, 1875
	53.6	160.6	Obermayer, 1875
	100.3	182.9	Obermayer, 1875
Oxygen..............	20	212.0	Graham, 1846
	15.4	195.7	Obermayer, 1876
	53.5	215.9	Obermayer, 1876
	20	206.0	Meyer-Springmuhl, 1873
Propyl alcohol, vapor..	97.4	142.0	Steudel, 1882
bromide, vapor.....	70.8	184.5	Steudel, 1882
iodide, vapor.......	102	210.0	Steudel, 1882
Sulphur dioxide......	0	122.5	Graham, 1846
	20	138.0	Graham, 1846
Water, vapor........	0	90.4	Puluj, 1874
	16.7	96.7	Puluj, 1874
	100	132.0	Meyer-Schumann, 1881
	15	97.5	Kundt-Warburg, 1875
Xenon..............	15	222.0	Rankine, 1910

VISCOSITY OF SOLIDS

C. G. S. Units.

Substance.	Temp. C.	Coefficient of viscosity.	Observer.
Glass, soda.......	575	11×10^{12}	Trouton and Andrews, 1904
Ice, glacier.......	......	12×10^{13}	Deelev, 1908
Menthol..........	14.9	2×10^{12}	Heydweiller, 1897
Pitch.............	0	51×10^{10}	Trouton and Andrews, 1904
	15	1.3×10^{10}	Trouton and Andrews, 1904
Turpentine, Venice	18.3	1300	Trouton and Andrews, 1904
Wax, shoe makers..	8	4.7×10^{6}	Trouton and Andrews, 1904

VISCOSITY OF AQUEOUS GLYCEROL SOLUTIONS FOR CALIBRATION

From the data of M. L. Sheely, Indust. and Eng. Chem., **24**, 1060, (1932)

Sp. gr. 25°/25°C	% Glycerol	Viscosity			Sp. gr. 25°/25°C	% Glycerol	Viscosity		
		20°	25°	30°			20°	25°	30°
1.00000	0	1.005	0.893	0.800	1.12720	50	6.050	5.041	4.247
1.00235	1	1.029	0.912	0.817	1.12995	51	6.396	5.319	4.467
1.00475	2	1.055	0.935	0.836	1.13265	52	6.764	5.597	4.709
1.00710	3	1.083	0.959	0.856	1.13540	53	7.158	5.910	4.957
1.00950	4	1.112	0.984	0.877	1.13815	54	7.562	6.230	5.210
1.01185	5	1.143	1.010	0.900	1.14090	55	7.997	6.582	5.494
1.01425	6	1.175	1.037	0.924	1.14365	56	8.482	6.963	5.816
1.01660	7	1.207	1.064	0.948	1.14640	57	9.018	7.394	6.148
1.01900	8	1.239	1.092	0.972	1.14915	58	9.586	7.830	6.495
1.02135	9	1.274	1.121	0.997	1.15185	59	10.25	8.312	6.870
1.02370	10	1.311	1.153	1.024	1.15460	60	10.96	8.823	7.312
1.02620	11	1.350	1.186	1.052	1.15735	61	11.71	9.428	7.740
1.02865	12	1.390	1.221	1.082	1.16010	62	12.52	10.11	8.260
1.03110	13	1.431	1.256	1.112	1.16285	63	13.43	10.83	8.812
1.03360	14	1.473	1.292	1.143	1.16560	64	14.42	11.57	9.386
1.03605	15	1.517	1.331	1.174	1.16835	65	15.54	12.36	10.02
1.03850	16	1.565	1.370	1.207	1.17110	66	16.73	13.22	10.68
1.04100	17	1.614	1.411	1.244	1.17385	67	17.96	14.18	11.45
1.04345	18	1.664	1.453	1.281	1.17660	68	19.40	15.33	12.33
1.04590	19	1.715	1.495	1.320	1.17935	69	21.07	16.62	13.27
1.04840	20	1.769	1.542	1.360	1.18210	70	22.94	17.96	14.32
1.05095	21	1.829	1.592	1.403	1.18480	71	25.17	19.53	15.56
1.05350	22	1.892	1.644	1.447	1.18755	72	27.56	21.29	16.88
1.05605	23	1.957	1.699	1.494	1.19025	73	30.21	23.28	18.34
1.05860	24	2.025	1.754	1.541	1.19295	74	33.04	25.46	19.93
1.06115	25	2.095	1.810	1.590	1.19565	75	36.46	27.73	21.68
1.06370	26	2.167	1.870	1.641	1.19840	76	40.19	30.56	23.60
1.06625	27	2.242	1.934	1.695	1.20110	77	44.53	33.58	25.90
1.06880	28	2.324	2.008	1.752	1.20380	78	49.57	37.18	28.68
1.07135	29	2.410	2.082	1.812	1.20655	79	55.47	41.16	31.62
1.07395	30	2.501	2.157	1.876	1.20925	80	62.0	45.86	34.92
1.07660	31	2.597	2.235	1.942	1.21190	81	69.3	51.02	38.56
1.07925	32	2.700	2.318	2.012	1.21455	82	77.9	56.90	42.92
1.08190	33	2.809	2.407	2.088	1.21720	83	87.9	64.2	47.90
1.08455	34	2.921	2.502	2.167	1.21990	84	99.6	72.2	53.63
1.08715	35	3.040	2.600	2.249	1.22255	85	112.9	81.5	60.05
1.08980	36	3.169	2.706	2.335	1.22520	86	129.6	92.6	68.1
1.09245	37	3.300	2.817	2.427	1.22790	87	150.4	106.1	77.5
1.09510	38	3.440	2.932	2.523	1.23055	88	174.5	122.6	88.8
1.09775	39	3.593	3.052	2.624	1.23320	89	201.4	141.8	101.1
1.10040	40	3.750	3.181	2.731	1.23585	90	234.6	163.6	115.3
1.10310	41	3.917	3.319	2.845	1.23850	91	278.4	189.3	134.4
1.10575	42	4.106	3.466	2.966	1.24115	92	328.4	221.8	156.5
1.10845	43	4.307	3.624	3.094	1.24380	93	387.7	262.9	182.8
1.11115	44	4.509	3.787	3.231	1.24645	94	457.7	308.7	212.0
1.11380	45	4.715	3.967	3.380	1.24910	95	545	366.0	248.8
1.11650	46	4.952	4.165	3.540	1.25165	96	661	435.0	296.7
1.11915	47	5.206	4.367	3.706	1.25425	97	805	522.9	354.0
1.12185	48	5.465	4.571	3.873	1.25685	98	974	629	424.0
1.12450	49	5.730	4.787	4.051	1.25945	99	1197	775	511.0
1.12720	50	6.050	5.041	4.247	1.26201	100	1499	945	624

DIFFUSION

GASES INTO AIR

Gas or vapor	Temp. °C	Coefficient of diffusion, sq. cm/sec	Observer
Alcohol, vapor	40.4	0.137	Winkelmann
Carbon dioxide	0.0	0.139	Mean of various
Carbon disulfide	19.9	0.102	Winkelmann
Ether, vapor	19.9	0.089	Winkelmann
Hydrogen	0.0	0.634	Obermayer
Oxygen	0.0	0.178	Obermayer
Water, vapor	8.0	0.239	Guglielmo

AQUEOUS SOLUTIONS INTO PURE WATER
Concentration in gram-molecules per liter.

Substance	Concentration	Temp. °C	Diffusion sq. cm/day	Observer
Acetic acid	0.2	13.5	0.77	Scheffer
	1.0	12	0.74	Arrhenius
	2.0	12	0.69	Arrhenius
	3.0	12	0.68	
	4.0	12	0.66	Arrhenius
Ammonia	1.0	15.23	1.54	Abegg
Barium chloride	0.2	8	0.66	Scheffer
Bromine	0.1	12	0.8	Euler
Cadmium sulfate	2.0	19.04	0.246	Seitz
Calcium chloride	2.0	10	0.68	Schuhmeister
Chlorine	0.1	12	1.22	Euler
Copper sulfate	0.1	17	0.39	Thovert
Formic acid	1.0	12	0.97	Abegg
Glycerine	0.1	10.14	0.357	Heimbrodt
	0.2	10.1	3.55	Heimbrodt
	1.0	10.14	0.339	Heimbrodt
Hydrochloric acid	0.1	19.2	2.21	Thovert
	1.0	12	2.09	Arrhenius
	2.0	12	2.21	Arrhenius
Iodine	0.1	12	(0.5)	Euler
Magnesium sulfate	1.0	7	0.30	Scheffer
Nitric acid	0.1	19.5	2.07	Thovert
Potassium bromide	1.0	10	1.13	Schuhmeister
carbonate	3.0	10	0.60	Schuhmeister
chloride	0.1	17.5	1.38	Thovert
chloride	4.0	10	1.27	Schuhmeister
hydrate	0.1	13.5	1.72	Thovert
	1.0	12	1.72	Arrhenius
	3.0	12	1.89	Arrhenius
Silver nitrate	0.1	12	0.985	Thovert
Sodium acetate	0.2	12	0.67	Kawalki
chloride	0.1	15	0.94	Thovert
	0.2	15	0.94	Thovert
	1.0	15	0.94	Thovert
	1.0	14.3	0.964	Heimbrodt
hydrate	1.0	12	1.11	Thovert
iodide	1.0	10	0.80	Schuhmeister
	2.0	10	0.90	Schuhmeister
Sugar	1.0	12	0.254	Arrhenius
Sulfuric acid	1.0	12	1.12	Arrhenius
	2.0	12	1.16	Arrhenius
Urea	0.1	14.8	0.97	Heimbrodt
	0.2	14.8	0.969	Heimbrodt
Zinc acetate	2.0	18.05	0.210	Seitz
	2.0	0.04	0.120	Seitz
sulfate	1.0	14.8	0.236	Seitz

OSMOTIC PRESSURE OF AQUEOUS SOLUTIONS

For a Membrane of Ferrocyanide of Copper

Dissolved Substance.	Gms. substance in 1 cm.^{3} sol.	Temp. ° C.	Pressure, cm. Hg.	Observer.
Glycerine...........	.00199	0	36.7	
Gum arabic.........	0.0099	15.5	7.0	Pfeffer
Gum arabic.........	0.164	15.6	119.3	Pfeffer
Phenol (carbolic acid)	.00127	0	23.3	Naccari
	Gm.-mol. substance per gm. sol.		Pressure in atm.	
Glucose.............	.0001	10.2	2.39	Morse, 1911
	.0005	10.2	11.55	Morse, 1911
	.0010	10.0	23.80	Morse, 1911
Saccharose (cane sugar)............	.0001	10.0	2.50	Morse, 1911
	.0005	10.0	12.30	Morse, 1911
	.0010	10.0	25.69	Morse, 1911
	Gm.-mol. substance in 1 ccm.^{3} sol.			
Potassium carbonate	.00005	15	1.17	Adie, 1891
ferrocyanide......	.00005	15	3.44	Adie, 1891
nitrate...........	.00005	15	1.56	Adie, 1891
Sodium citrate (acid)	.00005	15	4.32	Adie, 1891

HEAT AND HYGROMETRY

SOUND

ELECTRICITY AND MAGNETISM

LIGHT

HEAT

COEFFICIENT OF THERMAL EXPANSION

Linear

The coefficient given is the increase in length per unit length (measured at 0° C.) per degree Centigrade.

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Aluminum	−191 to +16	18.35	Henning, 1907
	20	25.5	Voigt, 1893
	40	23.13	Fizeau, 1869
	600	31.50	Chatelier
99.95%	20–100	23.8	Hidnert, 1925
	20–300	25.7	"
	20–600	28.7	"
commercial	20–100	24.0	"
	20–300	26.7	"
	20–600	28.7	"
Aluminum-bronze	20	17.0	National Physical Laboratory
Aluminum-beryllium alloy			
10% Be	20–100	21.4	Hidnert & Sweeney, 1927
	20–300	23.3	" "
	20–500	25.4	" "
32.7% Be	20–100	17.9	" "
	20–300	20.6	" "
	20–500	22.3	" "
Aluminum-copper alloy			
10% Cu	20–100	22.4	
	20–300	28.3	
	20–500	27.7	
Aluminum-silicon alloy 10% Si	20–100	21.1	
	20–300	22.9	Hidnert, 1925
Aluminum-zinc alloy 12% Zn	20–100	24.9	
	20–300	28.1	
97% Zn	20–100	27.5	
	20–200	29.6	
Antimony	−180 to +13	10.23	Gruneisen, 1910
	20	12.	Fizeau, 1869
	15–101	10.88	Gruneisen, 1910
parallel to axis	10–90	17.30	Fizeau, 1869
perpendicular to axis	10–90	8.28	"
Arsenic	10–90	3.86	"
*Bakelite-dilecto	20–60	22.	Souder & Hidnert, 1919
micarta 32X	25–50	33.	" "
Beryllium 98.9%	20–100	12.3	Hidnert, 1925
	20–300	14.0	"
	20–700	16.8	"
Bismuth	−180 to +15	12.98	
	19–101	13.45	
parallel to axis	10–90	15.37	
perpendicular to axis	10–90	10.84	
Brass			
cast	0–100	18.75	Smeaton
wire	0–100	19.30	"
66Cu, 34Zn	20	18.9	National Physical Laboratory

* See Scientific Paper of Bureau of Standards No. 352.

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Primer gilding 97Cu, 2.97Zn....	25–100	16.9	Hidnert, 1921 Scientific Paper No. 410 Bureau of Standards
.01Pb, .02Fe, cold rolled	25–300	17.7	
cast........................	25–100	17.2	
commercial bronze 90.26Cu.....	25–100	17.5	
9.7Zn, .01Pb, .03Fe	25–300	18.1	
cold rolled			
cast........................	25–100	17.4	
Low brass 80.02Cu............	25–100	18.0	
19.89Zn, .05Pb, .03Fe	25–300	19.1	
cold rolled			
cast........................	25–100	17.9	
Spring brass, 72.02Cu	25–100	18.5	
27.95Zn, .01Pb, .02Fe	25–300	19.8	
cold rolled			
cast........................	25–100	18.3	
Commercial brass, 64.81Cu.....	25–100	19.0	
34.92Zn, .24Pb, .03Fe	25–300	20.2	
cold rolled			
cast........................	25–100	18.9	
Leaded bronze 88.3Cu..........	25–100	17.5	
10.Zn, 1.68Pb, .02Fe	25–300	18.3	
cold rolled			
cast........................	25–100	17.6	
Free turning rod 62.33Cu.......	25–100	19.1	
35.04Zn, 2.57Pb, .06Fe	25–300	20.4	
cold rolled			
cast........................	25–100	19.0	
Brick...........................	....	9.5	National Physical Laboratory
Bronze			
3Cu, 1Sn......................	16.6–100	18.44	Daniell
	16.6–350	21.16	"
	16.6–957	17.37	"
93.5Cu, 6.5Sn.................	16–100	17.5	Bein, 1912
90Cu, 10Sn....................	0–900	22.0	Le Chatelier, 1889
80Cu, 20Sn....................	0–800	27.0	" "
70Cu, 30Sn....................	0–700	29.5	" "
phosphor			
97, 6Cu, 2Sn, 0.2P.............	0–85	16.8	Mean
Cadmium........................	−183 to +14	44.6	Gruneisen, 1901
	20	28.8	Matthiessen, 1866
	0–100	31.59	"
	10–90	29.39	Fizeau
	315	31.6	Vicentini & Omodie
Calcite, parallel to axis...........	0–85	25.14	Benoit, 1888
perpendicular to axis...........	0–85	−5.58	"
Caoutchouc.....................	....	65.7–68.6	Various
	17–25	77.0	Kohlrausch
Carbon			
diamond.......................	40	1.18	Fizeau, 1869
gas carbon....................	40	5.40	"
graphite.......................	40	7.86	"
Celluloid........................	20–70	109.	Souder & Hidnert, 1919
Cement and concrete.............	....	10.–14.	Fizeau
Cobalt..........................	40	12.36	"
*Condesite (No. 100)............	16–79	44.0	Souder & Hidnert, 1919
(No. 128).....................	18–56	20.0	" "
Constantan.....................	4–29	15.23	....
60Cu, 40Ni.....................	20	17.0	National Physical Laboratory

* See Scientific Paper Bureau of Standards No. 352.

COEFFICIENT OF THERMAL EXPANSION (Continued)

Linear

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Constantan	−191 to +16	12.02	Henning, 1907
	0–38	14.48	Guillaume, 1896
	0–500	14.81	Holborn & Day, 1900
Copper	−191 to +16	14.09	Henning, 1907
electrolytic	25–100	16.8	Hidnert, 1921
	25–300	17.8	"
	0–625	16.07	Dittenberger, 1902
Diamond, *see Carbon*			
Duralumin, cast	20–100	23.6	Hidnert, 1925
	20–300	26.0	"
	20–500	27.3	"
cold rolled	20–100	23.7	"
	20–300	26.4	"
	20–500	27.3	"
Ebonite	25–35	84.2	Kohlrausch
Emerald, parallel to axis	0–85	−1.35	Benoit
perpendicular to axis	0–85	1.00	
Fluor spar, CaF_2	0–100	19.5	Pfaff
Formica	20–60	30.0	Souder & Hidnert, 1919
Galena	....	19.9	....
German silver 60Cu, 15Ni, 25Zn	0–100	18.36	Pfaff
Glass			
tube	0–100	8.33	Fizeau
soft	....	8.5	Schott
hard	....	9.7	"
plate	0–100	8.91	Lavoisier & Laplace
crown	0–100	8.97	" "
flint	50–60	7.88	Pulfrich
Jena thermometer			
16^{III} normal	0–100	8.1	Schott
59^{III}	0–100	5.8	"
59^{III}	−191 to +16	4.24	Henning, 1907
Gold	−183 to +16	13.2	Gruneisen, 1910
	16–100	14.3	"
Gold-copper 2Au, 1Cu	0–100	15.52	Matthiessen
Gold-platinum 2Au, 1Pt.	0–100	15.23	"
Granite	....	8.3	....
Gun Metal	....	18.3	National Physical Laboratory
Gutta percha	....	198.3	Russner, 1882
Hard Rubber	20–60	80.	Souder & Hidnert, 1919
Ice	−20 to −1	51.0	....
	−10 to 0	50.7	Vincent, 1902
Indium	40	41.7	Fizeau, 1869
Invar, *see Nickel steel*			
Iodine	−188 to 16	83.7	Dewar, 1902
Iridium	−183 to +19	5.71	Gruneisen, 1910
Iron	−190 to +17	9.07	Henning, 1907
soft	40	12.10	Fizeau, 1869
cast	40	10.61	"
cast	−190 to +16	8.50	Henning, 1907
wrought	−18 to +100	11.40	Andrews
steel	40	13.22	Fizeau, 1869
steel, annealed	40	10.95	"
steel, 1.2% C	0–100	10.5	Le Chatelier, 1899
"	100–200	11.5	"
"	200–300	13.	"

COEFFICIENT OF THERMAL EXPANSION (Continued)

Linear

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Iron, steel	300–400	15.	Le Chatelier, 1899
"	400–500	14.	"
"	500–600	16.	"
"	600–700	16.	"
"	above 900	29.	"
Lead	−183 to +14	27.08	Gruneisen, 1910
	18–100	29.40	"
Lead-tin 2Pb, 1Sn	0–100	25.08	Smeaton
Magnesium	−183 to +15	21.40	Gruneisen, 1910
	18–100	26.08	"
	20–100	26.0	Hidnert & Sweeney, 1928
	20–200	27.9	" "
	20–500	29.8	" "
cast	20–100	26.96	C. D. H., 1917
wrought	20–100	26.73	"
Magnalium 96Al, 4Mg,	0–13	22.	Guillaume, 1902
86Al, 14Mg	12–39	23.8	Stadhagen, 1901
Marble	15–100	11.7	Frohlich
* Rutland blue (Vt) heated in air	25–100	15.	Souder & Hidnert, 1919
	100–200	23.	" "
	200–300	28.	" "
cooled	300–200	15.	" "
	200–100	9.	" "
	100–25	4.	" "
* Silver gray (Ga.) cooled	25–0	13.	" "
	0 to −60	10.	" "
heated in air	20–65	1.0	" "
cooled	65–20	.5	" "
Masonry	....	4.–7.	....
Mercury	−183 to −39	30.	Dewar, 1902
	−78 to −38	41.	Grunmach, 1901
Molybdenum	25–100	4.9	Hidnert & Gero, 1924
	25–500	5.5	" "
Monel metal	25–100	13.7–14.5	Souder & Hidnert
	25–300	14.9–15.2	" "
	25–600	15.9–16.7	" "
Nickel	−191 to +16	10.12	Henning, 1907
	40	12.79	Fizeau
	16–250	13.97	Holborn & Day, 1901
	375–1000	13.46	Holborn & Day, 1901
commercial	25–100	12.9	Souder & Hidnert, 1921
		13.5	
Nickel steel 10% Ni	20	13.0	Nat. Phys. Lab.
20	20	19.5	" " "
30	20	12.	" " "
36 (Invar)	20	.9	" " "
40	20	6.0	" " "
50	20	9.7	" " "
80	20	12.5	" " "
Osmium	40	6.57	Fizeau
Palladium	40	11.76	"
	0–100	11.04	Matthiessen
Paraffine	0–16	106.6	Rodwell
	16–38	130.3	"
	38–49	477.1	"
Phosphorus	0–44	124.	Laduc, 1891

* For full details and data on other samples see Scientific Paper 352 Bureau of Standards.

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Phosphor bronze, *see Bronze*			
Platinum	40	8.99	Fizeau
Platinum iridium	40	8.84	"
10 Pt. 1Ir			
Platinum silver	0–100	15.23	Matthiessen
33Pt, 67Ag			
Porcelain	20–790	4.13	Braun
Berlin	0–100	3.1	Holborn & Gruneisen
Bayeux	0	2.5	Tutton, 1902
	1000–1400	5.53	Deville & Troost
Clay .50, flint .15			
beryl .35	20–200	1.6	Souder & Hidnert, 1919
	400–540	3.6	" "
clay .80, feldspar	20–200	2.9	" "
.85, whiting .015	200–400	4.0	" "
clay .70, feldspar	20–200	3.3	" "
.19, flint .095, whiting 1.5	200–400		
		4.0	" "
clay .50, feldspar	20–200	4.7	" "
.16, flint .34	200–400	4.6	" "
Quartz (crystal)	−190 to +16	5.21	Scheel
parallel to axis	0–80	7.97	Benoit, 1888
perpendicular to axis	0–80	13.37	"
fused	−191 to +16	.256	Henning, 1907
	0–30	.42	Chappius, 1903
	0–100	.50	Scheel, 1907
	0–800	.546	Randall, 1910
	0–1200	.585	"
Rhodium	40	8.5	Fizeau
Rock salt	40	40.40	"
Rubidium	2–17	86.2	Elsa Deuss, 1911
Ruthenium	40	9.63	Fizeau
Sandstone	20	7.–12.	....
Selenium	−180 to 0	37.2	Dorsey, 1908
	40	36.80	Fizeau
Silicon	40	7.63	"
Silver	−191 to +16	17.04	Henning, 1907
	20	18.8	Voigt, 1893
Slate	20	6.–10.	....
Solder, *see Lead-tin*			
Speculum metal	20	19.3	Smeaton
68Cu, 32Sn			
Sodium	−188 to +17	62.2	Dewar, 1902
Stainless steel			
hardened	20–100	9.6	Souder & Hidnert, 1921
	20–200	9.8	" "
	20–600	11.2	" "
annealed	20–100	10.3	" "
	20–200	10.7	" "
	20–600	12.1	" "
Stellite, soft	20–100	14.1	Souder & Hidnert, 1921
80Co, 20Cr	20–300	15.2	" "
	20–600	16.1	" "
hard, 55Co, 40Cr	20–100	13.4	" "
3W, 2C	20–300	15.0	" "
	20–600	16.5	" "
"No. 2" 55Co, 35Cr	20–100	11.0	" "
10W	20–300	12.4	" "
	20–600	13.6	" "
Sulphur, crystal	40	64.13	Fizeau, 1869
Tellurium	40	16.75	Fizeau, 1869

COEFFICIENT OF THERMAL EXPANSION (Continued)
Linear

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Thallium	40	30.21	Fizeau, 1869
Thorium	0–100	12.3	Rentschler, Marden, 1925
Tin	−183 to +16	22.57	Gruneisen, 1910
	18–100	26.92	"
Topaz, axis a	0–100	8.32	Pfaff
" b	0–100	8.36	"
" c	0–100	4.72	"
Tourmaline			
parallel to axis	0–100	9.37	"
perpendicular to axis	0–100	7.73	"
Tungsten 99.978%	−100–0	4.2	Hidnert & Sweeney, 1925
	0–100	4.3	" "
	0–300	4.5	" "
	0–500	4.6	" "
filament	1000–2000	6.1	Worthen, 1916
Type metal	17-254	19.52	Daniell
Vulcanite	0–18	63.60	Mayer
Wood			
parallel to fiber			
ash	0–100	9.51	Glatzel
beech	2–34	2.57	Villari
chestnut	2–34	6.49	"
elm	2–34	5.65	"
mahogany	2–34	3.61	"
maple	2–34	6.38	"
oak	2–34	4.92	"
pine	2–34	5.41	"
walnut	2–34	6.58	"
across fiber			
beech	2–34	61.4	"
chestnut	2–34	32.5	"
elm	2–34	44.3	"
mahogany	2–34	40.4	"
maple	2–34	48.4	"
oak	2–34	54.4	"
pine	2–34	34.1	"
walnut	2–34	48.4	"
Zinc	−180 to 0	26.4	Dorsey, 1908
	10–100	26.28	Thiesen, 1895
Alundum, Al_2O_3	25–900	8.7	Boeck, 1912
Bauxite brick	25–100	4.4	Wilkes
Caoutchouc	16.7–25.3	77.0	Kohlrausch
Carborundum, SiC	25–100	6.58	Boeck, 1912
	100–900° C.	4.74	
Corundum	....	6.76	Pfaff
Fire clay brick	25–100	8.1±3	
Flint, SiO_2	15–1000	17.4	Houldsworth & Cobb, 1924
Limestone, Oolitic, (Ind.)	25–100	9	Souder & Hidnert, 1919
Magnesium oxide	25–100	9.7–11.4	
Rubber, "Red Antimony" tubing	10–100	111	Napier & Prettyman, 1932

THERMAL EXPANSION OF GLASSES

The following table gives the mean coefficient of linear expansion for various types of glass as determined by Peters and Cragoe of the Bureau of Standards. 1920.

Glass sample	Temp. interval	Coefficient	Temp. interval	Coefficient
		$\times 10^{-4}$		$\times 10^{-4}$
1 Barium flint	22–494	0.088	519–550	0.331
4 Plate, American	20–508	.108	540–560	.401
6 German	21–496	.099	564–589	.477
7 French	21–513	.094	597–613	.424
8 Light crown	24–422	.104	494–507	.548
10 Borosilicate crown	22–498	.090	539–562	.393
11 Barium crown	23–499	.090	589–610	.649
12 Medium flint	23–402	.097	452–478	.396
13 Light flint	22–451	.088	494–512	.347
16 Commercial glass	23–445	.107	510–534	.309
20 McBeth-Evans flask	22–449	.069	567–586	.454
21 Pyrex	21–471	.036	552–571	.151
22 Schott-Genossen flask	19–414	.056	540–562	.404
23 Soda tubing	21–372	.120	506–525	.234
24 Lead tubing	21–338	.091	464–483	.236
26 Fluorite tubing	22–364	.098	510–551	.284
29 Fusing in glass, German	23–383	.090	456–481	.283
30 Fusing in glass, Corning	22–376	.083	460–485	.258

More complete data, including the composition of the samples named above, will be found in Scientific Paper No. 393, Bureau of Standards.

EQUATION FOR THE LINEAR EXPANSION OF SOLIDS

If l_0 is the length at 0° C the length at t° C is $l_t = l_0\ (1 + \alpha t + \beta t^2)$.
The table gives the values of these coefficients.

Substance	Temp. limits °C	α	β	Observer
Aluminum	10–90	$.2221 \times 10^{-4}$	$.114 \times 10^{-7}$	Fizeau
Brass	10–90	.1781	.098	Fizeau
Copper	10–90	.1596	.102	Fizeau
Gold	10–90	.1410	.042	Fizeau
Iron, pure	0–38	.1145	.071	Guillaume
Lead	10–90	.2829	.120	Fizeau
Nickel	0–38	.1255	.057	Guillaume
Platinum	0–1000	.0868	.013	Holborn and Valentine
Silver	10–90	.1862	.074	Fizeau
Tin	10–90	.2094	.175	Fizeau
Zinc	10–90	.2969	−.0635	Fizeau

CUBICAL EXPANSION OF SOLIDS

The coefficient of cubical expansion for a solid is approximately three times the linear coefficient.

The experimental values for various solids are given in the following table. The coefficient is the increase in volume per unit volume per degree Centigrade.

Substance	Temp. ° C	Coefficient	Observer
Antimony	0–100	0.3167×10^{-4}	Matthiessen
Asphalt	....	5–7	....
Beryl	0–100	0.3167	Pfaff
Bismuth	....	0.4000	Kopp
Diamond	40	0.0354	Fizeau
Emerald	40	0.0168	Fizeau
Fiber, vulcanized	....	0.27	....
Fluor spar	14–47	0.6235	Kopp
Galena	0–100	0.558	Pfaff
Glass, white tube	0–100	0.2648	Regnault
green tube	0–100	0.2299	Regnault
Jena	0–100	0.2533	Reichsanstalt
Ice	−20 to −1	1.1250	Brunner
Iceland spar	50–60	0.1447	Pulfrich
Iron	0–100	0.3550	Dulong and Petit
Marble	....	0.3–0.6	....
Paraffin	20	5.88	Russner
Platinum	0–100	0.265	....
Porcelain	0–100	0.1080	Deville and Troost
Quartz	50–60	0.3530	Pulfrich
Rock salt	50–60	1.2120	Pulfrich
Silver	0–100	0.5831	Matthiessen
Slate	....	0.15–0.3	....
Sulfur	13.2–50.3	2.23	Kopp
Tar	....	6.–8.	....
Tin	0–100	0.6889	Matthiessen
Zinc	0–100	0.8928	Matthiessen

CUBICAL EXPANSION OF LIQUIDS

The table gives the mean coefficient of cubical expansion for the range 0–100° C. and the values of the quantities α, β and γ in the equation $V_t = V_0\,(1 + \alpha t + \beta t^2 + \gamma t^3)$.

(From Smithsonian Tables.)

Liquid.	Temp. Range ° C.	Mean coef. 0-100° C.	α	β	γ	Observer.
Acetic acid	16–107	.001433	1.0630×10^{-3}	0.1264×10^{-6}	1.0876×10^{-8}	Zander
Acetone	0–54	1616	1.3240	3.8090	0.8798	Zander
Alcohol:						
amyl	−15 to +80	.....	0.8900	0.6573	1.1846	Pierre
ethyl, sp.gr. .8095	0–80	.....	1.0414	0.7836	1.7168	Kopp
ethyl, 50% by volume	0–39	.....	0.7450	1.850	0.730	Recknagel
ethyl, 30% by volume	18–39	.....	0.2928	17.900	11.87	Recknagel
methyl	−38 to +70	1433	1.1856	1.5649	0.9111	Pierre
Benzene	11–81	1385	1.1763	1.2775	0.8065	Kopp
Bromine	− 7 to +60	1168	1.0382	1.7114	0.5447	Pierre
Calcium chloride:						
$CaCl_2$, 5.8% solution	18–25	0506	0.0788	4.2742	....	Decker
$CaCl_2$, 40.9% solution	17–24	0510	0.4238	0.8571	....	Decker
Carbon disulphide	−34 to +60	1468	1.1398	1.3706	1.9122	Pierre
Chloroform	0–63	1399	1.1071	4.6647	1.7433	Pierre
Ether	−15 to +38	2150	1.5132	2.3592	4.0051	Pierre
Glycerine	....	0534	0.4853	0.4895	....	Emo
Hydrochloric acid:						
$HCl + 6.25H_2O$	0–30	0489	0.4460	0.430	....	Marignac
$HCl + 50H_2O$	0–30	0933	0.0625	8.710	....	Marignac

CUBICAL EXPANSION OF LIQUIDS (Continued)

Liquid.	Temp. Range ° C.	Mean coef. 0-100° C.	α	β	γ	Observer.
Mercury	24–299	.....	0.18182×10^{-3}	0.00078×10^{-6}	....	Scheel
Olive oil	....	.000742	0.6821	1.1405	$-.539 \times 10^{-8}$	Spring
Potassium chloride:						
KCl, 2.5% solution	....	0572	....	....	....	Decker
KCl, 24.3% solution	....	0477	....	....	....	Decker
Potassium nitrate:						
KNO_3, 5.3% solution	....	0539	....	....	....	Nicol
KNO_3, 21.9% solution	....	0577	....	....	....	Nicol
Phenol, C_6H_6O	36–157	0899	0.8340	0.1073	0.4446	Pinette
Petroleum, sp.gr. 0.8467	24–120	1039	0.8994	1.396	....	Frankenheim
Sodium chloride, NaCl, 1.6% solution	....	1067	0.0213	10.462	....	Marignac
Sodium sulphate, Na_2SO_4, 24% solution	10–40	0611	0.3599	2.516	....	Marignac
Sodium nitrate, $NaNO_3$, 36.2% solution	20–78	0627	0.5408	1.075	....	Nicol
Sulphuric acid:						
H_2SO_4	0–30	0489	0.5758	0.864	....	Marignac
$H_2SO_4+50H_2O$	0–30	0799	0.2835	5.160	....	Marignac
Turpentine	−9 to +106	1051	0.9003	1.959	....	Kopp
Water	0–33	.....	−.0643	8.505	6.790	Scheel

COEFFICIENTS OF EXPANSION OF GASES AT CONSTANT PRESSURE

Change in volume per unit volume per degree Centigrade.

(From Smithsonian Tables.)

Gas.	Temp. °C.	Pressure in cm. of mercury.	Coefficient.	Observer.
Acetylene..........	0	76.	.003772	Leduc, 1912
Acetylene..........	0–100	76.	3739	Leduc, 1912
Air................	0–100	76.	3670	Regnault, 1842
Air................	0–100	100.1	36728	Chappuis, 1903
Ammonia..........	0	76.	3860	Leduc, 1912
Ammonia..........	0–100	76.	3800	Leduc, 1912
Carbon dioxide.....	0	76.	3751	Leduc, 1912
Carbon dioxide.....	0–100	76.	3723	Leduc, 1912
Carbon dioxide.....	0–20	51.8	37128	Chappuis, 1903
Carbon dioxide.....	0–40	51.8	37100	Chappuis, 1903
Carbon dioxide.....	0–100	51.8	37073	Chappuis, 1903
Carbon dioxide.....	0–20	99.8	37602	Chappuis, 1903
Carbon dioxide.....	0–100	99.8	37410	Chappuis, 1903
Carbon dioxide.....	0–20	137.7	37972	Chappuis, 1903
Carbon dioxide.....	0–100	137.7	37703	Chappuis, 1903
Carbon dioxide.....	0–7.5	2621.	1097	Baly-Ramsay, 1894
Carbon dioxide.....	64–100	2621.	6574	Baly-Ramsay, 1894
Carbon monoxide...	0–100	76.	3669	Regnault, 1842
Chlorine...........	0	76.	3900	Leduc, 1912
Chlorine...........	0–100	76.	3830	Leduc, 1912
Cyanogen..........	0	76.	396	Leduc, 1912
Cyanogen..........	0–100	76.	387	Leduc, 1912
Hydrochloric acid...	0	76.	3770	Leduc, 1912
Hydrochloric acid...	0–100	76.	3734	Leduc, 1912
Hydrogen..........	0–100	100.0	36600	Chappuis, 1903
Hydrogen..........	0–100	200. atm	332	Amagat, 1890
Hydrogen..........	0–100	400. atm	295	Amagat, 1890
Hydrogen..........	0–100	600. atm	261	Amagat, 1890
Hydrogen..........	0–100	800. atm	242	Amagat, 1890
Nitrogen..........	0	76.	3673	Leduc, 1912
Nitrogen..........	0–100	76.	3671	Leduc, 1912
Nitrous oxide......	0–100	76.	3719	Regnault, 1842
Oxygen............	0–100	100. atm	486	Amagat
Oxygen............	0–100	200. atm	534	Amagat
Oxygen............	0–100	400. atm	459	Amagat
Oxygen............	0–100	600. atm	357	Amagat
Oxygen............	0–100	800. atm	288	Amagat
Oxygen............	0–100	1000. atm	241	Amagat
Sulphur dioxide....	0–100	76.	3903	Regnault, 1842
Sulphur dioxide....	....	98.	3980	Regnault, 1842
Water vapor.......	0–119	76.	4187	Hirn, 1862
Water vapor.......	0–141	76.	4189	Hirn, 1862
Water vapor.......	0–162	76.	4071	Hirn, 1862
Water vapor.......	0–200	76.	3938	Hirn, 1862
Water vapor.......	0–247	76.	3799	Hirn, 1862

COEFFICIENT OF EXPANSION OF GASES AT CONSTANT VOLUME

Change in pressure per unit pressure per degree Centigrade.

(From Smithsonian Tables.)

Gas.	Temp. °C.	Pressure cm. of Hg.	Coefficient.	Observer.
Acetylene	0	76.	.003741	Leduc, 1912
Acetylene	0–100	76.	3726	Leduc, 1912
Air	.....	.6	37666	Meleander, 1890–92
Air	.....	1.3	37127	Meleander, 1890–92
Air	.....	10.0	36630	Meleander, 1890–92
Air	.....	25.4	36580	Meleander, 1890–92
Air	.....	75.2	36660	Meleander, 1890–92
Air	0–100	100.1	36744	Chappuis, 1903
Air	.....	76.0	36650	Regnault, 1842
Air	.....	200.0	36903	Regnault, 1842
Air	.....	2000.	38866	Regnault, 1842
Air	.....	10000.	4100	Regnault, 1842
Ammonia	0	76.	3800	Leduc, 1912
Ammonia	0–100	76.	3770	Leduc, 1912
Argon	.....	51.7	3668	Keunen-Randall, 1896
Carbon dioxide	0–20	51.8	36985	Chappuis, 1903
Carbon dioxide	0–40	51.8	36972	Chappuis, 1903
Carbon dioxide	0–100	51.8	36981	Chappuis, 1903
Carbon dioxide	0–20	99.8	37335	Chappuis, 1903
Carbon dioxide	0–100	99.8	37262	Chappuis, 1903
Carbon dioxide	0–100	100.0	37248	Chappuis, 1892
Carbon dioxide	0	76.	3724	Leduc, 1912
Carbon dioxide	0–100	76.	3714	Leduc, 1912
Carbon monoxide	.....	76.	36667	Regnault, 1842
Cyanogen	0	76.	3870	Leduc, 1912
Cyanogen	0–100	76.	3830	Leduc, 1912
Ethane	0	76.	3780	Leduc, 1912
Ethane	0–100	76.	3750	Leduc, 1912
Helium	.....	56.7	3665	Keunen-Randall, 1896
Hydrochloric acid	.....	76.	3740	Leduc, 1912
Hydrochloric acid	0–100	76.	3721	Leduc, 1912
Hydrogen	0	76.	3663	Leduc, 1912
Hydrogen	0–100	76.	3664	Leduc, 1912
Hydrogen	16–132	.0077	3328	Baly-Ramsay, 1894
Hydrogen	15–132	.025	3623	Baly-Ramsay, 1894
Hydrogen	12–105	.47	3656	Baly-Ramsay, 1894
Hydrogen	0–100	100.0	36626	Chappuis, 1903
Methane	0	76.	3680	Leduc, 1912
Methane	0–100	76.	3678	Leduc, 1912
Nitrogen	0	76.	3672	Leduc, 1912
Nitrogen	0–100	76.	3672	Leduc, 1912
Nitrogen	13–132	.06	3021	Baly-Ramsay, 1894
Nitrogen	9–133	.53	3290	Baly-Ramsay, 1894
Nitrogen	0–20	100.2	36754	Chappuis, 1903
Nitrogen	0–100	100.2	36744	Chappuis, 1903
Oxygen	0	76.	3673	Leduc, 1912
Oxygen	0–100	76.	3672	Leduc, 1912
Oxygen	11–132	.007	4161	Baly-Ramsay, 1894
Oxygen	9–132	.25	3984	Baly-Ramsay, 1894
Oxygen	11–132	.51	3831	Baly-Ramsay, 1894
Oxygen	.....	1.9	36683	Meleander, 1891
Oxygen	.....	18.5	36690	Meleander, 1891
Nitrous oxide	.....	76.	3676	Regnault, 1842
Sulphur dioxide, SO_2	.....	76.	3845	Regnault, 1842

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS

Factors and their logarithms for reducing a gas volume to normal conditions, 0° C., 760 mm pressure.

The volume of *dry* gas measured at any temperature 10–35° C. inclusive and pressure 690–784 mm of Hg may be reduced to the volume at 0° C. (273.18° K.) and 760 mm of Hg pressure by multiplying by the factor found in the table.

In case the volume of gas is measured in the presence of water vapor the pressure of the aqueous vapor must be subtracted from the value of the total or barometric pressure before entering the table. In the case of atmospheric air the vapor pressure may be found by determining the dew point or temperature of saturation. The pressure of water vapor may then be read from the small table below. If gas volumes are measured over water, the vapor pressure will be that of saturated aqueous vapor at the temperature used. A table giving the pressure of saturated aqueous vapor over water is given below.

Pressure of Saturated Water Vapor

°C.	mm	°C.	mm	°C.	mm
9	8.6	18	15.5	27	26.7
10	9.2	19	16.5	28	28.3
11	9.8	20	17.5	29	30.0
12	10.5	21	18.7	30	31.8
13	11.2	22	19.8	31	33.7
14	12.0	23	21.1	32	35.7
15	12.8	24	22.4	33	37.7
16	13.6	25	23.8	34	39.9
17	14.5	26	25.2	35	42.2

Factors and Logarithms

T°C.	690		692		694		696		697		698	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.8758	.9424	.8783	.9437	.8809	.9449	.8834	.9462	.8847	.9468	.8860	.9474
11	.8727	.9409	.8752	.9421	.8778	.9434	.8803	.9446	.8816	.9453	.8828	.9459
12	.8696	.9393	.8722	.9406	.8747	.9419	.8772	.9431	.8785	.9437	.8797	.9443
13	.8666	.9378	.8691	.9391	.8716	.9403	.8741	.9416	.8754	.9422	.8767	.9428
14	.8636	.9363	.8661	.9376	.8686	.9388	.8711	.9401	.8723	.9407	.8736	.9413
15	.8606	.9348	.8631	.9361	.8656	.9373	.8681	.9386	.8693	.9392	.8706	.9398
16	.8576	.9333	.8601	.9345	.8626	.9358	.8651	.9370	.8663	.9377	.8675	.9383
17	.8546	.9318	.8571	.9330	.8596	.9343	.8621	.9355	.8633	.9362	.8646	.9368
18	.8517	.9303	.8542	.9315	.8566	.9328	.8591	.9341	.8603	.9347	.8616	.9353
19	.8488	.9288	.8512	.9301	.8537	.9313	.8562	.9326	.8574	.9332	.8586	.9338
20	.8459	.9273	.8483	.9286	.8508	.9298	.8532	.9311	.8545	.9317	.8557	.9323
21	.8430	.9258	.8455	.9271	.8479	.9283	.8503	.9296	.8516	.9302	.8528	.9308
22	.8402	.9244	.8426	.9256	.8450	.9269	.8475	.9281	.8487	.9287	.8499	.9294
23	.8373	.9229	.8397	.9241	.8422	.9254	.8446	.9266	.8458	.9273	.8470	.9279
24	.8345	.9214	.8369	.9227	.8393	.9239	.8417	.9252	.8430	.9258	.8442	.9264
25	.8317	.9200	.8341	.9212	.8365	.9225	.8389	.9237	.8401	.9243	.8413	.9250
26	.8289	.9185	.8313	.9198	.8337	.9210	.8361	.9223	.8373	.9229	.8385	.9235
27	.8261	.9171	.8285	.9183	.8309	.9196	.8333	.9208	.8345	.9214	.8357	.9221
28	.8234	.9156	.8258	.9169	.8282	.9181	.8306	.9194	.8318	.9200	.8329	.9206
29	.8207	.9142	.8230	.9154	.8254	.9167	.8278	.9179	.8290	.9186	.8302	.9192
30	.8180	.9127	.8203	.9140	.8227	.9152	.8251	.9165	.8263	.9171	.8274	.9177
31	.8153	.9113	.8176	.9126	.8200	.9138	.8224	.9151	.8235	.9157	.8247	.9163
32	.8126	.9099	.8149	.9111	.8173	.9124	.8197	.9136	.8208	.9143	.8220	.9149
33	.8099	.9085	.8123	.9097	.8146	.9110	.8170	.9122	.8182	.9128	.8193	.9135
34	.8073	.9070	.8096	.9083	.8120	.9095	.8143	.9108	.8155	.9114	.8167	.9120
35	.8047	.9056	.8070	.9069	.8093	.9081	.8117	.9094	.8128	.9100	.8140	.9106

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	699		700		701		702		703		704	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.8872	.9480	.8885	.9487	.8898	.9493	.8910	.9499	.8923	.9505	.8936	.9511
11	.8841	.9465	.8854	.9471	.8866	.9477	.8879	.9484	.8892	.9490	.8904	.9496
12	.8810	.9450	.8823	.9456	.8835	.9462	.8848	.9468	.8860	.9474	.8873	9481
13	.8779	.9434	.8792	.9441	.8804	.9447	.8817	.9453	.8829	.9459	.8842	9465
14	.8748	.9419	.8761	.9426	.8774	.9432	.8786	.9438	.8799	.9444	.8811	.9450
15	.8718	.9404	.8731	.9410	.8743	.9417	.8756	.9423	.8768	.9429	.8780	.9435
16	.8688	.9389	.8700	.9395	.8713	.9402	.8725	.9408	.8738	.9414	.8750	.9420
17	.8658	.9374	.8670	.9380	.8683	.9387	.8695	.9393	.8707	.9399	.8720	.9405
18	.8628	.9359	.8641	.9365	.8653	.9372	.8665	.9378	.8678	.9384	.8690	.9390
19	.8599	.9344	.8611	.9350	.8623	.9357	.8636	.9363	.8648	.9369	.8660	.9375
20	.8569	.9329	.8582	.9336	.8594	.9342	.8606	.9348	.8618	.9354	.8631	.9360
21	.8540	.9315	.8552	.9321	.8565	.9327	.8577	.9333	.8589	.9339	.8601	.9346
22	.8511	.9300	.8523	.9306	.8535	.9312	.8548	.9318	.8560	.9325	.8572	.9331
23	.8482	.9285	.8494	.9291	.8507	.9298	.8519	.9304	.8531	.9310	.8543	.9316
24	.8454	.9271	.8466	.9277	.8478	.9283	.8490	.9289	.8502	.9295	.8514	.9301
25	.8425	.9256	.8437	.9262	.8449	.9268	.8462	.9275	.8474	.9281	.8486	.9287
26	.8397	.9241	.8409	.9248	.8421	.9254	.8433	.9260	.8445	.9266	.8457	.9272
27	.8369	.9227	.8381	.9233	.8393	.9239	.8405	.9245	.8417	.9252	.8429	.9258
28	.8341	.9212	.8353	.9219	.8365	.9225	.8377	.9231	.8389	.9237	.8401	.9243
29	.8314	.9198	.8326	.9204	.8338	.9210	.8349	.9217	.8361	.9223	.8373	.9229
30	.8286	.9184	.8298	.9190	.8310	.9196	.8322	.9202	.8334	.9208	.8346	.9215
31	.8259	.9169	.8271	.9175	.8283	.9182	.8294	.9188	.8306	.9194	.8318	.9200
32	.8232	.9155	.8244	.9161	.8255	.9167	.8267	.9174	.8279	.9180	.8291	.9186
33	.8205	.9141	.8217	.9147	.8228	.9153	.8240	.9159	.8252	.9165	.8264	.9172
34	.8178	.9127	.8190	.9133	.8202	.9139	.8213	.9145	.8225	.9151	.8237	.9158
35	.8152	.9112	.8163	.9119	.8175	.9125	.8187	.9131	.8198	.9137	.8210	.9143

T°C.	705		706		707		708		709		710	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.8948	.9517	.8961	.9524	.8974	.9530	.8986	.9536	.8999	.9542	.9012	.9548
11	.8917	.9502	.8929	.9508	.8942	.9514	.8955	.9521	.8967	.9527	.8980	.9533
12	.8886	.9487	.8898	.9493	.8911	.9499	.8923	.9505	.8936	.9511	.8949	.9518
13	.8854	.9472	.8867	.9478	.8880	.9484	.8892	.9490	.8905	.9496	.8917	.9502
14	.8824	.9456	.8836	.9463	.8849	.9469	.8861	.9475	.8874	.9481	.8886	.9487
15	.8793	.9441	.8805	.9447	.8818	.9454	.8830	.9460	.8843	.9466	.8855	.9472
16	.8762	.9426	.8775	.9432	.8787	.9439	.8800	.9445	.8812	.9451	.8825	.9457
17	.8732	.9411	.8745	.9417	.8757	.9424	.8769	.9430	.8782	.9436	.8794	.9442
18	.8702	.9396	.8715	.9402	.8727	.9409	.8739	.9415	.8752	.9421	.8764	.9427
19	.8672	.9381	.8685	.9388	.8697	.9394	.8709	.9400	.8722	.9406	.8734	.9412
20	.8643	.9367	.8655	.9373	.8667	.9379	.8680	.9385	.8692	.9391	.8704	.9397
21	.8613	.9352	.8626	.9358	.8638	.9364	.8650	.9370	.8662	.9376	.8674	.9382
22	.8584	.9337	.8596	.9343	.8609	.9349	.8621	.9355	.8633	.9362	.8645	.9368
23	.8555	.9322	.8567	.9328	.8579	.9335	.8592	.9341	.8604	.9347	.8616	.9353
24	.8526	.9308	.8538	.9314	.8551	.9320	.8563	.9326	.8575	.9332	.8587	.9338
25	.8498	.9293	.8510	.9299	.8522	.9305	.8534	.9311	.8546	.9318	.8558	.9324
26	.8469	.9278	.8481	.9285	.8493	.9291	.8505	.9297	.8517	.9303	.8529	.9309
27	.8441	.9264	.8453	.9270	.8465	.9276	.8477	.9282	.8489	.9289	.8501	.9295
28	.8413	.9249	.8425	.9256	.8437	.9262	.8449	.9268	.8461	.9274	.8473	.9280
29	.8385	.9235	.8397	.9241	.8409	.9247	.8421	.9254	.8433	.9260	.8445	.9266
30	.8357	.9221	.8369	.9227	.8381	.9233	.8393	.9239	.8405	.9245	.8417	.9251
31	.8330	.9206	.8342	.9213	.8354	.9219	.8365	.9225	.8377	.9231	.8389	.9237
32	.8303	.9192	.8314	.9198	.8326	.9204	.8338	.9211	.8350	.9217	.8361	.9223
33	.8275	.9178	.8287	.9184	.8299	.9190	.8311	.9196	.8322	.9202	.8334	.9209
34	.8248	.9164	.8260	.9170	.8272	.9176	.8284	.9182	.8295	.9188	.8307	.9194
35	.8222	.9150	.8233	.9156	.8245	.9162	.8257	.9168	.8268	.9174	.8280	.9180

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	711		712		713		714		715		716	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9025	.9554	.9037	.9560	.9050	.9566	.9063	.9573	.9075	.9579	.9088	.9585
11	.8993	.9539	.9005	.9545	.9018	.9551	.9031	.9557	.9043	.9563	.9056	.9569
12	.8961	.9524	.8974	.9530	.8986	.9536	.8999	.9542	.9012	.9548	.9024	.9554
13	.8930	.9508	.8942	.9515	.8955	.9521	.8967	.9527	.8980	.9533	.8993	.9539
14	.8899	.9493	.8911	.9499	.8924	.9505	.8936	.9512	.8949	.9518	.8961	.9524
15	.8868	.9478	.8880	.9484	.8893	.9490	.8905	.9496	.8918	.9503	.8930	.9509
16	.8837	.9463	.8849	.9469	.8862	.9475	.8874	.9481	.8887	.9487	.8899	.9494
17	.8807	.9448	.8819	.9454	.8831	.9460	.8844	.9466	.8856	.9472	.8869	.9479
18	.8776	.9433	.8789	.9439	.8801	.9445	.8813	.9451	.8826	.9457	.8838	.9464
19	.8746	.9418	.8759	.9424	.8771	.9430	.8783	.9436	.8795	.9443	.8808	.9449
20	.8716	.9403	.8729	.9409	.8741	.9416	.8753	.9422	.8765	.9428	.8778	.9434
21	.8687	.9389	.8699	.9395	.8711	.9401	.8723	.9407	.8736	.9413	.8748	.9419
22	.8657	.9374	.8669	.9380	.8682	.9386	.8694	.9392	.8706	.9398	.8718	.9404
23	.8628	.9359	.8640	.9365	.8652	.9371	.8664	.9377	.8677	.9383	.8689	.9390
24	.8599	.9344	.8611	.9351	.8623	.9357	.8635	.9363	.8647	.9369	.8659	.9375
25	.8570	.9330	.8582	.9336	.8594	.9342	.8606	.9348	.8618	.9354	.8630	.9360
26	.8541	.9315	.8553	.9321	.8565	.9327	.8577	.9334	.8589	.9340	.8601	.9346
27	.8513	.9301	.8525	.9307	.8537	.9313	.8549	.9319	.8561	.9325	.8573	.9331
28	.8485	.9286	.8497	.9292	.8508	.9299	.8520	.9305	.8532	.9311	.8544	.9317
29	.8456	.9272	.8468	.9278	.8480	.9284	.8492	.9290	.8504	.9296	.8516	.9302
30	.8429	.9258	.8440	.9264	.8452	.9270	.8464	.9276	.8476	.9282	.8488	.9288
31	.8401	.9243	.8413	.9249	.8424	.9255	.8436	.9261	.8448	.9268	.8460	.9274
32	.8373	.9229	.8385	.9235	.8397	.9241	.8409	.9247	.8420	.9253	.8432	.9259
33	.8346	.9215	.8358	.9221	.8369	.9227	.8381	.9233	.8393	.9239	.8405	.9245
34	.8319	.9201	.8330	.9207	.8342	.9213	.8354	.9219	.8365	.9225	.8377	.9231
35	.8292	.9186	.8303	.9193	.8315	.9199	.8327	.9205	.8338	.9211	.8350	.9217

T°C.	717		718		719		720		721		722	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9101	.9591	.9113	.9597	.9126	.9603	.9139	.9609	.9151	.9615	.9164	.9621
11	.9069	.9575	.9081	.9581	.9094	.9588	.9107	.9594	.9119	.9600	.9132	.9606
12	.9037	.9560	.9049	.9566	.9062	.9572	.9075	.9578	.9087	.9584	.9100	.9590
13	.9005	.9545	.9018	.9551	.9030	.9557	.9043	.9563	.9055	.9569	.9068	.9575
14	.8974	.9530	.8986	.9536	.8999	.9542	.9011	.9548	.9024	.9554	.9036	.9560
15	.8943	.9515	.8955	.9521	.8968	.9527	.8980	.9533	.8992	.9539	.9005	.9545
16	.8912	.9500	.8924	.9506	.8936	.9512	.8949	.9518	.8961	.9524	.8974	.9530
17	.8881	.9485	.8893	.9491	.8906	.9497	.8918	.9503	.8930	.9509	.8943	.9515
18	.8850	.9470	.8863	.9476	.8875	.9482	.8887	.9488	.8900	.9494	.8912	.9500
19	.8820	.9455	.8832	.9461	.8845	.9467	.8857	.9473	.8869	.9479	.8882	.9485
20	.8790	.9440	.8802	.9446	.8814	.9452	.8827	.9458	.8839	.9464	.8851	.9470
21	.8760	.9425	.8772	.9431	.8784	.9437	.8797	.9443	.8809	.9449	.8821	.9455
22	.8730	.9410	.8742	.9416	.8755	.9422	.8767	.9428	.8779	.9434	.8791	.9440
23	.8701	.9396	.8713	.9402	.8725	.9408	.8737	.9414	.8749	.9420	.8761	.9426
24	.8671	.9381	.8684	.9387	.8696	.9393	.8708	.9399	.8720	.9405	.8732	.9411
25	.8642	.9366	.8654	.9372	.8666	.9378	.8679	.9384	.8691	.9390	.8703	.9397
26	.8613	.9352	.8625	.9358	.8637	.9364	.8649	.9370	.8661	.9376	.8674	.9382
27	.8585	.9337	.8597	.9343	.8609	.9349	.8621	.9355	.8633	.9361	.8645	.9367
28	.8556	.9323	.8568	.9329	.8580	.9335	.8592	.9341	.8604	.9347	.8616	.9353
29	.8528	.9308	.8540	.9314	.8552	.9320	.8564	.9327	.8575	.9333	.8587	.9339
30	.8500	.9294	.8512	.9300	.8523	.9306	.8535	.9312	.8547	.9318	.8559	.9324
31	.8472	.9280	.8484	.9286	.8495	.9292	.8507	.9298	.8519	.9304	.8531	.9310
32	.8444	.9265	.8456	.9271	.8467	.9278	.8479	.9284	.8491	.9290	.8503	.9296
33	.8416	.9251	.8428	.9257	.8440	.9263	.8452	.9269	.8463	.9275	.8475	.9281
34	.8389	.9237	.8401	.9243	.8412	.9249	.8424	.9255	.8436	.9261	.8447	.9267
35	.8362	.9223	.8373	.9229	.8385	.9235	.8397	.9241	.8408	.9247	.8420	.9253

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	723 Value	723 Log	724 Value	724 Log	725 Value	725 Log	726 Value	726 Log	727 Value	727 Log	728 Value	728 Log
10	.9177	.9627	.9190	.9633	.9202	.9639	.9215	.9645	.9228	.9651	.9240	.9657
11	.9144	.9612	.9157	.9618	.9170	.9624	.9182	.9630	.9195	.9636	.9208	.9642
12	.9112	.9596	.9125	.9602	.9138	.9608	.9150	.9614	.9163	.9620	.9175	.9626
13	.9081	.9581	.9093	.9587	.9106	.9593	.9118	.9599	.9131	.9605	.9143	.9611
14	.9049	.9566	.9061	.9572	.9074	.9578	.9086	.9584	.9099	.9590	.9111	.9596
15	.9017	.9551	.9030	.9557	.9042	.9563	.9055	.9569	.9067	.9575	.9080	.9581
16	.8986	.9536	.8999	.9542	.9011	.9548	.9023	.9554	.9036	.9560	.9048	.9566
17	.8955	.9521	.8968	.9527	.8980	.9533	.8992	.9539	.9005	.9545	.9017	.9551
18	.8924	.9506	.8937	.9512	.8949	.9518	.8961	.9524	.8974	.9530	.8986	.9536
19	.8894	.9491	.8906	.9497	.8918	.9503	.8931	.9509	.8943	.9515	.8955	.9521
20	.8863	.9476	.8876	.9482	.8888	.9488	.8900	.9494	.8913	.9500	.8925	.9506
21	.8833	.9461	.8846	.9467	.8858	.9473	.8870	.9479	.8882	.9485	.8894	.9491
22	.8803	.9446	.8816	.9452	.8828	.9458	.8840	.9464	.8852	.9470	.8864	.9476
23	.8774	.9432	.8786	.9438	.8798	.9444	.8810	.9450	.8822	.9456	.8834	.9462
24	.8744	.9417	.8756	.9423	.8768	.9429	.8780	.9435	.8792	.9441	.8805	.9447
25	.8715	.9403	.8727	.9409	.8739	.9415	.8751	.9420	.8763	.9426	.8775	.9432
26	.8686	.9388	.8698	.9394	.8710	.9400	.8722	.9406	.8734	.9412	.8746	.9418
27	.8657	.9373	.8669	.9379	.8680	.9385	.8692	.9391	.8704	.9397	.8716	.9403
28	.8628	.9359	.8640	.9365	.8652	.9371	.8664	.9377	.8676	.9383	.8687	.9389
29	.8599	.9345	.8611	.9351	.8623	.9357	.8635	.9363	.8647	.9369	.8659	.9375
30	.8571	.9330	.8583	.9336	.8595	.9342	.8606	.9348	.8618	.9354	.8630	.9360
31	.8543	.9316	.8554	.9322	.8566	.9328	.8578	.9334	.8590	.9340	.8602	.9346
32	.8515	.9302	.8526	.9308	.8538	.9314	.8550	.9320	.8562	.9326	.8573	.9332
33	.8487	.9287	.8498	.9293	.8510	.9299	.8522	.9305	.8534	.9311	.8545	.9317
34	.8459	.9273	.8471	.9279	.8482	.9285	.8494	.9291	.8506	.9297	.8518	.9303
35	.8432	.9259	.8443	.9265	.8455	.9271	.8467	.9277	.8478	.9283	.8490	9289

T°C.	729 Value	729 Log	730 Value	730 Log	731 Value	731 Log	732 Value	732 Log	733 Value	733 Log	734 Value	734 Log
10	.9253	.9663	.9266	.9669	.9278	.9675	.9291	.9681	.9304	.9687	.9316	.9693
11	.9220	.9647	.9233	.9653	.9246	.9659	.9258	.9665	.9271	.9671	.9284	.9677
12	.9188	.9632	.9201	.9638	.9213	.9644	.9226	.9650	.9238	.9656	.9251	.9662
13	.9156	.9617	.9168	.9623	.9181	.9629	.9194	.9635	.9206	.9641	.9219	.9647
14	.9124	.9602	.9136	.9608	.9149	.9614	.9162	.9620	.9174	.9626	.9187	.9632
15	.9092	.9587	.9105	.9593	.9117	.9599	.9130	.9605	.9142	.9610	.9155	.9616
16	.9061	.9572	.9073	.9578	.9086	.9584	.9098	.9589	.9110	.9595	.9123	.9601
17	.9030	.9557	.9042	.9563	.9054	.9569	.9067	.9574	.9079	.9580	.9091	.9586
18	.8998	.9542	.9011	.9548	.9023	.9554	.9036	.9560	.9048	.9565	.9060	9571
19	.8968	.9527	.8980	.9533	.8992	.9539	.9005	.9545	.9017	.9551	.9029	.9556
20	.8937	.9512	.8949	.9518	.8962	.9524	.8974	.9530	.8986	.9536	.8998	.9542
21	.8907	.9497	.8919	.9503	.8931	.9509	.8943	.9515	.8955	.9521	.8968	.9527
22	.8876	.9482	.8889	.9488	.8901	.9494	.8913	.9500	.8925	.9506	.8937	.9512
23	.8846	.9468	.8859	.9474	.8871	.9480	.8883	.9486	.8895	.9491	.8907	.9497
24	.8817	.9453	.8829	.9459	.8841	.9465	.8853	.9471	.8865	.9477	.8877	.9483
25	.8787	.9438	.8799	.9444	.8811	.9450	.8823	.9456	.8835	.9462	.8847	.9468
26	.8758	.9424	.8770	.9430	.8782	.9436	.8794	.9442	.8806	.9448	.8818	.9454
27	.8728	.9409	.8740	.9415	.8752	.9421	.8764	.9427	.8776	.9433	.8788	.9439
28	.8699	.9395	.8711	.9401	.8723	.9407	.8735	.9413	.8747	.9419	.8759	.9425
29	.8671	.9380	.8682	.9386	.8694	.9392	.8706	.9398	.8718	.9404	.8730	.9410
30	.8642	.9366	.8654	.9372	.8666	.9378	.8677	.9384	.8689	.9390	.8701	.9396
31	.8613	.9352	.8625	.9358	.8637	.9364	.8649	.9370	.8661	.9376	.8673	.9381
32	.8585	.9338	.8597	.9343	.8609	.9349	.8621	.9355	.8632	.9361	.8644	.9367
33	.8557	.9323	.8569	.9329	.8581	.9335	.8592	.9341	.8604	.9347	.8616	.9353
34	.8529	.9309	.8541	.9315	.8553	.9321	.8564	.9327	.8576	.9333	.8588	.9339
35	.8502	.9295	.8513	.9301	.8525	.9307	.8537	.9313	.8548	.9319	.8560	.9325

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	735		736		737		738		739		740	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9329	.9698	.9342	.9704	.9355	.9710	.9367	.9716	.9380	.9722	.9393	.9728
11	.9296	.9683	.9309	.9689	.9322	.9695	.9334	.9701	.9347	.9707	.9360	.9713
12	.9264	.9668	.9276	.9674	.9289	.9680	.9301	.9686	.9314	.9691	.9327	.9697
13	.9231	.9653	.9244	.9659	.9256	.9664	.9269	.9670	.9281	.9676	.9294	.9682
14	.9199	.9637	.9212	.9643	.9224	.9649	.9237	.9655	.9249	.9661	.9262	.9667
15	.9167	.9622	.9180	.9628	.9192	.9634	.9205	.9640	.9217	.9646	.9229	.9652
16	.9135	.9607	.9148	.9613	.9160	.9619	.9173	.9625	.9185	.9631	.9198	.9637
17	.9104	.9592	.9116	.9598	.9129	.9604	.9141	.9610	.9153	.9616	.9166	.9622
18	.9073	.9577	.9085	.9583	.9097	.9589	.9110	.9595	.9122	.9601	.9134	.9607
19	.9041	.9562	.9054	.9568	.9066	.9574	.9078	.9580	.9091	.9586	.9103	.9592
20	.9011	.9548	.9023	.9553	.9035	.9559	.9047	.9565	.9060	.9571	.9072	.9577
21	.8980	.9533	.8992	.9539	.9004	.9545	.9017	.9550	.9029	.9556	.9041	.9562
22	.8949	.9518	.8962	.9524	.8974	.9530	.8986	.9536	.8998	.9542	.9010	.9547
23	.8919	.9503	.8931	.9509	.8943	.9515	.8956	.9521	.8968	.9527	.8980	.9533
24	.8889	.9489	.8901	.9495	.8913	.9500	.8925	.9506	.8938	.9512	.8950	.9518
25	.8859	.9474	.8871	.9480	.8883	.9486	.8895	.9492	.8908	.9498	.8920	.9503
26	.8830	.9459	.8842	.9465	.8854	.9471	.8866	.9477	.8878	.9483	.8890	.9489
27	.8800	.9445	.8812	.9451	.8824	.9457	.8836	.9463	.8848	.9469	.8860	.9474
28	.8771	.9430	.8783	.9436	.8795	.9442	.8807	.9448	.8819	.9454	.8831	.9460
29	.8742	.9416	.8754	.9422	.8766	.9428	.8778	.9434	.8789	.9440	.8801	.9446
30	.8713	.9402	.8725	.9408	.8737	.9414	.8749	.9419	.8760	.9425	.8772	.9431
31	.8684	.9387	.8696	.9393	.8708	.9399	.8720	.9405	.8732	.9411	.8743	.9417
32	.8656	.9373	.8668	.9379	.8679	.9385	.8691	.9391	.8703	.9397	.8715	.9403
33	.8628	.9359	.8639	.9365	.8651	.9371	.8663	.9377	.8675	.9382	.8686	.9388
34	.8599	.9345	.8611	.9351	.8623	.9357	.8635	.9362	.8646	.9368	.8658	.9374
35	.8572	.9331	.8583	.9336	.8595	.9342	.8607	.9348	.8618	.9354	.8630	.9360

T°C.	741		742		743		744		745		746	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9405	.9734	.9418	.9740	.9431	.9745	.9443	.9751	.9456	.9757	.9469	.9763
11	.9372	.9718	.9385	.9724	.9397	.9730	.9410	.9736	.9423	.9742	.9435	.9748
12	.9339	.9703	.9352	.9709	.9364	.9715	.9377	.9721	.9390	.9727	.9402	.9732
13	.9307	.9688	.9319	.9694	.9332	.9700	.9344	.9705	.9357	.9711	.9369	.9717
14	.9274	.9673	.9287	.9679	.9299	.9684	.9312	.9690	.9324	.9696	.9337	.9702
15	.9242	.9658	.9254	.9663	.9267	.9669	.9279	.9675	.9292	.9681	.9304	.9687
16	.9210	.9643	.9222	.9648	.9235	.9654	.9247	.9660	.9260	.9666	.9272	.9672
17	.9178	.9628	.9191	.9633	.9203	.9639	.9215	.9645	.9228	.9651	.9240	.9657
18	.9147	.9613	.9159	.9618	.9171	.9624	.9184	.9630	.9196	.9636	.9208	.9642
19	.9115	.9598	.9128	.9604	.9140	.9609	.9152	.9615	.9164	.9621	.9177	.9627
20	.9084	.9583	.9096	.9589	.9109	.9595	.9121	.9600	.9133	.9606	.9145	.9612
21	.9053	.9568	.9065	.9574	.9078	.9580	.9090	.9586	.9102	.9591	.9114	.9597
22	.9023	.9553	.9035	.9559	.9047	.9565	.9059	.9571	.9071	.9577	.9083	.9582
23	.8992	.9539	.9004	.9544	.9016	.9550	.9028	.9556	.9041	.9562	.9053	.9568
24	.8962	.9524	.8974	.9530	.8986	.9536	.8998	.9541	.9010	.9547	.9022	.9553
25	.8932	.9509	.8944	.9515	.8956	.9521	.8968	.9527	.8980	.9533	.8992	.9539
26	.8902	.9495	.8914	.9501	.8926	.9506	.8938	.9512	.8950	.9518	.8962	.9524
27	.8872	.9480	.8884	.9486	.8896	.9492	.8908	.9498	.8920	.9504	.8932	.9509
28	.8843	.9466	.8855	.9472	.8866	.9477	.8878	.9483	.8890	.9489	.8902	.9495
29	.8813	.9451	.8825	.9457	.8837	.9463	.8849	.9469	.8861	.9475	.8873	.9481
30	.8784	.9437	.8796	.9443	.8808	.9449	.8820	.9455	.8832	.9460	.8843	.9466
31	.8755	.9423	.8767	.9429	.8779	.9434	.8791	.9440	.8803	.9446	.8814	.9452
32	.8727	.9408	.8738	.9414	.8750	.9420	.8762	.9426	.8774	.9432	.8785	.9438
33	.8698	.9394	.8710	.9400	.8721	.9406	.8733	.9412	.8745	.9418	.8757	.9423
34	.8670	.9380	.8681	.9386	.8693	.9392	.8705	.9398	.8716	.9403	.8728	.9409
35	.8642	.9366	.8653	.9372	.8665	.9378	.8676	.9383	.8688	.9389	.8700	.9395

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	747 Value	747 Log	748 Value	748 Log	749 Value	749 Log	750 Value	750 Log	751 Value	751 Log	752 Value	752 Log
10	.9481	.9769	.9494	.9775	.9507	.9780	.9520	.9786	.9532	.9792	.9545	.9798
11	.9448	.9753	.9461	.9759	.9473	.9765	.9486	.9771	.9499	.9777	.9511	.9782
12	.9415	.9738	.9427	.9744	.9440	.9750	.9453	.9756	.9465	.9761	.9478	.9767
13	.9382	.9723	.9395	.9729	.9407	.9735	.9420	.9740	.9432	.9746	.9445	.9752
14	.9349	.9708	.9362	.9714	.9374	.9719	.9387	.9725	.9399	.9731	.9412	.9737
15	.9317	.9693	.9329	.9698	.9342	.9704	.9354	.9710	.9367	.9716	.9379	.9722
16	.9285	.9678	.9297	.9683	.9309	.9689	.9322	.9695	.9334	.9701	.9347	.9707
17	.9252	.9663	.9265	.9668	.9277	.9674	.9290	.9680	.9302	.9686	.9314	.9692
18	.9221	.9648	.9233	.9653	.9245	.9659	.9258	.9665	.9270	.9671	.9282	.9677
19	.9189	.9633	.9201	.9639	.9214	.9644	.9226	.9650	.9238	.9656	.9251	.9662
20	.9158	.9618	.9170	.9624	.9182	.9629	.9194	.9635	.9207	.9641	.9219	.9647
21	.9127	.9603	.9139	.9609	.9151	.9615	.9163	.9620	.9175	.9626	.9188	.9632
22	.9096	.9588	.9108	.9594	.9120	.9600	.9132	.9606	.9144	.9611	.9156	.9617
23	.9065	.9574	.9077	.9579	.9089	.9585	.9101	.9591	.9113	.9597	.9126	.9603
24	.9034	.9559	.9046	.9565	.9058	.9571	.9071	.9576	.9083	.9582	.9095	.9588
25	.9004	.9544	.9016	.9550	.9028	.9556	.9040	.9562	.9052	.9568	.9064	.9573
26	.8974	.9530	.8986	.9536	.8998	.9541	.9010	.9547	.9022	.9553	.9034	.9559
27	.8944	.9515	.8956	.9521	.8968	.9527	.8980	.9533	.8992	.9538	.9004	.9544
28	.8914	.9501	.8926	.9507	.8938	.9512	.8950	.9518	.8962	.9524	.8974	.9530
29	.8885	.9486	.8897	.9492	.8908	.9498	.8920	.9504	.8932	.9510	.8944	.9515
30	.8855	.9472	.8867	.9478	.8879	.9484	.8891	.9489	.8903	.9495	.8915	.9501
31	.8826	.9458	.8838	.9464	.8850	.9469	.8862	.9475	.8873	.9481	.8885	.9487
32	.8797	.9443	.8809	.9449	.8821	.9455	.8833	.9461	.8844	.9467	.8856	.9472
33	.8768	.9429	.8780	.9435	.8792	.9441	.8804	.9447	.8815	.9452	.8827	.9458
34	.8740	.9415	.8752	.9421	.8763	.9427	.8775	.9432	.8787	.9438	.8798	.9444
35	.8711	.9401	.8723	.9407	.8735	.9413	.8746	.9418	.8758	.9424	.8770	.9430

T°C.	753 Value	753 Log	754 Value	754 Log	755 Value	755 Log	756 Value	756 Log	757 Value	757 Log	758 Value	758 Log
10	.9558	.9803	.9570	.9809	.9583	.9815	.9596	.9821	.9608	.9827	.9621	.9832
11	.9524	.9788	.9537	.9794	.9549	.9800	.9562	.9805	.9575	.9811	.9587	.9817
12	.9491	.9773	.9503	.9779	.9516	.9784	.9528	.9790	.9541	.9796	.9554	.9802
13	.9457	.9758	.9470	.9763	.9482	.9769	.9495	.9775	.9508	.9781	.9520	.9786
14	.9424	.9743	.9437	.9748	.9449	.9754	.9462	.9760	.9474	.9766	.9487	.9771
15	.9392	.9727	.9404	.9733	.9417	.9739	.9429	.9745	.9441	.9750	.9454	.9756
16	.9359	.9712	.9372	.9718	.9384	.9724	.9396	.9730	.9409	.9735	.9421	.9741
17	.9327	.9697	.9339	.9703	.9352	.9709	.9364	.9715	.9376	.9720	.9389	.9726
18	.9295	.9682	.9307	.9688	.9319	.9694	.9332	.9700	.9344	.9705	.9356	.9711
19	.9263	.9667	.9275	.9673	.9287	.9679	.9300	.9685	.9312	.9690	.9324	.9696
20	.9231	.9653	.9244	.9658	.9256	.9664	.9268	.9670	.9280	.9676	.9293	.9681
21	.9200	.9638	.9212	.9644	.9224	.9649	.9236	.9655	.9249	.9661	.9261	.9667
22	.9167	.9623	.9181	.9629	.9193	.9635	.9205	.9640	.9217	.9646	.9230	.9652
23	.9138	.9608	.9150	.9614	.9162	.9620	.9174	.9626	.9186	.9631	.9198	.9637
24	.9107	.9594	.9119	.9599	.9131	.9605	.9143	.9611	.9155	.9617	.9167	.9622
25	.9076	.9579	.9088	.9585	.9100	.9591	.9112	.9596	.9124	.9602	.9137	.9608
26	.9046	.9565	.9058	.9570	.9070	.9576	.9082	.9582	.9094	.9588	.9106	9593
27	.9016	.9550	.9028	.9556	.9040	.9562	.9052	.9567	.9064	.9573	.9076	.9579
28	.8986	.9536	.8998	.9541	.9010	.9547	.9022	.9553	.9034	.9559	.9045	.9564
29	.8956	.9521	.8968	.9527	.8980	.9533	.8992	.9538	.9004	.9544	.9015	.9550
30	.8926	.9507	.8938	.9513	.8950	.9518	.8962	.9524	.8974	.9530	.8986	.9536
31	.8897	.9492	.8909	.9498	.8921	.9504	.8933	.9510	.8944	.9515	.8956	.9521
32	.8868	.9478	.8880	.9484	.8891	.9490	.8903	.9495	.8915	.9501	.8927	.9507
33	.8839	.9464	.8851	.9470	.8862	.9475	.8874	.9481	.8886	.9487	.8898	.9493
34	.8810	.9450	.8822	.9456	.8833	.9461	.8845	.9467	.8857	.9473	.8869	.9479
35	.8781	.9436	.8793	.9441	.8805	.9447	.8816	.9453	.8828	.9459	.8840	.9464

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	759		760		761		762		763		764	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9634	.9838	.9646	.9844	.9659	.9849	.9672	.9855	.9685	.9861	.9697	.9866
11	.9600	.9823	.9612	.9828	.9625	.9834	.9638	.9840	.9650	.9845	.9663	.9851
12	.9566	.9807	.9579	.9813	.9591	.9819	.9604	.9824	.9617	.9830	.9629	.9836
13	.9533	.9792	.9545	.9798	.9558	.9804	.9570	.9809	.9583	.9815	.9595	.9821
14	.9499	.9777	.9512	.9783	.9524	.9788	.9537	.9794	.9549	.9800	.9562	.9805
15	.9466	.9762	.9479	.9768	.9491	.9773	.9504	.9779	.9516	.9785	.9529	.9790
16	.9434	.9747	.9446	.9753	.9459	.9758	.9471	.9764	.9483	.9770	.9496	.9775
17	.9401	.9732	.9413	.9738	.9426	.9743	.9438	.9749	.9451	.9755	.9463	.9760
18	.9369	.9717	.9381	.9723	.9393	.9728	.9406	.9734	.9418	.9740	.9431	.9745
19	.9337	.9702	.9349	.9708	.9361	.9713	.9374	.9719	.9386	.9725	.9398	.9730
20	.9305	.9687	.9317	.9693	.9329	.9698	.9342	.9704	.9354	.9710	.9366	.9716
21	.9273	.9672	.9285	.9678	.9298	.9684	.9310	.9689	.9322	.9695	.9334	.9701
22	.9242	.9658	.9254	.9663	.9266	.9669	.9278	.9675	.9290	.9680	.9303	.9686
23	.9210	.9643	.9223	.9649	.9235	.9654	.9247	.9660	.9259	.9666	.9271	.9671
24	.9179	.9628	.9192	.9634	.9204	.9640	.9216	.9645	.9228	.9651	.9240	.9657
25	.9149	.9614	.9161	.9619	.9173	.9625	.9185	.9631	.9197	.9636	.9209	.9642
26	.9118	.9599	.9130	.9605	.9142	.9610	.9154	.9616	.9166	.9622	.9178	.9628
27	.9088	.9584	.9100	.9590	.9112	.9596	.9123	.9602	.9135	.9607	.9147	.9613
28	.9057	.9570	.9069	.9576	.9081	.9581	.9093	.9587	.9105	.9593	.9117	.9599
29	.9027	.9556	.9039	.9561	.9051	.9567	.9063	.9573	.9075	.9578	.9087	.9584
30	.8998	.9541	.9009	.9547	.9021	.9553	.9033	.9558	.9045	.9564	.9057	.9570
31	.8968	.9527	.8980	.9533	.8992	.9538	.9003	.9544	.9015	.9550	.9027	.9555
32	.8939	.9513	.8950	.9518	.8962	.9524	.8974	.9530	.8986	.9535	.8997	.9541
33	.8909	.9498	.8921	.9504	.8933	.9510	.8945	.9516	.8956	.9521	.8968	.9527
34	.8880	.9484	.8892	.9490	.8904	.9496	.8915	.9501	.8927	.9507	.8939	.9513
35	.8851	.9470	.8863	.9476	.8875	.9482	.8886	.9487	.8898	.9493	.8910	.9499

T°C.	765		766		767		768		769		770	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9710	.9872	.9723	.9878	.9735	.9883	.9748	.9889	.9761	.9895	.9773	.9900
11	.9676	.9857	.9688	.9863	.9701	.9868	.9714	.9874	.9726	.9879	.9739	.9885
12	.9642	.9842	.9654	.9847	.9667	.9853	.9680	.9859	.9692	.9864	.9705	.9870
13	.9608	.9826	.9621	.9832	.9633	.9838	.9646	.9843	.9658	.9849	.9671	.9855
14	.9575	.9811	.9587	.9817	.9600	.9823	.9612	.9828	.9625	.9834	.9637	.9839
15	.9541	.9796	.9554	.9802	.9566	.9807	.9579	.9813	.9591	.9819	.9604	.9824
16	.9508	.9781	.9521	.9787	.9533	.9792	.9546	.9798	.9558	.9804	.9570	.9809
17	.9475	.9766	.9488	.9772	.9500	.9777	.9513	.9783	.9525	.9789	.9537	.9794
18	.9443	.9751	.9455	.9757	.9468	.9762	.9480	.9768	.9492	.9774	.9505	.9779
19	.9410	.9736	.9423	.9742	.9435	.9747	.9447	.9753	.9460	.9759	.9472	.9764
20	.9378	.9721	.9391	.9727	.9403	.9733	.9415	.9738	.9427	.9744	.9440	.9750
21	.9346	.9706	.9359	.9712	.9371	.9718	.9383	.9723	.9395	.9729	.9408	.9735
22	.9315	.9692	.9327	.9697	.9339	.9703	.9351	.9709	.9363	.9714	.9376	.9720
23	.9283	.9677	.9295	.9683	.9308	.9688	.9320	.9694	.9332	.9700	.9344	.9705
24	.9252	.9662	.9264	.9668	.9276	.9674	.9288	.9679	.9300	.9685	.9312	.9691
25	.9221	.9648	.9233	.9653	.9245	.9659	.9257	.9665	.9269	.9670	.9281	.9676
26	.9190	.9633	.9202	.9639	.9214	.9645	.9226	.9650	.9238	.9656	.9250	.9661
27	.9159	.9619	.9171	.9624	.9183	.9630	.9195	.9636	.9207	.9641	.9219	.9647
28	.9129	.9604	.9141	.9610	.9153	.9616	.9165	.9621	.9177	.9627	.9189	.9633
29	.9099	.9590	.9111	.9595	.9123	.9601	.9134	.9607	.9146	.9612	.9158	.9618
30	.9069	.9575	.9081	.9581	.9092	.9587	.9104	.9592	.9116	.9598	.9128	.9604
31	.9039	.9561	.9051	.9567	.9062	.9572	.9074	.9578	.9086	.9584	.9098	.9589
32	.9009	.9547	.9021	.9553	.9033	.9558	.9045	.9564	.9056	.9570	.9068	.9575
33	.8980	.9533	.8991	.9538	.9003	.9544	.9015	.9550	.9027	.9555	.9038	.9561
34	.8950	.9518	.8962	.9524	.8974	.9530	.8986	.9535	.8997	.9541	.9009	.9547
35	.8921	.9504	.8933	.9510	.8945	.9516	.8956	.9521	.8968	.9527	.8980	.9533

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	771		772		773		774		775		776	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9786	.9906	.9799	.9912	.9811	.9917	.9824	.9923	.9837	.9929	.9850	.9934
11	.9752	.9891	.9764	.9896	.9777	.9902	.9790	.9908	.9802	.9913	.9815	.9919
12	.9717	.9875	.9730	.9881	.9743	.9887	.9755	.9892	.9768	.9898	.9780	.9904
13	.9683	.9860	.9696	.9866	.9708	.9872	.9721	.9877	.9734	.9883	.9746	.9888
14	.9650	.9845	.9662	.9851	.9675	.9856	.9687	.9862	.9700	.9868	.9712	.9873
15	.9616	.9830	.9629	.9836	.9641	.9841	.9654	.9847	.9666	.9852	.9678	.9858
16	.9583	.9815	.9595	.9821	.9608	.9826	.9620	.9832	.9633	.9837	.9645	.9843
17	.9550	.9800	.9562	.9806	.9575	.9811	.9587	.9817	.9599	.9822	.9612	.9828
18	.9517	.9785	.9529	.9791	.9542	.9796	.9554	.9802	.9566	.9807	.9579	.9813
19	.9484	.9770	.9497	.9776	.9509	.9781	.9521	.9787	.9534	.9793	.9546	.9798
20	.9452	.9755	.9464	.9761	.9476	.9766	.9489	.9772	.9501	.9778	.9513	.9783
21	.9420	.9740	.9432	.9746	.9444	.9752	.9456	.9757	.9469	.9763	.9481	.9768
22	.9388	.9726	.9400	.9731	.9412	.9737	.9424	.9742	.9437	.9748	.9449	.9754
23	.9356	.9711	.9368	.9717	.9380	.9722	.9392	.9728	.9405	.9733	.9417	.9739
24	.9325	.9696	.9337	.9702	.9349	.9708	.9361	.9713	.9373	.9719	.9385	.9724
25	.9293	.9682	.9305	.9687	.9317	.9693	.9329	.9699	.9341	.9704	.9354	.9710
26	.9262	.9667	.9274	.9673	.9286	.9678	.9298	.9684	.9310	.9690	.9322	.9695
27	.9231	.9653	.9243	.9658	.9255	.9664	.9267	.9669	.9279	.9675	.9291	.9681
28	.9201	.9638	.9213	.9644	.9224	.9649	.9236	.9655	.9248	.9661	.9260	.9666
29	.9170	.9624	.9182	.9629	.9194	.9635	.9206	.9641	.9218	.9646	.9230	.9652
30	.9140	.9609	.9152	.9615	.9164	.9621	.9175	.9626	.9187	.9632	.9199	.9637
31	.9110	.9595	.9122	.9601	.9133	.9606	.9145	.9612	.9157	.9618	.9169	.9623
32	.9080	.9581	.9092	.9586	.9103	.9592	.9115	.9598	.9127	.9603	.9139	.9609
33	.9050	.9567	.9062	.9572	.9074	.9578	.9085	.9583	.9097	.9589	.9109	.9595
34	.9021	.9552	.9032	.9558	.9044	.9564	.9056	.9569	.9067	.9575	.9079	.9580
35	.8991	.9538	.9003	.9544	.9015	.9550	.9026	.9555	.9038	.9561	.9050	.9566

T°C.	777		778		779		780		782		784	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9862	.9940	.9875	.9945	.9888	.9951	.9900	.9956	.9926	.9968	.9951	.9979
11	.9827	.9924	.9840	.9930	.9853	.9936	.9865	.9941	.9891	.9952	.9916	.9963
12	.9793	.9909	.9806	.9915	.9818	.9920	.9831	.9926	.9856	.9937	.9881	.9948
13	.9759	.9894	.9771	.9900	.9784	.9905	.9796	.9911	.9822	.9922	.9847	.9933
14	.9725	.9879	.9737	.9884	.9750	.9890	.9762	.9896	.9787	.9907	.9812	.9918
15	.9691	.9864	.9703	.9869	.9716	.9875	.9728	.9880	.9753	.9892	.9778	.9903
16	.9657	.9849	.9670	.9854	.9682	.9860	.9695	.9865	.9720	.9876	.9744	.9888
17	.9624	.9834	.9636	.9839	.9649	.9845	.9661	.9850	.9686	.9861	.9711	.9873
18	.9591	.9819	.9603	.9824	.9616	.9830	.9628	.9835	.9653	.9846	.9677	.9858
19	.9558	.9804	.9570	.9809	.9583	.9815	.9595	.9820	.9620	.9832	.9644	.9843
20	.9525	.9789	.9538	.9794	.9550	.9800	.9562	.9806	.9587	.9817	.9611	.9828
21	.9493	.9774	.9505	.9780	.9517	.9785	.9530	.9791	.9554	.9802	.9579	.9813
22	.9461	.9759	.9473	.9765	.9485	.9770	.9497	.9776	.9522	.9787	.9546	.9798
23	.9429	.9745	.9441	.9750	.9453	.9756	.9465	.9761	.9490	.9772	.9514	.9784
24	.9397	.9730	.9409	.9736	.9421	.9741	.9433	.9747	.9458	.9758	.9482	.9769
25	.9366	.9715	.9378	.9721	.9390	.9727	.9402	.9732	.9426	.9743	.9450	.9754
26	.9334	.9701	.9346	.9706	.9358	.9712	.9370	.9718	.9394	.9729	.9418	.9740
27	.9303	.9686	.9315	.9692	.9327	.9697	.9339	.9703	.9363	.9714	.9387	.9725
28	.9272	.9672	.9284	.9677	.9296	.9683	.9308	.9689	.9332	.9700	.9356	.9711
29	.9241	.9657	.9253	.9663	.9265	.9669	.9277	.9674	.9301	.9685	.9325	.9696
30	.9211	.9643	.9223	.9649	.9235	.9654	.9247	.9660	.9270	.9671	.9294	.9682
31	.9181	.9629	.9192	.9634	.9204	.9640	.9216	.9645	.9240	.9657	.9263	.9668
32	.9151	.9614	.9162	.9620	.9174	.9626	.9186	.9631	.9209	.9642	.9233	.9653
33	.9121	.9600	.9132	.9606	.9144	.9611	.9156	.9617	.9179	.9628	.9203	.9639
34	.9091	.9586	.9103	.9592	.9114	.9597	.9126	.9603	.9149	.9614	.9173	.9625
35	.9061	.9572	.9073	.9578	.9085	.9583	.9096	.9589	.9120	.9600	.9143	.9611

REDUCTION OF GAS VOLUME

Values of (1 + at) for Temperatures from 0 to 120° C.

T	0	1	2	3	4	5	6	7	8	9
00	1.0000	1.0037	1.0073	1.0110	1.0147	1.0183	1.0220	1.0257	1.0294	1.0330
10	1.0367	1.0404	1.0440	1.0477	1.0514	1.0550	1.0587	1.0624	1.0661	1.0697
20	1.0734	1.0771	1.0807	1.0844	1.0881	1.0917	1.0954	1.0991	1.1028	1.1064
30	1.1101	1.1138	1.1174	1.1211	1.1248	1.1284	1.1321	1.1358	1.1395	1.1431
40	1.1468	1.1505	1.1541	1.1578	1.1615	1.1651	1.1688	1.1725	1.1762	1.1798
50	1.1835	1.1872	1.1908	1.1945	1.1982	1.2018	1.2055	1.2092	1.2129	1.2165
60	1.2202	1.2239	1.2275	1.2312	1.2349	1.2385	1.2422	1.2459	1.2496	1.2532
70	1.2569	1.2606	1.2642	1.2679	1.2716	1.2752	1.2789	1.2826	1.2863	1.2899
80	1.2936	1.2973	1.3009	1.3046	1.3083	1.3119	1.3156	1.3193	1.3230	1.3266
90	1.3303	1.3340	1.3376	1.3413	1.3450	1.3486	1.3523	1.3560	1.3597	1.3633
100	1.3670	1.3707	1.3743	1.3780	1.3817	1.3853	1.3890	1.3927	1.3964	1.4000
110	1.4037	1.4074	1.4110	1.4147	1.4184	1.4220	1.4257	1.4294	1.4331	1.4367
120	1.4404									

Values of H/760 for Pressures from 700 to 780 mm of Mercury

H	0	1	2	3	4	5	6	7	8	9
700	0.9211	0.9224	0.9237	0.9250	0.9263	0.9276	0.9289	0.9303	0.9316	0.9329
710	0.9342	0.9355	0.9368	0.9382	0.9395	0.9408	0.9421	0.9434	0.9447	0.9461
720	0.9474	0.9487	0.9500	0.9513	0.9526	0.9539	0.9553	0.9566	0.9579	0.9592
730	0.9605	0.9618	0.9632	0.9645	0.9658	0.9671	0.9684	0.9697	0.9711	0.9724
740	0.9737	0.9750	0.9763	0.9776	0.9789	0.9803	0.9816	0.9829	0.9842	0.9855
750	0.9868	0.9882	0.9895	0.9908	0.9921	0.9934	0.9947	0.9961	0.9974	0.9987
760	1.0000	1.0013	1.0026	1.0039	1.0053	1.0066	1.0079	1.0092	1.0105	1.0118
770	1.0132	1.0145	1.0158	1.0171	1.0184	1.0197	1.0211	1.0224	1.0237	1.0250
780	1.0263									

SPECIFIC HEAT OF WATER AND MERCURY

Values for water from 0–100° C are the mean of various determinations including Calendar and Blonsfield, 1912; above 100, Regnault's values recomputed by Guillaume, 1912.

Values for mercury 0–80° C due to Barnes and Cooke; 90–140°, mean of Winkelmann, Naccari and Milthaler; above 140°, mean of Naccari and Milthaler.

Specific heat in normal calories (15° C).

Temp. ° C	Water	Mercury	Temp. ° C	Water	Mercury
0	1.00874	.03346	80	1.00239	.03284
5	1.00477	.03340	85	1.00329	
10	1.00184	.03335	90	1.00433	.03277
15	1.00000	.03330	95	1.00534	
20	0.99859	.03325	100	1.00645	.03269
25	0.99765	.03320	110	1.0116	.03262
30	0.99745	.03316	120	1.0144	.03255
35	0.99743	.03312	130	1.0174	.03248
40	0.99761	.03308	140	1.0206	.03241
45	0.99790		150	1.0240	.0324
50	0.99829	.03300	160	1.0275	
55	0.99873		170	1.0313	.0322
60	0.99934	.03294	180	1.0353	
65	1.00001		190	1.0395	.0320
70	1.00077	.03289	200	1.0439	
75	1.00158				

SPECIFIC HEAT OF WATER

Temperatures on the normal (hydrogen) scale: specific heat in normal calories (15°)

Ice

Temp. C.	Specific Heat.	Observer.	Temp. C.	Specific Heat.	Observer.
—252 to —188	0.146	Dieterici, 1903	—160	0.230	Nernst, 1910
			—140	.262	Nernst, 1910
—188 to —78	.285	Dieterici, 1903	—100	.325	Nernst, 1910
			—60	.392	Nernst, 1910
—78 to —18	.463	Dieterici, 1903	—20	.480	Nernst, 1910
			—10	.53	Nernst, 1910
—200	.168	Nernst, 1910	—21 to 0	.505	Person, 1847
—180	.199	Nernst, 1910			

Water Below 0° C.

Temp. C.	Specific Heat.	Observer.	Temp. C.	Specific Heat.	Observer.
—6	1.0119	Martinetti, 1890	—2	1.0097	Martinetti, 1890
—5	1.0113	Martinetti, 1890	—1	1.0092	Martinetti, 1890
—4	1.0105	Martinetti, 1890	—5	1.0155	Barnes, 1902
—3	1.0102				

Water 0–100° C.

Temp. ° C.	Barnes, 1902.	Dieterici,* 1905.	Callendar, 1912.	Blousfield, 1912.	Mean.**
0	....	1.0089	1.00934	1.0070	1.00874
5	1.00502	1.0051	1.00494	1.0039	1.00477
10	1.00201	1.0021	1.00187	1.0016	1.00184
15	1.00000	1.0000	1.00000	1.0000	1.00000
20	.99864	.9987	.99878	.9991	.99859
25	.99775	.9983	.99800	.9989	.99765
30	.99725	.9983	.99755	.9990	.99745
35	.99708	.9984	.99734	.9997	.99743
40	.99708	.9984	.99734	1.0006	.99761
45	.99730	.9989	.99749	1.0018	.99790
50	.99768	.9994	.99779	1.0031	.99829
55	.99818	.9998	.99820	1.0045	.99873
60	.99880	1.0005	.99872	1.0058	.99934
65	.99940	1.0013	.99933	1.0070	1.00001
70	1.00007	1.0022	1.00003	1.0083	1.00077
75	1.00072	1.0032	1.00081	1.0088	1.00158
80	1.00141	1.0041	1.00166	1.0091	1.00239
85	1.00208	1.0053	1.00260	......	1.00329
90	1.00275	1.0066	1.00357	......	1.00433
95	1.00341	1.0080	1.00462	......	1.00534
100	1.00410	1.0095	1.00574	......	1.00645

* Temperature by air thermometer. ** Mean of observations by Rowland, Bartoli and Stracciati, Griffiths, Barnes, Dieterici, and Callendar.

SPECIFIC HEAT OF WATER (Continued)

Water Above 100° C.

Temp. ° C.	Regnault, 1847, recomputed by Guillaume, 1912.	Dieterici, 1905.	Temp. ° C.	Dieterici, 1905.
110	1.0116	1.0126	210	1.0695
120	1.0144	1.0168	220	1.0769
130	1.0174	1.0214	230	1.0857
140	1.0206	1.0255	240	1.0939
150	1.0240	1.0310	250	1.1035
160	1.0275	1.0359	260	1.1126
170	1.0313	1.0422	270	1.1230
180	1.0353	1.0479	280	1.1329
190	1.0395	1.0550	290	1.1442
200	1.0439	1.0616	300	1.1549

MECHANICAL EQUIVALENT OF HEAT

Observer.	Ergs per calorie (15°).	Observer.	Ergs per calorie (15°).
Joule, 1878..........	4.177×10^7	Callendar and Barnes, 1900	4.186×10^7
Rowland, 1879.......	4.188	Dieterici, 1905.....	4.1879
Griffiths, 1893.......	4.196	Blousfield, 1912.....	4.1791
Schuster and Gannon, 1898	4.196	Jaeger and Steinwehr, 1921	4.184

ACCEPTED VALUES

1 gram calorie (20°C) = 4.181 joules
1 gram calorie (15°C) = 4.185 joules
1 gram calorie (mean) = 4.186 joules
1 British thermal unit (39°F) = 1060.4 joules
1 British thermal unit (60°F) = 1054.6 joules
1 British thermal unit (mean) = 1054.8 joules

SPECIFIC HEAT OF ELEMENTS

Element	Temp. °C	Sp. ht., cal./g
Aluminum	−250	0.0039
	−240.6	0.0092
	−233	0.0165
	−200	0.076
	−150	0.1367
	−100	0.1676
	−50	0.1914
	0	0.2079
	20	0.214
	100	0.225
	300	0.248
	600	0.277
liquid	660	0.25
Antimony	−207.1	0.0322
	−150	0.0412
	−100	0.0448
	−50	0.0476
	0	0.0494
	20–100	0.0504
	100	0.0513
	200	0.0520
	300	0.0537
	500	0.054
Argon, solid	−223	0.155
liquid	−100	0.134
Arsenic	−216	0.032
	−117.6	0.0666
	18	0.078
gray. crystal	0–100	0.0822
blk., amor	0–100	0.0861
Barium	−185 to +20	0.068
Beryllium	−202	0.017
	0–46	0.397
	0–100	0.425
	0–300	0.505
Bismuth	−150	0.0264
	−100	0.0273
	−50	0.0282
	0	0.0291
	20	0.0294
	100	0.0304
liquid	297	0.0292
	400	0.035
Boron	−191 to −78	0.071
	−76 to 0	0.168
	0–100	0.307
	100	0.287
	500	0.472
	900	0.510
Bromine, solid	−253.1	0.0205
	−173.1	0.0659
	−73.1	0.080
	−13.1	0.088
Bromine, liquid	13–45	0.107
Cadmium	−263	0.0019
	−203.1	0.0415
	−103.1	0.0518
	27.9	0.0552
	107.9	0.0569
	277	0.060
liquid	321	0.077
Calcium	−185 to +20	0.157
	0–20	0.145
	24	0.168
Calcium (continued)	100	0.1625
	300	0.1832
	600	0.188
Carbon, charcoal	0–24	0.165
diamond	−233	0.0005
	−185	0.0025
	−188 to −78	0.019
	−78 to +18	0.079
	0	0.1044
	20	0.12
	140	0.222
	223	0.264
	247	0.303
	606	0.441
	823	0.428
gas carbon	24–68	0.204
graphite	−243	0.005
	−203	0.0175
	−191 to −79	0.057
	−66	0.053
	20	0.17
	85	0.177
	138	0.254
	642	0.445
	896	0.454
Cerium	−253 to −196	0.033
	0–100	0.0423
	20–100	0.0511
Cesium, solid	20	0.052
	0–26	0.0482
liquid	50	0.058
Chlorine	−113	0.19
liquid	0–24	0.226
Chromium	−150	0.0599
	−100	0.0797
	−50	0.0941
	0	0.1044
	20	0.11
	18–100	0.111
	100	0.112
	400	0.133
	500	0.150
	600	0.187
Cobalt	−150	0.0672
	−100	0.0809
	−50	0.0914
	0	0.1028
	20	0.1001
	100	0.1067
	200	0.1134
	300	0.121
	*508	0.145 0.125
	800	0.160
	1000	0.184
	*1112	0.270 0.170
Copper	−253	0.0031
	−189	0.0506
	−150	0.0674
	−100	0.0783
	−50	0.0862
	0	0.0910

* Temperatures of transformation.

SPECIFIC HEAT OF ELEMENTS (Continued)

Element	Temp. °C	Sp. ht., cal./g	Element	Temp. °C	Sp. ht., cal./g
Copper (continued)	20	0.0921	Lead (continued)	300	0.0356
	15–100	0.09305	liquid	360	0.0375
	100	0.0939		500	0.0370
	200	0.0963	Lithium	−183	0.3
	900	0.1259		−100	0.600
	18–100	0.0928		0	0.079
liquid	1084	0.101		50	0.96
Gallium	−258.1	0.0049		100	1.0407
	−213.1	0.044		190	1.374
	−73.1	0.084	Magnesium	−150	0.1767
	12–23	0.079		−100	0.2025
liquid	13–110	0.080		−50	0.2228
	119	0.079		0	0.2316
Germanium	0–100	0.074		20	0.246
Gold	−258.1	0.0018		100	0.257
	−209.5	0.0211		300	0.279
	−150	0.0266		600	0.311
	−100	0.0281	liquid	650–775	0.284
	−50	0.0293	Manganese	−188 to −79	0.0820
	0	0.0302		−100	0.0979
	18	0.0312		0	0.1072
	0–100	0.0316		20–100	0.1211
	100	0.0314		60	0.1211
liquid	1100	0.0327		325	0.1783
Hydrogen, solid	−260.6	0.57	Mercury, solid	−263.3	0.00552
liquid	−252	0.231		−259.8	0.00783
Indium	−186 to −79	0.0263		−245.6	0.0172
	−79 to +18	0.0303		−220.2	0.0255
	0–100	0.057		−163.7	0.0298
Iodine	−263.2	0.0037		−81.4	0.0324
	−255.9	0.0118		−43.1	0.0337
	−221.1	0.0353	liquid	−33.1	0.0338
	−90 to +17	0.0485		0	0.03346
	20	0.0523		20	0.03325
liquid	107–180	0.108		40	0.03308
Iridium	−186 to +18	0.0282		60	0.03294
	18–100	0.0323		100	0.03269
	0–900	0.0371		200	0.0323
Iron, cast	20–100	0.1189		250	0.0321
wrought	15–100	0.1152	Molybdenum	−257	0.0004
hard drawn	20–100	0.1146		−239.1	0.0034
pure	−256.2	0.00067		−181.5	0.0300
	−214.0	0.0194		−152.7	0.0399
	−172.6	0.0512		−34.5	0.0561
	−67.5	0.0939		0	0.0589
	0	0.1043		20–100	0.065
	20	0.107		250	0.0632
α, β, γ	100	0.115		475	0.0750
	500	0.163	Neodymium	0–100	0.045
	760	0.320	Nickel	−258	0.0008
	1000	0.162		−247.9	0.0024
γ	100	0.127		−201.2	0.0363
	700	0.157		−150	0.0660
	1000	0.162		−100	0.0817
Lanthanum	0–100	0.0448		−50	0.0940
Lead	−270	0.00001		0	0.1032
	−267	0.00086		20	0.105
	−259	0.0073		100	0.1146
	−150	0.0279		500	0.1270
	−100	0.0283		800	0.1413
	−50	0.0289	liquid	1452	0.13
	0	0.0297	Nitrogen, solid	−212	0.39
	20	0.0306	liquid	−200	0.474
	100	0.0320			

SPECIFIC HEAT OF ELEMENTS (Continued)

Element	Temp. °C	Sp. ht., cal./g	Element	Temp. °C	Sp. ht., cal./g
Osmium	19–98	0.0311	Silver (continued)	500	0.0581
Oxygen, solid	−221.8	0.336		800	0.076
liquid	−200	0.394	liquid	900	0.0685
Palladium	−180 to +18	0.0528	Sodium	−256.1	0.026
	0	0.0538		−238.5	0.108
	100	0.0564		−155.5	0.245
	500	0.0653		−40	0.279
	900	0.0717		20	0.295
	1500	0.0766	liquid	100	0.32
Phosphorus, yellow	−136	0.124	Sulfur	−188 to +18	0.137
	−40	0.165	rhombic	15–96	0.176
	9	0.189	monocl	0–52	0.181
red	−136	0.107	liquid	115–160	0.220
	−40	0.182	Tantalum	−201.7	0.0205
	9	0.190		20	0.036
Platinum	−255.6	0.00123		380	0.035
	−237.7	0.0073		900	0.036
	−191.7	0.0211		1100	0.043
	−152.1	0.0261		1400	0.044
	−64.8	0.0307	Tellurium	−188 to +18	0.047
	0	0.03162	cryst	15–100	0.0483
	20	0.0324		15–200	0.0487
	500	0.0349	Thallium	−185 to +20	0.038
	750	0.0365		28	0.0311
	1000	0.0381		20–100	0.0326
	1300	0.0400	Thorium	−253 to −196	0.0197
Potassium	−258.4	0.032		0–100	0.0276
	−255.8	0.045	Tin	−186 to −79	0.0486
	−201.3	0.140		−186.7	0.0422
	−53.1	0.172		−150	0.0450
	14	0.18		−100	0.0483
	22–56	0.192		−50	0.0512
liquid	63	0.18		0	0.0536
	78–100	0.217		18	0.0542
	90	0.200		100	0.0577
	181	0.196	liquid	1100	0.0758
Praseodymium	0–100	0.046	gray	20	0.515
Rhenium	0–20	0.035	Titanium	−185 to +20	0.082
Rhodium	10–97	0.058		0–100	0.1125
Rubidium, solid	0	0.0802	Tungsten	−247.1	0.0012
liquid	50	0.0908		−218.4	0.0098
Ruthenium	0–100	0.0611		−173.1	0.0205
Selenium	−188 to +18	0.068		−73.1	0.0288
	3	0.072		20–100	0.034
	20.5	0.077		100	0.0320
	29.5	0.085		500	0.0344
	32	0.127		1000	0.0367
	38	0.131		1500	0.0390
Silicon	−212	0.029	Uranium	0–98	0.0280
	−143.3	0.087	Vanadium	0–100	0.1153
	−86.2	0.126	Zinc	−252.4	0.0071
	13.9	0.168		−201.3	0.0573
	18.2–99.1	0.181		−150	0.0740
	18.0–900.6	0.210		−100	0.0814
Silver	−238	0.0146		−50	0.0871
	−150	0.0461		0	0.0913
	−100	0.0505		0–100	0.095
	−50	0.0537		20	0.0925
	0	0.0557		100	0.0957
	20	0.0558		300	0.1043
	100	0.0564		400	0.1089
			Zirconium	0–100	0.068

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS

Specific heat is given in calories (15°) per gram per degree Centigrade. To change to joules per gram per degree Centigrade multiply by 4.185.

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Aluminum chloride	$AlCl_3$ (α)	93	.468
chloride	$AlCl_3$ (β)	0	.196
chloride	$AlCl_36H_2O$	35	.313
fluoride	AlF_3	35	.229
fluoride	$2AlF_3 \cdot 7H_2O$	35	.342
hydroxide	$Al(OH)_3$	0	.177
		50	.202
oxide	Al_2O_3	0	.174
		50	.198
sulfate	$Al_2(SO_4)_3$	50	.184
sulfate	$Al_2(SO_4)_3 \cdot 18H_2O$	34	.354
Ammonia	NH_3	−103 to −188	.502
Ammonium bromide	NH_4Br	20	.210
chloride	NH_4Cl	−200	.121
		−100	.263
		0	.357
		50	.389
iodide	NH_4I	0	.111
		50	.118
nitrate	NH_4NO_3	−100	.306
		0	.397
		100	.428
sulfate	$(NH_4)_2SO_4$	−100	.283
		0	.337
		50	.345
Antimony trioxide	Sb_2S_3	0	.0829
Arsenous oxide	As_2O_3	0	.117
Barium carbonate	$BaCO_3$	0	.0999
		100	.110
chlorate	$Ba(ClO_3)_2 \cdot H_2O$	32	.158
chloride	$BaCl_2 \cdot 2H_2O$	0	.140
nitrate	$Ba(NO_3)_2$	47	.148
sulfate	$BaSO_4$	0	.111
thiosulfate	BaS_2O_3	58	.162
Beryllium oxide	BeO	50	.260
sulfate	$BeSO_4$	50	.198
Bismuth sulfide	Bi_2S_3	50	.0600
trioxide	Bi_2O_3	50	.0569
Cadmium nitrate	$Cd(NO_3)_2 \cdot 4H_2O$	40	.260
sulfate	$3CdSO_4 \cdot 8H_2O$	0	.195
		20	.200
sulfide	CdS	0	.0882
		50	.0922
Calcium carbonate	$CaCO_3$	0	.203
		100	.214
chloride	$CaCl_2$	61	.164
chloride	$CaCl_2 \cdot 6H_2O$	0	.320
fluoride	CaF_2	0	.204
		40	.212
formate	$Ca(HCO_2)_2$	0	.238
hydroxide	$Ca(OH)_2$	0	.260
		50	.288
molybdate	$CaMoO_4$	15	.165
oxide	CaO	0	.177
		100	.197

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS (Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Calcium			
sulfate	$CaSO_4 \cdot 2H_2O$	36	.265
tungstate	$CaWO_4$	15	.104
Carbon dioxide, solid	CO_2	−225	.124
monoxide, solid	CO	−220	.417
		−206	.457
Ceric oxide	CeO_2	0	.0870
		50	.0946
sulfate	$Ce(SO_4)_2$	50	.117
sulfate	$CeSO_4 \cdot 5H_2O$	50	.201
Chromic oxide	Cr_2O_3	0	.168
		50	.189
sulfate	$Cr_2(SO_4)_3$	50	.172
sulfate	$Cr_2(SO_4)_3 \cdot 5H_2O$	50	.200
Cobaltous nitrate	$Co(NO_3)_2 \cdot 6H_2O$	32	.373
sulfate	$CoSO_4 \cdot 7H_2O$	48	.342
Columbium pentoxide	Cb_2O_5	50	.101
Copper ammonium sulfate	$CuSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	0	.256
Copper sulfate	$CuSO_4 \cdot H_2O$	0	.172
		50	.191
sulfate	$CuSO_4 \cdot 3H_2O$	9	.228
sulfate	$CuSO_4 \cdot 5H_2O$	0	.253
		50	.287
Cupric carbonate	$2CuO \cdot CO_2 \cdot H_2O$	57	.177
chloride	$CuCl_2$	58	.139
oxide	CuO	0	.125
		100	.144
sulfide	CuS	0	.129
		100	.151
Cuprous iodide	CuI	0	.0658
		50	.0671
oxide	Cu_2O	0	.110
		100	.116
selenide	Cu_2Se	60	.104
sulfide	Cu_2S	0	.148
		50	.166
Erbium oxide	Er_2O_3	50	.0650
Ferric oxide	Fe_2O_3	0	.148
		100	.182
Ferrosoferric oxide (magnetite)	Fe_3O_4	0	.151
		100	.179
Ferrous carbonate	$FeCO_3$	54	.194
sulfate	$FeSO_4$	45	.167
sulfate	$FeSO_4 \cdot 4H_2O$	9	.284
sulfate	$FeSO_4 \cdot 7H_2O$	0	.325
		10	.337
sulfide	FeS	0	.135
Gallium sesqui-oxide	Ga_2O_3	50	.105
Gold iodide	AuI	0	.0404
		50	.0432
Hydrogen peroxide	H_2O_2	−25	.471
Indium sesquioxide	In_2O_3	50	.0808
Iron diarsenide	$FeAs_2$	50	.0860
disulfide	FeS_2	0	.118
		50	.128
Lanthanum sesquioxide	La_2O_3	50	.0750

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Lead ammonium chloride	$2PbCl_2 \cdot NH_4Cl$	10	.0865
Lead borate	PbB_2O_4	57	.0903
Lead bromide	$PbBr_2$	0	.0502
		50	.0530
carbonate	$PbCO_3$	32	.0800
chloride	$PbCl_2$	0	.0649
		100	.0681
chromate	$PbCrO_4$	35	.0908
dioxide	PbO_2	0	.0619
		50	.0650
iodide	PbI_2	0	.0417
		100	.0437
molybdate	$PbMoO_4$	15	.100
monoxide	PbO	0	.0483
		50	.0509
nitrate	$Pb(NO_3)_2$	45	.115
pyrophosphate	$Pb_2P_2O_7$	55	.0820
silicate	$PbSiO_3$	60	.0779
sulfate	$PbSO_4$	45	.0839
sulfide	PbS	0	.0502
		100	.0511
thiosulfate	PbS_2O_3	58	.0918
tungstate	$PbWO_4$	15	.0769
Lithium chloride	$LiCl$	55	.282
fluoride	LiF	10	.373
hydride	LiH	0	.980
		50	1.07
hydroxide	$LiOH$	0	.327
		50	.356
nitrate	$LiNO_3$	210	.387
thiosulfate	$Li_2S_2O_3$	58	.0920
Magnesium carbonate	$MgCO_3$	25	.200
chloride	$MgCl_2 \cdot 6H_2O$	44	.378
chloride	$MgCl_2$	48	.194
nitrate	$Mg(NO_3)_2 \cdot 6H_2O$	55	.887
oxide	MgO	0	.209
		50	.232
sulfate	$MgSO_4 \cdot 7H_2O$	12	.361
sulfate	$MgSO_4 \cdot 6H_2O$	9	.349
sulfate	$MgSO_4H_2O$	9	.239
sulfate	$MgSO_4$	61	.222
Manganese dioxide	MnO_2	0	.152
		50	.163
nitrate	$Mn(NO_3)_2 \cdot 6H_2O$	47	.373
Manganic oxide	Mn_2O_3	58	.162
oxide	$Mn_2O_3 \cdot 3H_2O$	38	.177
Manganous oxide	MnO	58	.158
sulfate	$MnSO_4 \cdot 5H_2O$	32	.323
sulfate	$MnSO_4$	61	.182
Mercuric chloride	$HgCl_2$	0	.0640
		100	.0669
cyanide	$Hg(CN)_2$	29	.100
iodide	HgI_2 (red)	0	.0404
		50	.0413
oxide	HgO	0	.0485
		50	.0521
sulfide	HgS	0	.0506
		50	.0520

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS (Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Mercurous chloride	$HgCl$	0	.0499
		50	.0512
sulfate	Hg_2SO_4	0	.0616
		50	.0680
Molybdenum trioxide	MoO_3	54	.134
Nickel nitrate	$Ni(NO_3)_2 \cdot 6H_2O$	80	.473
sulfate	$NiSO_4 \cdot 6H_2O$	35	.313
sulfate	$NiSO_4$	58	.225
sulfide	NiS	0	.116
		100	.128
Nitrogen pentoxide	N_2O_5	−80 to −5	.239
Potassium acetate	$KC_2H_3O_2$	20	.272
	$KHSO_4$	35	.244
aluminum sulfate, (alum)	$K_2SO_4Al_2(SO_4)_3 \cdot 24H_2O$	0	.324
		50	.360
Potassium arsenate, acid	KH_2AsO_4	31	.174
Potassium bromide	KBr	0	.104
		100	.108
	K_2CO_3	47	.210
chlorate	$KClO_3$	0	.191
		50	.205
chloride	KCl	0	.162
		100	.168
chloroplatinate	K_2PtCl_6	30	.112
chromate	K_2CrO_4	46	.186
dichromate	$K_2Cr_2O_7$	0	.178
ferricyanide	$K_3Fe(CN)_6$	26	.232
ferrocyanide	$K_4Fe(CN)_6$	0	.210
		50	.225
ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$	0	.267
		50	.285
fluoride	KF	0	.199
		50	.204
metaborate	$K_2B_2O_4$	57	.225
nitrate	KNO_3	0	.214
		100	.240
perchlorate	$KClO_4$	30	.189
phosphate, dihydrogen	KH_2PO_4	33	.208
pyrophosphate	$K_4P_2O_7$	58	.191
thiosulfate	$K_2S_2O_3$	60	.196
Silicon carbide	SiC	0	.143
		100	.194
Silver bromide	$AgBr$	0	.0695
		100	.0734
chloride	$AgCl$	0	.0848
		50	.0906
cyanate	$AgCNO$	40	.124
iodide	AgI	0	.0548
		100	.0593
nitrate	$AgNO_3$	50	.146
selenide	Ag_2Se	37 to 187	.0693
sulfide	Ag_2S	0	.0719
		50	.0748
Sodium acetate	$NaC_2H_3O_2$	38	.339
acetate	$NaC_2H_3O_2 \cdot 3H_2O$	0	.344
		40	.602

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS (Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
bromide	NaBr	0	.118
		100	.124
carbonate	Na_2CO_3	45	.256
chloride	NaCl	0	.204
		100	.217
fluoride	NaF	0	.258
		100	.279
formate	$NaHCO_2$	46	.306
iodide	NaI	0	.0829
		50	.0848
metaborate	$Na_2B_2O_4$	57	.253
nitrate	$NaNO_3$	0	.247
		50	.270
phosphate, di-	$Na_2HPO_4 \cdot 12H_2O$	0	.404
		50	.464
phosphate, di-	$Na_2HPO_4 \cdot 7H_2O$	0	.351
		50	.406
pyrophosphate	$Na_4P_2O_7$	50	.227
sulfate	Na_2SO_4	0	.202
		100	.220
tetraborate	$Na_2B_4O_7$	45	.234
tetraborate (borax)	$Na_2B_4O_7 \cdot 10H_2O$	35	.385
thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	21	.346
thiosulfate	$Na_2S_2O_3$	9	.220
Stannic oxide	SnO_2	45	.0898
sulfide	SnS_2	54	.119
Stannous chloride	$SnCl_2$	60	.102
sulfide	SnS	56	.0839
Strontium molybdate	$SrMoO_4$	15	.148
nitrate	$Sr(NO_3)_2$	32	.182
sulfate	$SrSO_4$	48	.143
Sulfuric acid	H_2SO_4	−30	.239
		0	.270
Sulfur dioxide	SO_2	−185 to −103	.229
Thallium monochloride	TlCl	0	.0520
		100	.0542
Thorium chloride	ThCl	30	.406
dioxide	ThO_2	0	.0571
		50	.0589
sulfate	$Th(SO_4)_2$	50	.0980
Tin see under Stannous and Stannic			
Titanium dioxide	TiO_2	0	.168
Tungsten trioxide	WO_3	0	.0743
"		50	.0832
Uranium oxide (ous-ic)	U_3O_8	0	.0671
		50	.0750
Water, solid	H_2O	−250	.0361
		−200	.156
		−150	.246
		−100	.332
		−40	.435
		0	.492
Yttrium oxide	Y_2O_3	57	.112
Zinc chloride	$ZnCl_2$	60	.136

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Zinc nitrate	$Zn(NO_3)_2 \cdot 6H_2O$	30	.318
oxide	ZnO	0	.114
		100	.129
sulfate	$ZnSO_4 \cdot 7H_2O$	0	.322
sulfate	$ZnSO_4 \cdot 6H_2O$	9	.299
sulfate	$ZnSO_4 \cdot H_2O$	9	.194
sulfate	$ZnSO_4$	50	.174
sulfide	ZnS	0	.116
		100	.118
Zirconium dioxide	ZrO_2	0	.103

SPECIFIC HEAT OF LIQUID INORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Specific Heat Cal. (15°)/g
Ammonia	NH_3	−60	1.047
		0	1.098
		20	1.125
		100	1.48
Calcium chloride	$CaCl_2 \cdot 6H_2O$	33–99	.552
Hydrogen peroxide	H_2O_2	0	.578
Lead bromide	$PbBr_2$	550	.0779
chloride	$PbCl_2$	540	.121
Lithium nitrate	$LiNO_3$	280	.390
Potassium dichromate	$K_2Cr_2O_7$	397	.0335
nitrate	KNO_3	380	.0332
Silver bromide	$AgBr$	500	.0760
chloride	$AgCl$	490	.129
nitrate	$AgNO_3$	250	.187
Sodium acetate	$NaC_2H_3O_2$	61.8	.846
chlorate	$NaClO_3$	280	.325
nitrate	$NaNO_3$	350	.430
thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	13–98	.570
Stannic chloride	$SnCl_4$	14–98	.148
Sulfur dioxide	SO_2	−20	.313
		0	.318
		20	.327
		100	.418
Sulfuric acid	H_2SO_4	10	.339
acid pyro-	$H_2S_2O_7$	35	.334
Water	H_2O See special table		

SPECIFIC HEAT OF SOLID ORGANIC COMPOUNDS

Specific heat is given in calories (15°) per gram per degree Centigrade. To change to joules per gram per degree Centigrade multiply by 4.185.

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Acetic acid	CH_3CO_2H	0	.487
Acetone	$(CH_3)_2CO$	−210	.540
o-Aminobenzoic acid	$H_2NC_6H_4CO_2H$	85	.254
m-Aminobenzoic acid		120	.253
p-Aminobenzoic acid		128	.287
Aniline	$C_6H_5NH_2$	?	.741
Anthracene	$C_{14}H_{10}$	50	.308
		100	.350
Anthraquinone	$(C_6H_4)_2(CO)_2$	0	.258
Azobenzene	$(C_6H_5N)_2$	28	.330
Benzene	C_6H_6	−250	.0399
		−200	.124
		−100	.227
		−50	.299
Benzoic acid	$C_6H_5CO_2H$	20	.287
Benzophenone	$(C_6H_5)_2CO$	−150	.115
		−50	.220
		0	.275
		20	.303
Betol	$HOC_6H_4CO_2C_{10}H_7$	−150	.129
		−100	.167
o-Bromochlorobenzene	C_6H_4BrCl	−34	.192
m-Bromochlorobenzene		−52	.150
p-Bromochlorobenzene		−40	.150
		0	.170
o-Bromoiodobenzene	C_6H_4BrI	−50	.143
m-Bromoiodobenzene		−75 to −15	.143
p-Bromoiodobenzene		−40	.116
β-Bromonaphthalene	$C_{10}H_7Br$	41	.260
Bromophenol	HOC_6H_4Br	32	.263
Camphene	$C_{10}H_{16}$	35	.380
Capric acid	$CH_3(CH_2)_8CO_2H$	8	.695
Caprylic acid	$CH_3(CH_2)_6CO_2H$	−2	.628
Carbon tetrachloride	CCl_4	−200	.0812
		−80	.182
		−40	.201
Catechol	$C_6H_4(OH)_2$	163	.278
Chloral alcoholate	$CCl_3CHO\cdot C_2H_5OH$	78	.509
hydrate	$CCl_3CHO\cdot H_2O$	32	.213
Chloroacetic acid	CH_2ClCO_2H	60	.363
p-Chlorobenzoic acid	$ClC_6H_4CO_2H$	80	.228
m-Chlorobenzoic acid		94	.232
p-Chlorobenzoic acid		180	.242
Crotonic acid	$CH_3CHCHCO_2H$	38	.520
Cyamelide	$C_3H_3O_3N_3$	40	.263
Cyanuric acid	$(HNCO)_3$	40	.318
Dextrose	$C_6H_{12}O_6$	−250	.0155
		0	.277
		20	.275
Dextrin	$(C_6H_{10}O_5)x$	0 to 90	.292
o-Dibromobenzene	$C_6H_4Br_2$	−36	.249
m-Dibromobenzene		−25	.134
p-Dibromobenzene		−50	.139
Dichloroacetic acid	$CHCl_2CO_2H$	solid	.406
o-Dichlorobenzene	$C_6H_4Cl_2$	−48.5	.185

SPECIFIC HEAT OF SOLID ORGANIC COMPOUNDS (Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
m-Dichlorobenzene	....	−52	.186
p-Dichlorobenzene	....	−50	.219
Dicyandiamide	$C_2H_4N_4$	0 to 204	.456
Dulcitol	$C_6H_8(OH)_6$	20	.282
m-Diiodobenzene	$C_6H_4I_2$	−52	.100
p-Diiodobenzene	....	−50	.101
Dibenzyl	$(C_6H_5CH_2)_2$	28	.363
Dimethyl oxalate	$(CO_2CH_3)_2$	10	.212
Dimethylpyrone	$(CH_3)_2C_5H_2O_2$	50	.368
o-Dinitrobenzene	$C_6H_4(NO_2)_2$	−160	.252
m-Dinitrobenzene	....	−160	.248
p-Dinitrobenzene	....	119	.259
Diphenyl	$(C_6H_5)_2$	40	.385
Diphenylamine	$(C_6H_5)_2NH$	26	.337
Ethyl alcohol	C_2H_5OH	−190	.232
(crystalline)			
(vitreous)	....	−190	.260
Erythritol	$(CHOHCH_2OH)_2$	60	.351
Formic acid	HCO_2H	−22	.387
		0	.430
Glutaric acid	$(CH_2)_3(CO_2H)_2$	20	.299
Glyceral	$C_3H_5(OH)_3$	−250	.0471
		−200	.115
		−100	.217
		0	.330
Glycol	$(CH_2OH)_2$	40	.528
Hexadecane	$C_{16}H_{34}$	19	.495
Iodobenzene	C_6H_5I	40	.191
Lactose	$C_{12}H_{22}O_{11}$	20	.287
	$C_{12}H_{22}O_{11}\cdot H_2O$	20	.299
Lauric acid	$C_{11}H_{23}CO_2H$	−30	.430
Levulose	$C_6H_{12}O_6$	20	.275
Malonic acid	$CH_2(CO_2H)_2$	20	.275
Maltose	$C_{12}H_{22}O_{11}$	20	.320
Mannitol	$C_6H_8(OH)_6$	0	.313
Melamine	$C_3H_6N_6$	40	.351
Myristic acid	$C_{13}H_{27}CO_2H$	0	.381
Naphthalene	$C_{10}H_8$	−130	.281
α-Naphthol	$C_{10}H_7OH$	50	.240
β-Naphthol	....	61	.252
α-Naphthylamine	$C_{10}H_7NH_2$	0	.270
m-Nitroaniline	$H_2NC_6H_4NO_2$	−160	.275
o-Nitroaniline	....	−160	.269
p-Nitroaniline	....	−160	.276
Nitrobenzene	$C_6H_5NO_2$	20	.349
		100	.356
o-Nitrobenzoic acid	$NO_2C_6H_4CO_2H$	−163	.256
m-Nitrobenzoic acid	....	−160	.247
Nitronaphthalene	$C_{10}H_7NO_2$	0	.236
Oxalic acid	$(CO_2H)_2\cdot 2H_2O$	0	.338
		50	.385
Palmitic acid	$C_{15}H_{31}CO_2H$	−180	.167
		−100	.251
		−50	.306
		0	.382
		20	.430

SPECIFIC HEAT OF SOLID ORGANIC COMPOUNDS (Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Picric acid	$HOC_6H_2(NO_2)_3$	−100	.165
		0	.240
		50	.263
Phthalic acid	$C_6H_4(CO_2H)_2$	20	.232
Propionic acid	$C_2H_5CO_2H$	−33	.726
n-Propyl alcohol	C_3H_7OH	−200	.170
		−130	.497
iso-Propyl alcohol	C_3H_7OH	−200	.0507
Pyrotartaric acid	$C_5H_8O_4$	20	.301
Quinhydrone	$C_{12}H_{10}O_4$	−250	.0165
		−200	.0980
		0	.256
Quinol	$C_6H_4(OH)_2$	−250	.0246
		−150	.268
Quinone	$C_6H_4O_2$	−250	.0311
		−200	.113
		−150	.282
Resorcinol	$C_6H_4(OH)_2$	−160	.269
Salol	$HOC_6H_4CO_2C_6H_5$	32	.289
Stearic acid	$C_{17}H_{35}CO_2H$	15	.399
Succinic acid	$(CH_2CO_2H)_2$	0	.248
Sucrose	$C_{12}H_{22}O_{11}$	20	.299
Tartaric acid	$H_2C_4H_4O$	36	.287
		0	.308
		50	.366
Thymol	$C_{10}H_{14}O$	0	.315
Trichloroacetic acid	CCl_3CO_2H	solid	.459
Trimethyl carbinol	$(CH_3)_3COH$	−4	.559
Trinitrotoluene	$CH_3C_6H_2(NO_2)_3$	−100	.170
		0	.311
		100	.385
Trinitroxylene	$(CH_3)_2C_6H(NO_2)_3$	20 to 50	.423
Triphenylmethane	$(C_6H_5)_3CH$	0	.189
o-Toluic acid	$CH_3C_6H_4CO_2H$	54	.277
m-Toluic acid	....	54	.239
p-Toluic acid	....	130	.271
p-Toluidine	$CH_3C_6H_4NH_2$	0	.337
		20	.387
Urea	$(NH_2)_2CO$	20	.320

SPECIFIC HEAT OF LIQUID ORGANIC COMPOUNDS

Specific heat is given in calories (15°) per gram per degree Centigrade. To change to joules per gram per degree Centigrade multiply by 4.185.

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Acetic acid	CH_3COOH	0	.468
Acetone	$(CH_3)_2CO$	0	.506
		20	.528
Acetonitrile	CH_3CN	21–76	.541
Acetophenone	$C_6H_5COCH_3$	20–193	.474
Acetyl chloride	CH_3COCl	0	.339
Allyl acetate	$CH_3CO_2C_3H_5$	0	.431
alcohol	C_3H_5OH	21–96	.665
benzoate	$C_6H_5CO_2C_3H_5$	20	.388
butyrate	$C_3H_7CO_2C_3H_5$	20	.451
chloride	CH_2CHCH_2Cl	0	.313
isobutyrate	$C_3H_7CO_2C_3H_5$	20	.448
propionate	$C_2H_5CO_2C_3H_5$	20	.451
valerate	$C_4H_9CO_2C_3H_5$	20	.451
o-Aminobenzoic acid	$H_2NC_6H_4CO_2H$	145	.435
m-Aminobenzoic acid		174	.435
p-Aminobenzoic acid		186	.444
iso-Amyl acetate	$CH_3CO_2C_5H_{11}$	20	.459
alcohol	$C_5H_{11}OH$	0	.502
		20	.535
		75.5	.688
d-prim.-Amyl alcohol	$C_5H_{11}OH$	22–125	.712
tert.-Amyl alcohol		20–99	.753
iso-Amyl butyrate	$C_3H_7CO_2C_5H_{11}$	20	.459
formate	$HCO_2C_5H_{11}$	20	.459
isobutyrate	$C_3H_7CO_2C_5H_{11}$	20	.459
propionate	$C_2H_5CO_2C_5H_{11}$	20	.459
succinate	$(CH_2CO_2C_5H_{11})_2$	0	.449
valerate	$C_4H_9CO_2C_5H_{11}$	20	.459
iso-Amylamine	$C_5H_{11}NH_2$	22–91	.614
Amylene	C_5H_{10}	0	.282
Anethol	$C_9H_9OCH_3$	22.48	.551
Aniline	$C_6H_5{\cdot}NH_2$	0	.478
		50	.521
		100	.547
Anisol	$C_6H_5OCH_3$	20–152	.483
Benzaldehyde	C_6H_5CHO	22–172	.428
Benzene	C_6H_6	5	.389
		20	.406
		60	.444
		90	.473
Benzoic acid	$C_6H_5CO_2H$	0	.424
Benzonitrile	C_6H_5CN	22–186	.441
β-Benzophenone	$(C_6H_5)_2CO$	3–40	.383
Benzyl alcohol	$C_6H_5CH_2OH$	20–100	.511
chloride	$C_6H_5CH_2Cl$	0	.323
Betol	$HOC_6H_4CO_2C_{10}H_7$	19–63	.356
Bromobenzene	C_6H_5Br	20	.231
o-Bromochlorobenzene	C_6H_4BrCl	0	.215
m-Bromochlorobenzene		0	.212
o-Bromoiodobenzene	C_6H_4BrI	5–100	.160
m-Bromoidobenzene		5–100	.158
Bromophenol	HOC_6H_4Br	18–77	.316
n-Butane	C_4H_{10}	0	.550
iso-Butane		0	.550
iso-Butyl acetate	$CH_3CO_2C_4H_9$	20	.459

SPECIFIC HEAT OF LIQUID ORGANIC COMPOUNDS (Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
n-Butyl alcohol	C_4H_9OH	2.3	.526
		19.2	.563
iso-Butyl alcohol	....	21–109	.716
Butyl butyrate	$C_3H_7CO_2C_4H_9$	20	.459
iso-Butyl butyrate	....	20	.459
n-Butyl chloride	C_4H_9Cl	20	.451
formate	$HCO_2C_4H_9$	20	.459
Butyl propionate	$C_2H_5CO_2C_4H_9$	20	.459
iso-Butyl succinate	$(CH_2CO_2C_4H_9)_2$	0	.442
Butyl valerate	$C_4H_9CO_2C_4H_9$	20	.459
n-Butyric acid	$C_3H_7CO_2H$	20–100	.515
iso-Butyric acid	$C_4H_8O_2$	20	.450
n-Butyronitrile	C_3H_7CN	21–113	.547
Caproic acid	$C_5H_{11}CO_2H$	29–105	.533
Capronitrile	$C_5H_{11}CN$	18–156	.542
Carbon tetrachloride	CCl_4	0	.198
		20	.201
Carvacrol	$C_9H_{13}OH$	24–233	.577
Catechol	$C_6H_4(OH)_2$	0	.462
Chloral	CCl_3CHO	17–53	.250
hydrate	$CCl_3CHO \cdot H_2O$	55–88	.470
Chlorobenzene	C_6H_5Cl	20	.309
o-Chlorobenzoic acid	$ClC_6H_4CO_2H$	0	.392
m-Chlorobenzoic acid	....	0	.266
p-Chlorobenzoic acid	....	226	.547
Chloroform	$CHCl_3$	0	.232
		15	.226
		20	.234
o-Chlorophenol	HOC_6H_4Cl	0–20	.401
Chlorotoluene	$CH_3C_6H_4Cl$	0	.316
o-Cresol	$CH_3C_6H_4OH$	0–20	.499
m-Cresol	....	0–20	.479
p-Cresyl methyl ether	$CH_3C_6H_4OCH_3$	0	.405
Crotonic acid	$C_3H_5CO_2H$	71.4	.500
Cyclohexanol	$C_6H_{11}OH$	15–18	.417
Cyclohexanone	$C_6H_{10}O$	15–18	.433
o-Cymene	$C_3H_7C_6H_4CH_3$	0	.400
Decylene-2	$C_{10}H_{20}$	0–50	.469
Diallyl oxalate	$(CO_2C_3H_5)_2$	20	.426
succinate	$(CH_2CO_2C_3H_5)_2$	20	.452
Diamylene	$C_{10}H_{20}$	20–130	.545
o-Dibromobenzene	$C_6H_4Br_2$	0	.180
m-Dibromobenzene	....	0	.175
Dibutyl oxalate	$(CO_2C_4H_9)_2$	20	.441
Dichloroacetic acid	Cl_2CHCO_2H	21–106	.350
o-Dichlorobenzene	$C_6H_4Cl_2$	0	.270
m-Dichlorobenzene	....	0	.270
p-Dichlorobenzene	....	53–99	.298
Diethylamine	$(C_2H_5)_2NH$	22.5	.518
Diethylaniline	$C_6H_5N(C_2H_5)_2$	20	.452
Diethyl carbonate	$CO(OC_2H_5)_2$	20–100	.464
ketone	$(C_2H_5)_2CO$	20–98.5	.557
malate	$HOC_2H_3(CO_2C_2H_5)_2$	24–186	.475
malonate	$CH_2(CO_2C_2H_5)_2$	20	.433
oxalate	$(CO_2C_2H_5)_2$	20	.433
succinate	$(CH_2CO_2C_2H_5)_2$	20	.452
o-Diiodobenzene	$C_6H_4I_2$	0	.136

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
m-Diiodobenzene	....	34.2–99.6	.140
Diisoamyl	$C_{10}H_{22}$	21.5–155	.590
oxalate	$(CO_2C_5H_{11})_2$	20	.449
Diisobutylamine	$(C_4H_9)_2NH$	22–130	.571
Dimethylaniline	$C_6H_5N(CH_3)_2$	0–20	.418
Dimethyl carbonate	$CO(OCH_3)_2$	19.8–88	.452
o-Dinitrobenzene	$C_6H_4(NO_2)_2$	0	.349
m-Dinitrobenzene	....	90	.405
p-Dinitrobenzene	....	0	.279
Diphenylamine	$(C_6H_5)_2NH$	53	.464
Diphenyl oxide	$(C_6H_5)_2O$	30	.399
Dipropylamine	$(C_3H_7)_2NH$	22–100	.597
Dipropyl ketone	$(C_3H_7)_2CO$	20–140	.552
malonate	$CH_2(CO_2C_3H_7)_2$	20	.433
succinate	$(CH_2CO_2C_3H_7)_2$	20	.452
Di-n-propyl oxalate	$(CO_2C_3H_7)_2$	20	.433
Dodecane	$C_{12}H_{26}$	0–50	.500
Dodecylene	$C_{12}H_{24}$	0–50	.457
Ether	$(C_2H_5)_2O$	−50	.517
		0	.529
		30	.547
		120	.803
		180	1.041
Ethyl acetate	$CH_3CO_2C_2H_5$	20	.459
acetoacetate	$CH_3COCH_2CO_2C_2H_5$	20–100	.477
alcohol	$C_2H_5.OH$	−100	.456
		0	.535
		25	.581
		100	.824
benzene	$C_6H_5C_2H_5$	30	.409
benzoate	$C_6H_5CO_2C_2H_5$	20	.389
bromide	C_2H_5Br	5–10	.216
		15–20	.215
butyrate	$C_3H_7CO_2C_2H_5$	20	.459
chloride	C_2H_5Cl	0	.368
chloroacetate	$ClCH_2CO_2C_2H_5$	9–138	.418
dichloroacetate	$Cl_2CHCO_2C_2H_5$	20	.329
formate	$HCO_2C_2H_5$	14–49	.510
iodide	C_2H_5I	0	.162
isobutyrate	$C_3H_7CO_2C_2H_5$	20	.459
propionate	$C_2H_5CO_2C_2H_5$	20	.459
sulfide	$(C_2H_5)_2S$	0	.470
		15–20	.477
trichloroacetate	$CCl_3CO_2C_2H_5$	10–81	.295
valerate	$C_4H_9CO_2C_2H_5$	20	.459
Ethylene bromide	$(CH_2Br)_2$	20	.174
chloride	$(CH_2Cl)_2$	20	.301
		60	.319
Formamide	$HCONH_2$	19	.551
Formic acid	HCO_2H	0	.437
		15.5	.511
		20–100	.526
Furfural	$(C_4H_3O)CHO$	20–100	.418
Glycerol, (glycerine)	$HOCH_2{\cdot}CHOH{\cdot}CH_2OH$	0	.540
		50	.600
		100	.669
Glycol	$(CH_2OH)_2$	0	.544
		14.9	.571

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Heptaldehyde	$C_6H_{13}CHO$	0	.365
n-Heptane (B. P. 98°)	C_7H_{16}	20	.490
iso-Heptane		0–50	.501
Heptylene (B. P., 98°)	C_7H_{14}	0–50	.488
Heptylic acid	$C_6H_{13}CO_2H$	9	.558
n-Hexadecane (B.P., 275°)	$C_{16}H_{34}$	0–50	.496
1, 5-Hexadiene	C_6H_{10}	0	.407
o-Hexahydrocresol	$CH_3C_6H_{10}OH$	15–18	.418
m-Hexahydrocresol		15–18	.422
p-Hexahydrocresol		15–18	.423
n-Hexane	C_6H_{14}	20–100	.600
Hexylene	C_6H_{12}	0–50	.506
Lauric acid	$C_{11}H_{23}CO_2H$	57	.515
Mesitylene	$C_6H_3(CH_3)_3$	0	.393
Mesityl oxide	$C_6H_{10}O$	21–121	.521
Methyl acetate	$CH_3CO_2CH_3$	15	.468
alcohol	CH_3OH	0	.566
		20	.600
Methyl aniline	$C_6H_5NHCH_3$	20–197	.513
benzoate	$C_6H_5CO_2CH_3$	0	.363
butyl ketone	$CH_3COC_4H_9$	21–127	.553
n-butyrate	$C_3H_7CO_2CH_3$	20	.459
chloroacetate	$ClCH_2CO_2CH_3$	20	.382
dichloroacetate	$Cl_2CHCO_2CH_3$	20	.311
ethyl ketone	$CH_3COC_2H_5$	20–78	.549
ethyl ketoxime	$(CH_3)(C_2H_5)CNOH$	22–152	.650
formate	HCO_2CH_3	13–29	.516
hexyl ketone	$CH_3COC_6H_{13}$	22–168	.552
isobutyl ketone	$CH_3COC_4H_9$	20	.459
isopropyl ketone	$CH_3COC_3H_7$	20–91	.525
propionate	$C_3H_7CO_2CH_3$	20	.459
trichloroacetate	$Cl_3CCO_2CH_3$	20	.267
valerate	$C_4H_9CO_2CH_3$	20	.459
o-Methylcyclohexanone	$C_7H_{12}O$	15–18	.436
m-Methycyclohexanone		15–18	.441
p-Methylcyclohexanone		15–18	.441
Methylene chloride	CH_2Cl_2	15–40	.288
Myristic acid	$C_{13}H_{27}CO_2H$	56–100	.539
Naphthalene	$C_{10}H_8$	0	.313
α-Naphthol	$C_{10}H_7OH$	0	.389
β-Naphthol		0	.403
α-Naphthylamine	$C_{10}H_7NH_2$	53.2	.475
o-Nitraniline	$H_2NC_6H_4NO_2$	0	.400
m-Nitraniline		0	.392
p-Nitraniline		0	.427
Nitrobenzene	$C_6H_5NO_2$	30	.339
		120	.394
o-Nitrobenzoic acid	$O_2NC_6H_4CO_2H$	0	.314
m-Nitrobenzoic acid		0	.405
p-Nitrobenzoic acid		238	.449
Nitromethane	CH_3NO_2	17	.412
α-Nitronaphthalene	$C_{10}H_7NO_2$	58.6	.365
Nonane	C_9H_{20}	0–50	.503
Nonylene	C_9H_{18}	0–50	.485
n-Octane	C_8H_{18}	20–123	.578
Octylene	C_8H_{16}	0–50	.486
Olive oil		6.6	.471
Palmitic acid	$C_{15}H_{31}CO_2H$	65–104	.653

SPECIFIC HEAT OF LIQUID ORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Paraldehyde	$(CH_3CHO)_3$	0	.436
Pentadecane	$C_{15}H_{32}$	0–50	.497
Pentadecylene	$C_{15}H_{30}$	0–50	.471
iso-Pentane	C_5H_{12}	8	.527
Petroleum		21–58	.511
Phenetole	$C_6H_5OC_2H_5$	20	.446
Phenol	C_6H_5OH	14–26	.561
Piperidine	$C_5H_{11}N$	20–98	.523
Propane	C_3H_8	0	.576
Propionaldehyde	C_2H_5CHO	0	.522
Propionic acid	$C_2H_5CO_2H$	20–137	.560
Propionitrile	C_2H_5CN	19–95	.538
n-Propyl acetate	$CH_3CO_2C_3H_7$	20	.459
Propyl alcohol	$C_3H_7 \cdot OH$	−100	.435
		0	.526
		25	.586
benzene	$C_6H_5C_3H_7$	0	.400
Propyl benzoate	$C_6H_5CO_2C_3H_7$	20	.398
butyrate	$C_3H_7CO_2C_3H_7$	20	.459
chloroacetate	$CH_2ClCO_2C_3H_7$	20	.414
n-Propyl formate	$HCO_2C_3H_7$	20	.459
Propyl isobutyrate	$C_3H_7CO_2C_3H_7$	20	.459
phenyl ether	$C_6H_5OC_3H_7$	10	.429
propionate	$C_2H_5CO_2C_3H_7$	20	.459
valerate	$C_4H_9CO_2C_3H_7$	20	.459
Pseudocumene	$C_6H_3(CH_3)_3$	20	.414
Pyridine	C_5H_5N	21–108	.431
Quinol	$C_6H_4(OH)_2$	0	.492
Quinoline	C_9H_7N	0–20	.352
Quinone	$C_6H_4O_2$	0	.324
Resorcinol	$C_6H_4(OH)_2$	0	.452
Salicylaldehyde	HOC_6H_4CHO	18	.382
Salol	$HOC_6H_4CO_2C_6H_5$	44.1	.391
Stearic acid	$C_{17}H_{35}CO_2H$	74–137	.550
Tetrachloroethylene	C_2Cl_4	20	.211
Tetradecane	$C_{14}H_{30}$	0–50	.497
Tetradecylene	$C_{14}H_{28}$	0–50	.453
m-Thymol	$C_9H_{13}OH$	50	.567
Toluene	$C_6H_5CH_3$	0	.386
		50	.421
		100	.470
o-Toluic acid	$CH_3C_6H_4CO_2H$	0	.422
m-Toluic acid		0	.503
p-Toluic acid		0	.316
o-Toluidine	$CH_3C_6H_4NH_2$	22–195	.524
p-Toluidine		43	.598
Trichloroethylene	C_2HCl_3	20	.223
Tridecane	$C_{13}H_{28}$	0–50	.499
Tridecylene	$C_{13}H_{26}$	0–50	.457
Trinitrotoluene (2, 4, 6)	$CH_3C_6H_2(NO_2)_3$	?	.335
Turpentine, oil		0	.411
Undecane	$C_{11}H_{24}$	0–50	.501
Undecylene	$C_{11}H_{22}$	0–50	.482
Valeronitrile	C_4H_9CN	23–121	.520
iso-Valeric acid	$C_4H_9CO_2H$	23–93	.590
o-Xylene	$(CH_3)_2C_6H_4$	30	.411
m-Xylene		16–35	.387
p-Xylene		30	.397

SPECIFIC HEAT OF ALLOYS AND VARIOUS SOLIDS

Values given in calories per gram.

Substance.	Temp. ° C.	Sp. heat.	Observer.
Alloys			
aluminum bronze, 88.7 Cu, 11.3 Al	20–100	0.104	Louguinine
antimony bismuth tin, 21.6Sb, 36.7Bi, 41.7Sn	22–99	.046	Regnault
antimony lead, 37.1Sb, 62.9Pb	10–98	.0388	"
bell metal, 80Cu, 20Sn.......	14–98	.0862	"
Bismuth tin, 63.8Bi, 36.2Sn...	20–99	.0400	"
46.9Bi, 53.1Sn............	20–99	.0450	"
56.9Bi, 43.1Sn............	17–99	.0450	Person
brass, 60Cu, 40Zn...........	−186–−79	.0743	Behn
	−79–+18	.0873	"
	20–100	.0917	Voigt
72Cu, 28Zn...............	14–98	.094	Regnault
bronze, 80Cu, 20Sn..........	15–98	.086	"
88Cu, 12Sn, 0.94P	20–100	.0874	Voigt
constantan.................	0	.098	Jaeger, Diesselhorst
	100	.102	" "
German silver...............	0	.094	Tomlinson
	100	.095	"
invar, 64Fe, 36Ni	−182–+15	.095	"
	15–100	.120	"
	15–600	.126	"
lead bismuth, 39.9Pb, 60.1Bi..	16–99	.0317	Person
lead bismuth tin,			
32.5Pb, 49.0Bi, 18.5Sn......	14–80	.0600n	Person
31.8Pb, 32.0Bi, 36.2Sn.....	11–98	.0448	Regnault
lead tin, 63.7Pb, 36.3Sn......	12–99	.0407	"
46.7Pb, 53.3Sn............	10–99	.0451	"
Lipowitz alloy, 24.97Pb,...... 10.13Cd, 50.66Bi, 14.24Sn	5–50	.0345	Mazotto
manganin................	0	.097	Jaeger, Diesselhorst
	100	.095	" "
platinum iridium, 90Pt, 10Ir..	20–100	.0323	Pionchon
Rose alloy, 27.5Pb, 48.9Bi,.... 23.6 Sn	20–89	.0552	Schüz
solder, *see* lead tin			
steel, ordinary (.004C).......	20	0.107	Regnault
	100	.117	"
Wood's alloy, 25.85Pb, 6.99Cd, 52.43Bi, 14.73Sn	5–50	.0352	Mazotto
Amalgams			
50.8Pb, 49.2Hg.............	23–99	.0383	Regnault
78.3Pb, 37.1Sn, 62.9Hg.......	22–99	.0729	"
54.1Sn, 45.9Hg.............	25–99	.0659	Schüz
Asbestos..................	20–98	.195	Ulrich
Basalt....................	20–100	.20	Mean
Calcspar..................	0–100	.2005	Lindner
Carborundum................	3–44	.162	
Cellulose, dry..............	....	.37	Mean
Cement, powder..............	200–10	.20	
Chalk.....................	20–99	.214	Regnault
Charcoal..................	10	.16	Weber, 1875
Clay, dry..................	20–100	.22	Mean
Ebonite...................	20–100	.40	Louguinine, 1882
Glass, normal thermometer.....	19–100	.1988	Wachsmuth
crown......................	10–50	.161	KH. Meyer
flint......................	10–50	.117	H. Meyer

SPECIFIC HEAT OF ALLOYS AND VARIOUS SOLIDS (Continued)

Values given in calories per gram

Substance.	Temp ° C.	Sp. heat.	Observer.
Carboloy	....	.052	
Granite	12–100	.192	Joly
Ice	−200	.168	Nernst, 1910
	−180	.199	" "
	−160	.230	" "
	−140	.262	" "
	−100	.325	" "
	− 60	.392	" "
	− 20	.480	" "
	− 10	.530	" "
India rubber (Para)	?–100	.481	Gee and Terry
Leather, dry	....	.36	
Marble	0–100	.21	
Mica (Mg)	20–98	.2061	Ulrich
Paraffin	0–20	.6939	R. W. Weber
Porcelain	15–950	.26	Harker, 1905
Quartz	12–100	.188	Joly
Rock-salt	13–45	.219	Kopp
Sugar	20	.274	Hess, 1888
Vulcanite	20–100	.3312	A. M. Mayer
Wood	....	.42	

COLOR SCALE OF TEMPERATURE

This table is the result of an effort to interpret in terms of thermometric readings, the common expressions used in describing temperatures. It is obvious that the values are only approximations.

Color.	Temperature, °C.
Incipient red heat	500–550
Dark red heat	650–750
Bright red heat	850–950
Yellowish red heat	1050–1150
Incipient white heat	1250–1350
White heat	1450–1550

SPECIFIC HEAT

Variation with Temperature

The table gives the true specific heat at the temperatures named. From data of Wüst, Meuthen, and Durrer, 1918.

°C	Pb	Zn	Al	Ag	Au	Cu	Ni	Fe	Co	Quartz
0°C	0.0359	0.0878	0.2220	0.0573	0.0317	0.1008	0.1095	0.1055	0.0912	......
100	0.0336	0.0965	0.2297	0.0583	0.0320	0.1014	0.1200	0.1168	0.0993	0.2372
200	0.0313	0.1052	0.2374	0.0594	0.0322	0.1020	0.1305	0.1282	0.1073	0.2416
300	0.0290	0.1139	0.2451	0.0605	0.0325	0.1026	0.1409	0.1396	0.1154	0.2460
400	0.0266	0.1226	0.2529	0.0616	0.0328	0.1032	0.1294	0.1509	0.1235	0.2504
500	0.0259	0.1173	0.2606	0.0627	0.0330	0.1038	0.1294	0.1623	0.1316	0.2548
600	0.0252	0.1141	0.2683	0.0638	0.0333	0.1045	0.1294	0.1737	0.1396	0.2592
700	0.0246	0.1109	0.2523	0.0649	0.0335	0.1051	0.1295	0.1850	0.1477	0.2636
800	0.0239	0.1076	0.2571	0.0660	0.0338	0.1057	0.1295	0.1592	0.1558	0.2680
900	0.0233	0.1044	0.2619	0.0671	0.0341	0.1063	0.1295	0.1592	0.1639	0.2724
1000	0.0226	0.1012	0.2667	0.0637	0.0343	0.1069	0.1295	0.1448	......	0.2768
1100	......	......	......	0.0694	0.0329	0.1028	0.1296	0.1448	0.1424	0.2812
1200	......	......	......	0.0750	0.0346	0.1159	0.1296	0.1448	0.1454	0.2856
1300	......	......	......	0.0807	0.0364	0.1291	0.1296	0.1449	0.1483	0.2900
1400	......	......	......	......	......	......	0.1296	0.1449	0.1512	0.2944
1500	......	......	......	......	......	......	0.1338	0.2142	0.1472	0.2988
1600	......	......	......	......	......	......	......	0.1501	0.1472	......

SPECIFIC HEAT FOR AQUEOUS SOLUTIONS

Giving the specific heat referred to that of water at the same temperatures. Concentration of the solutions is stated as the number of molecules of water to each molecule of the solutes (anhydrous.)

Values from Marignac, Thomsen and others.

Substance	Temp. °C.	Concentration 25	50	100
Acetic acid	21–52	0.957	0.977	0.987
Aluminum sulphate	21–53	.....	.....	0.870
Ammonium acetate	17.5	0.911	0.951	0.976
chloride	18	0.881	0.937	0.966
hydroxide	18	.....	0.999	.....
nitrate	18	0.880	0.929	0.962
sulphate	19–51	0.803	0.879	0.933
Barium chloride	22–27	.....	0.780	0.875
Cadmium sulphate	12	0.696	0.813	0.893
Calcium acetate	22–52	.....	0.896	0.939
chloride	21–51	0.754	0.851	0.917
nitrâte	21–51	0.760	0.846	0.911
Chromic acid	21–53	0.825	0.896	0.942
Copper chloride	19–51	0.779	0.864	0.920
nitrate	18–50	.....	0.826	0.899
sulphate	18–23	.....	0.841	0.908
Ferric chloride	0–98	0.666	0.750	0.854
Hydrochloric acid	18	.....	0.932	0.964
Lactic acid	16.5	0.947	0.970	0.982
Lead acetate	18–51	0.682	0.794	0.881
nitrate	18–51	.....	0.750	0.851
Lithium chloride	11	.....	0.941	0.973
hydroxide	13	.....	0.958	0.978
Magnesium chloride	22–52	0.772	0.866	0.923
nitrate	19–51	.....	0.832	0.903
Sulphate	18	.....	0.857	0.917
Manganese chloride	0–98	0.787	0.861	0.914
nitrate	19–51	.....	0.832	0.903
sulphate	19–51	.....	0.844	0.912
Nickel chloride	24–55	0.735	0.831	0.902
nitrate	24–55	0.717	0.823	0.895
sulphate	25–56	.....	0.837	0.910
Nitric acid	18	.....	0.930	0.963
Oxalic acid	20–52	.....	0.942	0.965
Potassium bromide	20–51	0.769	0.864	0.925
carbonate	21–52	0.760	0.851	0.916
chloride	18	0.828	0.904	0.948
chromate	20–51	.....	0.810	0.890
hydroxide	18	.....	0.916	0.954
iodide	20–51	0.715	0.830	0.906
nitrate	18–23	0.832	0.900	0.943

SPECIFIC HEAT OF AQUEOUS SOLUTIONS
(Continued)

Giving the specific heat referred to that of water at the same temperatures. Concentration of the solutions is stated as the number of molecules of water to each molecule of the solutes (anhydrous).

Values from Marignac, Thomsen and others.

Substance.	Temp. °C.	Concentration. 25	50	100
Potassium oxalate	21–52	.....	0.839	0.908
sulphate	19–52	.....	.....	0.902
Silver nitrate	25–52	0.750	0.849	0.913
Sodium acetate	18	.....	0.938	0.965
bromide	20–52	0.809	0.886	0.939
carbonate	21–52	0.865	0.907	0.943
chloride	18	0.880	0.931	0.962
chromate	21–52	0.781	0.856	0.913
hydroxide	18	0.908	0.942	0.968
iodide	20–51	0.749	0.850	0.917
nitrate	18	0.863	0.918	0.950
sulphate	21–52	0.819	0.878	0.960
Strontium chloride	21–26	.....	0.814	0.894
nitrate	19–51	.....	0.817	0.890
Sulphuric acid	21	0.854	0.915	0.956
Zinc chloride	19–51	0.796	0.884	0.933
nitrate	20–52	0.718	0.823	0.899
sulphate	20–52	.....	0.842	0.911

SPECIFIC HEAT OF GASES

The following table gives values of the specific heat at constant pressure in calories per gram and the value of γ, the ratio of the specific heat at constant pressure to that at constant volume. Values are given for pressures of one atmosphere except where otherwise stated.

Gas or vapor	Sp. ht., const. press.			Value of γ		
	Temp. °C	Sp. ht. cal./g	Obs.	Temp. °C	γ	Obs.
Acetaldehyde, C_2H_4O				30	1.14	39
Acetic acid, $C_2H_4O_2$	118–140	1.50	1	136	1.15	30
	140–180	1.27	1			
Acetone, C_3H_6O	26–110	0.3470	23			
	130–230	0.4119	23			
Acetylene, C_2H_2	−71	0.3509	26	−71	1.31	26
	+15	0.3832		+15	1.26	
Air	−120 (10 atm.)	0.2719		−118	1.415	3
	(20 atm.)	0.3221		−78	1.408	3
	(40 atm.)	0.4791		+17	1.403	3
	(70 atm.)	0.7771				
	−50 (10 atm.)	0.2440				
	(20 atm.)	0.2521				
	(40 atm.)	0.2741				
	(70 atm.)	0.3121				
(Data for air compiled from various observers: 2, 6, 10, 19, 21)	+50 (20 atm.)	0.2480				
	(100 atm.)	0.2719				
	(220 atm.)	0.2961				
	100 (1 atm.)	0.2404		100	1.401	
	(20 atm.)	0.2471				
	(100 atm.)	0.2600				
	(220 atm.)	0.2841				
	400	0.3329		400	1.017	
	1000	0.3262		1000	1.076	
	1400	0.3204		1400	1.130	
	1800	0.3145		1800	1.193	
Ammonia, NH_3	15	0.5232		15	1.310	27
Amylene, C_5H_{10}	*ca.* 210	0.631	9			
Argon, A	−180	0.133	26	−180	ca. 1.76	26
	+15	0.1253		+15	1.668	
Benzene, C_6H_6	80	0.260	14			
	34–115	0.301	37			
	120–220	0.370	23			
Bromine, Br	19–388	0.055	31	20–350 (0.3–1.5 atm.)	1.32	31
Carbon dioxide, CO_2	−75	0.184	26	−75	1.37	26
	+15	0.1989		+15	1.304	
Carbon disulfide, CS_2	80–190	0.157	23			
Carbon monoxide, CO	−180	0.259	26	−180	1.41	26
	+15	0.2478		+15	1.404	
Carbon tetrachloride, CCl_4	0	0.140	16	20 (0.1 atm.)	1.13	4, 34
	30	0.132	16			
	70	0.115	16			
Chlorine, Cl_2	15	0.1149		15	1.355	
Chloroform, $CHCl_3$	27–118	0.145	37	100	1.15	30
	120–230	0.157	23			
Cyanogen, CN	15	0.4095		15	1.256	
Ethane, C_2H_6	−82	0.3475	26	−82	1.28	26
	+15	0.3861		+15	1.22	
				50	1.21	7
Ethyl acetate, $C_4H_8O_2$	35–189	0.3711	37			
Ethyl alcohol, C_2H_6O	90	0.406	8, 18	90	1.13	8, 18
	100–223	0.454	23			
Ethyl bromide, C_2H_5Br	28–116	0.161	37	14 (0.3 atm.)	1.19	4
Ethyl chloride, C_2H_5Cl	10–170	0.2750	23	16 (0.3–0.5 atm.)	1.19	4
Ethyl cyanide, C_3H_5N	114–223	0.4260	23			
Ethyl ether, $C_4H_{10}O$	27–189	0.4619	37			
	35	0.4449	14	35	1.08	14

SPECIFIC HEAT OF GASES (Continued)

Gas or vapor	Sp. ht., const. press.			Value of γ		
	Temp. °C	Sp. ht. cal./g	Obs.	Temp. °C	γ	Obs.
Ethylene, C_2H_4	−91	0.3086	26	−91	1.35	26
	+15	0.3592	.....	+15	1.255	.....
	15–100	0.399	23, 37	100	1.18	39
	25–200	0.430	37	.....	.....	.....
Ethylene chloride, $C_2H_4Cl_2$	111–221	0.23	23	.....	.....	.....
Helium, He	−180	1.25	26	−180	1.660	26
Hydriodic acid, HI	.....	.....	.....	+20–100	1.40	31
Hydrobromic acid, HBr	+11–100	0.082	23	.....	.....	.....
Hydrochloric acid, HCl	10–190	0.185	23	.....	.....	.....
	15	0.1939	.....	15	1.41	.....
				100	1.40	31
Hydrocyanic acid, HCN	.....	.....	.....	65	1.31	35
Hydrogen, H_2	.....	.....	.....	−185	1.605	3
	−181	2.64	26	−181	1.597	26
				−118	1.480	3
				−78	1.443	3
	−76	3.15	26	−76	1.453	26
				−21	1.420	3
	+15	3.389	.....	+15	1.410	.....
	100	3.429	.....	100	1.404	.....
	200	3.463	.....	200	1.398	.....
(Data for hydrogen compiled from various observers: 5, 21, 29)	400	3.533	.....	400	1.387	.....
	600	3.602	.....	600	1.377	.....
	800	3.672	.....	800	1.367	.....
	1000	3.741	.....	1000	1.358	.....
	2000	4.088	.....	2000	1.318	.....
Hydrogen sulfide, H_2S	−57	0.292	26	−57	1.29	26
	−45	0.279	26	−45	1.30	26
	+10–190	0.243	33	.....	.....	.....
	15	0.2533	.....	+15	1.32	.....
				18	1.30	32
Iodene, I	206–377	0.034	31	185	1.30	30
Krypton, Kr	.....	.....	.....	19	1.68	22
Mercury, Hg	.....	.....	.....	360 (0.5–1 atm.)	1.67	13
Methane, CH_4	−115	0.4502	15	−115	1.41	15
	−80	0.5038	26	−80	1.34	26
	−74	0.4979	15	−74	1.35	15
	+10–200	0.5931	6, 23	.....	.....	.....
	15	0.5284	.....	+15	1.31	.....
Methyl alcohol, CH_4O	77	0.390	8	77	1.203	8
	100–223	0.4581	23	.....	.....	.....
Methyl ether, C_2H_6O	.....	.....	.....	6–30	1.11	17
Neon, Ne	.....	.....	.....	19	1.64	22
Nitric oxide, NO	−80	0.2445	26	−80	1.38	26
	−45	0.2389	26	−45	1.39	26
	+10–180	0.232	23	.....	.....	.....
	15	0.2329	.....	+15	1.400	.....
Nitrogen, N_2	−181	0.256	26	−181	1.47	26
	+15	0.2477	.....	+15	1.404	.....
Nitrogen peroxide, NO_2	27–67	1.620	1, 15	.....	.....	.....
Nitrous oxide N_2O	−70	0.1900	26	−70	1.34	26
	−30	0.1998	26	−30	1.31	26
				0	1.32	39
	+15	0.2004	.....	+15	1.303	.....
	25–100	0.212	23	.....	.....	.....
Oxygen, O_2	−181	0.2285	26	−181	1.45	26
	−76	0.2143	26	−76	1.415	26
	+15	0.2178	.....	+15	1.401	.....
	100	0.2181	20	100	1.399	20
	200	0.2187	20	200	1.396	20

SPECIFIC HEAT OF GASES (Continued)

Gas or vapor	Sp. ht., const. press.			Value of γ		
	Temp. °C	Sp. ht. cal./g	Obs.	Temp. °C	γ	Obs.
Oxygen, O_2 (*Con't*)	400	0.2213	20	400	1.391	20
	600	0.2241	20	600	1.383	20
	800	0.2278	20	800	1.375	20
	1000	0.2325	20	1000	1.365	20
	2000	0.2669	20	2000	1.303	20
Phosphorus, P	.....	.....	.....	300	1.17	28
Phosphorus trichloride, PCl_3	110–250	0.135	23	.....	.....	.....
Potassium, K	.....	.....	.....	850	1.77	36
				680–1000	1.69	24
Propane, C_3H_8	.....	.....	.....	16 (0.5 atm.)	1.13	4
Silicon tetrachloride, $SiCl_4$	90–230	0.132	23	.....	.....	.....
Sodium, Na	.....	.....	.....	750–920	1.68	24
Stannic chloride, $SnCl_4$	149–273	0.094	23	.....	.....	.....
Sulfur dioxide, SO_2	10–190	0.134	23	.....	.....	.....
	15	0.1516	.....	15	1.29	.....
				20	1.27	27
Water, H_2O	100	0.4820	.....	100	1.324	.....
	120	0.4769	.....	.....	.....	.....
	140	0.4741	.....	.....	.....	.....
	160	0.4719	.....	.....	.....	.....
(Data for water compiled from various observers: 11, 12, 20)	180	0.4710	.....	.....	.....	.....
	200	0.4710	.....	200	1.310	.....
	300	0.4769	.....	300	1.304	.....
	400	0.4901	.....	400	1.301	.....
	500 (1 atm.)	0.5071	.....	500	1.296	.....
	(10 atm.)	0.5159	.....	.....	.....	.....
	(20 atm.)	0.5259	.....	.....	.....	.....
Xenon, Xe	.....	.....	.....	19	1.66	22

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BOILING-POINT OF WATER*

(Hydrogen Scale)

Pressure mm.	Tenths of millimeters .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
700	97.714	718	722	725	729	733	737	741	745	749
701	753	757	761	765	769	773	777	781	785	789
702	792	796	800	804	808	812	816	820	824	828
703	832	836	840	844	847	851	855	859	863	867
704	871	875	879	883	887	891	895	899	902	906
705	97.910	914	918	922	926	930	934	938	942	946
706	949	953	957	961	965	969	973	977	981	985
707	989	993	996	*000	*004	*008	*012	*016	*020	*024
708	98.028	032	036	040	043	047	051	055	059	063
709	067	071	075	079	082	086	090	094	098	102
710	98.106	110	114	118	121	125	129	133	137	141
711	145	149	153	157	160	164	168	172	176	180
712	184	188	192	195	199	203	207	211	215	219
713	223	227	230	234	238	242	246	250	254	258
714	261	265	269	273	277	281	285	289	292	296
715	98.300	304	308	312	316	320	323	327	331	335
716	339	343	347	351	355	358	362	366	370	374
717	378	382	385	389	393	397	401	405	409	412
718	416	420	424	428	432	436	440	443	447	451
719	455	459	463	467	470	474	478	482	486	490
720	98.493	497	501	505	509	513	517	520	524	528
721	532	536	540	544	547	551	555	559	563	567
722	570	574	578	582	586	590	593	597	601	605
723	609	613	617	620	624	628	632	636	640	643
724	647	651	655	659	662	666	670	674	678	683
725	98.686	689	693	697	701	705	709	712	716	720
726	724	728	732	735	739	743	747	751	755	758
727	762	766	770	774	777	781	785	789	793	797
728	800	804	808	812	816	819	823	827	831	835
729	838	842	846	850	854	858	861	865	869	873
730	98.877	880	884	888	892	896	899	903	907	911
731	915	918	922	926	930	934	937	941	945	949
732	953	956	960	964	968	972	975	979	983	987
733	991	994	998	*002	*006	*010	*013	*017	*021	*025
734	99.029	032	036	040	044	048	051	055	059	063
735	99.067	070	074	078	082	085	089	093	097	101
736	104	108	112	116	119	123	127	131	135	138
737	142	146	150	153	157	161	165	169	172	176
738	180	184	187	191	195	199	203	206	210	214
739	218	221	225	229	233	236	240	244	248	252
740	99.255	259	263	267	270	274	278	282	285	289
741	293	297	300	304	308	312	316	319	323	327
742	331	334	338	342	346	349	353	357	361	364
743	368	372	376	379	383	387	391	394	398	402
744	406	409	413	417	421	424	428	432	436	439
745	99.443	447	451	454	458	462	466	469	473	477
746	481	484	488	492	495	499	503	507	510	514
747	518	522	525	529	533	537	540	544	548	551
748	555	559	563	566	570	574	578	581	585	589
749	592	596	600	604	607	611	615	619	622	626

* See also under Vapor Tension.

BOILING POINT OF WATER (Continued)
(Hydrogen Scale)

Pressure mm	Tenths of millimeters									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
750	99.630	633	637	641	645	648	652	656	659	663
751	667	671	674	678	682	686	689	693	697	700
752	704	708	712	715	719	723	726	730	734	738
753	741	745	749	752	756	760	764	767	771	775
754	778	782	786	790	793	797	801	804	808	812
755	99.815	819	823	827	830	834	838	841	845	849
756	852	856	860	863	867	871	875	878	882	886
757	889	893	897	900	904	908	911	915	919	923
758	926	930	934	937	941	945	948	952	956	959
759	963	967	970	974	978	982	985	989	993	996
760	100.000	004	007	011	015	018	022	026	029	033
761	037	040	044	048	052	055	059	063	066	070
762	074	077	081	085	088	092	096	099	103	107
763	110	114	118	121	125	129	132	136	140	143
764	147	151	154	158	162	165	169	173	176	180
765	100.184	187	191	195	198	202	206	209	213	216
766	220	224	227	231	235	238	242	246	249	253
767	257	260	264	268	271	275	279	283	286	290
768	293	297	300	304	308	311	315	319	322	326
769	330	333	337	341	344	348	352	355	359	363
770	100.366	370	373	377	381	384	388	392	395	399
771	403	406	410	414	417	421	424	428	432	435
772	439	442	446	450	453	457	461	464	468	472
773	475	479	483	486	490	493	497	501	504	508
774	511	515	519	522	526	530	533	537	540	544
775	100.548	551	555	559	562	566	569	573	577	580
776	584	588	591	595	598	602	606	609	613	616
777	620	624	627	631	634	638	642	645	649	653
778	656	660	663	667	671	674	678	681	685	689
779	692	696	689	703	707	710	714	718	721	725
780	100.728	732	735	739	743	746	750	753	757	761
781	764	768	772	775	779	782	786	789	793	797
782	800	804	807	811	815	818	822	825	829	833
783	836	840	843	847	851	854	858	861	865	869
784	872	876	879	883	886	890	894	897	901	904
785	100.908	912	915	919	922	926	929	933	937	940
786	944	947	951	954	958	962	965	969	972	976
787	979	983	987	990	994	997	*001	*005	*008	*012
788	101.015	019	022	026	029	033	037	040	044	047
789	051	054	058	062	065	069	072	076	079	083
790	101.087	090	094	097	101	104	108	112	115	119
791	122	126	129	133	136	140	144	147	151	154
792	158	161	165	168	172	176	179	183	186	190
793	193	197	200	204	207	211	215	218	222	225
794	229	232	236	239	243	246	250	254	257	261
795	101.264	268	271	275	278	282	286	289	293	296
796	300	303	307	310	314	317	321	324	328	332
797	335	339	342	346	349	353	356	360	363	367
798	370	374	377	381	385	388	392	395	399	402
799	406	409	413	416	420	423	427	430	434	437
800	101.441	...	...	...	.....	...	...	...	...	...

MELTING AND BOILING POINTS OF THE ELEMENTS

Element	Melting point, °C	Boiling point, °C	Element	Melting point, °C	Boiling point, °C
Aluminum	659.7	1800	Neon	−248.67	−245.9
Antimony	630.5	1380	Nickel	1455	2900
Argon	−189.2	−185.7	Nitrogen	−209.86	−195.8
Arsenic	814 36 atm	615 (subl.)	Osmium	2700	>5300
Barium	850	1140	Oxygen	−218.4	−183
Beryllium	1350	1500	Ozone	−251.4	−112
Bismuth	271.3	1450	Palladium	1553	2200
Boron	2300	2550	Phosphorus (yel.)	44.1	280
Bromine	−7.2	58.78	Platinum	1773.5	4300
Cadmium	320.9	767	Potassium	62.3	760
Calcium	810	1170	Praseodymium	940	....
Carbon	>3500	4200	Radium	960	1140
Cerium	640	1400	Radon	−110	....
Cesium	28.5	670	Rhenium	3000	....
Chlorine	−101.6	−34.6	Rhodium	1985	>2500
Chromium	1615	2200	Rubidium	38.5	700
Cobalt	1480	3000	Ruthenium	2450	>2700
Columbium (niobium)	1950	2900	Samarium	>1300	....
Copper	1083	2300	Scandium	1200	2400
Erbium	....	....	Selenium, gray, trig.	220	688
Fluorine	−223	−187	Silicon	1420	2600
Gallium	29.75	>1600	Silver	960.5	1950
Germanium	958.5	2700	Sodium	97.5	880
Gold	1063	2600	Strontium	800	1150
Hafnium	1700	>3200	Sulfur (rhomb.)	112.8	444.6
Helium	< −272.2	−268.9	(monocl.)	119.0	....
Hydrogen	−259.14	−252.7	Tantalum	2850	>4100
Indium	155	1450	Tellurium	452	1390
Iodine	113.5	184.35	Thallium	303.5	1650
Iridium	2350	>4800	Thorium	1845	>3000
Iron	1535	3000	Tin	231.89	2260
Krypton	−157 (−169)	−152.9 (−151.8)	Titanium	1800	>3000
Lanthanum	826	1800	Tungsten	3370	5900
Lead	327.4	1620	Uranium	<1850	....
Lithium	186	>1220	Vanadium	1710	3000
Magnesium	651	1110	Xenon	−112 (−140)	−107.1 (−109.1)
Manganese	1260	1900	Ytterbium	1800	....
Mercury	−38.87	356.9	Yttrium	1490	2500
Molybdenum	2620	3700	Zinc	419.47	907
Neodymium	840	....	Zirconium	1900	>2900

MELTING POINTS OF MIXTURES OF METALS

(Smithsonian Physical Tables)

Melting-points, °C.

Metals	Percentage of metal in second column.										
	0% *	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Pb. Sn.	326	295	276	262	240	220	190	185	200	216	232
Bi.	322	290	...	...	179	145	126	168	205	...	268
Te.	322	710	790	880	917	760	600	480	410	425	446
Ag.	328	460	545	590	620	650	705	775	840	905	959
Na.	...	360	420	400	370	330	290	250	200	130	96
Cu.	326	870	920	925	945	950	955	985	1005	1020	1084
Sb.	326	250	275	330	395	440	490	525	560	600	632
Al. Sb.	650	750	840	925	945	950	970	1000	1040	1010	632
Cu.	650	630	600	560	540	580	610	755	930	1055	1084
Au.	655	675	740	800	855	915	970	1025	1055	675	1062
Ag.	650	625	615	600	590	580	575	570	650	750	954
Zn.	654	640	620	600	580	560	530	510	475	425	419
Fe.	653	860	1015	1110	1145	1145	1220	1315	1425	1500	1515
Sn.	650	645	635	625	620	605	590	570	560	540	232
Sb. Bi.	632	610	590	575	555	540	520	470	405	330	268
Ag.	630	595	570	545	520	500	505	545	680	850	959
Sn.	622	600	570	525	480	430	395	350	310	255	232
Zn.	632	555	510	540	570	565	540	525	510	470	419
Ni. Sn.	1455	1380	1290	1200	1235	1290	1305	1230	1060	800	232
Na. Bi.	96	425	520	590	645	690	720	730	715	570	268
Cd.	96	125	185	245	285	325	330	340	360	390	322
Cd. Ag.	322	420	520	610	700	760	805	850	895	940	954
Tl.	321	300	285	270	262	258	245	230	210	235	302
Zn.	322	280	270	295	313	327	340	355	370	390	419
Au. Cu.	1063	910	890	895	905	925	975	1000	1025	1060	1084
Ag.	1064	1062	1061	1058	1054	1049	1039	1025	1006	982	963
Pt.	1075	1125	1190	1250	1320	1380	1455	1530	1610	1685	1775
K. Na.	62	17.5	−10	−3.5	5	11	26	41	58	77	97.5
Hg.	...	...	...	...	...	90	110	135	162	265	...
Tl.	62.5	133	165	188	205	215	220	240	280	305	301
Cu. Ni.	1080	1180	1240	1290	1320	1355	1380	1410	1430	1440	1455
Ag.	1082	1035	990	945	910	870	830	788	814	875	960
Sn.	1084	1005	890	755	725	680	630	580	530	440	232
Zn.	1084	1040	995	930	900	880	820	780	700	580	419
Ag. Zn.	959	850	755	705	690	660	630	610	570	505	419
Sn.	959	870	750	630	550	495	450	420	375	300	232
Na. Hg.	96.5	90	80	70	60	45	22	55	95	215	...

* The data in this table are compiled from various sources,— hence the variations in the melting point of the metals as shown in this column.

MELTING AND BOILING TEMPERATURES

Temperature of Fusion for Various Substances for Atmospheric Pressure

For the melting- and boiling-points of the chemical elements and of inorganic compounds see under Physical Constants of the Elements, and Physical Constants of Inorganic Compounds.

Substance.	Temp. of fusion ° C.	Substance.	Temp. of fusion ° C.
Acetylene	−81	German silver	1000.
Alcohol, ethyl	−130.	Glass	1100.
Brass	900.	Glycerine	17.
Butter	31–31.5	Olive oil	2–6
Camphor	177.7	Paraffin	55.
Caoutchouc, pure gum	120.	Resin	135.
Chloroform	−63.2	Sea water	−2.5
Ether	−117.6	Sugar (cane)	160.

Boiling-point for Various Substances

Giving the boiling-point at atmospheric pressure and the variation per cm. pressure near 76 cm.

Substance.	Temp. ° C.	Variation.
Acetone	57.	0.39
Acetylene	−72.2	
Alcohol, ethyl	78.3	0.34
methyl	64.7	0.35
Amyl acetate	148.	
Benzene	80.	0.43
Camphor	205.	0.56
Chloroform	61.2	0.41
Ether	34.6	0.40
Gasoline	70–90.	
Glycerine	291.	—
Turpentine	159.	

MELTING POINT OF ICE—VARIATION WITH PRESSURE

(From Tamann, 1900, by permission.)

Pressure in kg. per sq.cm.	Temp. ° C.	Pressure in kg. per sq.cm.	Temp. ° C.
1	0.0	1410	−12.5
336	− 2.5	1625	−15.0
615	− 5.0	1835	−17.5
890	− 7.5	2042	−20.0
1155	−10.0	2200	−22.1

BOILING POINTS OF WATER-ALCOHOL MIXTURES

(P. N. Evans, Journal of Industrial and Engineering Chemistry.)

Boiling point, ° C.	Weight per cent alcohol in		Boiling point, ° C.	Weight per cent alcohol in	
	Liquid.	Vapor.		Liquid.	Vapor.
78.2	91	92	86.5	18	71
78.4	85	89	87.0	17	70
78.6	82	88	87.5	16	69
78.8	80	87	88.0	15	68
79.0	78	86	88.5	13	67
79.2	76	85	89.0	12	65
79.4	74	85	89.5	11	63
79.6	72	84	90.0	10	61
79.8	69	84	90.5	10	59
80.0	67	83	91.0	9	57
80.2	64	83	91.5	8	55
80.4	62	82	92.0	8	53
80.6	59	82	92.5	7	51
80.8	56	81	93.0	6	49
81.0	53	81	93.5	6	46
81.2	50	80	94.0	5	44
81.4	47	80	94.5	5	42
81.6	45	80	95.0	4	39
81.8	43	79	95.5	4	36
82.0	41	79	96.0	3	33
82.5	36	78	96.5	3	30
83.0	33	78	97.0	2	27
83.5	30	77	97.5	2	23
84.0	27	76	98.0	1	19
84.5	25	75	98.5	1	15
85.0	23	74	99.0	0	10
85.5	21	73	99.5	0	5
86.0	20	72	100.0	0	0

MOLECULAR ELEVATION OF THE BOILING POINT

Showing the elevation of the boiling point due to the addition of one gram molecular weight of the dissolved substance, for various solvents.

Solvent	Constant for one gram molecular weight dissolved in 100 gms. ° C.	Constant for one gram molecular weight dissolved in 100 c.c. at the boiling point. ° C.
Acetic acid	25.4–30.7	....
Acetone	16.7	22.2
Aniline	32.2–34.1	....
Benzene	26.7	32.0
Chloroform	36.6	26.0
Ether	21.1	30.3
Ethyl acetate	27.9	....
Ethyl alcohol	11.5	15.6
Methyl acetate	20.6	....
Methyl alcohol	8.4–9.3	....
Nitrobenzene	50.1–50.4	....
Phenol	30.4	....
Water	5.2	5.4

MOLECULAR DEPRESSION OF THE FREEZING POINT

Showing the depression of the freezing point due to the addition of one gram molecular weight of dissolved substance, for various solvents.

Solvent	Depression for one gram molecular weight dissolved in 100 gms. ° C.
Acetic acid	39.0
Benzene	49.0
Benzophenone	98.0
Diphenyl	80.0
Diphenylamine	86.0
Ethylene dibromide	118.0
Formic acid	27.7
Naphthalene	68–69
Nitrobenzene	70.0
Phenol	74.0
Stearic acid	45.0
Triphenyl methane	124.5
Urethane	51.4
Water	18.5–18.7

LOWERING OF FREEZING POINT FOR AQUEOUS SOLUTIONS

The concentration of the solutions is expressed as the number of gram formula weights per 1,000 grams of water. The table gives the molal lowering of freezing point in °C for the concentration stated.

Solute	Concentration										
	0.001	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1.0	2.0	5.0
$AgNO_3$	...	...	3.60	3.54	3.42	3.32	3.20	2.96	2.63	2.16	...
$AlCl_3$*	...	...	7.10	6.62	6.02	5.68	5.76	7.06	9.45	...	...
$Al(NO_3)_3$*	...	...	...	...	6.3	6.1	6.5	7.9	10.6	...	...
$Al_2(SO_4)_3$	...	...	...	...	...	...	3.92	4.19	...	...	...
$BaCl_2$	5.30	5.120	5.034	4.938	4.796	4.698	4.64	...	5.20	...	...
$Ba(NO_3)_2$	5.39	...	5.01	4.87	...	4.25	3.79	...	...	...	...
Br_2	...	...	1.95	1.90	1.875	1.870	...	...	...	...	...
$CaCl_2$	...	...	5.112	...	4.886	4.832	4.78	4.98	5.85	7.68	...
$Ca(NO_3)_2$	...	...	...	...	4.7	4.58	4.50	...	4.59	4.86	...
$CdBr_2$	...	4.76	4.47	...	3.65	3.22	...	...	...	...	...
$CdCl_2$	...	4.79	4.71	...	4.12	3.84	3.57	3.24	...	...	...
CdI_2	...	4.06	3.86	...	2.69	2.27	2.1	2.1	2.25	...	...
$Cd(NO_3)_2$	...	5.28	5.20	5.15	...	5.08	5.08	...	5.42	6.2	...
$CdSO_4$	...	2.916	2.744	...	2.3	2.1	1.93	...	1.79	...	...
Cl_2	...	...	4.0	3.816	3.145	...	...	...	...	...	...
$CoCl_2$	...	5.208	5.107	...	4.918	4.882	4.946	...	6.31	8.51	...
$Co(NO_3)_2$	...	...	...	...	...	4.6	4.5	...	5.5	...	...
$CoSO_4$	...	...	...	...	...	...	2.02	1.75	...	...	...
$Cr_2(SO_4)_3$*	...	...	...	...	4.6	4.2	...	...	...	...	...
$Cu(NO_3)_2$	...	...	...	...	...	5.1	5.0	...	5.7	6.7	...
$CuSO_4$	...	2.871	2.703	...	2.266	2.085	1.912	1.722	1.715	...	...
$FeCl_3$	...	...	...	6.93	6.28	6.01	6.02	6.55	8.18	12.45	...
$Fe(NO_3)_3$	...	...	...	...	...	6.30	6.48	...	9.4	...	...
$FeSO_4$	...	...	...	...	...	2.39	2.10	...	...	...	...
HCl	3.690	3.635	3.601	3.568	3.532	3.523	3.54	3.68	3.94	4.43	...
HF	...	...	...	...	...	1.98	1.91	...	1.93	2.03	...
HI	...	...	...	...	...	3.50	3.56	...	4.09	4.75	7.70
HIO_3	...	...	...	...	3.12	2.95	2.71	2.21	1.72	1.16	0.75
HNO_3	...	3.67	3.64	3.61	3.55	3.51	3.47	...	3.58	3.79	...
H_2O_2	...	...	...	...	...	1.84	1.84	1.86	1.88	1.91	1.96
H_3PO_4	...	3.1	2.95	2.75	...	2.36	2.23	...	2.14	2.41	...
H_2SO_3	...	...	...	...	...	2.8	2.6	...	2.35	...	...
H_2SO_4	...	4.814	4.584	...	4.112	3.940	3.790	...	4.04	5.07	...
$H_2S_2O_6$*	...	...	...	...	5.06	5.04	5.14	...	...	...	...
KBr	...	...	...	...	3.500	3.452	3.400	3.330	3.290	3.275	...
$KC_2H_3O_2$	...	...	...	...	...	...	...	3.78	3.92	4.22	...
KCN	...	...	...	...	3.49	3.41	3.34	3.27	3.25	3.27	3.44
$KCNS$	...	...	...	...	...	3.44	3.37	3.25	...	...	...
$K_2C_2O_4$*	...	...	...	...	...	4.46	...	4.18	...	...	...
K_2CO_3	...	...	5.20	5.00	4.74	4.56	4.42	4.39	4.51	5.01	...
KCl	3.66	3.648	3.610	3.566	3.503	3.451	3.394	3.314	3.250	3.220	...
$KClO_3$	...	...	3.556	3.513	3.435	3.334	...	...	...	...	...
K_2CrO_4	...	...	...	...	3.0	3.3	3.6	...	...	3.6	...
$K_2Cr_2O_7$	7.06	...	...	...	...	...	...	...	...	...	...
KF	...	...	...	...	...	3.39	3.35	3.36	3.39	...	...
$K_3Fe(CN)_6$	7.10	6.53	6.26	5.98	5.60	5.30	5.00	4.55	...	...	...
$K_4Fe(CN)_6$	...	...	...	...	5.72	5.18	...	...	...	...	...
$KHCO_3$	...	...	...	...	...	...	...	3.09	2.91	2.68	...
KH_2PO_4	...	...	...	3.59	3.47	3.34	3.19	...	...	...	...
KI	...	...	...	...	...	3.54	3.44	3.38	3.37	3.40	3.50
KNO_3	...	3.638	3.590	3.537	3.431	3.314	3.154	2.882	2.56	...	...
KOH	...	3.66	3.65	3.62	3.50	3.42	3.39	3.44	3.60	3.96	5.77
K_2SO_4	5.280	5.150	5.010	...	4.559	4.319	4.044	...	...	...	...
$LiCl$	...	3.612	3.598	3.582	3.553	3.52	3.50	3.58	3.80	4.41	...
$MgCl_2$	...	...	5.144	...	4.974	4.938	4.977	5.38	6.35	8.8	...

*Concentration stated as gram formula weights per liter.

Solute	Concentration										
	0.001	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1.0	2.0	5.0
$Mg(NO_3)_2$	....	....	....	....	....	4.74	4.78	5.08	5.78	7.0	....
$MgSO_4$	3.38	3.02	2.85	....	2.420	2.252	2.090	....	2.02	....	....
$MnCl_2$	....	....	....	....	....	4.86	4.90	....	6.05	....	....
$Mn(NO_3)_2$	....	....	....	....	....	....	4.92	....	6.00	6.64	....
$MnSO_4$	....	....	....	....	....	....	2.14	....	2.02	2.5	....
NH_3	....	....	....	....	....	....	....	....	1.94	1.94	2.06
NH_4Cl	....	3.617	3.582	3.544	3.489	3.442	3.392	3.34	3.33	3.34	....
NH_4NO_3	....	....	3.572	3.535	3.470	3.396	3.296	3.11	2.92	2.65	2.17
$NaBr$	....	....	....	3.611	3.551	3.507	3.468	3.456	3.51	3.68	....
$NaC_2H_3O_2$	....	....	....	....	....	3.59	3.58	....	3.78	4.14	....
Na_2CO_3	....	....	5.12	4.93	....	4.44	4.17	....	....	....	....
$NaCl$	3.66	....	3.604	3.570	....	3.478	3.424	....	3.37	3.45	....
$NaClO_3$	3.682	....	3.588	3.547	....	3.433	....	....	....	....	....
Na_2CrO_4	....	....	....	....	....	4.49	4.23	....	3.71	....	....
$NaHCO_3$	....	....	....	....	....	3.65	3.51	....	....	....	....
Na_2HPO_4	....	....	4.99	4.85	4.61	4.34	....	....	....	....	....
NaI	....	....	....	....	....	3.68	3.52	....	3.66	3.97	....
$NaNH_4HPO_4$	....	....	4.95	4.78	4.51	4.23	3.87	....	....	....	....
$NaNO_3$	....	....	3.55	3.53	....	3.406	3.327	....	3.02	2.79	....
$NaOH$	....	....	3.55	3.51	3.46	3.42	3.41	3.40	3.44	3.58	....
Na_3PO_4	....	....	7.15	6.85	6.11	5.69	....	....	....	....	....
Na_2S*	....	....	....	....	....	7.12	7.06	....	6.87	....	....
Na_2SiO_3	....	....	6.6	6.42	....	5.32	4.71	4.02	....	....	....
Na_2SO_3	....	....	....	....	....	....	4.36	....	....	....	....
Na_2SO_4	....	5.2	5.04	4.874	....	4.344	4.057	....	....	....	....
$NiCl_2$	....	....	....	5.58	5.41	5.38	5.43	5.69	6.22	8.67	....
$Ni(NO_3)_2$	....	....	....	....	....	4.91	4.91	....	5.86	....	....
$NiSO_4$	....	3.036	2.832	2.63	2.37	2.20	2.05	....	1.94	....	....
$Pb(C_2H_3O_2)_2$	....	....	....	....	3.63	2.85	2.37	....	....	....	....
$Pb(NO_3)_2$	5.368	5.090	4.898	4.657	4.276	3.955	3.560	2.940	2.435	....	....
$SrCl_2$	....	....	5.3	5.10	....	4.82	4.80	....	5.83	7.54	....
$Sr(NO_3)_2$	....	....	5.7	5.35	....	4.63	4.40	....	3.90	....	....
$UO_2(NO_3)_2$	....	....	....	....	5.16	5.00	4.92	....	6.15	....	....
$Zn(C_2H_3O_2)_2$	....	....	....	....	....	4.74	4.37	....	....	....	....
$ZnCl_2$	....	5.28	5.15	5.04	....	4.94	4.96	....	5.21	5.49	....
$Zn(NO_3)_2$	....	....	....	....	....	4.89	4.89	....	5.83	7.12	....
$ZnSO_4$	....	....	2.80	2.65	....	2.29	2.12	....	1.87	....	....

ORGANIC COMPOUNDS

Solute	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Acetic acid	....	....	....	....	1.90	....	....	1.79	....	1.6	1.4
Acetone	....	....	1.86	....	1.85	....	....	1.79	....	....	....
Aniline	....	1.85	....	1.82	1.79	1.73	....	....	....	....	....
Citric acid	....	2.26	2.14	2.08	2.03	....	1.93	1.94	2.00	....	....
Dextrose	....	....	....	1.86	1.86	1.87	....	1.92	....	....	....
Ethyl acetate	....	....	....	....	1.85	1.83	1.82	....	....	....	....
Ethylalcohol	....	....	1.83	....	1.83	....	....	1.83	1.84	....	2.2
Ethyl ether	....	1.67	1.67	1.70	1.72	1.70	....	....	....	....	....
Glycerol	....	1.86	....	....	....	1.87	1.89	1.92	....	2.1	....
Methyl alcohol	....	1.82	....	....	1.81	1.81	....	....	1.86	....	2.00
Oxalic acid	....	....	3.40	3.04	2.84	2.64	....	....	....	....	....
Phenol	....	....	....	....	1.81	1.83	1.63	....	....	....	....
Picric acid	3.82	3.63	3.28	....	....	....	....	....	....	....	....
n-Propyl alcohol	....	1.86	....	1.84	1.83	....	....	1.79	1.79	1.76	....
Sucrose	1.86	....	....	1.87	1.88	1.90	1.96	2.06	2.3	....	....
d-Tartaric acid	....	2.34	....	2.12	2.05	1.98	1.94	....	....	2.35	....

CORRECTION OF BOILING POINTS TO STANDARD PRESSURE

By H. B. Hass and R. F. Newton

This correction may be made by using the equation:

$$\Delta t = \frac{(273.1 + t)(2.8808 - \log p)}{\phi + .15(2.8808 - \log p)} \quad (1,$$

where Δt = degrees C to be added to the observed boiling point.
t = the observed boiling point.
$\log p$ = the logarithm of the observed pressure in millimeters of mercury.
ϕ = the entropy of vaporization at 760 mm.

The value of ϕ may be estimated from the graph and the table. Substances not included in the table may be classified by grouping them with compounds which bear a close physical or structural resemblance to them.

Example 1. Benzene boils at 20°C. at 75 mm pressure. What is its normal boiling point? We do not find benzene in the table but we find hydrocarbons in group 2, and a group 2 compound with a boiling point of 20° has a ϕ of 4.6.

Substituting in the equation:

$$\Delta t = \frac{(273.1 + 20)(2.8808 - 1.8751)}{4.60 + .15(2.8808 - 1.8751)} = 62°$$

Adding this to 20° gives 82° as a first approximation.

The graph shows that the ϕ for a compound of group 1 boiling at 82° is 4.72 instead of 4.60 which we originally used. Since ϕ is in the denominator, this increase will lower our Δt by the ratio, $\frac{4.60}{4.72}$, or the corrected Δt is $62 \times \frac{4.60}{4.72} = 60.4$. Adding Δt to t, gives 80.4° as a second approximation.

The formula can best be used in a slightly different form when the reverse calculation is desired, *i.e.*, when one calculates the vapor pressure at a given temperature, lower than the normal boiling point.

$$2.8808 - \log p = \frac{\phi \Delta t}{273.1 + t - .15\Delta t} \quad (2)$$

Example 2. Alcohol boils at 78.4°C. What is its vapor pressure at 20°C.? Substituting in equation 2:

$$2.8808 - \log p = \frac{6.06 \times 58.4}{293.1 - (.15 \times 58.4)} = 1.245$$

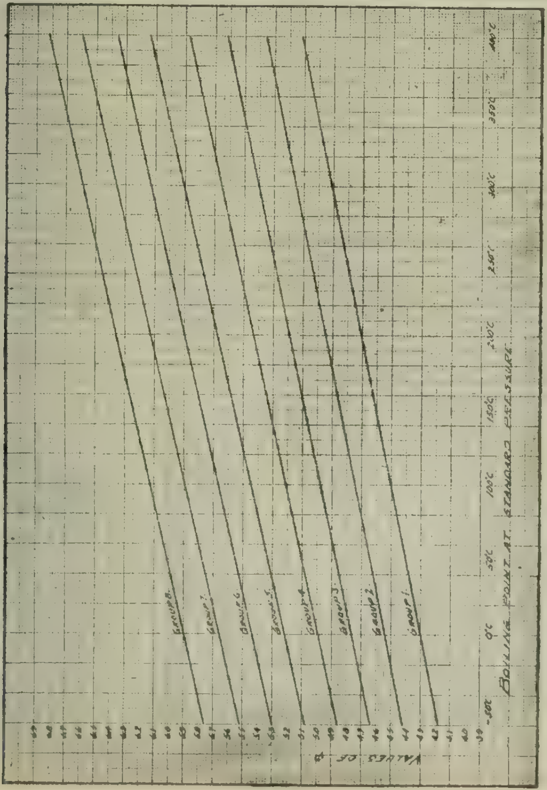
$$\log p = 2.8808 - 1.245 = 1.6358$$

$$p = 43.2 \text{ mm.}$$

Here no second approximation is necessary, since the correct value of ϕ was taken immediately, the normal boiling point having been known.

Compound	Group	Compound	Group
Acetaldehyde	3	Carbon sulfoselenide	2
Acetic acid	4	*m.p.* Chloroanilines	3
Acetic anhydride	6	Chlorinated derivatives	Same group as though Cl was H
Acetone	3		
Acetophenone	4		
Amines	3	*o.m.p.* Cresols	4
n-Amyl alcohol	8	Cyanogen	4
Anthracene	1	Cyanogen chloride	3
Anthraquinone	1	Dibenzyl ketone	2
Benzaldehyde	2	Dimethyl amine	4
Benzoic acid	5	Dimethyl oxalate	4
Benzonitrile	2	Dimethyl silicane	2
Benzophenone	2	Esters	3
Benzyl alcohol	5	Ethanol	8
Butylethylene	1	Ethers	2
Butyric acid	7	Ethylamine	4
Camphor	2	Ethylene glycol	7
Carbon monoxide	1	Ethylene oxide	3
Carbon oxysulfide	2	Formic acid	3
Carbon suboxide	2	Glycol diacetate	4

Compound	Group	Compound	Group
Halogen derivatives	Same group as though halogen were hydrogen.	Methyl formate	4
		Methyl salicylate	2
		Methyl silicane	1
		α, β Naphthols	3
		Nitrobenzene	3
Heptylic acid	7	Nitromethane	3
Hydrocarbons	2	o.m.p. Nitrotoluenes	2
Hydrogen cyanide	3	o.m.p. Nitrotoluidines	2
Isoamyl alcohol	7	Phenanthrene	1
Isobutyl alcohol	8	Phenol	5
Isobutyric acid	6	Phosgene	2
Isocaproic acid	7	Phthalic anhydride	2
Methane	1	Propionic acid	5
Methanol	7	n-Propyl alcohol	8
Methyl amine	5	Quinoline	2
Methyl benzoate	3	Sulfides	2
Methyl ether	3	Tetranitromethane	3
Methyl ethyl ether	3	Trichloroethylene	1
Methyl ethyl ketone	2	Valeric acid	7
Methyl fluoride	3	Water	6



CRITICAL CONSTANTS FOR GASES

Name	Formula	Temp., ° C.	Pressure, atm.	Density gms. per cm.^{3}
Acetaldehyde	CH_3CHO	188	....	....
Acetic acid	CH_3CO_2H	321.6	57.2	0.351
Acetic anhydride	$(CH_3CO)_2O$	296	46	....
Acetone	$(CH_3)_2CO$	235.0	47	0.268
Acetonitrile	CH_3CN	274.7	47.7	0.240
Acetylene	C_2H_2	36	62	0.231
Air	....	−140.7	37.2	0.35;* 0.31†
Allyl alcohol	C_3H_5OH	272	....	....
Allyl sulfide	$(C_3H_5)_2S$	380	....	....
Allylene	CH_3CCH	128	....	....
Ammonia	NH_3	132.4	111.5	0.235
iso-Amyl acetate	$CH_3CO_2C_5H_{11}$	326	....	....
iso-Amyl alcohol	$C_5H_{11}OH$	307	....	....
tert.-Amyl alcohol	$C_5H_{11}OH$	272	....	....
iso-Amyl butyrate	$C_3H_7CO_2C_5H_{11}$	346	....	....
iso-Amyl formate	$HCO_2C_5H_{11}$	303	34	0.282
iso-Amyl mercaptan	$C_5H_{11}SH$	321	....	....
iso-Amyl propionate	$C_2H_5CO_2C_5H_{11}$	338	....	....
iso-Amyl sulfide	$(C_5H_{11})_2S$	391	....	....
Aniline	$C_6H_5NH_2$	426	52.4	....
Anisole	$C_6H_5OCH_3$	369	41.3	....
Argon	A	−122	48	0.531
Benzene	C_6H_6	288.5	47.7	0.304
Benzonitrile	C_6H_5CN	426	41.6	....
Bromine	Br_2	302	....	....
Bromobenzene	C_6H_5Br	397	44.6	0.486
n-Butane	C_4H_{10}	153	36	....
iso-Butane	C_4H_{10}	134	37	....
n-Butyl acetate	$CH_3CO_2C_4H_9$	306	....	....
iso-Butyl acetate	$CH_3CO_2C_4H_9$	288	31	0.281
n-Butyl alcohol	C_4H_9OH	287	48.4	....
iso-Butyl alcohol	C_4H_9OH	265	48	....
sec.-Butyl alcohol	C_4H_9OH	265	....	....
tert.-Butyl alcohol	C_4H_9OH	235	....	....
iso-Butyl butyrate	$C_3H_7CO_2C_4H_9$	338	....	....
iso-Butyl formate	$HCO_2C_4H_9$	278	38	0.288
iso-Butyl isobutyrate	$C_3H_7CO_2C_4H_9$	329	....	....
iso-Butyl isovalerate	$C_4H_9CO_2C_4H_9$	348	....	....
iso-Butyl propionate	$C_2H_5CO_2C_4H_9$	319	....	....
n-Butyric acid	$C_3H_7CO_2H$	355	....	0.302
iso-Butyric acid	$C_3H_7CO_2H$	336	....	0.304
Butyronitrile	C_3H_7CN	309	37.4	....
Capronitrile	$C_5H_{11}CN$	349	32.2	....
Carbon dioxide	CO_2	31.1	73.0	0.460
Carbon disulfide	CS_2	273	76	....
Carbon monoxide	CO	−139	35	0.311
Carbon oxysulfide	COS	105	61	....
Carbon tetrachloride	CCl_4	283.1	45.0	0.558
Chlorine	Cl_2	144.0	76.1	0.573
Chlorobenzene	C_6H_5Cl	359	44.6	0.365
Chloroform	$CHCl_3$	263	....	0.516
m-Cresol	C_7H_7OH	432	45.0	....
o-Cresol	C_7H_7OH	422	49.4	....
p-Cresol	C_7H_7OH	426	50.8	....
Cyanogen	C_2N_2	128	59	....
Cyclohexane	C_6H_{12}	281.0	40.4	0.270
Diethyl amine	$(C_2H_5)_2NH$	223.5	36.2	0.246

* Plait point. † Critical point of contact.

CRITICAL CONSTANTS FOR GASES (Continued)

Name	Formula	Temp., °C.	Pressure, atm.	Density gms. per cm.³
Diisobutyl	C_8H_{18}	277	24.5	0.237
Diisopropyl	C_6H_{14}	227.4	30.6	0.241
Dimethyl amine	$(CH_3)_2NH$	164.6	51.7	....
Dimethyl aniline	$C_6H_5N(CH_3)_2$	415	35.8	....
Dimethyl-*o*-toluidine	$C_7H_7N(CH_3)_2$	395	30.8	....
Dipropyl amine	$(C_3H_7)_2NH$	277	31	....
Ethane	C_2H_6	32.1	48.8	0.21
Ethyl acetate	$CH_3CO_2C_2H_5$	250.1	37.8	0.308
Ethyl alcohol	C_2H_5OH	243.1	63.1	0.2755
Ethyl allyl ether	$C_2H_5OC_3H_5$	245	....	....
Ethyl amine	$C_2H_5NH_2$	183.2	55.5	....
Ethyl bromide	C_2H_5Br	231	....	0.513
Ethyl butyrate	$C_3H_7CO_2C_2H_5$	293	30	0.276
Ethyl caprylate	$C_7H_{15}CO_2C_2H_5$	386	....	....
Ethyl chloride	C_2H_5Cl	187.2	52	0.33
Ethyl chloroformate	$ClCO_2C_2H_5$	<235	....	....
Ethyl crotonate	$C_3H_5CO_2C_2H_5$	326	....	....
Ethyl disulfide	$(C_2H_5)_2S_2$	369	....	....
Ethyl ether	$(C_2H_5)_2O$	193.8	35.5	0.2625
Ethyl formate	$HCO_2C_2H_5$	235.3	46.65	0.323
Ethyl isobutyrate	$C_3H_7CO_2C_2H_5$	280	30	0.276
Ethyl isovalerate	$C_4H_9CO_2C_2H_5$	315	....	....
Ethyl mercaptan	C_2H_5SH	225.5	54.2	0.301
Ethyl nonylate	$C_8H_{17}CO_2C_2H_5$	400	....	....
Ethyl propionate	$C_2H_5CO_2C_2H_5$	272.9	33.0	0.2965
Ethyl propyl ether	$C_2H_5OC_3H_7$	227.4	32.1	0.258
Ethyl sulfide	$(C_2H_5)_2S$	283.8	39.1	0.279
Ethyl valerate	$C_4H_9CO_2C_2H_5$	297	....	....
Ethylene	C_2H_4	9.7	50.9	0.22
Ethylene oxide	$(CH_2)_2O$	192.0	....	....
Fluorobenzene	C_6H_5F	286	44.6	0.354
Germanium tetrachloride	$GeCl_4$	277	38	....
Helium	He	−267.9	2.26	0.0693
n-Heptane	C_7H_{16}	266.8	26.8	0.234
n-Heptyl alcohol	$C_7H_{15}OH$	365	....	....
n-Hexane	C_6H_{14}	234.8	29.5	0.234
Hydrazine	N_2H_4	380	145	....
Hydrogen	H_2	−239.9	12.8	0.0310
Hydrogen bromide	HBr	90	84	....
Hydrogen chloride	HCl	51.4	81.6	0.42
Hydrogen cyanide	HCN	183.5	50	0.20
Hydrogen iodide	HI	151	82	....
Hydrogen selenide	H_2Se	138	88	....
Hydrogen sulfide	H_2S	100.4	88.9	....
Iodine	I_2	553	....	....
Iodobenzene	C_6H_5I	448	44.6	0.581
Krypton	Kr	−63	54	0.78
Mercury	Hg	>1550	>200	4–5
Methane	CH_4	−82.5	45.8	0.162
Methyl acetate	$CH_3CO_2CH_3$	233.7	46.3	0.325
Methyl alcohol	CH_3OH	240.0	78.7	0.272
Methyl amine	CH_3NH_2	156.9	73.6	....
Methyl aniline	$C_6H_5NHCH_3$	429	51.3	....
Methyl butyrate	$C_3H_7CO_2CH_3$	281.3	34.2	0.300
Methyl chloride	CH_3Cl	143.1	65.8	0.37
Methyl ethyl ether	$C_2H_5OCH_3$	164.7	43.4	0.270
Methyl ethyl sulfide	$CH_3SC_2H_5$	260	42	....
Methyl fluoride	CH_3F	44.9	62.0	....
Methyl formate	HCO_2CH_3	214.0	59.15	0.349
Methyl isobutyrate	$C_3H_7CO_2CH_3$	267.55	33.7	0.301

CRITICAL CONSTANTS FOR GASES (Continued)

Name	Formula	Temp., °C.	Pressure, atm.	Density gms. per cm.^{3}
Methyl mercaptan	CH_3SH	196.8	71.4	0.323
Methyl oxalate	$(CO_2CH_3)_2$	260	9.48	....
Methyl propionate	$C_2H_5CO_2CH_3$	257.4	39.3	0.312
Methyl sulfide	$(CH_3)_2S$	229.9	54.6	0.306
Methyl valerate	$C_4H_9CO_2CH_3$	294d	32	0.279
Methylal	$H_2C(OCH_3)_2$	224	....	....
Neon	Ne	−228.7	25.9	0.484
Nitric oxide	NO	−94	65	0.52
Nitrogen	N_2	−147.1	33.5	0.3110
Nitrogen tetroxide	N_2O_4	158	99	....
Nitrous oxide	N_2O	36.5	71.7	0.45
***n*-Octane**	C_8H_{18}	296	24.6	0.234
***n*-Octyl** alcohol	$C_8H_{17}OH$	385	....	....
***sec*.-Octyl** alcohol	$C_8H_{17}OH$	364	....	....
Oxygen	O_2	−118.8	49.7	0.430
Paraldehyde	$C_6H_{12}O_3$	290	....	....
***n*-Pentane**	C_5H_{12}	197.2	33.0	0.232
***iso*-Pentane**	C_5H_{12}	187.8	32.8	0.234
Phenetole	$C_6H_5OC_2H_5$	374	33.8	....
Phenol	C_6H_5OH	419	60.5	....
Phosgene	$COCl_2$	182	56	0.52
Phosphine	PH_3	51	64	0.30
Phosphonium chloride	PH_4Cl	49	73	....
Propane	C_3H_8	95.6	43	....
Propionic acid	$C_2H_5CO_2H$	339.5	53.0	0.315
Propionitrile	C_2H_5CN	291.2	41.3	0.241
Propyl acetate	$CH_3CO_2C_3H_7$	276.2	32.9	0.296
***n*-Propyl** alcohol	C_3H_7OH	263.7	49.95	0.273
***iso*-Propyl** alcohol	C_3H_7OH	235	53	....
Propyl amine	$C_3H_7NH_2$	223.8	46.3	....
Propyl butyrate	$C_3H_7CO_2C_3H_7$	327	....	....
***n*-Propyl chloride**	C_3H_7Cl	230	45.2	....
Propyl formate	$HCO_2C_3H_7$	264.85	40.1	0.309
Propyl isobutyrate	$C_3H_7CO_2C_3H_7$	316	....	....
Propyl isovalerate	$C_4H_9CO_2C_3H_7$	336	....	....
Propyl propionate	$C_2H_5CO_2C_3H_7$	305	....	....
Propylene	C_3H_6	92.3	45.0	....
Pyridine	C_5H_5N	344	60.0	....
Quinoline	C_9H_7N	>520	....	....
Radon	Rn	104	62	....
Silicon tetrafluoride	SiF_4	−1.5	50	....
Silicon tetrahydride	SiH_4	−3.5	48	....
Stannic chloride	$SnCl_4$	318.7	37.0	0.742
Sulfur	S	1040	....	....
Sulfur dioxide	SO_2	157.2	77.7	0.52
Sulfur trioxide	SO_3	218.3	83.6	0.630
Thiophene	C_4H_4S	317	48	....
Thymol	$C_{10}H_{13}OH$	425	....	....
Toluene	$C_6H_5CH_3$	320.6	41.6	0.292
Tolunitrile	C_7H_7CN	450	....	....
Triethyl amine	$(C_2H_5)_3N$	262	30	0.251
Trimethyl amine	$(CH_3)_3N$	161	41	....
***n*-Valeric** acid	$C_4H_9CO_2H$	379	....	....
***iso*-Valeric** acid	$C_4H_9CO_2H$	361	....	....
Water	H_2O	374.0	217.72	0.4
Xenon	Xe	16.6	58.2	1.155

Name	Formula	*a*	*b*
Acetic acid	CH_3CO_2H	0.03505	0.004767
Acetic anhydride	$(CH_3CO)_2O$	0.03967	0.005639
Acetone	$(CH_3)_2CO$	0.02774	0.004437
Acetonitrile	CH_3CN	0.03503	0.005216
Acetylene	C_2H_2	0.00875	0.002293
Ammonia	NH_3	0.00831	0.001655
Amyl formate	$HCO_2C_5H_{11}$	0.05496	0.007724
Amylene	C_5H_{10}	0.03169	0.005390
iso-Amylene	C_5H_{10}	0.03604	0.006274
Aniline	$C_6H_5NH_2$	0.05282	0.006113
Argon	A	0.00268	0.001437
Benzene	C_6H_6	0.03588	0.005150
Benzonitrile	C_6H_5CN	0.06655	0.007697
Bromobenzene	C_6H_5Br	0.05692	0.006872
n-Butane	C_4H_{10}	0.02884	0.005472
iso-Butane	C_4H_{10}	0.02564	0.005098
iso-Butyl acetate	$CH_3CO_2C_4H_9$	0.05680	0.008185
iso-Butyl alcohol	C_4H_9OH	0.03394	0.005103
iso-Butyl benzene	$C_6H_5C_4H_9$	0.07692	0.009572
iso-Butyl formate	$HCO_2C_4H_9$	0.04492	0.006591
Butyronitrile	C_3H_7CN	0.05125	0.007126
Capronitrile	$C_5H_{11}CN$	0.06808	0.008858
Carbon dioxide	CO_2	0.00716	0.001905
Carbon disulfide	CS_2	0.02316	0.003431
Carbon monoxide	CO	0.00296	0.001779
Carbon oxysulfide	COS	0.00784	0.002597
Carbon tetrachloride	CCl_4	0.04064	0.006173
Chlorine	Cl_2	0.01294	0.002510
Chlorobenzene	C_6H_5Cl	0.05068	0.006485
Chloroform	$CHCl_3$	0.03023	0.004562
m-Cresol	C_7H_8O	0.06254	0.007175
Cyanogen	C_2N_2	0.01528	0.003081
Cyclohexane	C_6H_{12}	0.04347	0.006359
Cymene	$C_{10}H_{14}$	0.08403	0.010430
Decane	$C_{10}H_{22}$	0.09675	0.012970
Di-isobutyl	C_8H_{18}	0.06970	0.010250
Diethylamine	$(C_2H_5)_2NH$	0.03816	0.006216
Dimethylamine	$(CH_3)_2NH$	0.02069	0.003826
Dimethyl aniline	$C_6H_5N(CH_3)_2$	0.07473	0.008793
Diphenyl	$(C_6H_5)_2$	0.10520	0.011079
Diphenyl methane	$(C_6H_5)_2CH_2$	0.07616	0.010000
Dipropylamine	$(C_3H_7)_2NH$	0.05524	0.008124
Di-isopropyl	C_6H_{14}	0.04610	0.007453
Durene	$C_{10}H_{14}$	0.09032	0.010820
Ethane	C_2H_6	0.01074	0.002848
Ethyl acetate	$CH_3CO_2C_2H_5$	0.04076	0.006303
Ethyl alcohol	C_2H_5OH	0.02395	0.003753
Ethylamine	$C_2H_5NH_2$	0.02113	0.003754
Ethyl benzene	$C_6H_5C_2H_5$	0.05701	0.007443
Ethyl butyrate	$C_3H_7CO_2C_2H_5$	0.05993	0.008567
Ethyl isobutyrate	$C_3H_7CO_2C_2H_5$	0.05754	0.008410
Ethyl chloride	C_2H_5Cl	0.02174	0.003862
Ethyl ether	$(C_2H_5)_2O$	0.03464	0.006002
Ethyl formate	$HCO_2C_2H_5$	0.02949	0.004714
Ethyl mercaptan	C_2H_5SH	0.02240	0.003615
Ethyl propionate	$C_2H_5CO_2C_2H_5$	0.04861	0.007209
Ethyl sulfide	$(C_2H_5)_2S$	0.03737	0.005421
Ethylene	C_2H_4	0.00891	0.002551
Ethylene bromide	$(CH_2Br)_2$	0.02787	0.003868
Ethylene chloride	$(CH_2Cl)_2$	0.03370	0.004850
Ethylidene chloride	CH_3CHCl_2	0.03090	0.004790
Fluorobenzene	C_6H_5F	0.03972	0.005742
Germanium tetrachloride	$GeCl_4$	0.04504	0.006630
Helium	He	0.000068	0.001058
n-Heptane	C_7H_{16}	0.06280	0.011850

*For pressure in atom. Vol. at 0°C and 1 atm. =1

Name	Formula	*a*	*b*
n-Hexane	C_6H_{14}	0.04861	0.007747
Hydrogen	H_2	0.000487	0.001188
Hydrogen bromide	HBr	0.00887	0.001978
Hydrogen chloride	HCl	0.00731	0.001822
Hydrogen selenide	H_2Se	0.01050	0.002070
Hydrogen sulfide	H_2S	0.00883	0.001914
Iodobenzene	C_6H_5I	0.06592	0.007395
Krypton	Kr	0.00462	0.001776
Mercury	Hg	0.01613	0.000757
Mesitylene	C_9H_{12}	0.06840	0.008835
Methane	CH_4	0.00449	0.001910
Methyl acetate	$CH_3CO_2CH_3$	0.03047	0.004870
Methyl alcohol	CH_3OH	0.01898	0.002992
Methylamine	CH_3NH_2	0.01421	0.002675
Methyl butyrate	$C_3H_7CO_2CH_3$	0.04771	0.007004
Methyl isobutyrate	$C_3H_7CO_2CH_3$	0.04883	0.007308
Methyl chloride	CH_3Cl	0.01489	0.002894
Methyl ether	$(CH_3)_2O$	0.01609	0.003235
Methyl ethyl ether	$CH_3OC_2H_5$	0.02381	0.004364
Methyl ethyl sulfide	$CH_3SC_2H_5$	0.03833	0.005821
Methyl fluoride	CH_3F	0.00923	0.002350
Methyl formate	HCO_2CH_3	0.02160	0.003602
Methyl propionate	$C_2H_5CO_2CH_3$	0.03968	0.006070
Methyl sulfide	$(CH_3)_2S$	0.02564	0.004113
Methyl valerate	$C_4H_9CO_2CH_3$	0.05771	0.008237
Naphthalene	$C_{10}H_8$	0.07923	0.008648
Neon	Ne	0.00042	0.000763
Nitric oxide	NO	0.00267	0.001245
Nitrogen	N_2	0.00277	0.001747
Nitrogen dioxide	NO_2	0.01053	0.001975
Nitrous oxide	N_2O	0.00754	0.001971
n-Octane	C_8H_{18}	0.07440	0.010570
Oxygen	O_2	0.00271	0.001421
n-Pentane	C_5H_{12}	0.03788	0.006516
iso-Pentane	C_5H_{12}	0.03598	0.006328
Phenetole	$C_6H_5OC_2H_5$	0.07009	0.008764
Phosphine	PH_3	0.00923	0.002302
Phosphonium chloride	PH_4Cl	0.00808	0.002029
Phosphorus	P	0.10550	0.006990
Propane	C_3H_8	0.001727	0.003770
Propionic acid	$C_2H_5CO_2H$	0.04008	0.005297
Propionitrile	C_2H_5CN	0.03277	0.004750
Propyl acetate	$CH_3CO_2C_3H_7$	0.04908	0.007227
Propyl alcohol	C_3H_7OH	0.02974	0.004548
iso-Propyl alcohol	C_3H_7OH	0.02747	0.004377
Propyl amine	$C_3H_7NH_2$	0.02988	0.004865
Propyl benzene	$C_3H_7C_6H_5$	0.07146	0.009064
iso-Propyl benzene	$C_6H_5C_3H_7$	0.07105	0.009041
Propyl chloride	C_3H_7Cl	0.03170	0.005098
Propyl formate	$HCO_2C_3H_7$	0.03777	0.005724
Propylene	C_3H_6	0.01670	0.003693
Pseudo-cumene	C_9H_{12}	0.07298	0.009023
Silicon fluoride	SiF_4	0.00836	0.002487
Silicon tetrahydride	SiH_4	0.00861	0.002583
Stannic chloride	$SnCl_4$	0.05363	0.007332
Sulfur dioxide	SO_2	0.01338	0.002516
Thiophene	C_4H_4S	0.04130	0.005670
Toluene	$C_6H_5CH_3$	0.04795	0.006533
Triethylamine	$(C_2H_5)_3N$	0.05415	0.008176
Trimethylamine	$(CH_3)_3N$	0.02594	0.004841
Xenon	Xe	0.00816	0.002279
m-Xylene	$C_6H_4(CH_3)_2$	0.06051	0.007912
o-Xylene	$C_6H_4(CH_3)_2$	0.05974	0.007836
p-Xylene	$C_6H_4(CH_3)_2$	0.06165	0.008077
Water	H_2O	0.01089	0.001362

FREEZING MIXTURES

A is the proportion of the substance named in the first column to be added to the proportion of the substance given in column *B*. The table gives the temperature of the separate ingredients and the temperature attained by the mixture.

(From Smithsonian Tables.)

Substance.	*A*	*B*	Initial Temp. ° C.	Temp. ° C. attained by mixt.
$NaC_2H_3O_2$ (cryst.)	85	H_2O 100	10.7	− 4.7
NH_4Cl	30	H_2O 100	13.3	− 5.1
$NaNO_3$	75	H_2O 100	13.2	− 5.3
$Na_2S_2O_3$ (cryst.)	110	H_2O 100	10.7	− 8.0
KI	140	H_2O 100	10.8	−11.7
$CaCl_2$ (cryst.)	250	H_2O 100	10.8	−12.4
NH_4NO_3	60	H_2O 100	13.6	−13.6
$CaCl_2$	30	* Snow 100	− 1	−10.9
NH_4Cl	25	Snow 100	− 1	−15.4
NH_4NO_3	45	Snow 100	− 1	−16.75
$NaNO_3$	50	Snow 100	− 1	−17.75
NaCl	33	Snow 100	− 1	−21.3
$H_2SO_4+H_2O$ (66.1% H_2SO_4)	1	Snow 1.097	− 1	−37.0
	1	Snow 2.52	− 1	−30.0
	1	Snow 4.32	− 1	−25.0
	1	Snow 7.92	− 1	−20.0
	1	Snow 13.08	− 1	−16.0
$CaCl_2+6H_2O$	1	Snow .49	0	−19.7
	1	Snow .61	0	−39.0
	1	Snow .70	0	−54.9
	1	Snow .81	0	−40.3
	1	Snow 1.23	0	−21.5
	1	Snow 2.46	0	− 9.0
	1	Snow 4.92	0	− 4.0
Alcohol at 4°	77	Snow 73.	0	−30.0
	..	CO_2 solid	......	−72.0
Chloroform	....	CO_2 solid	......	−77.0
Ether	....	CO_2 solid	......	−77.0
Liquid SO_2	....	CO_2 solid	......	−82.0
NH_4NO_3	1	H_2O .94	20	− 4.0
	1	Snow .94	0	− 4.0
	1	H_2O 1.20	10	−14.0
	1	Snow 1.20	0	−14.0
	1	H_2O 1.31	10	−17.5
	1	Snow 1.31	0	−17.5

* Or finely pulverized ice.

PERCENTAGE COMPOSITION OF ANTI-FREEZE SOLUTIONS

Alcohol and Water Solutions

% alcohol by weight	Sp. gr. 20°/4° C. (68° F.)	Point of crystallization	
		Deg. C.	Deg. F.
2.5	0.99363	−1.0	30.2
4.8	0.98971	−2.0	28.4
6.8	0.98658	−3.0	26.6
11.3	0.98006	−5.0	23.0
13.8	0.97670	−6.1	21.0
16.4	0.97336	−7.5	18.5
17.5	0.97194	−8.7	16.3
18.8	0.97024	−9.4	15.1
20.3	0.96823	−10.6	12.9
22.1	0.96578	−12.2	10.0
24.2	0.96283	−14.0	6.8
26.7	0.95914	−16.0	3.2
29.9	0.95400	−18.9	−2.0
33.8	0.94715	−23.6	−10.5
39.0	0.93720	−28.7	−19.7
46.3	0.92193	−33.9	−29.0
56.1	0.90008	−41.0	−41.8
71.9	0.86311	−51.3	−60.3

Glycerol (Glycerine) and Water Solutions*

% glycerol by weight	Sp. gr. 15°/15° C. (59° F.)	Sp. gr. 20°/20° C. (68° F.)	Freezing point	
			Deg. C.	Deg. F.
10	1.02415	1.02395	−1.6	29.1
20	1.04935	1.04880	−4.8	23.4
30	1.07560	1.07470	−9.5	14.9
40	1.10255	1.10135	−15.4	4.3
50	1.12985	1.12845	−23.0	−9.4
60	1.15770	1.15605	−34.7	−30.5
70	1.18540	1.18355	−38.9	−38.0
80	1.21290	1.21090	−20.3	−5.5
90	1.23950	1.23755	−1.6	29.1
100	1.26557	1.26362	17.0	62.6

* Bosart and Snoddy, Jour. Ind. Eng. Chem. 19, 506 (1927); Lane, ibid. 17, 924 (1925). The Chemical Division of the Proctor and Gamble Co suggest that a correction of +2° F. be added to all temperatures below zero degree Fahrenheit.

Ethylene Glycol (Prestone) and Water Solutions

% glycol by volume	Sp. gr. 15.6° C. (60° F.)	Freezing point	
		Deg. C.	Deg. F.
12.5	1.019	3.9	25
17.0	1.026	−6.7	20
25.0	1.038	−12.2	10
32.5	1.048	−17.8	0
38.5	1.056	−23.3	−10
44.0	1.063	−28.9	−20
49.0	1.069	−34.4	−30
52.5	1.073	−40.0	−40

HEAT OF FUSION

Elements and Inorganic Compounds

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
Aluminum	Al	658	76.8
Ammonia	NH_3	−75	108.1
		−77.6	83.9
Antimony bromide	$SbBr_3$	94	9.76
trichloride	$SbCl_3$	73.2	13.3
trisulfide	Sb_2S_3	540	17.6
Argon	A	−190	6.71
Arsenous bromide	$AsBr_3$	31	8.94
Barium chloride	$BaCl_2$	958.9	27.5
Bismuth	Bi	268	12.64
Bromine	Br	−7.32	16.2
Cadmium	Cd	320.7	13.66
nitrate	$Cd(NO_3)_2{\cdot}4H_2O$	59.5	25.3
Caesium hydroxide	CsOH	272.3	10.8
Calcium chloride	$CaCl_2$	773.9	54.3
chloride	$CaCl_2{\cdot}6H_2O$	29	40.7
nitrate	$Ca(NO_3)_2{\cdot}4H_2O$	42.1	34.0
Carbon dioxide	CO_2	−56.2	45.3
monoxide	CO	−206	8.00
Chlorine	Cl	−103.5	23.0
Cobalt nitrate	$Co(NO_3)_2{\cdot}6H_2O$	....	30.2
Copper	Cu	1083	42.
Cupric nitrate	$Cu(NO_3)_2{\cdot}6H_2O$	24.4	29.4
Gold	Au	1064	15.8
Hydriodic acid	HI	−53	5.68
Hydrobromic acid	HBr	−86	7.67
Hydrochloric acid	HCl	−114	13.9
acid	$HCl{\cdot}2H_2O$	−18.5	34.6
Hydrogen	H	....	14.0
peroxide	H_2O_2	−1.7	74.1
Iodine	I	....	11.71
Iron, gray cast	Fe	....	5.50
white cast	....	....	7.89
slag	....	....	11.9
Lead	Pb	327	5.86
bromide	$PbBr_2$	490	12.3
chloride	$PbCl_2$	485	20.9
iodide	PbI_2	375	11.5
Lithium nitrate	$LiNO_3$	250	88.5
silicate	Li_2SiO_3	....	80.2
silicate	$Li_2SiO_3{\cdot}Li_2O$	....	62.1
Magnesium chloride	$MgCl_2{\cdot}6H_2O$	116.7	41.2
nitrate	$Mg(NO_3)_2{\cdot}6H_2O$	90	38.2
Manganese nitrate	$Mn(NO_3)_2{\cdot}6H_2O$	25.8	28.8
Mercuric bromide	$HgBr_2$	235	12.8
iodide	HgI_2	250	9.80
Mercury	Hg	−39	2.82
Nickel	Ni	1435	73.8
nitrate	$Ni(NO_3)_2{\cdot}6H_2O$	56.7	36.4
Nitric acid	HNO_3	−47	9.55
Nitrogen	N	−210	6.09
dioxide	NO	−163	18.4
pentoxide	N_2O_5	29.5	76.7
tetroxide	N_2O_4	−10.14	32.3 to 37.2
Oxygen	O	−219	3.30
Palladium	....	1545	36.3

HEAT OF FUSION (Continued)

Elements and Inorganic Compounds

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
Platinum	Pt	1755	27.2
Potassium	K	62	15.7
chloride	KCl	772.3	74.1
dichromate	$K_2Cr_2O_7$	397	29.7
fluoride	KF	859.9	108.
hydroxide	KOH	360.4	28.6
nitrate	KNO_3	308	25.4
Phosphorous acid, hypo	H_3PO_2	17.4	35.0
Phosphorus	P	44.2	5.03
oxychloride	$POCl_3$	2	19.8
Rubidium chloride	RbCl	....	38.0
hydroxide	RbOH	301	15.8
Silicon tetrachloride	$SiCl_4$	70.3	10.9
Silver	Ag	961	21.07
bromide	AgBr	430	12.5
chloride	AgCl	451	30.7
		455	21.3
nitrate	$AgNO_3$	208	17.7
Sodium	Na	97	31.7
chlorate	$NaClO_3$	255	49.0
chloride	NaCl	804.3	124.
chromate	$Na_2CrO_4 \cdot 10H_2O$	23	39.2
fluoride	NaF	992.2	186.
hydroxide	NaOH	318.4	40.0
nitrate	$NaNO_3$	333	45.3
phosphate, dibasic	$Na_2HPO_4 \cdot 12H_2O$	36.1	66.8
sulfate	$Na_2SO_4 \cdot 10H_2O$	31	51.3
thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	....	47.8
Stannic bromide	$SnBr_4$	25.5	6.26
chloride	$SnCl_4$	−33	8.40
Strontium chloride	$SrCl_2$	872.3	25.4
Sulfur	S	119	13.2
trioxide	SO_3	−30	24.0
Sulfuric acid	$H_2SO_4 \cdot H_2O$	8.56	39.1
acid	H_2SO_4	10.352	24.0
acid, pyro-	$H_2S_2O_7$	35	17.9
Thallium bromide	TlBr	460	12.7
monochloride	TlCl	427	16.6
Tin	Sn	232	14.0
Titanium tetrachloride	$TiCl_4$	−25	11.8
Water	H_2O	0	79.71
ice from sea water	H_2O	−8.7	54.0
Zinc	....	419	28.13
nitrate	$Zn(NO_3)_2 \cdot 6H_2O$	36.4	31.1

HEAT OF FUSION (Continued)

Organic Compounds

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
Acetic acid	CH_3CO_2H	16.58	44.7
		16.7	43.2
Acetone	$(CH_3)_2CO$	−95.5	23.4
		−94.6	19.6
Acrylic acid	$C_2H_3CO_2H$	13	37.0
Allocinnamic acid	$C_6H_5C_2H_2CO_2H$	58	27.4
o-Aminobenzoic acid	$H_2NC_6H_4CO_2H$	145	35.5
m-Aminobenzoic acid	....	180	38.0
p-Aminobenzoic acid	....	188.5	36.5
tert.-Amyl alcohol	$C_5H_{11}OH$	....	12.5
Anethole	$C_3H_5C_6H_4OCH_3$	21.5	25.8
Aniline	$C_6H_5NH_2$	−7.03	21.0
Anthracene	$C_{14}H_{10}$	216.55	38.7
Anthraquinone	$(C_6H_4)_2(CO)_2$	282	37.5
Azobenzene	$(C_6H_5N)_2$	69.1	28.9
		66	28.0
		68	32.4
Azoxybenzene	$(C_6H_5)_2ON_2$	34.6	21.6
Benzene	C_6H_6	5.42	30.3
		5.40	30.2
Benzil	$(C_6H_5CO)_2$	94.94	22.2
Benzoic acid	$C_6H_5CO_2H$	121.8	33.9
Benzophenone	$(C_6H_5)_2CO$	48.25	23.5
Benzylaniline	$C_6H_5NHC_7H_7$	36	21.9
Bromal hydrate	$CBr_3CHO \cdot H_2O$	46	16.9
Bromocamphor	$C_{10}H_{15}BrO$	....	41.6
o-Bromochlorobenzene	C_6H_4BrCl	−12.6	15.4
m-Bromochlorobenzene	....	−21.2	15.3
p-Bromochlorobenzene	....	64.6	23.4
o-Bromoiodobenzene	C_6H_4BrI	21	12.2
m-Bromoiodobenzene	....	−9.3	10.3
p-Bromoiodobenzene	....	90.1	16.6
p-Bromophenol	HOC_6H_4Br	64	20.5
p-Bromotoluene	$CH_3C_6H_4Br$	27.6	20.9
n-Butyl alcohol	C_4H_9OH	−89.2	29.9
tert.-Butyl alcohol	C_4H_9OH	25.45	21.0
		25.4	21.9
n-Butyric acid	$C_3H_7CO_2H$	−5.7	30.1
n-Capric acid	$C_9H_{19}CO_2H$	31.2	38.9
n-Caprylic acid	$C_7H_{15}CO_2H$	16.34	35.4
Carbazole	$C_{12}H_9N$	236	42.1
Carbon tetrachloride	CCl_4	−24	4.16
Carvoxime (d)	$C_{10}H_{14}NOH$	71.5	23.3
Carvoxime (l)	....	71	23.4
Carvoxime (dl)	....	91	24.6
Catechol	$C_6H_4(OH)_2$	104.3	49.4
Cetyl alcohol	$C_{16}H_{33}OH$	47	33.8
Cinnamic acid	$C_6H_5C_2H_2CO_2H$	133	36.5
anhydride	$(C_6H_5C_2H_4CO)_2O$	48	28.1
Chloral alcoholate	$CCl_3CHO \cdot C_2H_5OH$	9	24.0
hydrate	$CCl_3CHO \cdot H_2O$	....	33.2
Chloroacetic acid (α)	$ClCH_2CO_2H$	61.2	31.1
acid (β)	....	56	35.1
p-Chloroaniline	$H_2NC_6H_4Cl$	69.	37.2
o-Chlorobenzoic acid	$ClC_6H_4CO_2H$	140.2	39.3
m-Chlorobenzoic acid	....	154.25	36.4
p-Chlorobenzoic acid	....	239.7	49.2

HEAT OF FUSION (Continued)

Organic Compounds

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
m-Chloronitrobenzene	$ClC_6H_4NO_2$	43.8	29.4
		44.16	31.5
p-Chloronitrobenzene		82	21.4
p-Cresol	$CH_3C_6H_4OH$	34	26.3
Cyanamide	H_2NCN	42.9	49.8
Cyclohexanol	$C_6H_{11}(OH)$	23.2	4.19
Dibenzyl	$(C_6H_5CH_2)_2$	51	31.0
o-Dibromobenzene	$C_6H_4Br_2$	18	12.8
m-Dibromobenzene		−6.9	13.4
p-Dibromobenzene		86	20.5
Dibromophenol (2, 4)	$HOC_6H_3Br_2$	12	14.0
Dichloroacetic acid	Cl_2CHCO_2H	10.8	14.2
o-Dichlorobenzene	$C_6H_4Cl_2$	−17.5	21.0
m-Dichlorobenzene		−24.4	20.5
p-Dichlorobenzene		52.7	29.7
o-Diiodobenzene	$C_6H_4I_2$	23.4	10.2
m-Diiodobenzene		34.2	11.6
p-Diiodobenzene		129	16.2
Dimethyl tartrate (d)	$(CHOH)_2(CO_2CH_3)_2$	49	21.5
Dimethyl tartrate (dl)		87	35.1
o-Dinitrobenzene	$C_6H_4(NO_2)_2$	116.93	32.3
m-Dinitrobenzene		90.08	24.7
p-Dinitrobenzene		173.5	40.0
Dinitrotoluene (2, 4)	$CH_3C_6H_3(NO_2)_3$	70	26.4
Diphenyl	$(C_6H_5)_2$	71	26.1
Diphenylamine	$(C_6H_5)_2NH$	53.4	25.2
Diphenylmethane	$(C_6H_5)_2CH_2$	26.3	25.2
Ethyl alcohol	C_2H_5OH	−114.4	24.9
Ethylene dibromide	$(CH_2Br)_2$	9.55	13.5
Elaidic acid	$C_{17}H_{33}CO_2H$	47	52.1
Formic acid	HCO_2H	8.0	58.9
Glutaric acid	$(CH_2)_3(CO_2H)_2$	99.3	37.4
Glycerol	$C_3H_5(OH)_3$	18	47.5
Glycol	$(CH_2OH)_2$	−11.5	43.3
		−12.3	41.6
Hydrazobenzene	$(C_6H_5NH)_2$	134	22.9
Hydrocinnamic acid	$C_6H_5C_2H_4CO_2H$	48	28.1
p-Iodotoluene	$IC_6H_4CO_2H$	34	18.8
n-Lauric acid	$C_{11}H_{23}CO_2H$	43.85	43.7
Levulinic acid	$CH_3CO(CH_2)_2CO_2H$	33	19.0
α-Menthol (l)	$C_{10}H_{19}OH$	42	18.6
Methane	CH_4	−182.6	14.5
Methyl alcohol	CH_3OH	−97	16.4
		−97.8	22.0
cinnamate	$C_6H_5C_2H_2CO_2CH_3$	34.5	26.5
fumarate	$(CHCO_2CH_3)_2$	102	57.9
oxalate	$(CO_2CH_3)_2$	49.5	42.7
phenylpropiolate	$C_6H_5C_2CO_2CH_3$	18	22.9
succinate	$(CH_2CO_2CH_3)_2$	18	35.7
Myristic acid	$C_{13}H_{27}CO_2H$		47.5
Naphthalene	$C_{10}H_8$	79.9	35.6
α-Naphthol	$C_{10}H_7OH$	95	38.9
β-Naphthol		120.6	31.3
α-Naphthylamine	$C_{10}H_7NH_2$	47.5	22.3
		48.9	22.0
		50.1	24.9
o-Nitroaniline	$H_2NC_6H_4NO_2$	69.3	27.9

HEAT OF FUSION (Continued)

ORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
m-Nitroaniline	$H_2NC_6H_4NO_2$	111.8	41.0
p-Nitroaniline	....	147.5	36.5
Nitrobenzene	$C_6H_5NO_2$	5.72	22.5
o-Nitrobenzoic acid	$O_2NC_6H_4CO_2H$	145.8	40.1
m-Nitrobenzoic acid	....	141.1	27.6
p-Nitrobenzoic acid	....	239.2	52.8
α-Nitronaphthalene	$C_{10}H_7NO_2$	56	25.4
o-Nitrophenol	$HOC_6H_4NO_2$	42.8	26.8
		44.51	30.9
Palmitic acid	$C_{15}H_{31}CO_2H$	55	39.2
Paraffin	....	52.40	35.10
Paraldehyde	$(CH_3CHO)_3$	12.6	25.0
Phenanthrene	$C_{14}H_{10}$	98.2	24.3
Phenol	C_6H_5OH	25.37	29.0
Phenylacetic acid	$C_6H_5CH_2CO_2H$	74.9	25.4
		76.58	30.0
		77	32.0
Phenylhydrazine	$C_6H_5N_2H_3$	22.1	36.3
iso-Propyl alcohol	C_3H_7OH	−88.5	21.0
Quinol	$C_6H_4(OH)_2$	172.3	58.8
Quinone	$C_6H_4O_2$	112.85	40.9
Resorcinol	$C_6H_4(OH)_2$	109.65	46.2
Spermaceti	....	43.9	36.98
Stearic acid	$C_{17}H_{35}CO_2H$	64	47.6
Stilbene	$(C_6H_5CH)_2$	124	39.9
Succinic anhydride	$(CH_2CO)_2O$	119	48.7
Succinonitrile	$(CH_2CN)_2$	54.5	11.7
Thymol	$C_{10}H_{13}OH$	48.5	27.5
Tolane	$(C_6H_5C)_2$	60	28.7
o-Toluic acid	$CH_3C_6H_4CO_2H$	103.7	35.4
m-Toluic acid	....	108.75	27.6
p-Toluic acid	....	179.6	39.9
p-Toluidine	$CH_3C_6H_4NH_2$	40.01	39.9
Tribromoaniline (2, 4, 6)	$H_2NC_6H_2Br_3$	122	16.8
Tribromophenol (2, 4, 6)	$HOC_6H_2Br_3$	93	13.4
Trichloroacetic acid	CCl_3CO_2H	59.1	8.6
Trinitroglycerol	$C_3H_5(NO_3)_3$	12.3	23.0
metastable form	....	13	33.2
stable form	....	....	5.21
Trinitrotoluene (T. N. T.) (2, 4, 6)	$CH_3C_6H_2(NO_2)_3$	79	22.3
Triphenylmethane	$(C_6H_5)_3CH$	92.3	17.8
Tristearin	$(C_{17}H_{35}CO_2)_3C_3H_5$	56	45.6
n-Undecylic acid (α)	$C_{10}H_{21}CO_2H$	28.25	32.2
n-Undecylic acid (β)	....	....	42.9
Urethane	$H_2NCO_2C_2H_5$	48.7	40.9
Veratrol (1, 2)	$C_6H_4(OCH_3)_2$	22.7	27.5
Wax (Bees')	....	61.8	42.3
p-Xylene	$C_6H_4(CH_3)_2$	16	39.3

HEAT OF VAPORIZATION

Elements and Inorganic Compounds

Name	Formula	Temperature, °C	Heat of Vaporization Cal. (15°)/g
Air			50.97
Ammonia	NH_3	−33.4	327.1
		−20	317.6
		−10	309.7
		0	301.6
Ammonium chloride	NH_4Cl (solid)	350	78.9
Argon	A	−186	37.6
Boron chloride	BCl_3	10	38.2
Bromine	Br	63	43.7
Carbon dioxide	CO_2	−60	87.2
		−50	83.4
		−40	79.6
		−30	71.4
		−20	66.9
		−10	61.4
		0	55.0
		10	46.6
		20	35.1
		30	11.9
Carbon monoxide	CO	−192	50.4
Chlorosulfonic acid	$ClSO_3H$	151	110.2
Helium	He	−268.6	6.
Hydriodic acid	HI	−37.2	33.9
Hydrobromic acid	HBr	−69.9	48.7
Hydrochloric acid	HCl	−84.3	98.7
Hydrofluoric acid	HF	17	360.8
Hydrogen	H_2	−252.8	108.
sulfide	H_2S	−61.4	131.9
Iodine		184	23.95
Mercury		357	65.
Nitric acid	HNO_3	86.0	114.9
Nitrogen	N_2	−195.55	47.6
tetroxide	N_2O_4	18	93.4
Oxygen	O_2	−182.9	50.9
Phosphorus	P	287	130.
Phosphorus trichloride	PCl_3	78	51.4
Silicon tetrachloride	$SiCl_4$	57	36.1
Stannic chloride	$SnCl_4$	112	30.3
Sulfur chloride	S_2Cl_2	138	49.5
dioxide	SO_2	−10.08	94.9
		0	91.3
		10	87.7
		20	84.1
		30	80.8
		40	71.2
		50	73.8
		60	70.3
pentoxydichloride	$S_2O_5Cl_2$	140	61.2
trioxide	SO_3	53	118.5
Sulfuric acid	H_2SO_4	326	122.1
oxychloride	SO_2Cl_2	69.1	49.4
Sulfurous oxychloride	$SOCl_2$	82	54.5
Water	H_2O	0	595.9
		10	590.4
		20	584.9
		30	579.5

HEAT OF VAPORIZATION (Continued)

Elements and Inorganic Compounds

Name	Formula	Temperature, °C	Heat of Vaporization Cal. (15°)/g
Water	H_2O	40	574.0
		50	568.5
		60	563.2
		70	557.5
		80	551.7
		90	545.8
		100	539.55
		110	532.9
		120	525.7
		130	518.5
		140	511.1
		150	503.5
		160	495.6
		170	487.2
		180	478.6

ORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Heat of Vaporization Cal. (15°)/g
Acetaldehyde	CH_3CHO	21	136.
Acetic acid	CH_3CO_2H	118.3	96.8
anhydride	$(CH_3CO)_2O$	137	66.2
Acetone	$(CH_3)_2CO$	56.1	124.5
Acetonitrile	CH_3CN	80	174.
Acetyl chloride	CH_3COCl	51	78.9
Allyl alcohol	C_3H_5OH	96	163.
n-Amyl alcohol	$C_5H_{11}OH$	131	120.2
iso-Amyl alcohol		130.2	119.8
n-Amyl bromide	$C_5H_{11}Br$	129	48.3
n-Amyl ether	$(C_5H_{11})_2O$	170	69.5
n-Amyl iodide	$C_5H_{11}I$	155	47.6
iso-Amyl isobutyrate	$C_3H_7CO_2C_5H_{11}$	168	57.6
iso-Amyl n-valerate	$C_4H_9CO_2C_5H_{11}$	187	56.2
Amylene	C_5H_{10}	12.5	75.0
p-Anethole	$C_9H_9OCH_3$	232	71.4
Benzene	C_6H_6	80.2	394.8
Butane	C_4H_{10}	0	91.5
iso-Butane		10	82.4
		−10	87.5
n-Butyl alcohol	C_4H_9OH	116.8	141.
iso-Butyl alcohol		106.9	138.
sec.-Butyl alcohol		98.1	134.
tert.-Butyl alcohol		83	130.5
n-Butyl formate	$HCO_2C_4H_9$	105.1	86.8
iso-Butyl formate		97.0	78.5
n-Butyl iodide	C_4H_9I	129.5	45.9
iso-Butyl n-valerate	$C_4H_9CO_2C_4H_9$	169	57.8
iso-Butyl isovalerate		169	60.5
n-Butyric acid	$C_3H_7CO_2H$	163.5	114.0
iso-Butyric acid	$C_3H_7CO_2H$	154	111.6
n-Butyronitrile	C_3H_7CN	117.4	114.9
Carbon disulfide	CS_2	46.25	84.1
tetrachloride	CCl_4	76.75	46.4
Carvacrol	$C_{10}H_{13}OH$	237	68.1
Chloral	CCl_3CHO	....	54.0
hydrate	$Cl_3CCHO \cdot H_2O$	96	132.
Chloroform	$CHCl_3$	61.5	59.0
Cyanogen	$(CN)_2$	0	10.3
chloride	$ClCN$	13	135.
p-Cymene	$C_{10}H_{14}$	176	67.6
Dichloroacetic acid	Cl_2CHCO_2H	194.4	77.2
n-Decane	$C_{10}H_{22}$	160	60.2
Diethyl carbonate	$CO(OC_2H_5)_2$	126	73.1
ketone	$(C_2H_5)_2CO$	101	90.8
Diethylamine	$(C_2H_5)_2NH$	58	91.0
Dimethyl carbonate	$CO(OCH_3)_2$	90	88.2
Ethane	C_2H_6	0	75.0
		−20	87.0
		−40	97.5
		−90	127.
Ethyl acetate	$CH_3CO_2C_2H_5$	0.0	102.0
alcohol	C_2H_5OH	78.3	204.
bromide	C_2H_5Br	38.4	59.9
caprylate	$C_7H_{15}CO_2C_2H_5$	207	60.5
chloride	C_2H_5Cl	4.7	92.95
		15.0	92.5
		20.0	92.2
		25.0	92.0

HEAT OF VAPORIZATION (Continued)

Organic Compounds

Name	Formula	Temperature, °C.	Heat of Vaporization Cal. (15°)/g
Ethyl			
ether	$(C_2H_5)_2O$	34.6	83.9
formate	$HCO_2C_2H_5$	53.3	97.2
iodide	C_2H_5I	71.2	45.6
nonylate	$C_8H_{17}CO_2C_2H_5$	227	58.1
propionate	$C_2H_5CO_2C_2H_5$	97.6	80.1
Ethylene bromide	$(CH_2Br)_2$	130.8	46.2
chloride	$(CH_2Cl)_2$	0.0	85.3
		82.3	77.3
oxide	$(CH_2)_2O$	13	139.
Ethylamine	$C_2H_5NH_2$	15	14.6
Ethylidene chloride	CH_3CHCl_2	0.0	76.7
		60	67.1
Formic acid	HCO_2H	101	120.0
Furane	$(CH)_4O$	31	95.3
Furfural	C_4H_3OCHO	160.5	107.5
Glycol	$(CH_2OH)_2$	197	191.
Hydrocyanic acid	HCN	20	210.
Methane	CH_4	−159	138.
Methyl acetate	$CH_3CO_2CH_3$	0.0	114.0
		56.3	98.1
alcohol	CH_3OH	64.7	262.8
n-butyrate	$C_3H_7CO_2CH_3$	102.6	79.8
chloride	CH_3Cl	−23.8	102.3
		20.0	95.3
ethyl ketone	$CH_3COC_2H_5$	78.2	106.0
ethyl ketoxime	C_4H_8NOH	182	115.9
formate	HCO_2CH_3	31.3	112.4
iodide	CH_3I	42	45.9
isobutyrate	$C_3H_7CO_2CH_3$	91.1	78.1
isopropyl ketone	$C_4H_{10}CO$	92	89.8
propionate	$C_2H_5CO_2CH_3$	79.0	87.6
Methylene chloride	CH_2Cl_2	40.5	78.6
Naphthalene	$C_{10}H_8$	218	75.5
Nitromethane	CH_3NO_2	99.9	135.
iso-Pentane	C_5H_{12}	13	88.7
Piperidine	$C_5H_{11}N$	106	89.4
Propane	C_3H_8	20	83.4
		0	89.6
		−20	95.3
		−30	98.0
Propionic acid	$C_2H_5CO_2H$	139.3	98.8
Propionitrile	C_2H_5CN	97	134.
n-Propyl acetate	$CH_3CO_2C_3H_7$	100.4	80.3
n-Propyl alcohol	C_3H_7OH	97.2	164.
iso-Propyl alcohol	....	82.3	159.
n-Propyl formate	$HCO_2C_3H_7$	80.0	88.1
Pyridine	C_5H_5N	114.1	107.4
Tetrachloroethane-1, 1, 2, 2	$(CHCl_2)_2$	145.0	55.1
Tetrachloroethylene	$(CCl_2)_2$	120.7	50.1
Trichloroethylene	C_2HCl_3	85.7	57.3
Turpentine	$C_{10}H_{16}$	156	68.6
n-Valeric acid	$C_4H_9CO_2H$	184.6	103.2
Iso-Valeric acid	....	176.3	101.1
n-Valeronitrile	C_4H_9CN	129	96.3

CHANGE IN VOLUME DUE TO FUSION

The table gives the variation in volume expressed in c.cm. for one gram of the substance.

Substance.	Variation, cm.	Observer.
Aluminum.....	+0.019	Toepler, 1894
Bismuth.......	−0.0034	Toepler, 1894
Cadmium.....	+0.0064	Toepler, 1894
Iron..........	−0.0085	Wrightson, Roberts, 1881
Lead..........	+0.0034	Toepler, 1894
Tin...........	+0.0039	Toepler, 1894
Water.........	−0.083*	Toepler, 1894
Zinc..........	+0.0105	Toepler, 1894

*For one cubic centimeter.

FIXED TEMPERATURE FOR THERMOMETER CALIBRATION

Corrections for pressure are indicated by equations in which p indicates pressure in millimeters of mercury. and t the boiling point at normal pressure.

Points designated by an asterisk (*) are suggested by E. F. Mueller as base points to be used in defining a Standard Working Scale.

Substance	Point	Temperature thermodynamic scale °C	Condition or correction
Hydrogen..............	Boiling	−252.75	$+0.0044\ (p-760)$
Nitrogen..............	Vapor pressure	−195.80	$+0.0109\ (p-760)$
Liquid O_2*...........	Vapor pressure	−183.00	$+0.0126\ (p-760)$ $-0.0000065\ (p-760)^2$
Isopentane............	Freezing	−159.6	
Methylcyclohexane....	Freezing	−126.3	
Ether................	Rapid freezing or slow melting	−116.3	
Carbon disulfide.......	Freezing	−111.6	
Toluene..............	Freezing	− 95.1	
Ethyl acetate.........	Freezing	− 83.6	
Solid CO_2*...........	Vapor pressure	− 78.51	$+0.01595\ (p-760)$ $-0.000011\ (p-760)^2$
Chloroform...........	Freezing	− 63.5	
Chlorobenzene........	Freezing	− 45.2	
Mercury*.............	Freezing	− 38.87	
Carbon tetrachloride...	Freezing	− 22.9	
Ice*.................	Melting	0.000	
Sodium sulfate........	Transition	32.384	
Ethyl alcohol.........	Boiling	78.26	76 cm. variation 0.34° per cm.
Benzene..............	Boiling	80.0	76 cm. variation 0.43° per cm.

FIXED TEMPERATURE FOR THERMOMETER CALIBRATION (Continued)

Substance	Point	Temperature thermo-dynamic scale °C	Condition or correction
Water*	Boiling	100.000	$+0.0367\ (p-760)-0.000023\ (p-760)^2$
Chlorobenzene	Boiling	132.	76 cm. variation 0.50° per cm.
Xylene (m.)	Boiling	138.8	76 cm. variation 0.50° per cm.
Aniline	Boiling	184.51	76 cm. variation 0.51° per cm.
Toluidine (o.)	Boiling	199.7	76 cm. variation 0.58° per cm.
Naphthalene	Condensing	217.96	$+0.2075\ (t+273.1)\ \log_{10}\ (p/760)$
Tin	Freezing	231.85	
Diphenylamine	Boiling	302.	
Benzophenone	Condensing	305.9	$+0.194\ (t+273.1)\ \log_{10}\ (p/760)$
Cadmium	Freezing	320.9	
Lead	Freezing	327.4	
Mercury	Boiling	356.9	
Potassium dichromate	Melting	397.5	
Zinc	Freezing	419.45	
Sulfur*	Condensing	444.60	$+0.0909\ (p-760)-0.000048\ (p-760)^2$
Potassium sulfate	Inversion	583.0	
Antimony*	Freezing	630.5	Approx. To be determined with resistance thermometer.
30.5 NaCl+69.5 Na_2SO_4	Melting	637.0	
Aluminum (99.85%)	Freezing	658.9	
Potassium chloride	Melting	770.3	
Sodium chloride	Melting	800.4	
Sodium sulfate	Melting	884.7	
Silver*	Freezing	960.5	(reducing atmosphere)
Gold*	Freezing	1063.	
Potassium sulfate	Melting	1069.1	
Copper	Freezing	1083.	(reducing armosphere)
Lithium metasilicate	Melting	1202.	
Diopside	Melting	1395.	
Nickel	Melting or freezing	1452.	
Palladium	Freezing	1555. ±2	
Anorthite	Melting	1555.	
Platinum	Melting	1755. ±6	
Alumina	Melting	2000.	
Tungsten	Melting	3370. ±30	

PRESSURE OF AQUEOUS VAPOR

Vapor Pressure of Ice

Pressure of aqueous vapor over ice in mm of Hg for temperatures from −98 to 0°C.

Temp. °C	0	2	4	6	8
−90	.000070	.000048	.000033	.000022	.000015
−80	.00040	.00029	.00020	.00014	.00010
−70	.00194	.00143	.00105	.00077	.00056
−60	.00808	.00614	.00464	.00349	.00261
−50	.02955	.0230	.0178	.0138	.0106
−40	.0966	.0768	.0609	.0481	.0378
−30	.2859	.2318	.1873	.1507	.1209

Temp. °C	0.0	0.2	0.4	0.6	0.8
−29	0.317	0.311	0.304	0.298	0.292
−28	0.351	0.344	0.337	0.330	0.324
−27	0.389	0.381	0.374	0.366	0.359
−26	0.430	0.422	0.414	0.405	0.397
−25	0.476	0.467	0.457	0.448	0.439
−24	0.526	0.515	0.505	0.495	0.486
−23	0.580	0.569	0.558	0.547	0.536
−22	0.640	0.627	0.615	0.603	0.592
−21	0.705	0.691	0.678	0.665	0.652
−20	0.776	0.761	0.747	0.733	0.719
−19	0.854	0.838	0.822	0.806	0.791
−18	0.939	0.921	0.904	0.887	0.870
−17	1.031	1.012	0.993	0.975	0.956
−16	1.132	1.111	1.091	1.070	1.051
−15	1.241	1.219	1.196	1.175	1.153
−14	1.361	1.336	1.312	1.288	1.264
−13	1.490	1.464	1.437	1.411	1.386
−12	1.632	1.602	1.574	1.546	1.518
−11	1.785	1.753	1.722	1.691	1.661
−10	1.950	1.916	1.883	1.849	1.817
− 9	2.131	2.093	2.057	2.021	1.985
− 8	2.326	2.285	2.246	2.207	2.168
− 7	2.537	2.493	2.450	2.408	2.367
− 6	2.765	2.718	2.672	2.626	2.581
− 5	3.013	2.962	2.912	2.862	2.813
− 4	3.280	3.225	3.171	3.117	3.065
− 3	3.568	3.509	3.451	3.393	3.336
− 2	3.880	3.816	3.753	3.691	3.630
− 1	4.217	4.147	4.079	4.012	3.946
− 0	4.579	4.504	4.431	4.359	4.287

VAPOR PRESSURE OF WATER BELOW 100°C

Pressure of aqueous vapor over water in mm of Hg for temperatures from −15.8 to 100°C. Values for fractional degrees between 50 and 89 were obtained by interpolation.

Temp. °C	0.0	0.2	0.4	0.6	0.8
−15	1.436	1.414	1.390	1.368	1.345
−14	1.560	1.534	1.511	1.485	1.460
−13	1.691	1.665	1.637	1.611	1.585
−12	1.834	1.804	1.776	1.748	1.720
−11	1.987	1.955	1.924	1.893	1.863
−10	2.149	2.116	2.084	2.050	2.018
− 9	2.326	2.289	2.254	2.219	2.184
− 8	2.514	2.475	2.437	2.399	2.362
− 7	2.715	2.674	2.633	2.593	2.553
− 6	2.931	2.887	2.843	2.800	2.757
− 5	3.163	3.115	3.069	3.022	2.976
− 4	3.410	3.359	3.309	3.259	3.211
− 3	3.673	3.620	3.567	3.514	3.461
− 2	3.956	3.898	3.841	3.785	3.730
− 1	4.258	4.196	4.135	4.075	4.016
− 0	4.579	4.513	4.448	4.385	4.320
0	4.579	4.647	4.715	4.785	4.855
1	4.926	4.998	5.070	5.144	5.219
2	5.294	5.370	5.447	5.525	5.605
3	5.685	5.766	5.848	5.931	6.015
4	6.101	6.187	6.274	6.363	6.453
5	6.543	6.635	6.728	6.822	6.917
6	7.013	7.111	7.209	7.309	7.411
7	7.513	7.617	7.722	7.828	7.936
8	8.045	8.155	8.267	8.380	8.494
9	8.609	8.727	8.845	8.965	9.086
10	9.209	9.333	9.458	9.585	9.714
11	9.844	9.976	10.109	10.244	10.380
12	10.518	10.658	10.799	10.941	11.085
13	11.231	11.379	11.528	11.680	11.833
14	11.987	12.144	12.302	12.462	12.624
15	12.788	12.9[illegible]	13.121	13.290	13.461
16	13.634	13.8[illegible]	13.987	14.166	14.347
17	14.530	14.71[illegible]	14.903	15.092	15.284
18	15.477	15.673	15.871	16.071	16.272
19	16.477	16.685	16.894	17.105	17.319

VAPOR PRESSURE OF WATER BELOW 100°C (Continued)

Temp. °C	0.0	0.2	0.4	0.6	0.8
20	17.535	17.753	17.974	18.197	18.422
21	18.650	18.880	19.113	19.349	19.587
22	19.827	20.070	20.316	20.565	20.815
23	21.068	21.324	21.583	21.845	22.110
24	22.377	22.648	22.922	23.198	23.476
25	23.756	24.039	24.326	24.617	24.912
26	25.209	25.509	25.812	26.117	26.426
27	26.739	27.055	27.374	27.696	28.021
28	28.349	28.680	29.015	29.354	29.697
29	30.043	30.392	30.745	31.102	31.461
30	31.824	32.191	32.561	32.934	33.312
31	33.695	34.082	34.471	34.864	35.261
32	35.663	36.068	36.477	36.891	37.308
33	37.729	38.155	38.584	39.018	39.457
34	39.898	40.344	40.796	41.251	41.710
35	42.175	42.644	43.117	43.595	44.078
36	44.563	45.054	45.549	46.050	46.556
37	47.067	47.582	48.102	48.627	49.157
38	49.692	50.231	50.774	51.323	51.879
39	52.442	53.009	53.580	54.156	54.737
40	55.324	55.91	56.51	57.11	57.72
41	58.34	58.96	59.58	60.22	60.86
42	61.50	62.14	62.80	63.46	64.12
43	64.80	65.48	66.16	66.86	67.56
44	68.26	68.97	69.69	70.41	71.14
45	71.88	72.62	73.36	74.12	74.88
46	75.65	76.43	77.21	78.00	78.80
47	79.60	80.41	81.23	82.05	82.87
48	83.71	84.56	85.42	86.28	87.14
49	88.02	88.90	89.79	90.69	91.59
50	92.51	93.5	94.4	95.3	96.3
51	97.20	98.2	99.1	100.1	101.1
52	102.09	103.1	104.1	105.1	106.2
53	107.20	108.2	109.3	110.4	111.4
54	112.51	113.6	114.7	115.8	116.9
55	118.04	119.1	120.3	121.5	122.6
56	123.80	125.0	126.2	127.4	128.6
57	129.82	131.0	132.3	133.5	134.7
58	136.08	137.3	138.5	139.9	141.2
59	142.60	143.9	145.2	146.6	148.0

VAPOR PRESSURE OF WATER BELOW 100°C (Continued)

Temp. °C	0.0	0.2	0.4	0.6	0.8
60	149.38	150.7	152.1	153.5	155.0
61	156.43	157.8	159.3	160.8	162.3
62	163.77	165.2	166.8	168.3	169.8
63	171.38	172.9	174.5	176.1	177.7
64	179.31	180.9	182.5	184.2	185.8
65	187.54	189.2	190.9	192.6	194.3
66	196.09	197.8	199.5	201.3	203.1
67	204.96	206.8	208.6	210.5	212.3
68	214.17	216.0	218.0	219.9	221.8
69	223.73	225.7	227.7	229.7	231.7
70	233.7	235.7	237.7	239.7	241.8
71	243.9	246.0	248.2	250.3	252.4
72	254.6	256.8	259.0	261.2	263.4
73	265.7	268.0	270.2	272.6	274.8
74	277.2	279.4	281.8	284.2	286.6
75	289.1	291.5	294.0	296.4	298.8
76	301.4	303.8	306.4	308.9	311.4
77	314.1	316.6	319.2	322.0	324.6
78	327.3	330.0	332.8	335.6	338.2
79	341.0	343.8	346.6	349.4	352.2
80	355.1	358.0	361.0	363.8	366.8
81	369.7	372.6	375.6	378.8	381.8
82	384.9	388.0	391.2	394.4	397.4
83	400.6	403.8	407.0	410.2	413.6
84	416.8	420.2	423.6	426.8	430.2
85	433.6	437.0	440.4	444.0	447.5
86	450.9	454.4	458.0	461.6	465.2
87	468.7	472.4	476.0	479.8	483.4
88	487.1	491.0	494.7	498.5	502.2
89	506.1	510.0	513.9	517.8	521.8
90	525.76	529.77	533.80	537.86	541.95
91	546.05	550.18	554.35	558.53	562.75
92	566.99	571.26	575.55	579.87	584.22
93	588.60	593.00	597.43	601.89	606.38
94	610.90	615.44	620.01	624.61	629.24
95	633.90	638.59	643.30	648.05	652.82
96	657.62	662.45	667.31	672.20	677.12
97	682.07	687.04	692.05	697.10	702.17
98	707.27	712.40	717.56	722.75	727.98
99	733.24	738.53	743.85	749.20	754.58
100	760.00	765.45	770.93	776.44	782.00
101	787.57	793.18	798.82	804.50	810.21

VAPOR PRESSURE OF WATER ABOVE 100° C.

Based on values given by Keyes in the International Critical Tables.

Temp. °C	Pressure mm	Pressure Pounds per sq. in.	Temp. °F	Temp. °C	Pressure mm	Pressure Pounds per sq. in.	Temp. °F
100	760.	14.696	212.0	145	3116.76	60.268	293.0
101	787.51	15.228	213.8	146	3203.40	61.944	294.8
102	815.86	15.776	215.6	147	3292.32	63.663	296.6
103	845.12	16.342	217.4	148	3382.76	65.412	298.4
104	875.06	16.921	219.2	149	3476.24	67.220	300.2
105	906.07	17.521	221.0	150	3570.48	69.042	302.0
106	937.92	18.136	222.8	151	3667.00	70.908	303.8
107	970.60	18.768	224.6	152	3766.56	72.833	305.6
108	1004.42	19.422	226.4	153	3866.88	74.773	307.4
109	1038.92	20.089	228.2	154	3970.24	76.772	309.2
110	1074.56	20.779	230.0	155	4075.88	78.815	311.0
111	1111.20	21.487	231.8	156	4183.80	80.901	312.8
112	1148.74	22.213	233.6	157	4293.24	83.018	314.6
113	1187.42	22.961	235.4	158	4404.96	85.178	316.4
114	1227.25	23.731	237.2	159	4519.72	87.397	318.2
115	1267.98	24.519	239.0	160	4636.00	89.646	320.0
116	1309.94	25.330	240.8	161	4755.32	91.953	321.8
117	1352.95	26.162	242.6	162	4876.92	94.304	323.6
118	1397.18	27.017	244.4	163	5000.04	96.685	325.4
119	1442.63	27.896	246.2	164	5126.96	99.139	327.2
120	1489.14	28.795	248.0	165	5256.16	101.638	329.0
121	1536.80	29.717	249.8	166	5386.88	104.165	330.8
122	1586.04	30.669	251.6	167	5521.40	106.766	332.6
123	1636.36	31.642	253.4	168	5658.20	109.412	334.4
124	1687.81	32.637	255.2	169	5798.04	112.116	336.2
125	1740.93	33.664	257.0	170	5940.92	114.879	338.0
126	1795.12	34.712	258.8	171	6085.32	117.671	339.8
127	1850.83	35.789	260.6	172	6233.52	120.537	341.6
128	1907.83	36.891	262.4	173	6383.24	123.432	343.4
129	1966.35	38.023	264.2	174	6538.28	126.430	345.2
130	2026.16	39.180	266.0	175	6694.08	129.442	347.0
131	2087.42	40.364	267.8	176	6852.92	132.514	348.8
132	2150.42	41.582	269.6	177	7015.56	135.659	350.6
133	2214.64	42.824	271.4	178	7180.48	138.848	352.4
134	2280.76	44.103	273.2	179	7349.20	142.110	354.2
135	2347.26	45.389	275.0	180	7520.20	145.417	356.0
136	2416.34	46.724	276.8	181	7694.24	148.782	357.8
137	2488.16	48.113	278.6	182	7872.08	152.221	359.6
138	2560.67	49.515	280.4	183	8052.96	155.719	361.4
139	2634.84	50.950	282.2	184	8236.88	159.275	363.2
140	2710.92	52.421	284.0	185	8423.84	162.890	365.0
141	2788.44	53.920	285.8	186	8616.12	166.609	366.8
142	2867.48	55.448	287.6	187	8809.92	170.356	368.6
143	2948.80	57.020	289.4	188	9007.52	174.177	370.4
144	3031.64	58.622	291.2	189	9208.16	178.057	372.2

VAPOR PRESSURE OF WATER ABOVE 100° C.
(Continued)

Temp. °C	Pressure		Temp. °F	Temp. °C	Pressure		Temp. °F
	mm	Pounds per sq. in.			mm	Pounds per sq. in.	
190	9413.36	182.025	374.0	235	22967.96	444.128	455.0
191	9620.08	186.022	375.8	236	23382.92	452.152	456.8
192	9831.36	190.107	377.6	237	23802.44	460.264	458.6
193	10047.20	194.281	379.4	238	24229.56	468.523	460.4
194	10265.32	198.499	381.2	239	24661.24	476.871	462.2
195	10488.76	202.819	383.0	240	25100.52	485.365	464.0
196	10715.24	207.199	384.8	241	25543.60	493.933	465.8
197	10944.76	211.637	386.6	242	25994.28	502.647	467.6
198	11179.60	216.178	388.4	243	26449.52	511.450	469.4
199	11417.48	220.778	390.2	244	26912.36	520.400	471.2
200	11659.16	225.451	392.0	245	27381.28	529.467	473.0
201	11905.40	230.213	393.8	246	27855.52	538.638	474.8
202	12155.44	235.048	395.6	247	28335.84	547.926	476.6
203	12408.52	239.942	397.4	248	28823.76	557.360	478.4
204	12666.16	244.924	399.2	249	29317.00	566.898	480.2
205	12929.12	250.008	401.0	250	29817.84	576.583	482.0
206	13197.40	255.196	402.8	251	30324.00	586.370	483.8
207	13467.96	260.428	404.6	252	30837.76	596.305	485.6
208	13742.32	265.733	406.4	253	31356.84	606.342	487.4
209	14022.76	271.156	408.2	254	31885.04	616.556	489.2
210	14305.48	276.623	410.0	255	32417.80	626.858	491.0
211	14595.04	282.222	411.8	256	32957.40	637.292	492.8
212	14888.40	287.895	413.6	257	33505.36	647.888	494.6
213	15184.80	293.626	415.4	258	34059.40	658.601	496.4
214	15488.04	299.490	417.2	259	34618.76	669.417	498.2
215	15792.80	305.383	419.0	260	35188.00	680.425	500.0
216	16104.40	311.408	420.8	261	35761.80	691.520	501.8
217	16420.56	317.522	422.6	262	36343.20	702.763	503.6
218	16742.04	323.738	424.4	263	36932.20	714.152	505.4
219	17067.32	330.028	426.2	264	37529.56	725.703	507.2
220	17395.64	336.377	428.0	265	38133.00	737.372	509.0
221	17731.56	342.872	429.8	266	38742.52	749.158	510.8
222	18072.80	349.471	431.6	267	39361.92	761.135	512.6
223	18417.84	356.143	433.4	268	39986.64	773.215	514.4
224	18766.68	362.888	435.2	269	40619.72	785.457	516.2
225	19123.12	369.781	437.0	270	41261.16	797.861	518.0
226	19482.60	376.732	438.8	271	41910.20	810.411	519.8
227	19848.92	383.815	440.6	272	42566.08	823.094	521.6
228	20219.80	390.987	442.4	273	43229.56	835.923	523.4
229	20596.76	398.276	444.2	274	43902.16	848.929	525.2
230	20978.28	405.654	446.0	275	44580.84	862.053	527.0
231	21365.12	413.134	447.8	276	45269.40	875.367	528.8
232	21757.28	420.717	449.6	277	45964.04	888.799	530.6
233	22154.00	428.388	451.4	278	46669.32	902.437	532.4
234	22558.32	436.207	453.2	279	47382.20	916.222	534.2

VAPOR PRESSURE OF WATER ABOVE 100° C. (Continued)

Temp. °C	Pressure		Temp. °F
	mm	Pounds per sq. in.	
280	48104.20	930.183	536.0
281	48833.80	944.291	537.8
282	49570.24	958.532	539.6
283	50316.56	972.963	541.4
284	51072.76	987.586	543.2
285	51838.08	1002.385	545.0
286	52611.76	1017.345	546.8
287	53395.32	1032.497	548.6
288	54187.24	1047.810	550.4
289	54989.04	1063.314	552.2
290	55799.20	1078.980	554.0
291	56612.40	1094.705	555.8
292	57448.40	1110.871	557.6
293	58284.40	1127.036	559.4
294	59135.60	1143.496	561.2
295	59994.40	1160.102	563.0
296	60860.80	1176.856	564.8
297	61742.40	1193.903	566.6
298	62624.00	1210.950	568.4
299	63528.40	1228.439	570.2
300	64432.80	1245.927	572.0
301	65352.40	1263.709	573.8
302	66279.60	1281.638	575.6
303	67214.40	1299.714	577.4
304	68156.80	1317.937	579.2
305	69114.40	1336.454	581.0
306	70072.00	1354.971	582.8
307	71052.40	1373.929	584.6
308	72048.00	1393.181	586.4
309	73028.40	1412.139	588.2
310	74024.00	1431.390	590.0
311	75042.40	1451.083	591.8
312	76076.00	1471.070	593.6
313	77117.20	1491.203	595.4
314	78166.00	1511.484	597.2
315	79230.00	1532.058	599.0
316	80294.00	1552.632	600.8
317	81373.20	1573.501	602.6
318	82467.60	1594.663	604.4
319	83569.60	1615.972	606.2
320	84686.80	1637.575	608.0
321	85819.20	1659.472	609.8
322	86959.20	1681.516	611.6
323	88114.40	1703.854	613.4
324	89277.20	1726.339	615.2
325	90447.60	1748.971	617.0
326	91633.20	1771.897	618.8
327	92826.40	1794.969	620.6
328	94042.40	1818.483	622.4
329	95273.60	1842.291	624.2
330	96512.40	1866.245	626.0
331	97758.80	1890.346	627.8
332	99020.40	1914.742	629.6
333	100297.20	1939.431	631.4
334	101581.60	1964.267	633.2
335	102881.20	1989.398	635.0
336	104196.00	2014.822	636.8
337	105526.00	2040.540	638.6
338	106871.20	2066.552	640.4
339	108224.00	2092.710	642.2
340	109592.00	2119.163	644.0
341	110967.60	2145.763	645.8
342	112358.40	2172.657	647.6
343	113749.20	2199.550	649.4
344	115178.00	2227.179	651.2
345	116614.40	2254.954	653.0
346	118073.60	2283.171	654.8
347	119532.80	2311.387	656.6
348	121014.80	2340.044	658.4
349	122504.40	2368.848	660.2
350	124001.60	2397.799	662.0
351	125521.60	2427.191	663.8
352	127049.20	2456.730	665.6
353	128599.60	2486.710	667.4
354	130157.60	2516.837	669.2
355	131730.80	2547.258	671.0
356	133326.80	2578.119	672.8
357	134945.60	2609.422	674.6
358	136579.60	2641.018	676.4
359	138228.80	2672.908	678.2
360	139893.20	2705.093	680.0
361	141572.80	2737.571	681.8
362	143275.20	2770.490	683.6
363	144992.80	2803.703	685.4
364	146733.20	2837.357	687.2
365	148519.20	2871.892	689.0
366	150320.40	2906.722	690.8
367	152129.20	2941.698	692.6
368	153960.80	2977.116	694.4
369	155815.20	3012.974	696.2
370	157692.40	3049.273	698.0
371	159584.80	3085.866	699.8
372	161507.60	3123.047	701.6
373	163468.40	3160.963	703.4
374	165467.20	3199.613	705.2

VAPOR PRESSURE OF MERCURY

Vapor pressure of mercury in mm. of Hg for temperatures from −38 to 400°C. Note that the values for the first four lines only, are to be multiplied by 10^{-6}.

Temp. °C	0	2	4	6	8
	10^{-6}	10^{-6}	10^{-6}	10^{-6}	10^{-6}
−30	4.78	3.59	2.66	1.97	1.45
−20	18.1	14.0	10.8	8.28	6.30
−10	60.6	48.1	38.0	29.8	23.2
− 0	185.	149.	119.	95.4	76.2
+ 0	.000185	.000228	.000276	.000335	.000406
+10	.000490	.000588	.000706	.000846	.001009
20	.001201	.001426	.001691	.002000	.002359
30	.002777	.003261	.003823	.004471	.005219
40	.006079	.007067	.008200	.009497	.01098
50	.01267	.01459	.01677	.01925	.02206
60	.02524	.02883	.03287	.03740	.04251
70	.04825	.05469	.06189	.06993	.07889
80	.08880	.1000	.1124	.1261	.1413
90	.1582	.1769	.1976	.2202	.2453
100	.2729	.3032	.3366	.3731	.4132
110	.4572	.5052	.5576	.6150	.6776
120	.7457	.8198	.9004	.9882	1.084
130	1.186	1.298	1.419	1.551	1.692
140	1.845	2.010	2.188	2.379	2.585
150	2.807	3.046	3.303	3.578	3.873
160	4.189	4.528	4.890	5.277	5.689
170	6.128	6.596	7.095	7.626	8.193
180	8.796	9.436	10.116	10.839	11.607
190	12.423	13.287	14.203	15.173	16.200
200	17.287	18.437	19.652	20.936	22.292
210	23.723	25.233	26.826	28.504	30.271
220	32.133	34.092	36.153	38.318	40.595
230	42.989	45.503	48.141	50.909	53.812
240	56.855	60.044	63.384	66.882	70.543
250	74.375	78.381	82.568	86.944	91.518
260	96.296	101.28	106.48	111.91	117.57
270	123.47	129.62	136.02	142.69	149.64
280	156.87	164.39	172.21	180.34	188.79
290	197.57	206.70	216.17	226.00	236.21
300	246.80	257.78	269.17	280.98	293.21
310	305.89	319.02	332.62	346.70	361.26
320	376.33	391.92	408.04	424.71	441.94
330	459.74	478.13	497.12	516.74	537.00
340	557.90	579.45	601.69	624.64	648.30
350	672.69	697.83	723.73	750.43	777.92
360	806.23	835.38	865.36	896.23	928.02
370	960.66	994.34	1028.9	1064.4	1100.9
380	1138.4	1177.0	1216.6	1257.3	1299.1
390	1341.9	1386.1	1431.3	1477.7	1525.2
400	1574.1	....	....	....	....

VAPOR PRESSURE OF CARBON DIOXIDE

SOLID

From Bureau of Standards Journal of Research

(Mercury column, density = 13.5951 g/cm³, g = 980.665)

Pressure in microns of mercury

°C	0	1	2	3	4	5	6	7	8	9
−180	0.013	0.008	0.006	0.004	0.003	0.0017	0.0011	0.0007	0.0005	0.0003
−170	.37	.27	.20	.14	.10	.074	.052	.037	.026	.018
−160	5.9	4.6	3.6	2.7	2.1	1.58	1.19	.90	.67	.50
−150	60.5	48.8	39.2	31.4	25.1	19.9	15.8	12.4	9.8	7.6
−140	431	359	298	247	204	168	138	113	92	75

Pressure in mm of mercury

°C	0	1	2	3	4	5	6	7	8	9
−130	2.31	1.97	1.68	1.43	1.22	1.03	0.87	0.73	0.61	0.51
−120	9.81	8.57	7.46	6.49	5.63	4.88	4.22	3.64	3.13	2.69
−110	34.63	30.76	27.27	24.14	21.34	18.83	16.58	14.58	12.80	11.22
−100	104.81	94.40	84.91	76.27	68.43	61.30	54.84	48.99	43.71	38.94
− 90	279.5	254.7	231.8	210.8	191.4	173.6	157.3	142.4	128.7	116.2
− 80	672.2	618.3	568.2	521.7	478.5	438.6	401.6	367.4	335.7	306.5
− 70	1486.1	1377.3	1275.6	1180.5	1091.7	1008.9	931.7	859.7	792.7	730.3
− 60	3073.1	2865.1	2669.7	2486.3	2314.2	2152.8	2001.5	1859.7	1726.9	1602.5
− 50	......	......	......	......	......	......	......	3780.9	3530.2	3294.6

LIQUID

°C	0	1	2	3	4	5	6	7	8	9
−50	5127.8	4922.7	4723.9	4531.1	4344.3	4163.2	3987.9	3818.2*	3653.9*	3495.0*
−40	7545	7271	7005	6746	6494	6250	6012	5781	5557	5339
−30	10718	10363	10017	9679	9350	9029	8716	8412	8115	7826
−20	14781	14331	13891	13461	13040	12630	12229	11838	11455	11082
−10	19872	19312	18764	18228	17703	17189	16686	16194	15712	15241
− 0	26142	25457	24786	24127	23482	22849	22229	21622	21026	20443
0	26142	26840	27552	28277	29017	29771	30539	31323	32121	32934
10	33763	34607	35467	36343	37236	38146	39073	40017	40980	41960
20	42959	43977	45014	46072	47150	48250	49370	50514	51680	52871
30	54086	55327	......	......	......	......	......	......	......	......

* Undercooled liquid.
Critical temperature = 31.0°C. Triple point, −56.602 ± 0.005°C; 3885.2 ± 0.4 mm.

VAPOR PRESSURE

Pressure and Density (or Specific Volume) of Saturated Vapor

Pressure of the saturated vapor is given in millimeters of mercury or in atmospheres as indicated; the density of the liquid and saturated vapor in g/cm³, and the specific volume in cm³/g. The temperatures are stated in degrees Centigrade. The normal boiling point is the temperature for which the pressure is 1 atm. or 760 mm. Data refers to the liquid state unless otherwise indicated.

The following abbreviations are used: b.p., boiling point; c.p., critical point; liq., liquid; m.p., melting point: sol., solid; t.p., triple point.

Elements and Inorganic Compounds

°C	Pressure	Density g/cm³	
		liq.	vap.
Aluminum Al			
liq. 1800 b.p.	760 mm		

Ammonia NH_3

°C	Pressure	Sp. Vol. cm³/g	
		liq.	vap.
−78 liq.	0.0582 atm.	1.3618	....
−76	0.0683	1.3660	13752.
−74	0.0797	1.3702	11889.
−72	0.0929	1.3745	10314.
−70	0.1078	1 3788	8976.2
−68	0.1246	1.3832	7837.0
−66	0.1437	1.3876	6863.3
−64	0.1651	1.3920	6028.3
−62	0.1891	1.3965	5310.0
−60	0.2161	1 4010	4690.3
−58	0.2461	1.4056	4154.0
−56	0.2796	1.4103	3688.5
−54	0 3167	1.4150	3283.4
−52	0.3578	1.4197	2929.9
−50	0.4034	1 4245	2620.7
−48	0.4536	1.4293	2349.4
−46	0.5087	1.4342	2110.8
−44	0.5693	1.4392	1900.5
−42	0 6357	1.4442	1714.7
−40	0.7083	1.4493	1550.2
−38	0.7875	1.4545	1404.2
−36	0.8738	1.4597	1274.4
−34	0.9676	1.4649	1158.7
−32	1.0695	1.4703	1055.3
−30	1.1799	1.4757	962.82
−28	1.2992	1.4811	879.92
−26	1.4281	1.4867	805.44
−24	1.5671	1.4923	738.44
−22	1.7166	1.4980	678.03
−20	1.8774	1.5037	623.48
−18	2.0499	1.5096	574.15
−16	2.2349	1.5155	529.45

Ammonia NH_3 (Continued)

°C	Pressure	Sp. Vol. cm³/g	
		liq.	vap.
−14	2.4328 atm.	1.5215	488.88
−12	2.6443	1.5276	452.02
−10	2.8703	1.5338	418.46
− 8	3.1112	1.5400	387.87
− 6	3.3677	1.5464	359.95
− 4	3.6405	1.5528	334.42
− 2	3.9303	1.5594	311.04
0	4.2380	1.5660	289.62
+ 2	4.5640	1.5727	269.95
4	4.9090	1.5796	251.88
6	5.2750	1.5866	235.25
8	5.6610	1.5936	219.92
10	6.0685	1.6008	205.79
12	6.4985	1.6081	192.73
14	6.9520	1.6156	180.66
16	7.4290	1.6231	169.49
18	7.9310	1.6308	159.14
20	8.4585	1.6386	149.53
22	9.0125	1.6466	140.61
24	9.5940	1.6547	132.33
26	10.2040	1.6630	124.61
28	10.8430	1.6714	117.43
30	11.512	1.6800	110.73
32	12.212	1.6888	104.48
34	12.943	1.6977	98.640
36	13.708	1.7069	93.181
38	14.507	1.7162	88.074
40	15.339	1.7257	83.290
42	16.209	1.7354	78.806
44	17.113	1.7454	74.600
46	18.056	1.7555	70.650
48	19.038	1.7659	66.939
50	20.059	1.7766	63.448
52	21.121	1.7875	....
54	22.224	1.7987	....
56	23.372	1.8102	....
58	24.562	1.8220	....
60	25.797	1.8341	48.8
62	27.079	1.8465	....
64	28.407	1.8593	....
66	29.784	1.8725	....
68	31.211	1.8860	....
70	32.687	1.9000	37.7
72	34.227	1.9145	....
74	35.813	1.9294	....

VAPOR PRESSURE (Continued)

Ammonia NH_3 (Continued)

°C	Pressure	Sp. Vol. cm^3/g liq.	Sp. Vol. cm^3/g vap.
76	37.453 atm.	1.9448	....
78	39 149	1.9608	....
80	40.902	1.9774	29.3
82	42.712	1.9946	....
84	44.582	2.0124	....
86	46.511	2.0311	....
88	48.503	2.0505	....
90	50.558	2.0708	22 8
92	52.677	2.0920	....
94	54.860	2.1143	....
96	57.111	2.1377	....
98	59.429	2.1623	....
100	61.816	2.1885	17.6
102	64.274	2.2162	....
104	66.804	2.2510	....
106	69.406	2.2773	....
108	72.084	2.3112	....
110	74.837	2.3478	....
112	77.668	2.3877	....
114	80.578	2.4314	....
116	83.570	2.4796	....
118	86.644	2.5393	....
120	89.802	2.5948	....
122	93.045	2.6656	....
124	96.376	2.7495	....
126	99.796	2.8523	....
128	103.309	2.9851	....
130	106.913	3.1769	....
132	110.613	3.5315	....
132.9 c.p.	112.3	4.2830	....

Ammonium chloride NH_4Cl

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
338.0 sol.	760. mm	......	....
459	8360.	......	....
520	26220.	......	....

Antimony Sb

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
818 liq.	1 mm	......	....
1327 b.p	760.	......	....

Antimony bromide $SbBr_3$

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
180 liq.	42 mm	....	....
200	82.	....	....
220	148.		

Antimony trichloride $SbCl_3$

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
120 liq.	29. mm	....	....
130	43.	....	....
140	64.	....	....
150	92.	....	....
160	127.	....	....

Antimony triiodide SbI_3

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
250 liq.	23. mm	....	....
280	53.	....	....
310	115.	....	....

Argon A

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
−189.19 t.p.	512.17 mm	....	....
−185.66 b.p.	1.0000 atm.	....	....
−183.15 liq.	....	1.37396	0.00801
−161.23	7.4332	1.22414	0.03723
−150.76	....	1.13851	0.06785
−150.57	13.707	....	....
−140.80	22.185	....	....
−135.51	....	0 97385	0.15994
−129.83	35.846	....	....
−122.44 c.p.	47.996	....	....

Arsine AsH_3

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
liq.			
−55 b.p.	1.00 atm.	....	....
−40	2.0	....	....
−20	4.3	....	....
0	8.4	....	....
+20	15.	....	....

Arsenic As

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
604.3 sol.	760. mm	....	....

Barium Ba

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
887 liq.	1. mm	....	....
1146 b.p.	760.	....	....

Bismuth Bi

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
606.8 liq.	0.001 mm	....	....
904.	.1.	....	....
1470 b.p.	760.	....	....

Boron chloride BCl_3

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
−80 liq.	4.0 mm	....	....
−60	18.0	....	....
−30	116.0	....	....
−15	251.0	....	....
0	477.0	....	....

Bromine Br

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
−90 sol.	0.0052 mm	....	....
−80	0.0251	....	....

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Bromine Br (Continued)			
−70	0.102 mm	......	....
−60	0.357	......	....
−50	1.09	......	....
−40	2.98	......	....
−30	7.45	......	....
−20	17.1	......	....
−10	36.6	......	....
− 7.3 m.p.	44.4	......	....
0 liq.	65.9	......	....
+10	109.	......	....
20	173.	......	....
30	264.	......	....
40	392.	......	....
50.	564.	......	....
58.78 b.p.	760.	......	....
Cadmium Cd			
219.1 sol.	0.001 mm	......	....
392.2 liq.	1.	......	....
454.6	5.	......	....
485.3	10.	......	....
767 b.p.	760.	......	....
Caesium Cs			
112.3 liq.	0.001 mm	......	....
278.6	1.	......	....
669.3 b.p.	760.	......	....
Calcium Ca			
529 sol.	0.001 mm	......	....
917 liq.	1.	......	....
1174 b.p.	760.	......	....
Carbon C			
liq. 3927 b.p.	760. mm	......	....

Carbon dioxide CO_2*

°C	Pressure	Sp. Vol. cm³/g liq.	Sp. Vol. cm³/g vap.
−56 liq.	5.2485 atm.	0.8496	....
−54	5.7156	0.8554	....
−52	6.2139	0.8606	....
−50	6.7446	0.8658	....
−48	7.3089	0.8718	....
−46	7.9078	0.8780	....
−44	8.5426	0.8834	....
−42	9.2147	0.8897	....
−40	9.9251	0.8961	....
−38	10.675	0.9025	....
−36	11.466	0.9091	....
Carbon dioxide CO_2 (Continued)			
−34	12.299 atm.	0.9158	....
−32	13.176	0.9226	....
−30	14.099	0.9302	27.19
−28	15.067	0.9381	25.40
−26	16.084	0.9452	23.71
−24	17.150	0.9533	22.11
−22	18.267	0.9615	20.62
−20	19.437	0.9699	19.22
−18	20.661	0.9794	17.95
−16	21.940	0.9892	16.78
−14	23.277	0.9990	15.70
−12	24.673	1.0091	14.73
−10	26.129	1.0194	13.83
− 8	27.648	1.0309	13.01
− 6	29.231	1.0428	12.25
− 4	30.879	1.0548	11.54
− 2	32.595	1.0683	10.88
0	34.379	1.0811	10.26
+ 2	36.235	1.0953	9.68
4	38.163	1.1099	9.13
6	40.166	1.1261	8.59
8	42.247	1.1442	8.06
10	44.406	1.1628	7.57
12	46.648	1.1834	7.04
14	48.974	1.2063	6.58
16	51.388	1.2330	6.14
18	53.895	1.2626	5.68
20	56.495	1.2953	5.26
22	59.197	1.3351	4.83
24	62.006	1.3831	4.39
26	64.928	1.4430	3.97
28	67.971	1.5267	3.53
30	71.143	1.6722	3.00
31.1 c.p.	72.947	2.1547	2.15

Carbon disulfide CS_2

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
−70 liq.	1.6 mm	......	......
−60	3.5	......	......
−50	7.1	......	......
−40	14.0	......	......
−30	26.2	......	......
−20	46.5	......	......
−10	78.8	......	......
0	127.3	......	......
+10	198.1	......	......
20	297.5	......	......
30	432.7	......	......
40	616.7	......	......
46.25 b.p.	1.00 atm.	1.225	......

* See special table preceding.

VAPOR PRESSURE (Continued)

Carbon disulfide CS_2 (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
50	1.13 atm.	......	....
60	1.54	......	0.0045
70	2.05	......	0.0058
80	2.69	......	0.0075
90	3.47	......	0.0095
100	4.42	......	0.012
110	5.55	......	0.015
120	6.90	......	0.018
130	8.47	......	0.021
140	10.3	......	0.026
150	12.4	......	0.031
160	14.9	......	0.035
170	17.6	......	0.041
180	20.8	......	0.052
190	24.3	......	0.068
200	28.3	......	0.084
210	32.8	......	0.101
220	37.8	......	0.122
230	43.4	......	0.144
240	49.6	......	0.178
250	56.5	......	0.212
260	64.1	......	0.247
270	72.5	......	0.301
273 c.p.	75.	......	....

Carbon monoxide CO

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
−220.6 sol.	4. mm	......	....
−209.1	50.	......	....
−205.70	111.33	......	....
−192.0	1.0 atm.	0.803	0.0044
−190	1.2	0.794	0.0054
−180	3.2	0.748	0.013
−170	6.7	0.697	0.027
−160	12.4	0.639	0.046
−150	20.9	0.560	0.088
−140	33.2	0.420	0.190
−139 c.p.	35.	0.303	0.303

Chlorine Cl

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
liq. −103 m.p.	8.9 mm	......	....
−100	11.8	......	....
− 90	27.8	......	....
− 80	58.7	......	....
− 70	115.	......	....
− 60	211.	......	....
− 50	363.	......	....
− 40	594.	......	....
− 34.6 b.p.	760.	......	....
− 30	1.23 atm.	1.550	....
− 20	1.84	1.524	....
− 10	2.61	1.496	....
0	3.65	1.468	0.0128
+ 10	4.96	1.438	0.0175
20	6.57	1.408	0.0226

Chlorine Cl (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
30	8.60 atm.	1.377	0.0300
40	11.1	1.344	0.0384
50	14.1	1.310	0.0486
60	17.6	1.375	0.0600
70	21.6	1.240	0.0740
80	26.2	1.199	0.0910
90	31.5	1.156	0.1125
100	37.6	1.109	0.136
110	44.4	1.059	0.164
120	52.4	0.998	0.206
130	61.4	0.920	0.258
140	71.4	0.750	0.405
144 c.p.	76.1	0.573	0.573

Chromium Cr

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
liq. 2200 b.p.	760. mm	......	......

Cobalt Co

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
1254 liq.	0.001 mm	......	......
1859	1.	......	......
3168 b.p.	760.	......	......

Copper Cu

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
1320 liq.	0.001 mm	......	......
1707	1.	......	......
2310 b.p.	760.	......	......

Cupric chloride $CuCl_2$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
487.6 sol.	223.9 mm	......	......
470.5	128.8	......	......
407.2	22.39	......	......
335.2	5.0	......	......
318.6	3.55	......	......

Cupric oxide CuO

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
600 sol.	1.34×10^{-7} mm	......	......
800	1.15×10^{-4}	......	......
950	6.8×10^{-4}	......	......

Cyanogen chloride CNCl

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
−32.69 sol.	58.6 mm	......	......
−24.7	101.71	......	......
−11.41	250.67	......	......

Ferric chloride $FeCl_3$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
245.0 sol.	19.95 mm	......	......
292.3	316.2	......	......

Gold Au

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
1292 liq.	0.001 mm	......	......
1768	1.	......	......
2611 b.p.	760.	......	......

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Gold chloride $AuCl_3$			
100 sol.	7.0 mm	...	...
138.5	11.0	...	...
181	61.2	...	...
202	154.5	...	...
229	424.2	...	...
251	808.7	...	...
Helium He			
−271.9 liq.	...	0.1459	...
−271.7	3. mm	...	...
−271.0	...	0.1464	...
−270.8	...	0.1466	0.001368
−269.9	197.	...	...
−269.2	...	0.1311	0.01176
−268.9 b.p.	1.000 atm.	...	...
−268.9	...	0.1253	0.01637
−268.4	...	0.1139	0.02699
−268.2	1.749	...	...
−267.9 c.p.	2.261	0.06930	0.06930
Hydriodic acid HI			
liq.			
−35.5 b.p.	1.00 atm.	2.793	...
−20	1.86	...	...
0	3.70	...	...
+20	6.65	2.230	...
40	11.1	...	...
60	17.3	...	...
80	25.8	...	...
100	37.0	...	...
120	51.6	...	...
140	70.4	...	...
150.5 c.p.	82.	...	...
Hydrobromic acid HBr			
liq.			
−67.0 b.p.	1.00 atm.	...	...
−60	1.41	...	...
−40	3.31	...	...
−20	6.72	...	...
0	12.3	...	...
+20	20.6	1.589	...
40	32.5	...	...
60	49.0	...	...
80	71.4	...	...
90 c.p.	85.	...	...
Hydrochloric acid HCl			
−108 liq.	168.5 mm	...	...
−104	226.2	...	...
−100	329.8	...	...
− 96	503.4	...	...
− 88	640.3	...	...
− 85.03 b.p.	1.00 atm.	1.191	0.0025
− 80	1.32	1.178	0.0032
− 60	3.45	1.122	0.0083
− 40	7.55	1.063	0.017
− 20	14.53	0.997	0.032

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Hydrochloric acid HCl (Continued)			
0	25.46 atm.	0.924	0.054
+20	41.58	0.831	0.097
40	64.52	0.697	0.180
51.5 c.p.	81.6	0.424	0.424
Hydrocyanic acid HCN			
25.65 liq.	1.00 atm.	0.695	0.0011
40	1.67	...	...
60	3.15	...	...
80	5.52	...	...
100	9.16	...	...
120	14.5	...	...
140	22.1	...	...
160	32.7	0.420	0.050
180	47.1	0.290	0.120
183.5 c.p.	50.	0.20	0.20
Hydrogen H_2			
liq.			
−259.14 t.p.	51.4 mm	...	...
−258.46	79.9	...	...
−258.27	...	0.07631	0.00020
−256.61	191.9	...	...
−254.73	397.6	...	...
−253.24	...	0.07131	0.00116
−252.74 b.p.	1.0000 atm.	...	...
−248.50	2.8937	...	...
−245.73	...	0.06050	0.00613
−245.68	5.0566	...	...
−240.49	11.752	...	...
−239.91 c.p.	12.80	0.03102	0.03102
Hydrogen sulfide H_2S			
−82 liq.	172 mm	...	...
−78	235.	...	...
−74	339.	...	...
−70	432.	...	...
−66	535.	...	...
−62	660.	...	...
−59.5 b.p.	1.00 atm.	0.965	...
−40	2.50	...	...
−20	5.39	...	...
0	10.2	...	...
+20	17.7	...	...
40	28.3	...	...
60	43.0	...	...
80	62.6	...	...
100.4 c.p.	88.9	...	...
Iodine I			
−50 sol.	0.000037 mm	...	...
−40	0.00019	...	...
−30	0.00080	...	...
−20	0.0030	...	...
−10	0.0099	...	...
0	0.0299	...	...
+10	0.0808	...	...
20	0.202	...	...

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Iodine I (Continued)			
30	0.471 mm		
40	1.03		
50	2.16		
60	4.31		
70	8.22		
80	15.1		
90	26.8		
100	45.5		
110	74.9		
114.15 m.p.	90.1		
120 liq.	111.		
130	157.		
140	217.		
150	294.		
160	394.		
170	521.		
180	679.		
184.35 b.p.	760.		
190	869.		
Iron Fe			
1884 liq.	1. mm		
3235 b.p.	760.		
Krypton Kr			
sol.			
−169 t.p.	132.5 mm		
−160.3 liq.	386.4		
−151.8 b.p.	1.000 atm.		
−130	4.315		
− 90	24.27		
− 62.6 c.p.	54.24		
Lead Pb			
636.2 liq.	0.001 mm		
985.	1.		
Lead chloride $PbCl_2$			
400 sol.	0.00174 mm		
425	0.0058		
450	0.0178		
475	0.051		
Lead sulfide PbS			
850 sol.	2.0 mm		
917	4.0		
968	10.5		
995	17.0		
Magnesium Mg			
772. liq.	1. mm		
1070 b.p.	760.		
Manganese Mn			
liq.			
1900 b.p.	760. mm		
Mercurous chloride HgCl			
100 sol.	0.0089 mm		
120	0.016		
140	0.038		
160	0.15		
180	0.45		
310	103.0		
330	189.2		
350	329.9		
370	548.9		
Mercury Hg (See special table.)			
−76.4 sol.	10^{-9} mm		
−65.7	10^{-8}		
−53.6	10^{-7}		
−40.4	10^{-6}		
Molybdenum Mo			
2293 sol.	0.001 mm		
Neon Ne			
−257.62 sol.	0.55 mm		
−254.92	7.8		
−253.16	28.2		
−251.24	91.		
−250.22	148.		
−249.09	250.		
−248.56	317.		
−248.51 liq.	325.0		
−247.49	451.6		
−246.66	605.2		
−245.92 b.p.	1.000 atm.		
−236.82	7.970		
−228.71 c.p.	26.86		
Nickel Ni			
1851 liq.	1. mm		
3147 b.p.	760.		
Nitric oxide NO			
liq.			
−151.0 b.p.	1.0 atm.		
−140	3.0		
−120	14.3		
−100	46.		
− 93 c.p.	65.		
Nitrogen N_2			
sol.			
−209.86 t.p.	96.4 mm		
−198.26 liq.	561.3		
−195.78 b.p.	1.000 atm.		
−173.58	7.3705		
−152.11	25.889		
−147.13 c.p.	33.490		
Nitrogen peroxide N_2O_4			
liq.			
21.3 b.p.	1.00 atm.		

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Nitrogen peroxide N_2O_4 (Continued)			
40	2.28 atm.	......	......
60	5.03	......	......
80	10.3	......	......
100	19.8	......	......
120	35.9	......	......
140	62.2	......	......
158 c.p.	99.	......	......
Nitrous oxide N_2O			
liq.			
−89.5 b.p.	1.00 atm.	1.226	0.0031
−80	1.70	1.199	0.0050
−60	4.40	1.140	0.0122
−40	9.5	1.075	0.025
−20	18.1	1.001	0.048
0	31.3	0.910	0.087
+20	50.3	0.784	0.161
36.5	71.7	0.451	0.451
Oxygen O_2			
−210.4 liq.	......	1.2746	0.0000865
−204.52	36.11 mm	......	......
−195.50	162.15	......	......
−186.91	493.30	......	......
−182.95 b.p.	1.000 atm.	......	......
−154.5	......	0.9758	0.0385
−149.25	12.506	......	......
−129.9	......	0.7781	0.1320
−125.28	38.571	......	......
−118.82 c.p.	49.713	0.4299	0.4299
Ozone O_3			
−193.1 liq.	0.015 mm	......	......
−173.1	1.3	......	......
−153.1	25.4	......	......
−133.1	182.8	......	......
−112.4 b.p.	760.	......	......
− 5 c.p.	67. atm.	......	......
Phosphine PH_3			
−129 liq.	43.0 mm	......	......
−121	85.7	......	......
−113	158.3	......	......
−101	354.2	......	......
− 89	699.5	......	......
− 87.5 b.p.	1.00 atm.	0.746	0.0023
− 80	1.46	0.738	0.0032
− 60	3.47	0.712	0.0073
− 40	7.1	0.684	0.014
− 20	12.9	0.651	0.025
0	21.6	0.613	0.042
20	34.2	0.566	0.067
40	51.9	0.50	0.11
51 c.p.	64.	0.30	0.30
Phosphonium chloride PH_4Cl			
−63.0 sol.	39.81 mm	......	......
−26.8	760.0	......	......
0.9	5623.0	......	......

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Phosphorus pentachloride PCl_5			
156.1 sol.	562.3 mm	......	......
136.7	266.1	......	......
101.4	37.58	......	......
Phosphorus trioxide P_2O_3			
30 liq.	3. mm	......	......
50	9.0	......	......
60	20.	......	......
70	60.	......	......
80	150.	......	......
90	300.	......	......
Pictet's fluid $64SO_2 + 44CO_2$ by weight			
−30	585.2 mm	......	......
−25	676.4	......	......
−20	744.8	......	......
−15	896.8	......	......
−10	1018.4	......	......
− 5	1216.0	......	......
0	1390.8	......	......
+ 5	1672.0	......	......
10	1938.0	......	......
15	2264.8	......	......
20	2584.0	......	......
25	2979.2	......	......
30	3382.0	......	......
35	3838.0	......	......
40	4347 2	......	......
45	4788.0	......	......
50	5213.6	......	......
Potassium K			
162.3 liq.	0.001 mm	......	......
344.2	1.	......	......
758 b.p.	760.	......	......
Radon Rn			
−101 sol.	50 mm	......	......
− 70.5 t.p.	500.	......	......
− 61.8 liq.	1.000 atm.	......	......
− 50	2.065	......	......
− 20	5.260	......	......
10	11.40	......	......
70	37.67	......	......
104.4 c.p.	62.44	......	......
Selenium Se			
200 sol.	0.0015 mm	......	......
210	0.0032	......	......
217.4 m.p.	0.0055	......	......
220 liq.	0.0062	......	......
230	0.0097	......	......
390	3.0	......	......
400	4.0	......	......
420	7.0	......	......
440	11.	......	......
460	17.	......	......
480 liq.	28	......	......
500	42.	......	......

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³	
		liq.	vap.
Selenium Se (Continued)			
620	313. mm	......	......
640	420.	......	......
660	550.	......	......
680	700.	......	......
688 b.p.	760.	......	......
Selenium dioxide SeO_2			
72.0 sol.	13.43 mm	......	......
180.9	39.00	......	......
236.9	66.07	......	......
289.2	316.2	......	......
317.0	760.0	......	......
Silicon Si			
719.2 sol.	0.001 mm	......	......
1219	1.	......	......
Silver Ag			
837 liq.	0.001 mm	......	......
1218	1.	......	......
1948 b.p.	760.	......	......
Silver oxide Ag_2O			
1316 sol.	0.46 mm	......	......
1435	3.4	......	......
Sodium Na			
238.1 liq.	0.001 mm	......	......
441.2	1.	......	......
882. b.p.	760.	......	......
Stannic chloride $SnCl_4$			
− 10 liq.	2.8 mm	......	......
10	10.3	......	......
30	31.3	......	......
60	112.0	......	......
90	360.5	......	......
114.1 b.p.	1.00 atm.	1.978	0.0085
120	1.18	1.963	0.0099
140	1.96	1.907	0.0162
Strontium Sr			
713.4 liq.	0.001 mm	......	......
899	1.	......	......
1154 b.p.	760.	......	......
Sulfur S			
50 sol.	0.0002 mm	......	......
60	0.0004	......	......
70	0.0010	......	......
80	0.0023	......	......
90	0.0049	......	......
100	0.010	......	......
110	0.021	......	......
114.5 m.p.	0.028	......	......
120 liq.	0.040	......	......
130	0.074	......	......
140	0.13	......	......
150	0.22	......	......
160	0.37	......	......
170	0.59	......	......
180	0.91	......	......

°C	Pressure	Density g/cm³	
		liq.	vap.
Sulfur S (Continued)			
190	1.4 mm	......	......
200	2.1	......	......
210	3.1	......	......
220	4.4	......	......
230	6.3	......	......
240	8.7	......	......
250	12.	......	......
260	16.	......	......
270	21.	......	......
280	28.	......	......
290	37.	......	......
300	48.	......	......
310	60.	......	......
320	76.	......	......
330	95.	......	......
340	118.	......	......
350	146.	......	......
360	179.	......	......
370	218.	......	......
380	263.	......	......
390	325.	......	......
400	376.	......	......
410	446.	......	......
420	525.	......	......
430	613.	......	......
440	711.	......	......
444.60 b.p.	760.0	......	......
450	821.	......	......
460	948.	......	......
470	1093.	......	......
480	1257.	......	......
490	1441.	......	......
500	1647.	......	......
510	1876.	......	......
520	2130.	......	......
530	2410.	......	......
540	2718.	......	......
550	3055.	......	......
560	3423.	......	......
570	3824.	......	......

Sulfur dioxide SO_2

°C	Pressure	Sp. Vol. cm³/g	
		liq.	vap.
−70 liq.	19.9 mm	......	......
−65	30.0	......	......
−60	42.8	......	......
−55	61.8	......	......
−50	86.7	0.6423	......
−45	119.6	0.6472	......
−40	162.3	0.6523	......
−35	217.1	0.6575	......
−30	286.0	0.6627	......

VAPOR PRESSURE (Continued)

°C	Pressure	Sp. Vol. cm^3/g	
		liq.	vap.
Sulfur dioxide SO_2 (Continued)			
−25	373.0 mm	0.6680	....
−20	478.0	0.6739	....
−15	607.0	0.6798	....
−10	761.0	0.6859	....
− 5	947.0	0.6916	....
0	1.529 atm.	0.6974	....
+ 2	1.657	0.6998	....
4	1.793	0.7022	....
6	1.938	0.7047	....
8	2.092	0.7072	156.3
10	2.256	0.7097	147.1
12	2.429	0.7123	137.0
14	2.613	0.7153	128.2
16	2.807	0.7179	119.0
18	3.012	0.7205	111.1
20	3.228	0.7231	103.1
22	3.456	0.7262	97.09
24	3.697	0.7289	90.91
26	3.951	0.7315	86.21
28	4.217	0.7348	81.30
30	4.498	0.7375	75.76
32	4.793	0.7407	70.92
34	5.102	0.7440	66.67
36	5.427	0.7474	62.50
38	5.768	0.7508	58.14
40	6.125	0.7536	54.64
42	6.499	0.7570	51.02
44	6.890	0.7610	48.08
46	7.300	0.7646	45.25
48	7.729	0.7680	42.74
50	8.176	0.7722	40.65
60	10.729	0.7918	31.85
70	13.867	0.8137	25.77
80	17.682	0.8382	20.92
90	22.268	0.8658	16.39
100	27.714	0.8977	12.94
110	34.091	0.9355	10.31
120	41.432	0.9823	8.078
130	49.705	1.0449	6.146
140	58.783	1.1363	4.554
150	68.405	1.3038	3.256

°C	Pressure	Density g/cm^3	
		liq.	vap.
Sulfur trioxide SO_3			
liq.			
44.6 b.p.	1.00 atm	1.807	0.003
60	2.0	1.732	0.006
80	4.3	1.639	0.013
100	8.0	1.547	0.025
120	13.3	1.465	0.037
140	20.6	1.382	0.056
160	30.3	1.296	0.086
180	43.4	1.196	0.137
200	61.1	1.058	0.233
218.3 c.p.	83.6	0.630	0.630
Thallium Tl			
412.7 liq.	0.001 mm	.....	....
748	1.	.....	....
1650 b.p.	760.	.....	....
Tin Sn			
1282 liq.	0.001 mm	......	....
1503	1.	......	....
2260 b.p.	760.	......	....
Tungsten W			
3353 sol.	0.001 mm	......	....
Xenon Xe			
liq			
−109.1 b.p.	1.000 atm.	......	......
−100	1.629	......	....
− 60	8.570	2.699	0.079
− 20	26.73	2.292	0.238
0.0	41.24	1.987	0.421
16.6 c.p.	58.22	1.154	1.154
Zinc Zn			
296.3 sol.	0.001 mm	......	....
487.7 liq.	1.	......	......
558.9	5.	......	....
594.1	10.	......	......
632.3	20.	......	......

Organic Compounds

°C	Pressure	Density g/cm^3	
		liq.	vap.
Acetic acid $C_2H_4O_2$			
20 liq	11.7 mm	......	....
30	20.6	......	....
40	34.8	......	....
50	56.6	......	....
60	88.9	......	....
70	136.0	......	....
80	202.3	......	....

°C	Pressure	Density g/cm^3	
		liq.	vap.
Acetic acid $C_2H_4O_2$ (Continued)			
90	293.7 mm	......	....
100	417.1	......	....
110	580.8	......	....
118.5 b.p.	1.000 atm.	0.9380	0.003150
120	1.058	0.9362	0.003271
140	1.884	0.9091	0.005515
160	3.149	0.8829	0.00887

VAPOR PRESSURE (Continued)

Acetic acid $C_2H_4O_2$ (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
180	5.014 atm.	0.8555	0.01370
200	7.682	0.8265	0.02052
220	11.39	0.7941	0.03021
240	16.42	0.7571	0.04327
260	23.07	0.7136	0.06165
280	31.67	0.6629	0.0883
300	42.54	0.5950	0.1331
320	56.01	0.4615	0.2417
321.6 c.p.	57.21	0.3506	0.3506

Acetone C_3H_6O

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
−94.8 sol.	0.017 mm	......	......
−90 liq.	0.021	......	......
−70	0.34	......	......
−50	2.4	......	......
−30	11.2	......	......
−10	38.7	......	......
5	89.1	......	......
+10	115.6	......	......
15	147.1	......	......
20	184.8	......	......
25	229.2	......	......
30	282.7	......	......
35	346.4	......	......
40	421.5	......	......
45	510.5	......	......
50	612.6	......	......
56.1 b.p.	1.000 atm.	0.750	0.002
60	1.14	0.746	0.003
70	1.58	0.734	0.003
80	2.12	0.719	0.004
90	2.81	0.706	0.005
100	3.67	0.693	0.007
110	4.74	0.679	0.009
120	6.01	0.665	0.011
130	7.53	0.650	0.013
140	9.33	0.634	0.016
150	11.5	0.618	0.020
160	13.9	0.601	0.024
170	16.6	0.588	0.030
180	20.0	0.568	0.039
190	23.8	0.540	0.050
200	28.0	0.514	0.065
210	32.7	0.482	0.085
220	38.1	0.443	0.110
230	44.1	0.393	0.152
235 c.p.	47.0	0.268	0.268

Acetonitrile C_2H_3N

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
80 liq.	......	0.717	0.001
100	......	0.694	0.002
120	......	0.670	0.004
140	......	0.646	0.007
160	......	0.620	0.011
180	......	0.590	0.015
200	......	0.555	0.022
220	......	0.514	0.034
240	......	0.467	0.053
260	......	0.399	0.091
274.7 c.p.	......	0.240	0.240

Acetylene C_2H_2

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
−84.0 liq.	1.00 atm.	......	......
−81.5 t.p.	1.20	0.618	0.0021
−60	3.48	0.585	0.0056
−40	7.7	0.551	0.012
−20	14.9	0.512	0.024
0	26.3	0.464	0.045
+20	43.1	0.400	0.082
36.0	61.7	0.230	0.230

Amyl alcohol $C_5H_{12}O$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
0 liq.	0.6 mm	......	......
10	1.3	......	......
20	2.8	......	......
40	10.6	......	......
60	34.1	......	......
80	95.1	......	......
100	233.3	......	......
110	350.3	......	......
120	512.3	......	......
130	730.8	......	......

iso-Amyl alcohol $C_5H_{12}O$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
10 liq.	1.0 mm	......	......
20	2.3	......	......
40	9.7	......	......
60	33.3	......	......
80	95.9	......	......
100	238.6	......	......
110	358.6	......	......
120	523.3	......	......
130	743.2	......	......
140	1033.	......	......
150	1400.	......	......

Aniline C_6H_7N

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
50 liq.	2.4 mm	......	......
60	5.7	......	......
70	10.6	......	......
80	18.0	......	......
90	29.2	......	......
100	45.7	......	......
110	69.2	......	......
120	96.6	......	......
130	144.5	......	......
140	204.0	......	......

Benzoic acid $C_7H_6O_2$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
100 liq.	1.79 mm	......	......
140	14.6	......	......
150	23.6	......	......
160	36.3	......	......
170	55.8	......	......
180	81.6	......	......
190	119.1	......	......
200	171.3	......	......
210	239.	......	......
220	331.5	......	......
230	451.	......	......

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Benzoic acid $C_7H_6O_2$ (Continued)			
240	597. mm	......	......
250	780.	......	......
Benzophenone $C_{13}H_{10}O$			
0 sol.	2.03×10^{-5} mm	......	......
8	6.94×10^{-5}	......	......
32	1.418×10^{-3}	......	......
Benzoyl chloride C_6H_5ClO			
40 liq.	1.1 mm	......	......
50	2.4	......	......
60	4.8	......	......
70	8.2	......	......
80	13.6	......	......
90	21.8	......	......
100	33.9	......	......
110	51.4	......	......
120	75.1	......	......
130	107.8	......	......
140	152.0	......	......
Bromobenzene C_6H_5Br			
30 liq.	5.67 mm	......	......
40	9.99	......	......
50	16.96	......	......
60	27.61	......	......
70	43.55	......	......
80	66.22	......	......
90	97.72	......	......
100	141.1	......	......
110	198.7	......	......
120	274.9	......	......
140	495.8	......	......
156.15 b.p.	760.	......	......
160	846.	1.2994	0.0052
180	1350.	1.2697	0.0081
200	2075.	1.2385	0.0121
220	3055.	1.2037	0.0174
240	4360.	1.1689	0.0248
260	6080.	1.1310	0.0343
397 c.p.	33900.	0.4859	0.4859
iso-Butane C_4H_{10}			
−30 liq.	463. mm	......	......
−25	544.	......	......
−20	646.	......	......
−15	745.	......	......
n-Butyl alcohol $C_4H_{10}O$			
20 liq.	4.39 mm	......	......
25	6.44	......	......
30	9.52	......	......
35	13.1	......	......
40	18.6	......	......
45	24.9	......	......
50	33.7	......	......
55	44.9	......	......
60	59.2	......	......
n-Butyl alcohol $C_4H_{10}O$ (Continued)			
65	77.7 mm	......	......
70	112.3	......	......
75	131.3	......	......
iso-Butyl alcohol $C_4H_{10}O$			
60 liq.	99.1 mm	......	......
70	158.5	......	......
80	248.9	......	......
90	384.6	......	......
100	583.5	......	......
110	845.3	......	......
120	1197.	......	......
130	1668.	......	......
iso-Butyl formate $C_5H_{10}O_2$			
40 liq.	84. mm	......	......
60	200.	......	......
80	417.	......	......
95	687.	......	......
97.9 b.p.	1.000 atm.	......	......
100	1.067	......	......
120	1.92	......	......
140	3.25	......	......
160	5.19	......	......
180	7.89	......	......
200	11.5	......	......
220	16.3	......	......
240	22.3	......	......
260	29.8	......	......
278 c.p.	38.	......	......
Butyric acid $C_4H_8O_2$			
20 liq.	0.75 mm	......	......
30	1.5	......	......
40	3.0	......	......
50	5.25	......	......
60	9.35	......	......
Camphor $C_{10}H_{16}O$			
180 liq.	380. mm	......	......
190	490.	......	......
200	624.	......	......
Caproic acid $C_6H_{12}O_2$			
80 liq.	2.5 mm	......	......
90	5.3	......	......
100	10.6	......	......
110	18.9	......	......
120	31.4	......	......
130	51.0	......	......
135	62.6	......	......
Carbon tetrachloride CCl_4			
−20 liq.	9.8 mm	......	......
−15	13.5	......	......
−10	18.5	......	......
− 5	24.8	......	......
0	32.9	......	......

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm^3 liq.	Density g/cm^3 vap.
Carbon tetrachloride CCl_4 (Continued)			
+5	43.2 mm		
10	56.0		
15	71.7		
20	91.		
25	114.5		
30	143.0		
35	176.2		
40	215.8		
45	262.5		
50	317.1		
55	379.3		
60	450.8		
65	530.9		
70	622.3		
76.75 b.p.	760.		
80	838.	1.4765	0.0061
90	1112.	1.4554	0.0080
100	1457.	1.4343	0.0103
110	1880.	1.4124	0.0131
120	2390.	1.3902	0.0164
130	3000.	1.3680	0.0204
140	3725.	1.3450	0.0250
150	4555.	1.3215	0.0304
160	5535.	1.2983	0.0365
170	6640.	1.2734	0.0437
180	7900.	1.2470	0.0525
190	9315.	1.2192	0.0625
200	10940.	1.1888	0.0742
210	12760.	1.1566	0.0879
220	14800.	1.1227	0.1040
230	17060.	1.0857	0.1232
240	19600.	1.0444	0.1464
250	22410.	0.9980	0.1754
o-Chloroaniline C_6H_6ClN			
80 liq.	7.7 mm		
100	20.7		
120	48.4		
140	101.9		
160	199.1		
180	358.5		
200	608.2		
m-Chloroaniline C_6H_6ClN			
100 liq.	9.0 mm		
120	23.1		
140	52.1		
160	107.2		
180	203.5		
200	363.1		
220	616.6		
Chlorobenzene C_6H_5Cl			
0. liq.	2.52 mm		
10	4.86		
20	8.76		
30	15.45		
40	26.00		
Chlorobenzene C_6H_5Cl (Continued)			
50	41.98 mm		
60	65.54		
70	97.90		
80	144.75		
90	208.35		
100	292.75		
110	402.55		
120	542.80		
130	718.95		
132 b.p.	760.		
140	939.5	0.9723	0.0043
160	1535.	0 9480	0.0068
180	2370.	0.9224	0.0102
200	3520.	0.8955	0.0151
220	5055.	0.8672	0.0214
240	7050.	0.8356	0.0300
260	9650.	0.8016	0.0417
359.2 c.p.	33900.	0.3654	0.3654
o-Chlorobenzoic acid $C_7H_5ClO_2$			
100 sol.	0.1803 mm		
m-Chlorobenzoic acid $C_7H_5ClO_2$			
100.63 sol.	0.197 mm		
p-Chlorobenzoic acid $C_7H_5ClO_2$			
100 sol.	0.045 mm		
Chloroform $CHCl_3$			
−60 liq.	0.81 mm		
−50	2.06		
−40	4.7		
−30	10.0		
−20	19.6		
−10	34.75		
0	61.0		
+10	100.5		
20	159.6		
25	199.1		
30	246.0		
35	301.3		
40	366.4		
45	439.0		
50	526.0		
55	625.2		
60	739.6		
60.9 b.p.	760.0		
70	1019.		
80	1403.		
90	1880		
100	2430.		
110	3100.		
120	3890.		
130	4860		
140	5950		
150	7080		
160	8800.		

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
	o-Cresol C_7H_8O		
60 liq.	3.55 mm	......	......
80	11.5	......	......
100	31.6	......	......
120	74.1	......	......
140	158.1	......	......
160	308.3	......	......
180	566.9	......	......
	m-Cresol C_7H_8O		
60 liq.	1.76 mm	......	......
80	6.37	......	......
100	19.05	......	......
120	48.6	......	......
140	106.9	......	......
160	219.3	......	......
180	411.2	......	......
	p-Cresol C_7H_8O		
60 liq.	1.7 mm	......	......
80	6.17	......	......
100	18.3	......	......
120	47.4	......	......
140	105.0	......	......
160	216.8	......	......
180	407.4	......	......
	Cyanogen C_2N_2		
−25 liq.	629.8 mm	......	......
−21.17 b.p.	1.000 atm.	......	......
−20	1.055	......	......
0	2.414	......	......
+20	4.85	......	......
40	8.80	......	......
60	14.8	......	......
80	23.4	......	......
100	35.3	......	......
120	51.5	......	......
128.3 c.p.	59.7	......	......
	Cyclohexane C_6H_{12}		
liq. 80.75 b.p.	760. mm	0.7199	0.0029
100	1304.	0.6988	0.0049
120	2140.	0.6775	0.0080
140	3355.	0.6553	0.0123
160	5040.	0.6313	0.0184
180	7285.	0.6060	0.0265
200	10130.	0.5773	0.0380
220	13690.	0.5443	0.0534
240	18140.	0.5058	0.0746
260	23590.	0.4537	0.1097
281.0 c.p.	30835.	0.2703	0.2703
	Cymene $C_{10}H_{14}$		
0 liq.	4.65 mm	......	......
20	6.3	......	......
40	10.95	......	......
60	21.4	......	......

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
	Cymene $C_{10}H_{14}$ (Continued)		
80	43.55 mm	......	......
100	87.85	......	......
120	169.25	......	......
140	304.65	......	......
160	519.6	......	......
	p-Dibromobenzene $C_6H_4Br_2$		
84.0 sol.	7.586 mm	......	......
52.8	0.6607	......	......
21.0	0.0158	......	......
	Diethylamine $C_4H_{11}N$		
54.0 liq.	724. mm	......	......
55.4 b.p.	1.000 atm.	0.668	0.003
60	1.16	0.663	0.003
80	2.13	0.640	0.005
100	3.67	0.616	0.008
120	5.92	0.591	0.014
140	9.10	0.562	0.022
160	13.4	0.528	0.035
180	18.9	0.489	0.053
200	25.8	0.438	0.080
220	34.4	0.339	0.150
223.5 c.p.	36.2	0.246	0.246
	Diethylaniline $C_{10}H_{15}N$		
60 liq.	2.7 mm	......	......
80	6.8	......	......
100	16.2	......	......
120	38.2	......	......
140	80.6	......	......
160	158.0	......	......
180	291.7	......	......
200	504.0	......	......
220	837.0	......	......
	Dimethylamine C_2H_7N		
6.05 liq.	724. mm	......	......
7.2 b.p.	1.000 atm.	......	......
20	1.66	......	......
40	3.32	......	......
60	6.04	......	......
80	10.2	......	......
100	16.0	......	......
120	23.9	......	......
140	34.4	......	......
160	48.0	......	......
164.6 c.p.	51.7	......	......
	Dinitrophenol-2, 4 $C_6H_4N_2O_5$		
100 sol.	0.228 mm	......	......
	Diphenyl $C_{12}H_{10}$		
210 liq.	243. mm	......	......
220	330.	......	......
225	376.5	......	......
230	426.6	......	......
235	482.	......	......

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Diphenyl $C_{12}H_{10}$ (Continued)			
240	542.9 mm	......	......
245	609.5	......	......
250	681.6	......	......
Ethane C_2H_6			
−140 liq.	14.1 mm	......	......
−130	39.5	......	......
−120	94.7	......	......
−110	202.8	......	......
−100	393.8	......	......
− 90	705.2	......	......
− 88.62 b.p.	1.000 atm.	0.546	0.00206
− 80.	1.556	0.535	0.00311
− 60	3.743	0.509	0.00707
− 40	7.672	0.482	0.0141
− 20	14.02	0.453	0.0260
0	23.56	0.416	0.0463
+ 20	37.28	0.363	0.085
32.2 c.p.	48.2	0.220	0.220
Ethyl acetate $C_4H_8O_2$			
−20 liq.	6.5 mm	......	......
−10	12.9	......	......
0	24.2	......	......
+10	42.8	......	......
20	72.8	......	......
30	118.7	......	......
40	186.3	......	......
50	282.3	......	......
60	415.3	......	......
70	596.3	......	......
77.15 b.p.	1.000 atm.	0.8283	0.003230
80	1.093	0.8245	0.003495
100	2.000	0.7972	0.006158
120	3.404	0.7683	0.01030
140	5.461	0.7378	0.01650
160	8.349	0.7033	0.02577
180	12.27	0.6653	0.03883
200	17.45	0.6210	0.05797
220	24.15	0.5648	0.08905
240	32.68	0.4778	0.1499
250.1 c.p.	37.80	0.3077	0.3077
Ethyl alcohol C_2H_6O			
−65 liq.	0.021 mm	......	......
−60	0.045	......	......
−55	0.087	......	......
−50	0.12	......	......
−45	0.24	......	......
−40	0.39	......	......
−35	0.68	......	......
−30	1.04	......	......
−25	1.63	......	......
−20	2.5	......	......
−15	3.65	......	......
−10	5.6	......	......
− 5	8.3	......	......
0	12.2	......	......
Ethyl alcohol C_2H_6O (Continued)			
+5	17.3 mm	......	......
10	23.6	......	......
15	32.2	......	......
20	43.9	......	......
25	59.0	......	......
30	78.8	......	......
35	103.7	......	......
40	135.3	......	......
45	174.0	......	......
50	222.2	......	......
55	280.6	......	......
60	352.7	......	......
65	448.8	......	......
70	542.5	......	......
75	666.1	......	......
78.3 b.p.	1.000 atm.	0.7365	0.00165
80	1.069	0.7348	0.00174
90	1.562	0.7251	0.00250
100	2.228	0.7157	0.00351
110	3.107	0.7057	0.00486
120	4.243	0.6925	0.00658
130	5.685	0.6789	0.00877
140	7.486	0.6631	0.01152
150	9.700	0.6489	0.01488
160	12.39	0.6329	0.01916
170	15.61	0.6165	0.02446
180	19.44	0.5984	0.03115
190	23.94	0.5782	0.0397
200	29.20	0.5568	0.0508
210	35.31	0.5291	0.0655
220	42.38	0.4958	0.0854
230	50.53	0.4550	0.1135
240	59.92	0.3825	0.1715
243.1 c.p.	63.11	0.2755	0.2755
Ethylamine C_2H_7N			
15.45 liq.	724. mm	......	......
16.6 b.p.	1.000 atm.	......	......
20	1.14	......	......
40	2.34	......	......
60	4.35	......	......
80	7.48	......	......
100	12.1	......	......
120	18.5	......	......
140	27.0	......	......
160	38.4	......	......
180	52.9	......	......
183.2 c.p.	55.5	......	......
Ethyl bromide C_2H_5Br			
−20 liq.	59. mm	......	......
−10	101.	......	......
0	165.	......	......
+10	257.	......	......
20	386.	......	......
30	564.	......	......
40	802.	......	......
50	1113.	......	......
60	1512.	......	......

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³	
		liq.	vap.
Ethyl chloride C_2H_5Cl			
liq.			
12.2 b.p.	1.00 atm.	0.9060	0.00285
20	1.33	0.8943	0.00372
40	2.55	0.8633	0.00692
60	4.50	0.8306	0.0120
80	7.41	0.7958	0.0190
100	11.5	0.7575	0.0294
120	17.2	0.715	0.043
140	24.7	0.665	0.064
160	34.3	0.602	0.099
180	46.6	0.494	0.178
187 c.p.	51.6	0.331	0.331
Ethylene C_2H_4			
liq.			
−103.8 b.p.	1.00 atm.	0.569	0.0022
−100	1.24	0.564	0.0026
− 80	3.35	0.534	0.0063
− 60	7.38	0.500	0.0133
− 40	14.2	0.461	0.025
− 20	24.8	0.414	0.046
0	40.6	0.345	0.088
+ 9.6 c.p.	50.6	0.210	0.210
Ethylene bromide $C_2H_4Br_2$			
−28.21 sol.	1.51 mm	......	....
−12.30	2.65	......	....
0.	3.47	......	....
6.54	6.16	......	....
−10 liq.	2.5	......	....
0	3.9	......	....
Ethylene oxide C_2H_4O			
−50 liq.	15.3 mm	......	....
−40	64.1	......	....
−20	196.4	......	....
−10	316.3	......	....
0	493.1	......	....
+10	738.0	......	....
Ethyl ether $C_4H_{10}O$			
−119.8 sol.	0.0027 mm	......	....
−117.3	0.0065	......	....
−100 liq.	0.05	......	....
− 80	0.6	......	....
− 60	4.1	......	....
− 40	19.0	......	....
− 30	37.6	......	....
− 10	112.3	......	....
0	185.3	......	....
+ 5	233.2	......	....
10	291.7	......	....
15	360.7	......	....
20	442.2	......	....
25	537.0	......	....
30	647.3	......	....
34.6 b.p.	1.000 atm.	0.6962	0.003162
40	1.212	0.6894	0.003731
50	1.680	0.6764	0.005079
Ethyl ether $C_4H_{10}O$ (Continued)			
60	2.275 atm.	0.6658	0.006771
70	3.021	0.6532	0.00892
80	3.939	0.6402	0.01155
90	5.054	0.6250	0.01477
100	6.394	0.6105	0.01867
110	7.987	0.5942	0.02349
120	9.861	0.5764	0.02934
130	12.05	0.5580	0.03638
140	14.58	0.5385	0.04488
150	17.48	0.5179	0.05551
160	20.80	0.4947	0.06911
170	24.57	0.4658	0.08731
180	28.81	0.4268	0.1135
185	31.12	0.4018	0.1320
190	33.57	0.3663	0.1620
193.8 c.p.	35.52	0.2625	0.2625
Ethyl formate $C_3H_6O_2$			
−20 liq.	22.5 mm	......	....
0	72.4	......	....
+20	192.5	......	....
40	446.7	......	....
54.35 b.p.	1.000 atm.	0.8767	0.002843
60	1.208	0.8689	0.003370
80	2.251	0.8409	0.006098
100	3.883	0.8112	0.01032
120	6.290	0.7796	0.01657
140	9.674	0.7448	0.02564
160	14.26	0.7058	0.03876
180	20.28	0.6610	0.05747
200	28.00	0.6066	0.08621
220	37.70	0.5290	0.1379
230	43.39	0.4635	0.1890
235.3 c.p.	46.65	0.3282	0.3232
Ethyl iodide C_2H_5I			
0 liq.	41.5 mm	......	....
10	68.5	......	....
20	108.5	......	....
30	167.5	......	....
40	251.5	......	....
50	364.0	......	....
60	512.0	......	....
Ethyl propionate $C_5H_{10}O_2$			
0 liq.	8.3 mm	......	....
20	27.75	......	....
40	77.9	......	....
60	188 0	......	....
80	403.6	......	....
99.0 b.p.	1.000 atm.	0.7964	0.003489
100	1.027	0.7951	0.003580
120	1.828	0.7692	0 00620
140	3.042	0.7413	0 01024
160	4.788	0.7115	0 01615
180	7.206	0.6795	0 02469
200	10.45	0.6443	0.03676
220	14.73	0.6027	0.05435
240	20.28	0.5501	0.08230

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Ethyl propionate $C_5H_{10}O_2$ (Continued)			
260	27.40 atm.	0.4744	0.1337
270	31.69	0.4018	0.1957
272.9 c.p.	33.03	0.2965	0.2965
Ethyl sulfide $C_4H_{10}S$			
20 liq.	63.8 mm	......	......
40	137.0	......	......
60	283.5	......	......
80	539.5	......	......
90.3 b.p.	1.000 atm.	0.765	0.003
100	1.32	0.755	0.003
120	2.26	0.732	0.005
140	3.66	0.709	0.008
160	5.68	0.684	0.011
180	8.36	0.656	0.017
200	12.0	0.625	0.027
220	16.6	0.590	0.041
240	22.3	0.549	0.061
260	29.3	0.494	0.094
280	37.6	0.395	0.175
283.8 c.p.	39.1	0.279	0.279
Formic acid CH_2O_2			
2 sol.	9.7 mm	......	......
4	11.6	......	......
6	14.1	......	......
8	17.4	......	......
10 liq.	18.9	......	......
20	33.1	......	......
30	52.2	......	......
40	82.6	......	......
50	125.9	......	......
60	189.7	......	......
70	279.6	......	......
80	398.1	......	......
90	552.1	......	......
100	753.4	......	......
Glycol $C_2H_6O_2$			
120 liq.	39. mm	......	......
130	62.	......	......
140	96.8	......	......
150	147.9	......	......
160	218.8	......	......
170	316.2	......	......
180	446.2	......	......
190	615.9	......	......
Heptane C_7H_{16}			
0 liq.	11.45 mm	......	......
10	20.5	......	......
20	35.5	......	......
30	58.35	......	......
40	92.05	......	......
50	140.9	......	......
60	208.9	......	......
70	302.3	......	......
80	426.6	......	......
90	588.8	......	......

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Heptane C_7H_{16} (Continued)			
100	795.2 mm	......	......
110	1047.	......	......
120	1367.	......	......
Hydroquinol $C_6H_6O_2$			
155.0 sol.	5.9 mm	......	......
164.3	1.0	......	......
150 liq.	4.0	......	......
170	15.2	......	......
190	37.7	......	......
200	55.7	......	......
210	79.8	......	......
230	158.5	......	......
250	291.8	......	......
270	509.3	......	......
o-Hydroxybenzoic acid $C_7H_6O_3$			
100 sol.	0.397 mm	......	......
m-Hydroxybenzoic acid $C_7H_6O_3$			
101.06 sol.	0.00149 mm	......	......
p-Hydroxybenzoic acid $C_7H_6O_3$			
100.91 sol.	0.00030 mm	......	......
Iodobenzene C_6H_5I			
30 liq.	1.48 mm	......	......
40	2.24	......	......
50	4.85	......	......
60	8.30	......	......
70	13.65	......	......
80	21.78	......	......
90	33.50	......	......
100	50.23	......	......
110	73.88	......	......
120	105.4	......	......
130	148.3	......	......
140	204.9	......	......
150	276.7	......	......
160	367.3	......	......
170	479.7	......	......
180	618.7	......	......
188.45 b.p.	760.	......	......
200	991.	1.5470	0.0073
220	1520.	1.5124	0.0108
240	2245.	1.4764	0.0156
260	3220.	1.4384	0.0220
448 c.p.	33900.	0.5814	0.5814
Mesitylene C_9H_{12}			
0 liq.	15.6 mm	......	......
20	27.15	......	......
40	48.9	......	......
60	87.35	......	......
80	150.8	......	......
100	247.25	......	......
120	381.1	......	......
140	550.05	......	......
160	740.35	......	......

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Methane CH_4			
−182 liq.	94.0 mm	......	......
−178	152.1	......	......
−176	190.5	......	......
−161.5 b.p.	1.00 atm.	0.4245	0.0018
−160	1.13	0.4222	0.0020
−140	4.38	0.3916	0.0068
−120	11.84	0.3547	0.0175
−100	25.7	0.3050	0.0413
− 82.1 c.p.	45.8	0.1615	0.1615
Methyl acetate $C_3H_6O_2$			
−135 sol.	0.00354 mm	......	......
− 20 liq.	19.	......	......
0	62.1	......	......
20	169.8	......	......
40	400.4	......	......
57.15 b.p.	1.000 atm.	0.8840	0.002830
60	1.104	0.8800	0.003076
80	2.092	0.8519	0.005618
100	3.659	0.8221	0.009671
120	5.998	0.7893	0.01570
140	9.325	0.7532	0.02454
160	13.88	0.7133	0.03731
180	19.95	0.6671	0.05682
200	27.84	0.6100	0.08658
220	37.92	0.5281	0.1416
233.7 c.p.	46.31	0.3252	0.3252
Methyl alcohol CH_4O			
liq.			
64.7 b.p.	1.000 atm.	0.7510	0.001222
80	1.764	0.7355	0.002084
100	3.452	0.7140	0.003984
120	6.255	0.6900	0.007142
140	10.63	0.6640	0.01216
160	17.11	0.6340	0.01994
180	26.35	0.5980	0.03186
200	39.08	0.5530	0.05075
220	56.18	0.4900	0.08635
230	66.67	0.4410	0.1187
240.0 c.p.	78.67	0.2722	0.2722
Methylamine CH_5N			
liq.			
− 6.6 b.p.	1.000 atm.	......	......
0	1.33	......	......
+ 20	2.92	......	......
40	5.93	......	......
60	10.15	......	......
80	16.7	......	......
100	25.9	......	......
120	38.5	......	......
140	55.1	......	......
156.9 c.p.	73.6	......	......
Methyl n-butyrate $C_5H_{10}O_2$			
0 liq.	7.3 mm	......	......
20	24.5	......	......
40	69.2	......	......

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Methyl n-butyrate $C_5H_{10}O_2$ (Continued)			
60	167.5 mm	......	......
80	361.4	......	......
100	700.7	......	......
102.75 b.p.	1.000 atm.	0.8035	0.003595
120	1.649	0.7816	0.005708
140	2.756	0.7551	0.009294
160	4.359	0.7270	0.01459
180	6.587	0.6964	0.02215
200	9.593	0.6633	0.03268
220	13.55	0.6251	0.04831
240	18.69	0.5773	0.07143
260	25.25	0.5166	0.1091
280	33.58	0.3812	0.2201
281.3 c.p.	34.19	0.3002	0.3002
Methyl iso-butyrate $C_5H_{10}O_2$			
0	12.1 mm	......	......
20	38.9	......	......
40	104.7	......	......
60	243.8	......	......
80	505.0	......	......
92.3 b.p.	1.000 atm.	0.8040	0.003617
100	1.257	0.7945	0.004472
120	2.193	0.7680	0.007628
140	3.588	0.7396	0.01224
160	5.569	0.7095	0.01903
180	8.280	0.6767	0.02869
200	11.89	0.6411	0.04228
220	16.59	0.5961	0.06289
240	22.64	0.5386	0.09615
260	30.32	0.4495	0.1623
267.55 c.p.	33.72	0.3012	0.3012
Methyl chloride CH_3Cl			
liq.			
− 24.0 b.p.	1.00 atm.	0.997	0.00255
− 20	1.18	0.990	0.00297
0	2.50	0.955	0.00599
+ 20	4.75	0.918	0.0110
40	8.33	0.878	0.0189
60	13.6	0.832	0.032
80	21.2	0.783	0.049
100	31.4	0.725	0.075
120	45.0	0.647	0.120
140	62.6	0.497	0.238
143.2 c.p.	65.8	0.365	0.365
Methylene bromide CH_2Br_2			
0 liq.	11.5 mm	......	......
10	20.4	......	......
20	34.7	......	......
30	56.4	......	......
Methylene chloride CH_2Cl_2			
0 liq.	147. mm	......	......
10	229.7	......	......
20	348.9	......	......
30	511.4	......	......

VAPOR PRESSURE (Continued)

Methyl ether C_2H_6O

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
liq.			
− 23.7 b.p.	1.000 atm.	0.7222	0.0024
− 20	1.17	0.7174	0.0027
− 10	1.74	0.7040	0.0039
0	2.54	0.6905	0.0055
+ 10	3.59	0.6759	0.0076
20	4.95	0.6610	0.0104
30	6.62	0.6455	0.0142
40	8.69	0.6292	0.0188
50	11.25	0.6116	0.0241
60	14.27	0.5932	0.0306
70	17.90	0.5735	0.0385
80	22.10	0.5517	0.0484
90	26.9	0.5257	0.0623
100	32.6	0.4950	0.0810
110	39.0	0.4575	0.1060
115	42.5	0.4350	0.1222
120	46.3	0.4040	0.1465
125	50.3	0.3510	0.1930
126.9 c.p.	52.0	0.2714	0.2714

Methyl ethyl ether C_3H_8O

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
liq.			
7.5 b.p.	1.000 atm.	0.716	0.003
10	1.10	0.713	0.004
20	1.61	0.700	0.006
30	2.29	0.687	0.008
40	3.14	0.672	0.010
50	4.24	0.658	0.013
60	5.56	0.644	0.016
70	7.21	0.628	0.019
80	9.16	0.612	0.023
90	11.4	0.596	0.029
100	14.2	0.579	0.034
110	17.3	0.560	0.040
120	20.9	0.540	0.050
130	25.0	0.516	0.064
140	29.6	0.487	0.082
150	34.7	0.450	0.109
160	40.5	0.401	0.153
164.7 c.p.	43.4	0.270	0.270

Methyl ethyl ketone C_4H_8O

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
20 liq.	77.5 mm	......	....
30	121.4	......	....
40	188.4	......	....
50	300.0	......	....

Methyl formate $C_2H_4O_2$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
− 20 liq.	67.7 mm		.....
0	195.0	......	....
+ 20	476.4		
31.9 b.p.	1.000 atm.	0.9569	0.002468
40	1.355	0.9447	0.003236
60	2.608	0.9133	0.006039
80	4.610	0.8803	0.01049
100	7.614	0.8452	0.01723
120	11.91	0.8070	0.02688

Methyl formate $C_2H_4O_2$ (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
140	17.83 atm.	0.7638	0.04124
160	25.64	0.7136	0.06231
180	35.76	0.6521	0.09434
200	48.50	0.5658	0.1524
214.0 c.p.	59.15	0.3489	0.3489

Methyl iodide CH_3I

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
0 liq.	141.2 mm	......	....
10	220.2	......	....
20	331.4	......	....
30	483.4	......	....

Methyl propionate $C_4H_8O_2$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
− 20 liq.	5.6 mm	......	....
0	21.9	......	....
+ 20	66.2	......	....
40	169.3	......	....
60	380.3	......	....
79.7 b.p.	1.000 atm.	0.8412	0.003173
80	1.006	0.8408	0.003199
100	1.851	0.8137	0.005714
120	3.165	0.7852	0.009569
140	5.096	0.7553	0.01529
160	7.812	0.7221	0.02356
180	11.50	0.6856	0.03552
200	16.38	0.6445	0.05236
220	22.68	0.5938	0.07812
240	30.70	0.5220	0.1236

Methyl salicylate $C_8H_8O_3$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
216 liq.	645.5 mm	......	....
218	677.2	......	....
220	710.2	......	....
222	744.3	......	....
224	779.8	......	....
225	798.1	......	....

Methyl sulfide C_2H_6S

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
liq.			
35.8 b.p.	1.000 atm.	0.831	0.002
40	1.15	0.826	0.003
60	2.15	0.803	0.003
80	3.68	0.777	0.006
100	5.97	0.750	0.010
120	9.14	0.721	0.016
140	13.4	0.689	0.026
160	19.1	0.652	0.040
180	26.2	0.610	0.063
200	35.6	0.559	0.092
220	47.0	0.486	0.146
229.9 c.p.	54.6	0.306	0.306

Naphthalene $C_{10}H_8$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
85 liq.	9.8 mm	......	....
90	12.5	......	....
100	18.9	......	....
110	28.3	......	....
225	887.	......	....

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
Naphthalene $C_{10}H_8$ (Continued)			
230	958. mm	......	......
235	1095.	......	......
240	1215.	......	......
245	1347.	......	......
250	1487.	......	......
α-Naphthol $C_{10}H_8O$			
120 liq.	2.8 mm	......	......
140	7.4	......	......
160	17.9	......	......
180	37.5	......	......
200	74.7	......	......
220	139.0	......	......
240	243.2	......	......
260	403.7	......	......
280	639.6	......	......
β-Naphthol $C_{10}H_8O$			
140 liq.	5.8 mm	......	......
160	13.6	......	......
180	29.5	......	......
200	59.2	......	......
220	111.5	......	......
240	198.5	......	......
260	336.2	......	......
280	544.3	......	......
300	848.7	......	......
m-Nitroacetanilide $C_8H_8N_2O_3$			
100 sol.	0.0042 mm	......	......
p-Nitroacetanilide $C_8H_8N_2O_3$			
100 sol.	0.0021 mm	......	......
p-Nitroaniline $C_6H_6N_2O_2$			
100 sol.	0.0136 mm	......	......
Nitrobenzene $C_6H_5NO_2$			
80 liq.	7.5 mm	......	......
90	12.9	......	......
100	20.85	......	......
110	32.5	......	......
p-Nitrobenzoic acid $C_7H_5NO_4$			
100 sol.	0.0096 mm	......	......
Nitroglycerol $C_3H_5N_3O_9$			
20 liq.	0.00025 mm	......	......
30	0.00083	......	......
40	0.0024	......	......
50	0.0073	......	......
60	0.0188	......	......
70	0.043	......	......
80	0.098	......	......
90	0.23	......	......
n-Octane C_8H_{18}			
−20 liq.	0.64 mm	......	......
0	2.94	......	......

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
n-Octane C_8H_{18} (Continued)			
+20	10.45 mm	......	......
40	30.85	......	......
60	77.55	......	......
80	174.8	......	......
100	353.6	......	......
120	646.4	......	......
140	1114.	......	......
iso-Pentane C_5H_{12}			
−20 liq.	100.00 mm	......	......
0	257.35	......	......
+20	572.2	......	......
40	1140.5	......	......
Phosgene CCl_2O			
liq. 7.95 b.p.	1.00 atm.	1.409	0.005
20	1.55	1.381	0.007
40	2.97	1.332	0.012
60	5.25	1.280	0.020
80	8.68	1.224	0.030
100	13.6	1.165	0.046
120	20.3	1.100	0.072
140	29.1	1.017	0.112
160	40.4	0.903	0.182
180	54.4	0.685	0.359
182 c.p.	56.	0.520	0.520
Picric acid $C_6H_3N_3O_7$			
100.4 sol.	0.00249 mm	......	......
Propane C_3H_8			
−38.4 liq.	1050. mm	......	......
−30.85	1368.	......	......
Propyl acetate $C_5H_{10}O_2$			
0	7.0 mm	......	......
20	25.0	......	......
40	70.9	......	......
60	171.9	......	......
80	373.0	......	......
100	723.8	......	......
101.55 b.p.	1.000 atm.	0.7938	0.003495
120	1.703	0.7702	0.005760
140	2.851	0.7435	0.009497
160	4.518	0.7149	0.01489
180	6.832	0.6835	0.02268
200	9.947	0.6488	0.03390
220	14.05	0.6087	0.05025
240	19.36	0.5586	0.07576
260	26.13	0.4908	0.1205
276.2 c.p.	32.91	0.2957	0.2957
n-Propyl alcohol C_3H_8O			
0 liq.	3.44 mm	......	......
5	5.04	......	......
10	7.26	......	......

VAPOR PRESSURE (Continued)

n-Propyl alcohol C_3H_8O (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
15	10.3	......	....
20	14.5	......	....
25	20.1	......	....
30	27.6	......	....
35	37.4	......	....
40	50.2	......	....
45	66.4	......	....
50	87.2	......	....
55	113.6	......	....
60	147.0	......	....
65	186.8	......	....
70	239.0	......	....
75	301.0	......	....
80	376.0	......	....
85	466.	......	....
90	574.	......	....
95	697.	......	....
97.4 b.p.	1.000 atm.	0.7351	0.00208
100	1.100	0.7325	0.00226
110	1.577	0.7220	0.00320
120	2.208	0.7110	0.00443
130	3.022	0.6995	0.00605
140	4.055	0.6875	0.00805
150	5.341	0.6740	0.01060
160	6.915	0.6600	0.01380
170	8.817	0.6450	0.01770
180	11.08	0.6285	0.0225
190	13.75	0.6110	0.0282
200	16.86	0.5920	0.0353
210	20.46	0.5715	0.0442
220	24.57	0.5485	0.0556
230	29.26	0.5230	0.0704
240	34.57	0 4920	0.0904
250	40.55	0.4525	0.1180
260	47.27	0.3905	0.1610
263.7 c.p.	49.95	0 2734	0.2734

Propylene C_3H_6

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
−127 4 liq.	3. mm	......	....
−110 4	15.	......	....
− 34.4	1307.	......	....

Propyl formate $C_4H_8O_2$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
0	21.4 mm	......	....
20	63 9	......	....
40	163.6	......	....
60	364 9	......	....
80	734.5	......	....
80.9 b.p.	1 000 atm.	0.8330	0.003136
100	1.769	0.8080	0.005432
120	3.010	0.7811	0.009033
140	4.821	0.7523	0.01422
160	7.343	0.7209	0 02179
180	10.74	0 6873	0.03236
200	15.20	0 6487	0.04717
220	20.94	0.6024	0.06897
240	28.27	0.5438	0.1045

Propyl formate $C_4H_8O_2$ (Continued)

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
260	37.54 atm.	0.4404	0.1848
264.85 c.p.	40.13	0.3093	0.3093

Quinoline C_9H_7N

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
80 liq.	3.1 mm	......	....
100	8.5	......	....
120	20.7	......	....
140	45.3	......	....
160	91.4	......	....

Turpentine $C_{10}H_{16}$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
0 liq.	2.1 mm	......	....
10	2.9	......	....
20	4.4	......	....
30	6.9	......	....
40	10.8	......	....
50	17.0	......	....
60	26.5	......	....
70	40.6	......	....
80	61.3	......	....
90	90.6	......	....
100	131.1	......	....
110	186.0	......	....
120	257.0	......	....
130	349.0	......	....
140	464.0	......	....
155	605.0	......	....
160	686.0	......	....
165	775.0	......	....

Tetrachloroethylene C_2Cl_4

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
40 liq.	41. mm	......	....
60	104.	......	....
80	226.	......	....
100	438.5	......	....

Toluene C_7H_8

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
30 liq.	36.7 mm	......	....
40	59.1	......	....
50	92 6	......	....
60	139 5	......	....
70	202 4	......	....
80	289 7	......	....
90	404 6	......	....
100	557.2	......	....

p-Toluic acid $C_8H_8O_2$

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
100 sol.	0.216 mm	......	....

o-Toluidine C_7H_9N

°C	Pressure	Density g/cm³ liq.	Density g/cm³ vap.
40 liq.	1.1 mm	......	....
60	3.7	......	....
80	10.5	......	....
100	27.2	......	....
120	62.3	......	....
140	129.9	......	....
160	250.2	......	....
180	450.2	......	....
200	762.9	......	....

VAPOR PRESSURE (Continued)

°C	Pressure	Density g/cm³	
		liq.	vap.
m-Toluidine C_7H_9N			
60 liq.	3.4 mm	......	....
80	9.4	......	....
100	23.9	......	....
120	54.8	......	....
140	115.5	......	....
160	224.9	......	....
180	410.6	......	....
200	706.7	......	....
p-Toluidine C_7H_9N			
40 liq.	1.1 mm	......	....
60	3.7	......	....
80	10.5	......	....
100	26.6	......	....
120	60.6	......	....
140	126.3	......	....
160	244.0	......	....
180	441.3	......	....
200	753.0	......	....
Trichloroethylene C_2HCl_3			
25 liq.	73. mm	......	....
30	94.	......	....
40	149.	......	....
50	224.	......	....
60	324.5	......	....
70	453.0	......	....
80	618.0	......	....
Trinitrotoluene $C_7H_5N_3O_6$			
80 liq.	0.042 mm	......	....
85	0.053	......	....
90	0.067	......	....
95	0.085	......	....
100	0.106	......	....
Urethane $C_3H_7NO_2$			
120 liq.	103. mm	......	....
140	203.	......	....
160	392.	......	....
Valeric acid $C_5H_{10}O_2$			
60 liq.	2.07 mm	......	....
80	9.3	......	....

°C	Pressure	Density g/cm³	
		liq.	vap.
Valeric acid $C_5H_{10}O_2$ (Continued)			
100	28.2 mm	......	....
120	70.5	......	....
140	159.6	......	....
160	336.1	......	....
180	660.7	......	....
iso-Valeric acid $C_5H_{10}O_2$			
10 liq	0.2 mm	......	....
30	0.75	......	....
50	2.9	......	....
70	9.4	......	....
90	27.3	......	....
110	69.8	......	....
130	159.8	......	....
150	338.3	......	....
o-Xylene C_8H_{10}			
0 liq.	4.0 mm	......	....
20	10.05	......	....
40	23.7	......	....
60	52.4	......	....
80	108.9	......	....
100	213.1	......	....
120	393.85	......	....
140	689.9	......	....
m-Xylene C_8H_{10}			
0 liq.	1.75 mm	......	....
20	6.43	......	....
40	19.48	......	....
60	50.59	......	....
80	115.72	......	....
100	238.22	......	....
120	448.85	......	....
140	784.64	......	....
p-Xylene C_8H_{10}			
0 liq.	8.29 mm	......	....
20	16.35	......	....
40	34.00	......	....
60	70.64	......	....
80	142.04	......	....
100	270.46	......	....
120	481.33	......	....
140	794.84	......	....

VAPOR PRESSURE

Variation with Temperature

The following table gives the value of the constants a and b in the following equation:

$$\log_{10} p = -\frac{0.05223a}{T} + b$$

where p is the pressure in mm of mercury of the saturated vapor at the absolute temperature T. ($T = t°C + 273.1$).

Elements and Inorganic Compounds

Compound	Formula	Temp. range °C	a	b
Aluminum oxide	Al_2O_3	1840 to 2200 liq.	540,000	14.22
Ammonia	NH_3	−127 to −78 sol.	31,211	9.9974
Ammonium bromide	NH_4Br	250 to 400 sol.	90,208	9.9404
Ammonium chloride	NH_4Cl	100 to 400 sol.	83,486	10.0164
Ammonium cyanide	NH_4CN	7 to 17 sol.	41,484	9.978
Ammonium iodide	NH_4I	300 to 400 sol.	95,730	10.2700
Ammonium sulfhydrate	NH_4HS	6 to 40 sol.	46,025	10.7500
Antimony	Sb	1070 to 1325 liq.	189,000	9.051
Argon	A	−208 to −189 sol.	7,814.5	7.5741
		−189 to −183 liq.	6,826.0	6.9605
Arsenic	As	800 to 860 liq.	47,100	6.692
		440 to 815 sol.	133,000	10.800
Arsenous oxide	As_2O_3	100 to 310 sol.	111,350	12.127
		315 to 490 liq.	52,120	6.513
Barium	Ba	930 to 1130 liq.	350,000	15.765
Bismuth	Bi	1210 to 1420 liq.	200,000	8.876
Bismuth trichloride	$BiCl_3$	91 to 213 sol.	13,125	2.681
Cadmium	Cd	150 to 320.9 sol.	109,000	8.564
		500 to 840 liq.	99,900	7.897
Cadmium iodide	CdI_2	385 to 450 liq.	122,200	9.269
Caesium	Cs	200 to 350 liq.	73,400	6.949
Caesium chloride	CsCl	986 to 1295 liq.	163,200	8.340

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	a	b
Calcium	Ca	960 to 1110 liq.	370,000	16.240
Carbon	C	3880 to 4430 liq.	540,000*	9.596*
Carbon dioxide	CO_2	−135 to −56.7 sol.	26,179.3	9.9082
Carbon monoxide	CO	−290 to −206 liq.	6,354	6.976
Chlorine	Cl	−154 to −103 sol.	29,293	9.950
Cobalt	Co	2375 liq.	309,000	7.571
Copper	Cu	2100 to 2310 liq.	468,000	12.344
Cuprous chloride	Cu_2Cl_2	878 to 1369 liq.	80,700	5.454
Cyanogen	$(CN)_2$	−72 to −28 sol.	32,437	9.6539
		−32 to −6 liq.	23,750	7.808
Ferrous chloride	$FeCl_2$	700 to 930 sol.	135,200	8.33
Gold	Au	2315 to 2500 liq.	385,000	9.853
Hydriodic acid	HI	−97 to −51 sol.	24,160	8.259
		−50 to −34 liq.	21,580	7.630
Hydrobromic acid	HBr	−114 to −86 sol.	22,420	8.734
		−86 to −66 liq.	17,960	7.427
Hydrochloric acid	HCl	−158 to −110 sol.	19,588	8.4430
Hydrocyanic acid	HCN	−8 to +27 liq.	27,830	7.7446
Hydrofluoric acid	HF	−83 to +48 liq.	25,180	7.370
Hydrogen peroxide	H_2O_2	10 to 90 liq.	48,530	8.853
Hydrogen sulfide	H_2S	−110 to −83 sol.	20,690	7.880
Iron	Fe	2220 to 2450 liq.	309,000	7.482
Krypton	Kr	−189 to −169 sol.	10,065	7.1770
		−169 to −150 liq.	9,377.0	6.92387
Lead	Pb	525 to 1325 liq.	188,500	7.827
Lead bromide	$PbBr_2$	735 to 918 liq.	118,000	8.064
Lead chloride	$PbCl_2$	500 to 950 liq.	141,900	8.961
Lithium bromide	LiBr	1010 to 1265 liq.	152,700	8.068
Lithium chloride	LiCl	1045 to 1325 liq.	155,900	7.939
Lithium fluoride	LiF	1398 to 1666 liq.	218,400	8.753
Lithium iodide	LiI	940 to 1140 liq.	143,600	8.011
Magnesium	Mg	900 to 1070 liq.	260,000	12.993

* Based on boiling point of 3927° C or 4200° absolute.

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	a	b
Manganese	Mn	1510 to 1900 liq.	267,000	9.300
Mercuric bromide	$HgBr_2$	111 to 235 sol.	79,800	10.181
		238 to 331 liq.	61,250	8.284
Mercuric chloride	$HgCl_2$	60 to 130 sol.	85,030	10.888
		130 to 270 sol.	78,850	10.094
		275 to 309 liq.	61,020	8.409
Mercuric iodide	HgI_2	100 to 250 sol.	82,340	10.057
		266 to 360 liq.	62,770	8.115
Mercury	Hg	−80 to −38.87 sol.	73,000	10.383
		400 to 1300 liq.	58,700	7.752
Molybdenum	Mo	1800 to 2240 sol.	680,000	10.844
Nitrogen	N_2	−215 to −210 sol.	6,881.3	7.66558
Nitrogen dioxide	NO	−200 to −161 sol.	16,423	10.048
		−163.7 to −148 liq.	13,040	8.440
Nitrogen monoxide	N_2O	−144 to −90 sol.	23,590	9.579
		−90.1 to −88.7 liq.	16,440	7.535
Nitrogen pentoxide	N_2O_5	−30 to +30 sol.	57,180	12.647
Nitrogen tetroxide	N_2O_4	−100 to −40 sol.	55,160	13.400
		−40 to −10 sol.	45,440	11.214
		−8 to +43.2 liq.	33,430	8.814
Nitrogen trioxide	N_2O_3	−25 to 0 liq.	39,400	10.30
Phosphorus (white)	P	20 to 44.1 sol.	63,123	9.6511
Phosphorus (violet)	P	380 to 590 sol.	108,510	11.0842
Platinum	Pt	1425 to 1765 sol.	486,000	7.786
Potassium	K	260 to 760 liq.	84,900	7.183
Potassium bromide	KBr	906 to 1063 liq.	168,100	8.2470
		1095 to 1375 liq.	163,800	7.936
Potassium chloride	KCl	906 to 1105 liq.	174,500	8.3526
		1116 to 1418 liq.	169,700	8.130
Potassium fluoride	KF	1278 to 1500 liq.	207,500	9.000
Potassium hydroxide	KOH	1170 to 1327 liq.	136,000	7.330
Potassium iodide	KI	843 to 1028 liq.	157,600	8.0957
		1063 to 1333 liq.	155,700	7.949

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	a	b
Rubidium	Rb	250 to 370 liq.	76,000	6.976
Rubidium chloride	RbCl	1142 to 1395 liq.	198,600	9.111
Silicon	Si	1200 to 1320 sol.	170,000	5.950
Silicon dioxide	SiO_2	1860 to 2230 liq.	506,000	13.43
Silver	Ag	1650 to 1950 liq.	250,000	8.762
Silver chloride	AgCl	1255 to 1442 liq.	185,500	8.179
Sodium	Na	180 to 883 liq.	103,300	7.553
Sodium bromide	NaBr	1138 to 1394 liq.	161,600	7.948
Sodium chloride	NaCl	976 to 1155 liq.	180,300	8.3297
		1156 to 1430 liq.	185,800	8.548
Sodium cyanide	NaCN	800 to 1360 liq.	155,520	7.472
Sodium fluoride	NaF	1562 to 1701 liq.	218,200	8.640
Sodium hydroxide	NaOH	1010 to 1402 liq.	132,000	7.030
Sodium iodide	NaI	1063 to 1307 liq.	165,100	8.371
Stannic chloride	$SnCl_4$	−52 to −38 sol.	46,740	9.824
Strontium	Sr	940 to 1140 liq.	360,000	16.056
Sulfur dioxide	SO_2	−95 to −75 sol.	35,827	10.5916
Sulfur trioxide	SO_3	24 to 48 liq.	43,450	10.022
Thallium	Tl	950 to 1200 liq.	120,000	6.140
Thallium chloride	TlCl	665 to 807 liq.	105,200	7.974
Tin	Sn	1950 to 2270 liq.	328,000	9.643
Tungsten	W	2230 to 2770 sol.	897,000	9.920
Zinc	Zn	250 to 419.4 sol.	133,000	9.200
		600 to 985 liq.	118,000	8.108

Organic Compounds

Compound	Formula	Temp. range °C	a	b
Acetaldehyde	C_2H_4O	−24.3 to +27.5 liq.	27,707	7.8206
Acetic acid	$C_2H_4O_2$	−35 to 10 sol.	41,689	8.502
Acetic anhydride	$C_4H_6O_3$	100 to 140 liq.	45,585	8.688

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	*a*	*b*
Acetylene	C_2H_2	−140 to −82 sol.	21,914	8.933
Aniline	C_6H_7N	145 to185 liq.	45,951.6	8.1278
Anthracene	$C_{14}H_{10}$	100 to 600 sol.	70,390	8.706
		100 to 160 liq.	72,000	8.91
		223 to 342 liq.	59,219	7.910
Anthraquinone	$C_{14}H_8O_2$	224 to 286 sol.	110,040	12.305
Benzene	C_6H_6	−58 to −30 sol.	42,904	9.556
		−30 to +5 sol.	44,222	9.846
		0 to 42 liq.	34,172	7.9622
		42 to 100 liq.	32,295	7.6546
Benzoic acid	$C_7H_6O_2$	60 to 110 sol.	63,820	9.033
Benzophenone	$C_{13}H_{10}O$	260 to 308 liq.	58,221	8.137
Benzoyl chloride	C_7H_5ClO	140 to 200 liq.	45,416	7.9245
Benzyl alcohol	C_7H_8O	100 to 135 liq.	59,491	9.5152
		135 to 205 liq.	53,118	8.6977
Butane	C_4H_{10}	−100 to +12 liq.	23,450	7.395
iso-Butane	C_4H_{10}	−115 to −34 liq.	21,273	7.25
n-Butyl alcohol	$C_4H_{10}O$	75 to 117.5 liq.	46,774	9.1362
Butyric acid	$C_4H_8O_2$	80 to 165 liq.	51,103	9.010
Bromobenzene	C_6H_5Br	−26 to −15 liq.	42,500	8.075
p-Bromochlorobenzene	C_6H_4BrCl	23 to 63 sol.	69,755	11.629
Camphor	$C_{10}H_{16}O$	0 to 180 sol.	53,559	8.799
Carbon tetrachloride	CCl_4	−70 to −50 sol.	34,608	8.05
		−19 to +20 liq.	33,914	8.004
Chlorobenzene	C_6H_5Cl	−35 to −15 liq.	42,250	8.500
Cyclohexane	C_6H_{12}	−5 to +5 sol.	37,394	8.594
p-Dichlorobenzene	$C_6H_4Cl_2$	30 to 50 sol.	72,218	12.480
Dichloroethane-1,1	$C_2H_4Cl_2$	0 to 30 liq.	31,706	7.909
Dichloroethane-1,2	$C_2H_4Cl_2$	0 to 30 liq.	35,598	8.126
Diphenylamine	$C_{12}H_{11}N$	278 to 284 liq.	57,350	8.088
Ethyl chloride	C_2H_5Cl	−30 to +30 liq.	26,319	7.691
Ethylene	C_2H_4	−160 to −104 liq.	14,396	7.330

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	a	b
Ethylene bromide	$C_2H_4Br_2$	10 to 150 liq.	38,082	7.792
Heptane	C_7H_{16}	−63 to −40 liq.	37,358	8.2585
Hexane	C_6H_{14}	−10 to +90 liq.	31,679	7.724
Iodobenzene	C_6H_5I	−30 to +18 liq.	43,000	7.500
Methane	CH_4	−194 to −184 sol.	9,896.2	7.6509
		−174 to −163 liq.	8,516.9	6.8626
Methyl alcohol	CH_4O	−62 to −44 liq.	39,234	8.9547
		−10 to +80 liq.	38,324	8.8017
Methyl chloride	CH_3Cl	−47 to −10 liq.	21,988	7.481
Methyl ether	C_2H_6O	−70 to −20 liq.	23,025	7.720
Methyl fluoride	CH_3F	−102 to −76 liq.	17,053	7.445
Methyl salicylate	$C_8H_8O_3$	175 to 215 liq.	48,670	8.008
Naphthalene	$C_{10}H_8$	0 to 80 sol.	71,401	11.450
		120 to 200 liq.	47,362	7.927
o-Nitroaniline	$C_6H_6N_2O_2$	150 to 260 liq.	63,881	8.8684
m-Nitroaniline	$C_6H_6N_2O_2$	170 to 260 liq.	65,880	8.8188
p-Nitroaniline	$C_6H_6N_2O_2$	190 to 260 liq.	77,345	9.5595
Nitrobenzene	$C_6H_5NO_2$	112 to 209 liq.	48,955	8.192
Nitromethane	CH_3NO_2	47 to 100 liq.	36,914	8.033
Oxalic acid	$C_2H_2O_4$	55 to 105 sol.	90,502.6	12.2229
n-Pentane	C_6H_{r2}	−20 to +50 liq.	27,691	7.558
Phenol	C_6H_6O	116 to 180 liq.	49,644	8.587
Phthalic anhydride	$C_8H_4O_3$	160 to 285 liq.	54,920	8.022
Propane	C_3H_8	−136 to −40 liq.	19,037	7.217
Propionic acid	$C_3H_6O_2$	20 to 140 liq.	46,150	8.715
n-Propyl alcohol	C_3H_8O	−45 to −10 liq.	47,274	9.5180
Propyl bromide	C_3H_7Br	0 to 30 liq.	32,430	7.821
Propyl chloride	C_3H_7Cl	0 to 50 liq.	28,894	7.593
Propylene	C_3H_6	−95 to −48 liq.	19,693	7.4463
Quinoline	C_9H_7N	180 to 240 liq.	49,720	7.969
Tetrachloroethane-1, 1, 1, 2	$C_2H_2Cl_4$	105 to 145 liq.	36,508	7.605
Tetrachloroethane-1, 1, 2, 2	$C_2H_2Cl_4$	26 to 145 liq.	39,729	7.846
Toluene	C_7H_8	−92 to +15 liq.	39,198	8.330

LOWERING OF VAPOR PRESSURE BY SALTS IN AQUEOUS SOLUTIONS

The table gives the reduction of the vapor pressure in millimeters due to the presence of the number of grammolecules of salt per liter of water given at the head of the columns, at the temperature 100° C., at which temperature the vapor pressure of pure water is 76.0 centimeters.

(From Smithsonian Tables.)

Substance	0.5	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0
Ammonium chloride.	12.0	23.7	45.1	69.3	94.2	118.5	138.2	179.0	213.8
Barium chloride.....	16.4	36.7	77.6						
Calcium chloride....	17.0	39.8	95.3	166.6	241.5	319.5			
Ferrous sulphate....	5.8	10.7	24.0	42.4					
Potassium hydroxide.	15.0	29.5	64.0	99.2	140.0	181.8	223.0	309.5	387.8
Potassium iodide....	12.5	25.3	52.2	82.6	112.2	141.5	171.8	225.5	278.5
Sodium chloride.....	12.3	25.2	52.1	80.0	111.0	143.0	176.5		
Sodium hydroxide...	11.8	22.8	48.2	77.3	107.5	139.1	172.5	243.3	314.0
Sulphuric acid......	12.9	26.5	62.8	104.0	148.0	198.4	247.0	343.2	
Zinc sulphate.......	4.9	10.4	21.5	42.1	66.2				

CONSTANTS OF THE KINETIC THEORY OF GASES

Giving the velocity, mean free path and diameter of molecules for various gases and vapors at 0° C. and 760 mm. pressure.

Gas.	Mean vel. cm./s.	Mean free path, cm.	Diam. cm.	Observer.
Ammonia.....	5.8×10^4	6.2×10^{-6}	3.9×10^{-8}	Graham, 1846
Argon........	3.81	8.84	3.23	Schultze, 1901
Benzene......	2.7	2.1	6.6	
Carbon dioxide	3.6	5.6	4.1	Breitenbach 1899
Chlorine......	2.86	4.07	4.76	Graham, 1846
Chloroform...	2.2	2.3	6.3	Puluj, 1878
Ether........	2.8	2.1	6.6	Puluj, 1878
Ethyl alcohol.	3.5	3.2	5.3	Puluj, 1878
Helium.......	12.02	25.1	1.9	Schultze, 1901
Hydrogen....	16.94	16.3	2.38	Puluj, 1878
Nitrogen.....	4.53	8.61	3.27	Markowski, 1904
Oxygen......	4.25	9.06	3.19	Markowski, 1904
Water vapor..	5.7	5.7	4.0	Puluj, 1878

NUMBER OF MOLECULES IN A GRAM-MOLECULE

Perrin, 1909–11 .... 6.2×10^{23}
Perrin (Brownian movement) 6.85
Millikan, 1910 .... 6.2
Millikan, 1917 .... 6.06

MASS OF THE HYDROGEN ATOM

1.66×10^{-24} grams

HEAT CONDUCTIVITY

Giving the quantity of heat in calories which is transmitted per second through a plate one centimeter thick across an area of one square centimeter when the temperature difference is one degree Centigrade.

METALS

Substance	Temp. °C.	Conductivity	Observer
Aluminum	−160	0.514	Lees. 1908
	18	0.480	Jaeger & Diesselhorst, 1900
	18	0.504	Lees, 1908
	100	0.492	Jaeger & Diesselhorst, 1900
	100	0.49	Angell, 1911
	200	0.55	"
	300	0.64	"
	400	0.76	"
	600	1.01	"
Antimony	0	0.0442	Lorenz, 1881
	100	0.040	"
	0–30	0.042	Berget, 1890
Bismuth	−186	0.025	Macchia, 1907
	0	0.0177	Lorenz
	18	0.0194	Jaeger & Diesselhorst, 1900
	100	0.0161	Jaeger & Diesselhorst, 1900
Brass (70Cu+30Zn)	−160	0.181	Lees, 1908
(70Cu+30Zn)	17	0.260	" "
yellow	0	0.204	Lorenz
red	0	0.246	"
Bronze, aluminum (90Cu, 10Al)	....	0.18	Van Aubel
Cadmium	−160	0.239	Lees, 1908
	0	0.220	Lorenz
	18	0.222	Jaeger & Diesselhorst, 1900
	100	0.216	Jaeger & Diesselhorst, 1900
Constantan	18	0.054	Jaeger & Diesselhorst, 1900
(60Cu, 40Ni)	100	0.064	Jaeger & Diesselhorst, 1900
Copper, pure	−160	1.097	Lees, 1908
	13	1.00	Angström, 1863
	18	0.918	Jaeger & Diesselhorst, 1900

HEAT CONDUCTIVITY (Continued)

Metals

Substance	Temp. ° C.	Conductivity	Observer
Copper, pure........	100	0.908	Jaeger & Diesselhorst, 1900
	100-197	1.043	Hering, 1910
	100-268	0.969	"
	100-370	0.931	"
	100-541	0.902	"
	100-837	0.858	"
German silver.......	0	0.070	Lorenz, 1881
	100	0.089	"
(52Cu, 26Zn, 22Ni)	....	0.10	Glage, 1905
Gold...............	17	0.705	Barratt, 1914
	18	0.700	Jaeger & Diesselhorst, 1900
	100	0.703	Jaeger & Diesselhorst, 1900
Iridium............	17	0.141	Barratt, 1914
Iron, pure..........	18	0.161	Jaeger & Diesselhorst
	100	0.151	" "
	100-727	0.202	Hering, 1910
	100-1245	0.191	"
wrought..........	−160	0.152	Lees, 1908
	18	0.144	Jaeger & Diesselhorst
	100	0.143	" "
cast.............	18	0.109	" "
	100	0.108	" "
	54	0.114	Callendar
	102	0.111	"
Steel...............	−160	0.113	Lees, 1908
	18	0.115	" "
	18	0.108	Jaeger & Diesselhorst
	100	0.107	" "
Lead...............	−160	0.092	Lees, 1908
	18	0.083	Jaeger & Diesselhorst
	100	0.082	" "
Magnesium.........	0-100	0.376	Lorenz, 1881
Manganin..........	18	0.15186	Jaeger & Diesselhorst
(84Cu, 4Ni, 12Mn)	100	0.06310	" "
	−160	0.035	Lees, 1908
Mercury...........	0	0.0148	H. F. Weber, 1880
	50	0.0189	" "
	17	0.0197	R. Weber, 1902
Molybdenum.......	17	0.346	Barratt, 1914
Nickel.............	−160	0.129	Lees, 1908

HEAT CONDUCTIVITY (Continued)

Metals

Substance	Temp. ° C.	Conductivity	Observer
Nickel	18	0.142	Jaeger & Diesselhorst, 1900
	100	0.138	Jaeger & Diesselhorst, 1900
	300	0.126	Angell, 1911
	600	0.088	"
	800	0.068	"
	1200	0.058	"
Palladium..........	18	0.1683	Jaeger & Diesselhorst, 1900
	100	0.182	
Platinum...........	18	0.1664	Jaeger & Diesselhorst, 1900
	100	0.1733	Jaeger & Diesselhorst, 1900
Platinum-iridium. .. 10 % Ir	17	0.074	Barratt, 1914
Platinum-rhodium... 10 % Rh	17	0.072	Barratt, 1914
Platinoid..........	18	0.060	Lees, 1908
Rhodium............	17	0.210	Barratt, 1914
Silver, pure.........	−160	0.998	Lees, 1908
	18	0.974	"
	18	1.006	Jaeger & Diesselhorst, 1900
	100	0.992	Jaeger & Diesselhorst, 1900
Tin................	−160	0.192	Lees, 1908
	0	0.1528	Lorenz, 1881
	18	0.155	Jaeger & Diesselhorst, 1900
	100	0.145	Jaeger & Diesselhorst, 1900
	100	0.1423	Lorenz, 1881
Tantalum..........	17	0.130	Barratt, 1914
Tungsten...........	17	0.476	"
	18	0.35	Coolidge
Wood's alloy........	....	0.0319	H. F. Weber
Zinc...............	−160	0.278	Lees, 1908
	18	0.2653	Jaeger & Diesselhorst
	100	0.2619	" "

HEAT CONDUCTIVITY (Continued)

Various Solids

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Asbestos fiber, 500° C. .	0.00019	Randolph, 1912
paper	0.0006	. . . .
	0.0004	Lees-Chorlton, 1896
Basalt	0.0052	Hecht, 1903
Brick, common red	0.0015	Herschel-Lebour & Dunn, 1879
Blotting paper	0.00015	Lees-Charlton, 1896
Carbon	0.01	
Carborundum	0.0005	Lorenz
brick, 150°–1200° . . .	0.032–0.027	Wologdine
Cardboard	0.0005	. . . .
Cement, Portland	0.00071	Lees-Chorlton, 1896
Chalk	0.0020	Herschel-Lebour & Dunn, 1879
Concrete, cinder	0.00081	. . . .
stone	0.0022	Norton
Cork	0.00072	G. Forbes, 1875
	0.00013	Lees, 1892–8
Cotton wool	0.000043	G. Forbes
felted	0.000033	"
Diatomic earth	0.00013	Hutton-Blard
Earth's crust, ave	0.004	. . . .
Ebonite	0.00042	Lees
	0.00014	Barratt, 1914
Eiderdown	0.000011	Peclet, 1878
Felt	0.000087	. . . .
Fiber, red	0.0011	Barratt, 1914
Fire brick	0.00028	Hutton-Blard
	0.0011	Barratt, 1914
Flannel	0.00023	
Gas carbon, 20°	0.0085	Barratt, 1914
100°	0.0095	"
Glass		
crown (window)	0.0025	Lees, 1892–8
flint	0.002	"
Jena	0.001–0.002	"
soda, 20°	0.0017	Barratt, 1914
100°	0.0018	"
Granite, 100°	0.0045–0.0050	Poole, 1912
500°	0.0040	"
Graphite	0.012	. . . .
Graphite brick, 300° to 700°	0.24	Wologdine, 1909

HEAT CONDUCTIVITY (Continued)

Various Solids (Continued)

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Gutta percha	0.00048	Péclet, 1878
Gypsum	0.0031	R. Weber, 1878
Haircloth, felt	0.000042	G. Forbes
Ice	0.005	....
	0.0039	....
	0.0022	Forbes, 1875
Infusorial earth, 100°	0.00034	Skinner
300°	0.00040	"
pressed bricks, 100°	0.00030	"
Lamp black, 100	0.00007	Randolph, 1912
Leather, cowhide	0.00042	Lees-Chorlton, 1896
chamois	0.00015	" "
Lime	0.00029	Hutton-Blard
Linen	0.00021	Lees-Chorlton, 1896
Magnesia, MgO	0.00016–0.00045	Hutton-Blard
brick, 50°–1130°	0.0027–0.0072	Wologdine, 1909
Magnesium carbonate, 100°	0.00023	Skinner
300°	0.00025	"
Marble	0.0071	Lees, 1892–8
Mica, perpendicular to cleavage plane	0.0018	Lees
Paper	0.0003	"
Paraffine	0.0006	"
0°	0.00023	R. Weber, 1878
Plaster of Paris	0.00070	Lees-Chorlton, 1896
Porcelain	0.0025	Lees, 1892–8
165°–1055°	0.0039–0.0047	Wologdine, 1909
Quartz, parallel to axis	0.030	Lees, 1892–8
perpendicular to axis	0.16	"
Rubber, para	0.00045	"
Sand, dry	0.00093	Herschel-Lebour & Dunn, 1879
Sandstone	0.0055	Herschel-Lebour & Dunn, 1879
Sawdust	0.00012	G. Forbes, 1875
Silica, fused, 20°	0.00237	Barratt, 1914
100°	0.00255	"
Silica brick, 100° to 1000° C.	0.002–0.003	Wologdine, 1909
Silk	0.000095	Lees-Chorlton, 1896
Slate	0.004700	Lees, 1892–8

HEAT CONDUCTIVITY (Continued)

Various Solids (Continued)

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Snow, compact	0.00051	Hjeltström
Soil, dry	0.00033	Lees-Chorlton, 1896
Wax, bees'	0.00009	G. Forbes
Wood, fir || to axis	0.00030	....
perpendicular to axis	0.00009	....

Liquids

Substance	Conductivity	Observer
Acetic acid	0.00047	H. F. Weber
Amyl alcohol	0.000328	"
Aniline, 12°	0.00041	....
Benzole, 5°	0.000333	H. F. Weber
Carbon disulphide, 9° to 15°	0.000343	"
Chloroform, 9°–15°	0.000288	"
Ether, 9°–15°	0.000303	"
Ethyl alcohol	0.000423	"
Glycerine, 9°–15°	0.000637	Graetz
Methyl alcohol	0.000495	H. F. Weber
Oils: olive	0.000395	Wachsmuth
castor	0.000425	"
petroleum, 13°	0.000355	Graetz
turpentine	0.000325	"
Vaseline, 25°	0.00044	Lees
Water, 4°	0.00138	H. F. Weber
0°	0.00120	"
17°	0.00131	R. Weber
20°	0.00143	Milner & Chattock

Gases

Substance	Conductivity	Observer
Air, 0°	0.0000568	Winklemann
Argon, 0°	0.0000389	Schwarze
Ammonia gas, 0°	0.0000458	Winklemann
Carbon dioxide, 0°	0.0000307	"
monoxide	0.0000499	"
Ethylene	0.0000395	"
Helium, 0°	0.000339	Schwarze
Hydrogen, 0°	0.000327	Winklemann
100°	0.000369	Graetz
Methane, 7°–8°	0.0000647	Winklemann
Nitric oxide, NO, 8°	0.0000460	"
Nitrogen, 7°–8°	0.0000524	"
Nitrous oxide, N_2O	0.0000350	
Oxygen, 7°–8°	0.0000563	

THERMAL CONDUCTIVITY OF MATERIALS

(Bureau of Standards Letter Circular No. 227)

D = Density in pounds per cubic foot.
K = Thermal conductivity in B.T.U. per hour, square foot, and temperature gradient of 1 degree Fahrenheit per inch thickness. The lower the conductivity, the greater the insulating values.

Soft Flexible Materials in Sheet Form

		D	K
Dry Zero	Kapok between burlap or paper	1.0	0.24
		2.0	0.25
Cabots Quilt	Eel grass between kraft paper	3.4	0.25
		4.6	0.26
Hair Felt	Felted cattle hair	11.0	0.26
		13.0	0.26
Balsam Wool	Chemically treated wood fibre	2.2	0.27
Hairinsul	75% hair 25% jute	6.3	0.27
	50% hair 50% jute	6.1	0.26
Linofelt	Flax fibres between paper	4.9	0.28
Thermofelt	Jute and asbestos fibres, felted	10.0	0.37
	Hair and asbestos fibres, felted	7.8	0.28

Loose Materials

		D	K
Rock Wool	Fibrous material made from rock,	6.0	0.26
	also made in sheet form, felted and	10.0	0.27
	confined with wire netting	14.0	0.28
		18.0	0.29
Glass Wool	Pyrex glass, curled	4.0	0.29
		10.0	0.29
Sil-O-Cel	Powdered diatomaceous earth	10.6	0.31
Regranulated Cork	Fine particles	9.4	0.30
	about 3/16 inch particles	8.1	0.31
Thermofill	Gypsum in powdered form	26.	0.52
		34.	0.60
Sawdust	Various	12.0	0.41
	redwood	10.9	0.42
Shavings	Various, from planer	8.8	0.41
Charcoal	From maple, beech and birch,		
	coarse	13.2	0.36
	6 mesh	15.2	0.37
	20 mesh	19.2	0.39

Semi-flexible Materials in Sheet Form

		D	K
Flaxlinum	Flax fibre	13.0	0.31
Fibrofelt	Flax and rye fibre	13.6	0.32

THERMAL CONDUCTIVITY OF MATERIALS (Continued)

Semi-rigid Materials in Board Form

Corkboard	No added binder; very low density	5.4	0.25
Corkboard	No added binder; low density....	7.0	0.27
Corkboard	No added binder; medium density	10.6	0.30
Corkboard	No added binder; high density ..	14.0	0.34
Eureka	Corkboard with asphaltic binder .	14.5	0.32
Rock Cork	Rock wool block with binder..... Also called "Tucork"	16.7	0.37
Lith	Board containing rock wool, flax and straw pulp.................	14.3	0.40

Stiff Fibrous Materials in Sheet Form

Insulite	Wood pulp....................	16.2	0.34
		16.9	0.34
Celotex	Sugar cane fibre...............	13.2	0.34
		14.8	0.34

*Masonite........................	K = 0.33
*Inso-board........................	0.33
*Maizewood........................	0.33 to 0.39
*Cornstalk Pith Board................	0.24 to 0.30
*Maftex........................	0.34

Cellular Gypsum

Insulex or Pyrocell..................	8	0.35
	12	0.44
	18	0.59
	24	0.77
	30	1.00

Woods (Across Grain)

Balsa..............................	7.3	0.33
	8.8	0.38
	20	0.58
Cypress............................	29	0.67
White pine.........................	32	0.78
Mahogany...........................	34	0.90
Virginia pine......................	34	0.98
Oak................................	38	1.02
Maple..............................	44	1.10

Miscellaneous Building Materials

(Data taken from various sources)

	K		K
Cinder concrete....	2 to 3	Limestone..........	4 to 9
Building gypsum....	About 3	Concrete...........	6 to 9
Plaster............	2 to 5	Sandstone..........	8 to 16
Building brick......	3 to 6	Marble............	14 to 20
Glass..............	5 to 6	Granite............	13 to 28

* From various commercial laboratories and the work of O. R. Sweeney at Iowa State College.

TEMPERATURE OF SATURATED STEAM

The following table gives the temperature of saturated water vapor in degrees Centigrade and degrees Fahrenheit corresponding to gauge pressure in pounds from 0 to 3184. Zero gauge pressure corresponds to an absolute pressure of 14.696 pounds per square inch.

Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C
0	212.0	100.0	55	302.5	150.3	110	344.1	173.4
1	215.4	101.9	56	303.6	150.9	111	344.7	173.7
2	218.5	103.6	57	304.5	151.4	112	345.4	174.1
3	221.5	105.3	58	305.4	151.9	113	345.9	174.4
4	224.4	106.9	59	306.3	152.4	114	346.5	174.7
5	227.1	108.4	60	307.4	153.0	115	347.2	175.1
6	229.6	109.8	61	308.3	153.5	116	347.7	175.4
7	232.3	111.3	62	309.2	154.0	117	348.3	175.7
8	234.7	112.6	63	309.9	154.4	118	348.8	176.0
9	237.0	113.9	64	310.8	154.9	119	349.5	176.4
10	239.4	115.2	65	311.7	155.4	120	350.1	176.7
11	241.5	116.4	66	312.6	155.9	121	350.6	177.0
12	243.7	117.6	67	313.5	156.4	122	351.1	177.3
13	245.8	118.8	68	314.2	156.8	123	351.7	177.6
14	247.8	119.9	69	315.1	157.3	124	352.2	177.9
15	249.8	121.0	70	316.0	157.8	125	352.9	178.3
16	251.6	122.0	71	316.8	158.2	126	353.5	178.6
17	253.4	123.0	72	317.7	158.7	127	354.0	178.9
18	255.4	124.1	73	318.4	159.1	128	354.6	179.2
19	257.0	125.0	74	319.3	159.6	129	355.1	179.5
20	258.8	126.0	75	320.0	160.0	130	355.6	179.8
21	260.4	126.9	76	320.9	160.5	131	356.2	180.1
22	262.0	127.8	77	321.6	160.9	132	356.7	180.4
23	263.7	128.7	78	322.3	161.3	133	357.3	180.7
24	265.3	129.6	79	323.1	161.7	134	357.8	181.0
25	266.7	130.4	80	323.8	162.1	135	358.3	181.3
26	268.3	131.3	81	324.7	162.6	136	358.9	181.6
27	269.8	132.1	82	325.4	163.0	137	359.2	181.8
28	271.2	132.9	83	326.1	163.4	138	359.8	182.1
29	272.7	133.7	84	326.8	163.8	139	360.3	182.4
30	274.1	134.5	85	327.6	164.2	140	360.9	182.7
31	275.4	135.2	86	328.3	164.6	141	361.4	183.0
32	276.8	136.0	87	329.0	165.0	142	361.9	183.3
33	278.1	136.7	88	329.7	165.4	143	362.3	183.5
34	279.3	137.4	89	330.4	165.8	144	362.8	183.8
35	280.6	138.1	90	331.2	166.2	145	363.4	184.1
36	281.8	138.8	91	331.9	166.6	146	363.9	184.4
37	283.1	139.5	92	332.6	167.0	147	364.5	184.7
38	284.4	140.2	93	333.1	167.3	148	364.8	184.9
39	285.6	140.9	94	333.9	167.7	149	365.4	185.2
40	286.7	141.5	95	334.6	168.1	150	365.9	185.5
41	288.0	142.2	96	335.1	168.4	151	366.4	185.8
42	289.0	142.8	97	335.8	168.8	152	366.8	186.0
43	290.1	143.4	98	336.6	169.2	153	367.3	186.3
44	291.2	144.0	99	337.3	169.6	154	367.9	186.6
45	292.3	144.6	100	337.8	169.9	155	368.2	186.8
46	293.5	145.3	101	338.5	170.3	156	368.8	187.1
47	294.4	145.8	102	339.1	170.6	157	369.3	187.4
48	295.5	146.4	103	339.8	171.0	158	369.7	187.6
49	296.6	147.0	104	340.5	171.4	159	370.2	187.9
50	297.7	147.6	105	341.1	171.7	160	370.6	188.1
51	298.6	148.1	106	341.6	172.0	161	371.1	188.4
52	299.7	148.7	107	342.3	172.4	162	371.7	188.7
53	300.7	149.3	108	342.9	172.7	163	372.0	188.9
54	301.6	149.8	109	343.6	173.1	164	372.6	189.2

TEMPERATURE OF SATURATED STEAM (Continued)

Gauge pressure lbs./in.²	Temp. °F	Temp. °C	Gauge pressure lbs./in.²	Temp. °F	Temp. °C	Gauge pressure lbs./in.²	Temp. °F	Temp. °C
165	372.9	189.4	**225**	397.2	202.9	**285**	417.2	214.0
166	373.5	189.7	226	397.6	203.1	286	417.6	214.2
167	373.8	189.9	227	397.9	203.3	287	417.9	214.4
168	374.4	190.2	228	398.3	203.5	288	418.1	214.5
169	374.7	190.4	229	398.7	203.7	289	418.5	214.7
170	375.3	190.7	230	399.0	203.9	290	418.8	214.9
171	375.8	191.0	231	399.4	204.1	291	419.0	215.0
172	376.2	191.2	232	399.7	204.3	292	419.4	215.2
173	376.5	191.4	233	400.1	204.5	293	419.7	215.4
174	376.9	191.6	234	400.3	204.7	294	419.9	215.5
175	377.4	191.9	**235**	400.8	204.9	**295**	420.3	215.7
176	377.8	192.1	236	401.2	205.1	296	420.6	215.9
177	378.3	192.4	237	401.5	205.3	297	420.8	216.0
178	378.7	192.6	238	401.9	205.5	298	421.2	216.2
179	379.2	192.9	239	402.3	205.7	299	421.3	216.3
180	379.6	193.1	240	402.6	205.9	300	421.7	216.5
181	379.9	193.3	241	403.0	206.1	301	422.1	216.7
182	380.5	193.6	242	403.3	206.3	302	422.2	216.8
183	380.8	193.8	243	403.7	206.5	303	422.6	217.0
184	381.4	194.1	244	404.1	206.7	304	423.0	217.2
185	381.7	194.3	**245**	404.4	206.9	**305**	423.1	217.3
186	382.1	194.5	246	404.8	207.1	306	423.5	217.5
187	382.6	194.8	247	405.0	207.2	307	423.9	217.7
188	383.0	195.0	248	405.3	207.4	308	424.0	217.8
189	383.4	195.2	249	405.7	207.6	309	424.4	218.0
190	383.7	195.4	250	406.0	207.8	310	424.6	218.1
191	384.1	195.6	251	406.4	208.0	311	424.9	218.3
192	384.6	195.9	252	406.8	208.2	312	425.3	218.5
193	385.0	196.1	253	407.1	208.4	313	425.5	218.6
194	385.3	196.3	254	407.3	208.5	314	425.8	218.8
195	385.9	196.6	**255**	407.7	208.7	**315**	426.2	219.0
196	386.2	196.8	256	408.0	208.9	316	426.4	219.1
197	386.6	197.0	257	408.4	209.1	317	426.7	219.3
198	387.0	197.2	258	408.7	209.3	318	426.9	219.4
199	387.5	197.5	259	408.9	209.4	319	427.3	219.6
200	387.9	197.7	260	409.3	209.6	320	427.5	219.7
201	388.2	197.9	261	409.6	209.8	321	427.8	219.9
202	388.6	198.1	262	410.0	210.0	322	428.0	220.0
203	388.9	198.3	263	410.4	210.2	323	428.4	220.2
204	389.3	198.5	264	410.7	210.4	324	428.5	220.3
205	389.8	198.8	**265**	410.9	210.5	**325**	428.9	220.5
206	390.2	199.0	266	411.3	210.7	326	429.3	220.7
207	390.6	199.2	267	411.6	210.9	327	429.4	220.8
208	390.9	199.4	268	412.0	211.1	328	429.8	221.0
209	391.3	199.6	269	412.2	211.2	329	430.0	221.1
210	391.6	199.8	270	412.5	211.4	330	430.3	221.3
211	392.2	200.1	271	412.9	211.6	331	430.5	221.4
212	392.5	200.3	272	413.2	211.8	332	430.9	221.6
213	392.9	200.5	273	413.4	211.9	333	431.1	221.7
214	393.3	200.7	274	413.8	212.1	334	431.4	221.9
215	393.6	200.9	**275**	414.1	212.3	**335**	431.6	222.0
216	394.0	201.1	276	414.5	212.5	336	432.0	222.2
217	394.3	201.3	277	414.7	212.6	337	432.1	222.3
218	394.7	201.5	278	415.0	212.8	338	432.5	222.5
219	395.1	201.7	279	415.4	213.0	339	432.7	222.6
220	395.4	201.9	280	415.8	213.2	340	433.0	222.8
221	395.8	202.1	281	415.9	213.3	341	433.2	222.9
222	396.1	202.3	282	416.3	213.5	342	433.6	223.1
223	396.5	202.5	283	416.7	213.7	343	433.9	223.3
224	396.9	202.7	284	417.0	213.9	344	434.1	223.4

TEMPERATURE OF SATURATED STEAM (Continued)

Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C
345	434.3	223.5	**585**	486.1	252.3	**960**	541.6	283.1
346	434.7	223.7	590	487.0	252.8	970	542.8	283.8
347	434.8	223.8	595	487.9	253.3	980	544.1	284.5
348	435.2	224.0	600	488.8	253.8	990	545.2	285.1
349	435.4	224.1	605	489.7	254.3	1000	546.4	285.8
350	435.7	224.3	610	490.6	254.8	1010	547.7	286.5
351	435.9	224.4	615	491.5	255.3	1020	548.8	287.1
352	436.3	224.6	620	492.3	255.7	1030	550.0	287.8
353	436.5	224.7	625	493.2	256.2	1040	551.1	288.4
354	436.6	224.8	630	494.1	256.7	1050	552.4	289.1
355	437.0	225.0	**635**	495.0	257.2	**1060**	553.5	289.7
356	437.2	225.1	640	495.7	257.6	1070	554.7	290.4
357	437.5	225.3	645	496.6	258.1	1080	555.8	291.0
358	437.7	225.4	650	497.5	258.6	1090	556.9	291.6
359	438.1	225.6	655	498.2	259.0	1100	558.0	292.2
360	438.3	225.7	660	499.1	259.5	1110	559.0	292.8
365	439.5	226.4	665	499.8	259.9	1120	560.1	293.4
370	440.8	227.1	670	500.7	260.4	1130	561.2	294.0
375	442.0	227.8	675	501.4	260.8	1140	562.5	294.7
380	443.3	228.5	680	502.3	261.3	1150	563.5	295.3
385	444.6	229.2	**685**	503.1	261.7	**1160**	564.6	295.9
390	445.8	229.9	690	504.0	262.2	1170	565.5	296.4
395	447.1	230.6	695	504.7	262.6	1180	566.6	297.0
400	448.2	231.2	700	505.6	263.1	1190	567.7	297.6
405	449.4	231.9	705	506.3	263.5	1200	568.8	298.2
410	450.5	232.5	710	507.0	263.9	1210	569.8	298.8
415	451.8	233.2	715	507.7	264.3	1220	570.7	299.3
420	452.8	233.8	720	508.6	264.8	1230	571.8	299.9
425	453.9	234.4	725	509.4	265.2	1240	572.9	300.5
430	455.2	235.1	730	510.1	265.6	1250	573.8	301.0
435	456.3	235.7	**735**	510.8	266.0	**1260**	574.9	301.6
440	457.3	236.3	740	511.7	266.5	1270	576.0	302.2
445	458.4	236.9	745	512.4	266.9	1280	576.9	302.7
450	459.5	237.5	750	513.1	267.3	1290	578.0	303.3
455	460.6	238.1	755	513.9	267.7	1300	578.8	303.8
460	461.7	238.7	760	514.6	268.1	1310	579.7	304.3
465	462.7	239.3	765	515.3	268.5	1320	580.8	304.9
470	463.8	239.9	770	516.0	268.9	1330	581.7	305.4
475	464.9	240.5	775	516.7	269.3	1340	582.8	306.0
480	466.0	241.1	780	517.5	269.7	1350	583.7	306.5
485	467.1	241.7	**785**	518.2	270.1	**1360**	584.6	307.0
490	468.0	242.2	790	518.9	270.5	1370	585.5	307.5
495	469.0	242.8	795	519.6	270.9	1380	586.6	308.1
500	470.1	243.4	800	520.3	271.3	1390	587.5	308.6
505	471.0	243.9	805	521.1	271.7	1400	588.4	309.1
510	472.1	244.5	810	521.8	272.1	1410	589.3	309.6
515	473.0	245.0	820	523.2	272.9	1420	590.4	310.2
520	474.1	245.6	830	524.7	273.7	1430	591.3	310.7
525	475.0	246.1	840	525.9	274.4	1440	592.2	311.2
530	476.1	246.7	850	527.4	275.2	1450	593.1	311.7
535	477.0	247.2	**860**	528.6	275.9	**1460**	594.0	312.2
540	477.9	247.7	870	530.1	276.7	1470	594.9	312.7
545	478.8	248.2	880	531.3	277.4	1480	595.8	313.2
550	479.8	248.8	890	532.6	278.1	1490	596.7	313.7
555	480.7	249.3	900	534.0	278.9	1500	597.6	314.2
560	481.6	249.8	910	535.3	279.6	1510	598.5	314.7
565	482.5	250.3	920	536.5	280.3	1520	599.2	315.1
570	483.4	250.8	930	537.8	281.0	1530	600.1	315.6
575	484.3	251.3	940	539.1	281.7	1540	601.0	316.1
580	485.2	251.8	950	540.3	282.4	1550	601.9	316.6

TEMPERATURE OF SATURATED STEAM (Continued)

Gauge pressure lbs./in.²	Temp. °F	Temp. °C	Gauge pressure lbs./in.²	Temp. °F	Temp. °C	Gauge pressure lbs./in.²	Temp. °F	Temp. °C
1560	602.6	317.0	**2110**	644.4	340.2	**2660**	678.4	359.1
1570	603.5	317.5	2120	645.1	340.6	2670	678.9	359.4
1580	604.4	318.0	2130	645.8	341.0	2680	679.5	359.7
1590	605.3	318.5	2140	646.3	341.3	2690	680.0	360.0
1600	606.0	318.9	2150	647.1	341.7	2700	680.5	360.3
1610	606.9	319.4	2160	647.8	342.1	2710	681.1	360.6
1620	607.8	319.9	2170	648.5	342.5	2720	681.6	360.9
1630	608.5	320.3	2180	649.0	342.8	2730	682.2	361.2
1640	609.4	320.8	2190	649.8	343.2	2740	682.7	361.5
1650	610.2	321.2	2200	650.3	343.5	2750	683.2	361.8
1660	611.1	321.7	**2210**	651.0	343.9	**2760**	684.0	362.2
1670	612.0	322.2	2220	651.7	344.3	2770	684.5	362.5
1680	612.7	322.6	2230	652.3	344.6	2780	685.0	362.8
1690	613.4	323.0	2240	653.0	345.0	2790	685.6	363.1
1700	614.3	323.5	2250	653.5	345.3	2800	686.1	363.4
1710	615.0	323.9	2260	654.3	345.7	2810	686.5	363.6
1720	615.9	324.4	2270	654.8	346.0	2820	687.0	363.9
1730	616.6	324.8	2280	655.5	346.4	2830	687.6	364.2
1740	617.4	325.2	2290	656.1	346.7	2840	688.1	364.5
1750	618.3	325.7	2300	656.8	347.1	2850	688.6	364.8
1760	619.0	326.1	**2310**	657.3	347.4	**2860**	689.2	365.1
1770	619.9	326.6	2320	658.0	347.8	2870	689.7	365.4
1780	620.6	327.0	2330	658.6	348.1	2880	690.3	365.7
1790	621.3	327.4	2340	659.3	348.5	2890	690.8	366.0
1800	622.0	327.8	2350	659.8	348.8	2900	691.3	366.3
1810	622.8	328.2	2360	660.6	349.2	2910	691.7	366.5
1820	623.7	328.7	2370	661.1	349.5	2920	692.2	366.8
1830	624.4	329.1	2380	661.8	349.9	2930	692.8	367.1
1840	625.1	329.5	2390	662.4	350.2	2940	693.3	367.4
1850	625.8	329.9	2400	663.1	350.6	2950	693.9	367.7
1860	626.5	330.3	**2410**	663.6	350.9	**2960**	694.2	367.9
1870	627.4	330.8	2420	664.2	351.2	2970	694.8	368.2
1880	628.2	331.2	2430	664.9	351.6	2980	695.3	368.5
1890	628.9	331.6	2440	665.4	351.9	2990	695.8	368.8
1900	629.6	332.0	2450	666.0	352.2	3000	696.4	369.1
1910	630.3	332.4	2460	666.7	352.6	3010	696.7	369.3
1920	631.0	332.8	2470	667.2	352.9	3020	697.3	369.6
1930	631.8	333.2	2480	667.9	353.3	3030	697.8	369.9
1940	632.5	333.6	2490	668.5	353.6	3040	698.4	370.2
1950	633.2	334.0	2500	669.0	353.9	3050	698.7	370.4
1960	633.9	334.4	**2510**	669.7	354.3	**3060**	699.3	370.7
1970	634.6	334.8	2520	670.3	354.6	3070	699.8	371.0
1980	635.4	335.2	2530	670.8	354.9	3080	700.3	371.3
1990	636.1	335.6	2540	671.5	355.3	3090	700.7	371.5
2000	636.8	336.0	2550	672.1	355.6	3100	701.2	371.8
2010	637.5	336.4	2560	672.6	355.9	3110	701.8	372.1
2020	638.2	336.8	2570	673.2	356.2	3120	702.1	372.3
2030	639.0	337.2	2580	673.7	356.5	3130	702.7	372.6
2040	639.5	337.5	2590	674.4	356.9	3140	703.2	372.9
2050	640.2	337.9	2600	675.0	357.2	3150	703.6	373.1
2060	640.9	338.3	**2610**	675.5	357.5	**3160**	704.1	373.4
2070	641.7	338.7	2620	676.0	357.8	3170	704.5	373.6
2080	642.4	339.1	2630	676.6	358.1	3180	705.0	373.9
2090	642.9	339.4	2640	677.3	358.5	3184	705.2	*374.0
2100	643.6	339.8	2650	677.8	358.8	....	.....	......

* Critical point.

PROPERTIES OF SATURATED STEAM

PROPERTIES OF

METRIC AND

The heat units used are the large calorie, 15° to 16° C and the B.T.U., 62° to 63° F. The heat of the liquid, q, is the heat required to raise unit mass of water from 0° C (32° F) to the temperature indicated. The heat of vaporization, r, is the heat required to vaporize unit mass of water at the indicated temperature and pressure. Total heat involved, $H = r + q$.

The heat of vaporization overcomes external pressure and changes the state from liquid to vapor at constant temperature and pressure. If u is the

Temperature, degrees Centigrade.	Total pressure, (Gauge pressure plus atmospheric pressure)			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
0	4.579	0.00623	0.0886	0.00	0.0	595.4	1071.7	565.3	1017.5	**32**
1	4.924	0.00670	0.0952	1.01	1.8	594.9	1070.8	564.7	1016.4	**33.8**
2	5.290	0.00719	0.1023	2.02	3.6	594.4	1069.9	564.0	1015.3	**35.6**
3	5.681	0.00772	0.1099	3.03	5.5	593.9	1069.0	563.4	1014.2	**37.4**
4	6.097	0.00829	0.1179	4.03	7.3	593.3	1068.0	562.8	1013.1	**39.2**
5	6.541	0.00889	0.1265	5.04	9.1	592.8	1067.1	562.2	1011.9	**41**
6	7.011	0.00953	0.1356	6.04	10.9	592.3	1066.1	561.5	1010.7	**42.8**
7	7.511	0.01021	0.1453	7.05	12.7	591.8	1065.2	560.9	1009.6	**44.6**
8	8.042	0.01093	0.1555	8.05	14.5	591.2	1064.2	560.2	1008.5	**46.4**
9	8.606	0.01170	0.1664	9.05	16.3	590.7	1063.3	559.6	1007.4	**48.2**
10	9.205	0.01252	0.1780	10.06	18.1	590.2	1062.3	559.0	1006.2	**50**
11	9.840	0.01338	0.1903	11.06	19.9	589.6	1061.3	558.3	1005.0	**51.8**
12	10.513	0.01429	0.2033	12.06	21.7	589.1	1060.4	557.7	1003.9	**53.6**
13	11.226	0.01526	0.2171	13.06	23.5	588.6	1059.4	557.1	1002.7	**55.4**
14	11.980	0.01629	0.2317	14.06	25.3	588.1	1058.5	556.5	1001.6	**57.2**
15	12.779	0.01737	0.2471	15.06	27.1	587.6	1057.6	555.9	1000.5	**59**
16	13.624	0.01852	0.2635	16.06	28.9	587.0	1056.6	555.2	999.4	**60.8**
17	14.517	0.01974	0.2807	17.06	30.7	586.5	1055.7	554.6	998.3	**62.6**
18	15.460	0.02102	0.2990	18.06	32.5	585.9	1054.7	553.9	997.1	**64.4**
19	16.456	0.02237	0.3182	19.06	34.3	585.4	1053.8	553.3	996.0	**66.2**
20	17.51	0.02381	0.3386	20.06	36.1	584.9	1052.8	552.7	994.8	**68**
21	18.62	0.02532	0.3601	21.06	37.9	584.4	1051.9	552.1	993.7	**69.8**
22	19.79	0.02691	0.3827	22.06	39.7	583.9	1051.0	551.5	992.6	**71.6**
23	21.02	0.02858	0.4065	23.06	41.5	583.3	1050.0	550.8	991.4	**73.4**
24	22.32	0.03035	0.4316	24.06	43.3	582.8	1049.1	550.2	990.3	**75.2**
25	23.69	0.03221	0.4581	25.05	45.1	582.3	1048.1	549.5	989.1	**77**
26	25.13	0.03417	0.4860	26.05	46.9	581.8	1047.2	548.9	988.0	**78.8**
27	26.65	0.03623	0.5154	27.05	48.7	581.2	1046.2	548.2	986.9	**80.6**
28	28.25	0.03841	0.5463	28.05	50.5	580.7	1045.2	547.6	985.7	**82.4**
29	29.94	0.04071	0.5790	29.04	52.3	580.2	1044.3	547.0	984.6	**84.2**
30	31.71	0.04311	0.6132	30.04	54.1	579.6	1043.3	546.3	983.4	**86**

SATURATED STEAM

English Units

change in volume the external work is pu and the corresponding amount of heat is Apu where A is the reciprocal of the mechanical equivalent of heat. The part of the heat of vaporization not used in external work is considered used in changing the state from liquid to vapor. The heat required for this work may be represented by $\rho = r - Apu$.

(From Peabody, Steam and Entropy Tables, John Wiley and Sons, Inc., publishers, by permission.)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
0	30.1	54.2	0.0000	2.1804	206.3	3304	0.00485	0.000303	**32**
1	30.2	54.4	0.0037	2.1706	192.7	3087	0.00519	0.000324	**33.8**
2	30.4	54.6	0.0074	2.1609	180.0	2884	0.00556	0.000347	**35.6**
3	30.5	54.8	0.0110	2.1513	168.2	2694	0.00595	0.000371	**37.4**
4	30.5	54.9	0.0146	2.1416	157.2	2518	0.00636	0.000397	**39.2**
5	30.6	55.2	0.0183	2.1320	147.1	2356	0.00680	0.000424	**41**
6	30.8	55.4	0.0219	2.1225	137.7	2206	0.00726	0.000453	**42.8**
7	30.9	55.6	0.0256	2.1130	129.0	2067	0.00775	0.000484	**44.6**
8	31.0	55.7	0.0290	2.1036	120.9	1937	0.00827	0.000516	**46.4**
9	31.1	55.9	0.0326	2.0943	113.4	1816	0.00882	0.000551	**48.2**
10	31.2	56.1	0.0361	2.0850	106.3	1703	0.00941	0.000587	**50**
11	31.3	56.3	0.0397	2.0758	99.8	1599	0.01002	0.000625	**51.8**
12	31.4	56.5	0.0433	2.0667	93.7	1502	0.01067	0.000666	**53.6**
13	31.5	56.7	0.0467	2.0576	88.1	1411	0.01135	0.000709	**55.4**
14	31.6	56.9	0.0502	2.0486	82.9	1327	0.01206	0.000754	**57.2**
15	31.7	57.1	0.0537	2.0396	77.9	1248	0.01283	0.000801	**59**
16	31.8	57.3	0.0571	2.0308	73.3	1174	0.01364	0.000852	**60.8**
17	31.9	57.4	0.0607	2.0220	69.1	1105	0.01447	0.000905	**62.6**
18	32.0	57.6	0.0641	2.0132	65.1	1041	0.01536	0.000961	**64.4**
19	32.1	57.8	0.0675	2.0045	61.3	982	0.01631	0.001018	**66.2**
20	32.2	58.0	0.0709	1.9959	57.8	926	0.01730	0.001080	**68**
21	32.3	58.2	0.0743	1.9873	54.5	873	0.01835	0.001145	**69.8**
22	32.4	58.4	0.0776	1.9788	51.5	824	0.01942	0.001214	**71.6**
23	32.5	58.6	0.0811	1.9703	48.60	778	0.02058	0.001286	**73.4**
24	32.6	58.8	0.0845	1.9620	45.92	735	0.02178	0.001361	**75.2**
25	32.8	59.0	0.0878	1.9536	43.40	695	0.02304	0.001439	**77**
26	32.9	59.2	0.0911	1.9453	41.05	657	0.02436	0.001522	**78.8**
27	33.0	59.3	0.0945	1.9370	38.83	622	0.02575	0.001608	**80.6**
28	33.1	59.5	0.0978	1.9288	36.74	589	0.02722	0.001698	**82.4**
29	33.2	59.7	0.1011	1.9207	34.78	557	0.02875	0.001795	**84.2**
30	33.3	59.9	0.1044	1.9126	32.95	528	0.03035	0.001894	**86**

PROPERTIES OF

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	*p*	*p*	*p*	*q*	*q*	*r*	*r*	*ρ*	*ρ*	*t*
31	33.57	0.04564	0.6492	31.04	55.9	579.1	1042.4	545.7	982.2	**87.8**
32	35.53	0.04830	0.6871	32.04	57.7	578.6	1041.4	545.1	981.0	**89.6**
33	37.59	0.05111	0.7269	33.04	59.5	578.0	1040.4	544.4	979.9	**91.4**
34	39.75	0.05404	0.7687	34.03	61.3	577.4	1039.4	543.7	978.7	**93.2**
35	42.02	0.05713	0.8126	35.03	63.1	576.9	1038.5	543.1	977.6	**95**
36	44.40	0.06037	0.8586	36.03	64.9	576.4	1037.5	542.5	976.4	**96.8**
37	46.90	0.06376	0.9068	37.02	66.6	575.8	1036.5	541.8	975.2	**98.6**
38	49.51	0.06731	0.9574	38.02	68.4	575.3	1035.5	541.2	974.0	**100.4**
39	52.26	0.07105	1.0105	39.02	70.2	574.7	1034.5	540.5	972.8	**102.2**
40	55.13	0.07495	1.0661	40.02	72.0	574.2	1033.5	539.9	971.7	**104**
41	58.14	0.07905	1.1243	41.01	73.8	573.6	1032.5	539.2	970.5	**105.8**
42	61.30	0.08334	1.1854	42.01	75.6	573.1	1031.5	538.6	969.3	**107.6**
43	64.59	0.08782	1.2492	43.01	77.4	572.5	1030.5	537.9	968.2	**109.4**
44	68.05	0.09252	1.3159	44.01	79.2	571.9	1029.4	537.2	966.9	**111.2**
45	71.66	0.09743	1.3858	45.00	81.0	571.3	1028.4	536.5	965.7	**113**
46	75.43	0.10256	1.4587	46.00	82.8	570.8	1027.4	535.8	964.5	**114.8**
47	79.38	0.10792	1.5350	47.00	84.6	570.2	1026.4	535.1	963.3	**116.6**
48	83.50	0.11353	1.6147	48.00	86.4	569.6	1025.3	534.4	962.0	**118.4**
49	87.80	0.11937	1.6979	48.99	88.2	569.0	1024.3	533.7	960.8	**120.2**
50	92.30	0.12549	1.7849	49.99	90.0	568.4	1023.2	533.0	959.6	**122**
51	96.99	0.13187	1.8756	50.99	91.8	567.8	1022.2	532.3	958.4	**123.8**
52	101.88	0.13852	1.9701	51.99	93.6	567.3	1021.2	531.7	957.2	**125.6**
53	106.99	0.14546	2.0689	52.99	95.4	566.8	1020.2	531.1	956.0	**127.4**
54	112.30	0.15268	2.172	53.98	97.2	566.2	1019.1	530.4	954.7	**129.2**
55	117.85	0.16023	2.279	54.98	99.0	565.6	1018.1	529.7	953.5	**131**
56	123.61	0.16806	2.390	55.98	100.8	565.1	1017.1	529.1	952.3	**132.8**
57	129.63	0.17624	2.506	56.98	102.6	564.5	1016.1	528.4	951.1	**134.6**
58	135.89	0.18475	2.627	57.98	104.4	563.9	1015.1	527.7	949.9	**136.4**
59	142.41	0.19362	2.754	58.97	106.2	563.4	1014.1	527.1	948.7	**138.2**
60	149.19	0.20284	2.885	59.97	108.0	562.8	1013.1	526.4	947.5	**140**
61	156.24	0.21242	3.021	60.97	109.8	562.2	1012.0	525.7	946.3	**141.8**
62	163.58	0.2224	3.163	61.97	111.6	561.7	1011.0	525.1	945.1	**143.6**
63	171.20	0.2328	3.310	62.97	113.4	561.1	1009.9	524.4	943.8	**145.4**
64	179.13	0.2435	3.464	63.98	115.2	560.5	1008.9	523.7	942.6	**147.2**
65	187.36	0.2547	3.623	64.98	117.0	559.9	1007.8	523.0	941.3	**149**
66	195.92	0.2664	3.789	65.98	118.8	559.3	1006.8	522.3	940.1	**150.8**
67	204.80	0.2784	3.960	66.98	120.6	558.8	1005.8	521.7	938.9	**152.6**
68	214.02	0.2910	4.139	67.98	122.4	558.2	1004.7	521.0	937.6	**154.4**
69	223.58	0.3040	4.324	68.98	124.2	557.6	1003.6	520.3	936.3	**156.2**
70	233.53	0.3175	4.516	69.98	126.0	556.9	1002.5	519.5	935.0	**158**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
31	33.4	60.2	0.1077	1.9046	31.24	501	0.03201	0.001996	**87.8**
32	33.5	60.4	0.1110	1.8966	29.62	474.7	0.03376	0.002107	**89.6**
33	33.6	60.5	0.1142	1.8886	28.08	449.7	0.03561	0.002224	**91.4**
34	33.7	60.7	0.1175	1.8806	26.62	426.5	0.03757	0.002345	**93.2**
35	33.8	60.9	0.1207	1.8728	25.25	404.7	0.03960	0.002471	**95**
36	33.9	61.1	0.1239	1.8650	23.98	384.2	0.04170	0.002603	**96.8**
37	34.0	61.3	0.1272	1.8572	22.78	364.9	0.04390	0.002740	**98.6**
38	34.1	61.5	0.1304	1.8494	21.65	346.8	0.04619	0.002884	**100.4**
39	34.2	61.7	0.1336	1.8417	20.58	329.7	0.04859	0.003033	**102.2**
40	34.3	61.8	0.1368	1.8341	19.57	313.5	0.0511	0.003190	**104**
41	34.4	62.0	0.1399	1.8265	18.61	298.0	0.0537	0.003356	**105.8**
42	34.5	62.2	0.1431	1.8189	17.69	283.3	0.0565	0.003530	**107.6**
43	34.6	62.3	0.1463	1.8113	16.82	269.5	0.0595	0.003711	**109.4**
44	34.7	62.5	0.1494	1.8038	16.01	256.5	0.0625	0.003899	**111.2**
45	34.8	62.7	0.1526	1.7963	15.25	244.4	0.0656	0.004092	**113**
46	35.0	62.9	0.1557	1.7889	14.54	233.0	0.0688	0.004292	**114.8**
47	35.1	63.1	0.1588	1.7815	13.86	222.1	0.0722	0.004502	**116.6**
48	35.2	63.3	0.1619	1.7742	13.21	211.7	0.0757	0.004724	**118.4**
49	35.3	63.5	0.1650	1.7669	12.60	201.9	0.0794	0.00495	**120.2**
50	35.4	63.6	0.1682	1.7597	12.02	192.6	0.0832	0.00519	**122**
51	35.5	63.8	0.1713	1.7525	11.47	183.8	0.0872	0.00544	**123.8**
52	35.6	64.0	0.1743	1.7454	10.96	175.5	0.0912	0.00570	**125.6**
53	35.7	64.2	0.1774	1.7383	10.47	167.7	0.0955	0.00596	**127.4**
54	35.8	64.4	0.1804	1.7312	10.00	160.3	0.1000	0.00624	**129.2**
55	35.9	64.6	0.1835	1.7242	9.56	153.2	0.1046	0.00653	**131**
56	36.0	64.8	0.1865	1.7173	9.14	146.5	0.1094	0.00683	**132.8**
57	36.1	65.0	0.1895	1.7104	8.74	140.1	0.1144	0.00713	**134.6**
58	36.2	65.2	0.1925	1.7035	8.36	134.0	0.1196	0.00746	**136.4**
59	36.3	65.4	0.1955	1.6967	8.00	128.3	0.1250	0.00779	**138.2**
60	36.4	65.6	0.1986	1.6899	7.66	122.8	0.1305	0.00814	**140**
61	36.5	65.7	0.2016	1.6831	7.34	117.6	0.1362	0.00850	**141.8**
62	36.6	65.9	0.2046	1.6764	7.03	112.7	0.1422	0.00887	**143.6**
63	36.7	66.1	0.2075	1.6696	6.74	108.0	0.1484	0.00926	**145.4**
64	36.8	66.3	0.2105	1.6629	6.46	103.5	0.1548	0.00966	**147.2**
65	36.9	66.5	0.2135	1.6563	6.19	99.2	0.1615	0.01008	**149**
66	37.0	66.7	0.2164	1.6497	5.94	95.1	0.1684	0.01051	**150.8**
67	37.1	66.9	0.2194	1.6431	5.70	91.3	0.1754	0.01095	**152.6**
68	37.2	67.1	0.2223	1.6366	5.47	87.6	0.1828	0.01142	**154.4**
69	37.3	67.3	0.2253	1.6300	5.25	84.1	0.1905	0.01189	**156.2**
70	37.4	67.4	0.2282	1.6235	5.04	80.7	0.1984	0.01239	**158**

PROPERTIES OF

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
71	243.8	0.3315	4.715	70.98	127.8	556.4	1001.5	518.8	933.9	**159.8**
72	254.5	0.3460	4.921	71.99	129.6	555.8	1000.4	518.1	932.6	**161.6**
73	265.6	0.3611	5.136	72.99	131.4	555.2	999.4	517.4	931.4	**163.4**
74	277.1	0.3767	5.358	73.99	133.2	554.6	998.3	516.7	930.1	**165.2**
75	289.0	0.3929	5.589	74.99	135.0	554.0	997.3	516.0	928.8	**167**
76	301.3	0.4096	5.826	76.00	136.8	553.4	996.2	515.3	927.6	**168.8**
77	314.0	0.4269	6.072	77.00	138.6	552.9	995.2	514.7	926.4	**170.6**
78	327.2	0.4449	6.327	78.00	140.4	552.3	994.1	514.0	925.2	**172.4**
79	340.9	0.4635	6.592	79.01	142.2	551.7	993.0	513.3	923.9	**174.2**
80	355.1	0.4828	6.867	80.01	144.0	551.1	991.9	512.6	922.6	**176**
81	369.7	0.5026	7.150	81.02	145.8	550.5	990.8	511.9	921.3	**177.8**
82	384.9	0.5233	7.443	82.02	147.6	549.9	989.8	511.2	920.1	**179.6**
83	400.5	0.5445	7.745	83.03	149.4	549.3	988.7	510.5	918.8	**181.4**
84	416.7	0.5665	8.058	84.03	151.2	548.7	987.6	509.8	917.6	**183.2**
85	433.5	0.5894	8.383	85.04	153.1	548.1	986.5	509.1	916.3	**185**
86	450.8	0.6129	8.717	86.04	154.9	547.4	985.4	508.3	915.0	**186.8**
87	468.6	0.6371	9.062	87.05	156.7	546.8	984.3	507.6	913.7	**188.6**
88	487.1	0.6623	9.419	88.06	158.5	546.2	983.2	506.9	912.5	**190.4**
89	506.1	0.6881	9.787	89.06	160.3	545.6	982.1	506.2	911.2	**192.2**
90	525.8	0.7149	10.167	90.07	162.1	544.9	980.9	505.4	909.9	**194**
91	546.1	0.7425	10.560	91.08	163.9	544.3	979.8	504.7	908.5	**195.8**
92	567.1	0.7710	10.966	92.08	165.7	543.7	978.7	504.0	907.2	**197.6**
93	588.7	0.8004	11.384	93.09	167.5	543.1	977.6	503.3	906.0	**199.4**
94	611.0	0.8307	11.815	94.10	169.3	542.5	976.5	502.6	904.7	**201.2**
95	634.0	0.8620	12.260	95.11	171.2	541.9	975.4	501.9	903.4	**203**
96	657.7	0.8942	12.718	96.12	173.0	541.2	974.2	501.1	902.1	**204.8**
97	682.1	0.9274	13.190	97.12	174.8	540.6	973.1	500.4	900.8	**206.6**
98	707.3	0.9616	13.678	98.13	176.6	539.9	971.9	499.6	899.4	**208.4**
99	733.3	0.9970	14.180	99.14	178.5	539.3	970.8	498.9	898.2	**210.2**
100	760.0	1.0333	14.697	100.2	180.3	538.7	969.7	498.2	896.9	**212**
101	787.5	1.0707	15.229	101.2	182.1	538.1	968.5	497.5	895.5	**213.8**
102	815.9	1.1093	15.778	102.2	183.9	537.4	967.3	496.8	894.1	**215.6**
103	845.1	1.1490	16.342	103.2	185.7	536.8	966.2	496.1	892.9	**217.4**
104	875.1	1.1898	16.923	104.2	187.6	536.2	965.1	495.4	891.6	**219.2**
105	906.1	1.2319	17.522	105.2	189.4	535.6	964.0	494.7	890.3	**221**
106	937.9	1.2752	18.137	106.2	191.2	534.9	962.8	493.9	889.0	**222.8**
107	970.6	1.3196	18.769	107.2	193.0	534.2	961.6	493.1	887.6	**224.6**
108	1004.3	1.3653	19.420	108.2	194.8	533.6	960.5	492.4	886.3	**226.4**
109	1038.8	1.4123	20.089	109.3	196.7	532.9	959.3	491.6	885.0	**228.2**
110	1074.5	1.4608	20.777	110.3	198.5	532.3	958.1	490.9	883.6	**230**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
71	37.6	67.6	0.2311	1.6171	4.838	77.5	0.2067	0.01290	**159.8**
72	37.7	67.8	0.2340	1.6107	4.647	74.4	0.2152	0.01344	**161.6**
73	37.8	68.0	0.2369	1.6044	4.466	71.5	0.2239	0.01398	**163.4**
74	37.9	68.2	0.2398	1.5981	4.294	68.8	0.2329	0.01453	**165.2**
75	38.0	68.5	0.2427	1.5918	4.130	66.2	0.2421	0.01510	**167**
76	38.1	68.6	0.2456	1.5856	3.973	63.7	0.2517	0.01570	**168.8**
77	38.2	68.8	0.2484	1.5793	3.822	61.2	0.2616	0.01634	**170.6**
78	38.3	68.9	0.2513	1.5731	3.676	58.8	0.2720	0.01700	**172.4**
79	38.4	69.1	0.2541	1.5670	3.537	56.6	0.2827	0.01767	**174.2**
80	38.5	69.3	0.2570	1.5609	3.404	54.5	0.2938	0.01835	**176**
81	38.6	69.5	0.2598	1.5548	3.277	52.5	0.3052	0.01905	**177.8**
82	38.7	69.7	0.2626	1.5487	3.156	50.6	0.3168	0.01976	**179.6**
83	38.8	69.9	0.2654	1.5426	3.040	48.71	0.3289	0.02053	**181.4**
84	38.9	70.0	0.2682	1.5366	2.929	46.92	0.3414	0.02131	**183.2**
85	39.0	70.2	0.2711	1.5307	2.824	45.23	0.3541	0.02211	**185**
86	39.1	70.4	0.2739	1.5247	2.723	43.62	0.3672	0.02293	**186.8**
87	39.2	70.6	0.2767	1.5187	2.627	42.08	0.3807	0.02376	**188.6**
88	39.3	70.7	0.2795	1.5128	2.534	40.59	0.3946	0.02463	**190.4**
89	39.4	70.9	0.2823	1.5069	2.444	39.15	0.4091	0.02554	**192.2**
90	39.5	71.0	0.2851	1.5010	2.358	37.77	0.4241	0.02648	**194**
91	39.6	71.3	0.2879	1.4952	2.275	36.45	0.4395	0.02743	**195.8**
92	39.7	71.5	0.2906	1.4894	2.197	35.19	0.4552	0.02842	**197.6**
93	39.8	71.6	0.2934	1.4836	2.122	34.00	0.4713	0.02941	**199.4**
94	39.9	71.8	0.2961	1.4779	2.050	32.86	0.4878	0.03043	**201.2**
95	40.0	72.0	0.2989	1.4723	1.980	31.75	0.505	0.03149	**203**
96	40.1	72.1	0.3016	1.4666	1.913	30.67	0.523	0.03260	**204.8**
97	40.2	72.3	0.3043	1.4609	1.849	29.63	0.541	0.03375	**206.6**
98	40.3	72.5	0.3070	1.4552	1.787	28.64	0.560	0.03492	**208.4**
99	40.4	72.6	0.3097	1.4496	1.728	27.69	0.579	0.03611	**210.2**
100	40.5	72.8	0.3125	1.4441	1.671	26.78	0.598	0.03734	**212**
101	40.6	73.0	0.3152	1.4386	1.617	25.90	0.618	0.03861	**213.8**
102	40.6	73.2	0.3179	1.4330	1.564	25.06	0.639	0.03990	**215.6**
103	40.7	73.3	0.3205	1.4275	1.514	24.25	0.661	0.04124	**217.4**
104	40.8	73.5	0.3232	1.4220	1.465	23.47	0.683	0.04261	**219.2**
105	40.9	73.7	0.3259	1.4165	1.419	22.73	0.705	0.04400	**221**
106	41.0	73.8	0.3286	1.4111	1.374	22.01	0.728	0.04543	**222.8**
107	41.1	74.0	0.3312	1.4057	1.331	21.31	0.751	0.04692	**224.6**
108	41.2	74.2	0.3339	1.4003	1.289	20.64	0.776	0.04845	**226.4**
109	41.3	74.3	0.3365	1.3949	1.248	19.99	0.801	0.0500	**228.2**
110	41.4	74.5	0.3392	1.3895	1.209	19.37	0.827	0.0516	**230**

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
111	1111.1	1.5106	21.486	111.3	200.3	531.6	956.9	490.2	882.3	**231.8**
112	1148.7	1.5617	22.214	112.3	202.1	530.9	955.7	489.4	880.9	**233.6**
113	1187.4	1.6144	22.962	113.3	203.9	530.3	954.5	488.7	879.5	**235.4**
114	1227.1	1.6684	23.729	114.3	205.8	529.6	953.3	487.9	878.2	**237.2**
115	1267.9	1.7238	24.518	115.3	207.6	528.9	952.1	487.1	876.8	**239**
116	1309.8	1.7808	25.328	116.4	209.4	528.2	950.8	486.3	875.4	**240.8**
117	1352.8	1.8393	26.160	117.4	211.2	527.5	949.5	485.5	873.9	**242.6**
118	1397.0	1.8993	27.015	118.4	213.0	526.9	948.4	484.8	872.6	**244.4**
119	1442.4	1.9611	27.893	119.4	214.9	526.2	947.2	484.0	871.3	**246.2**
120	1488.9	2.0243	28.792	120.4	216.7	525.6	946.0	483.4	870.0	**248**
121	1536.6	2.0891	29.715	121.4	218.5	524.9	944.8	482.6	868.6	**249.8**
122	1585.7	2.1556	30.664	122.5	220.4	524.2	943.5	481.8	867.1	**251.6**
123	1636.0	2.2241	31.637	123.5	222.2	523.5	942.3	481.0	865.8	**253.4**
124	1687.5	2.2943	32.64	124.5	224.1	522.8	941.0	480.2	864.3	**255.2**
125	1740.5	2.3663	33.66	125.5	225.9	522.1	939.8	479.4	863.0	**257**
126	1794.7	2.4401	34.71	126.5	227.7	521.4	938.6	478.6	861.6	**258.8**
127	1850.3	2.5156	35.78	127.5	229.5	520.7	937.3	477.8	860.2	**260.6**
128	1907.3	2.5931	36.88	128.6	231.4	520.0	936.1	477.0	858.8	**262.4**
129	1965.8	2.6726	38.01	129.6	233.3	519.3	934.8	476.3	857.4	**264.2**
130	2025.6	2.7540	39.17	130.6	235.1	518.6	933.6	475.5	856.0	**266**
131	2086.9	2.8373	40.36	131.6	236.9	517.9	932.3	474.7	854.6	**267.8**
132	2149.8	2.9227	41.57	132.6	238.7	517.3	931.1	474.0	853.2	**269.6**
133	2214.0	3.0101	42.81	133.7	240.6	516.6	929.8	473.3	851.8	**271.4**
134	2280.0	3.0999	44.09	134.7	242.4	515.9	928.5	472.5	850.4	**273.2**
135	2347.5	3.1916	45.39	135.7	244.2	515.1	927.2	471.6	848.9	**275**
136	2416.5	3.2854	46.73	136.7	246.0	514.4	925.9	470.8	847.5	**276.8**
137	2487.3	3.3816	48.10	137.7	247.9	513.7	924.6	470.1	846.1	**278.6**
138	2559.7	3.4801	49.50	138.8	249.7	513.0	923.3	469.3	844.6	**280.4**
139	2633.8	3.581	50.93	139.8	251.6	512.3	922.1	468.5	843.3	**282.2**
140	2709.5	3.684	52.39	140.8	253.4	511.5	920.7	467.6	841.8	**284**
141	2787.1	3.789	53.89	141.8	255.3	510.7	919.3	466.8	840.2	**285.8**
142	2866.4	3.897	55.43	142.8	257.1	510.1	918.1	466.1	838.9	**287.6**
143	2947.7	4.008	57.00	143.9	259.0	509.3	916.7	465.3	837.4	**289.4**
144	3030.5	4.121	58.60	144.9	260.8	508.6	915.4	464.4	835.9	**291.2**
145	3115.3	4.236	60.24	145.9	262.7	507.8	914.1	463.6	834.5	**293**
146	3202.1	4.354	61.92	146.9	264.5	507.1	912.8	462.8	833.1	**294.8**
147	3290.8	4.474	63.64	148.0	266.4	506.4	911.5	462.0	831.6	**296.6**
148	3381.3	4.597	65.39	149.0	268.2	505.6	910.1	461.2	830.1	**298.4**
149	3474.0	4.723	67.18	150.0	270.1	504.9	908.8	460.4	828.7	**300.2**
150	3568.7	4.852	69.01	151.0	271.9	504.1	907.4	459.5	827.2	**302**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
111	41.4	74.6	0.3418	1.3842	1.172	18.77	0.853	0.0533	**231.8**
112	41.5	74.8	0.3445	1.3789	1.136	18.20	0.880	0.0550	**233.6**
113	41.6	75.0	0.3471	1.3736	1.101	17.64	0.908	0.0567	**235.4**
114	41.7	75.1	0.3498	1.3683	1.068	17.10	0.936	0.0585	**237.2**
115	41.8	75.3	0.3524	1.3631	1.036	16.59	0.965	0.0603	**239**
116	41.9	75.4	0.3550	1.3579	1.005	16.09	0.995	0.0622	**240.8**
117	42.0	75.6	0.3576	1.3527	0.9746	15.61	1.026	0.0641	**242.6**
118	42.1	75.8	0.3602	1.3475	0.9460	15.16	1.057	0.0659	**244.4**
119	42.2	75.9	0.3628	1.3423	0.9183	14.72	1.089	0.0679	**246.2**
120	42.2	76.0	0.3654	1.3372	0.8914	14.28	1.122	0.0700	**248**
121	42.3	76.2	0.3680	1.3321	0.8653	13.86	1.156	0.0721	**249.8**
122	42.4	76.4	0.3705	1.3269	0.8401	13.46	1.190	0.0743	**251.6**
123	42.5	76.5	0.3731	1.3218	0.8158	13.07	1.226	0.0765	**253.4**
124	42.6	76.7	0.3756	1.3167	0.7924	12.69	1.262	0.0788	**255.2**
125	42.7	76.8	0.3782	1.3117	0.7698	12.33	1.299	0.0811	**257**
126	42.8	77.0	0.3807	1.3067	0.7479	11.98	1.337	0.0835	**258.8**
127	42.9	77.1	0.3833	1.3017	0.7267	11.64	1.376	0.0859	**260.6**
128	43.0	77.3	0.3858	1.2967	0.7063	11.32	1.416	0.0883	**262.4**
129	43.0	77.4	0.3884	1.2917	0.6867	11.00	1.456	0.0909	**264.2**
130	43.1	77.6	0.3909	1.2868	0.6677	10.70	1.498	0.0935	**266**
131	43.2	77.7	0.3934	1.2818	0.6493	10.40	1.540	0.0961	**267.8**
132	43.3	77.9	0.3959	1.2769	0.6315	10.12	1.583	0.0988	**269.6**
133	43.3	78.0	0.3985	1.2720	0.6142	9.839	1.628	0.1016	**271.4**
134	43.4	78.1	0.4010	1.2672	0.5974	9.569	1.674	0.1045	**273.2**
135	43.5	78.3	0.4035	1.2623	0.5812	9.309	1.721	0.1074	**275**
136	43.6	78.4	0.4060	1.2574	0.5656	9.060	1.768	0.1104	**276.8**
137	43.6	78.5	0.4085	1.2526	0.5506	8.820	1.816	0.1134	**278.6**
138	43.7	78.7	0.4110	1.2479	0.5361	8.587	1.865	0.1165	**280.4**
139	43.8	78.8	0.4135	1.2431	0.5219	8.360	1.916	0.1196	**282.2**
140	43.9	78.9	0.4160	1.2383	0.5081	8.140	1.968	0.1229	**284**
141	43.9	79.1	0.4185	1.2335	0.4948	7.926	2.021	0.1262	**285.8**
142	44.0	79.2	0.4209	1.2288	0.4819	7.719	2.075	0.1296	**287.6**
143	44.0	79.3	0.4234	1.2241	0.4694	7.519	2.130	0.1330	**289.4**
144	44.2	79.5	0.4259	1.2194	0.4574	7.326	2.186	0.1365	**291.2**
145	44.2	79.6	0.4283	1.2147	0.4457	7.139	2.244	0.1401	**293**
146	44.3	79.7	0.4307	1.2100	0.4343	6.957	2.303	0.1437	**294.8**
147	44.4	79.9	0.4332	1.2054	0.4232	6.780	2.363	0.1475	**296.6**
148	44.4	80.0	0.4356	1.2008	0.4125	6.609	2.424	0.1513	**298.4**
149	44.5	80.1	0.4380	1.1962	0.4022	6.443	2.486	0.1552	**300.2**
150	44.6	80.2	0.4405	1.1916	0.3921	6.282	2.550	0.1592	**302**

PROPERTIES OF

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
151	3665.3	4.984	70.88	152.1	273.8	503.4	906.1	458.7	825.7	**303.8**
152	3764.1	5.118	72.79	153.1	275.6	502.6	904.7	457.9	824.2	**305.6**
153	3864.9	5.255	74.74	154.1	277.4	501.9	903.3	457.1	822.7	**307.4**
154	3968	5.395	76.73	155.1	279.2	501.1	901.9	456.3	821.2	**309.2**
155	4073	5.538	78.76	156.2	281.1	500.3	900.5	455.4	819.6	**311**
156	4181	5.684	80.84	157.2	283.0	499.6	899.2	454.6	818.2	**312.8**
157	4290	5.833	82.96	158.2	284.8	498.8	897.8	453.8	816.7	**314.6**
158	4402	5.985	85.12	159.3	286.7	498.1	896.5	453.0	815.3	**316.4**
159	4517	6.141	87.33	160.3	288.5	497.3	895.1	452.1	813.7	**318.2**
160	4633	6.300	89.59	161.3	290.4	496.5	893.7	451.2	812.2	**320**
161	4752	6.462	91.89	162.3	292.2	495.7	892.3	450.4	810.7	**321.8**
162	4874	6.628	94.25	163.4	294.1	494.9	890.9	449.5	809.2	**323.6**
163	4998	6.796	96.65	164.4	295.9	494.2	889.5	448.7	807.7	**325.4**
164	5124	6.967	99.09	165.4	297.7	493.4	888.1	447.9	806.2	**327.2**
165	5253	7.142	101.58	166.5	299.6	492.6	886.7	447.0	804.7	**329**
166	5384	7.320	104.11	167.5	301.5	491.9	885.4	446.3	803.3	**330.8**
167	5518	7.502	106.71	168.5	303.3	491.1	883.9	445.4	801.7	**332.6**
168	5655	7.688	109.35	169.5	305.1	490.3	882.5	444.6	800.1	**334.4**
169	5794	7.877	112.04	170.6	307.0	489.5	881.0	443.7	798.5	**336.2**
170	5937	8.071	114.79	171.6	308.9	488.7	879.6	442.8	797.0	**338**
171	6081	8.268	117.59	172.6	310.7	487.9	878.3	441.9	795.6	**339.8**
172	6229	8.469	120.45	173.7	312.6	487.1	876.9	441.1	794.1	**341.6**
173	6379	8.673	123.36	174.7	314.5	486.3	875.4	440.2	792.5	**343.4**
174	6533	8.882	126.33	175.7	316.3	485.5	873.9	439.4	790.9	**345.2**
175	6689	9.094	129.35	176.8	318.2	484.7	872.4	438.5	789.3	**347**
176	6848	9.310	132.43	177.8	320.0	483.9	871.0	437.7	787.8	**348.8**
177	7010	9.531	135.56	178.8	321.8	483.1	869.5	436.8	786.2	**350.6**
178	7175	9.755	138.75	179.9	323.7	482.3	868.1	436.0	784.7	**352.4**
179	7343	9.983	142.00	180.9	325.6	481.4	866.6	435.0	783.1	**354.2**
180	7514	10.216	145.30	181.9	327.5	480.6	865.1	434.2	781.5	**356**
181	7688	10.453	148.67	183.0	329.3	479.8	863.6	433.3	779.9	**357.8**
182	7866	10.695	152.11	184.0	331.2	479.0	862.2	432.5	778.4	**359.6**
183	8046	10.940	155.60	185.0	333.0	478.2	860.7	431.6	776.9	**361.4**
184	8230	11.189	159.15	186.1	334.9	477.4	859.2	430.8	775.3	**363.2**
185	8417	11.444	162.77	187.1	336.8	476.6	857.7	429.9	773.7	**365**
186	8608	11.703	166.46	188.1	338.6	475.7	856.3	429.0	772.2	**366.8**
187	8802	11.967	170.21	189.2	340.5	474.8	854.7	428.0	770.5	**368.6**
188	8999	12.235	174.02	190.2	342.4	474.0	853.2	427.2	768.9	**370.4**
189	9200	12.508	177.90	191.2	344.2	473.2	851.7	426.3	767.4	**372.2**
190	9404	12.786	181.85	192.3	346.1	472.3	850.2	425.4	765.8	**374**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
151	44.6	80.4	0.4429	1.1870	0.3824	6.126	2.615	0.1632	**303.8**
152	44.7	80.5	0.4453	1.1824	0.3729	5.974	2.682	0.1674	**305.6**
153	44.8	80.6	0.4477	1.1778	0.3637	5.826	2.750	0.1716	**307.4**
154	44.8	80.7	0.4501	1.1733	0.3548	5.683	2.818	0.1759	**309.2**
155	44.9	80.9	0.4525	1.1688	0.3463	5.546	2.888	0.1803	**311**
156	45.0	81.0	0.4549	1.1644	0.3380	5.413	2.959	0.1847	**312.8**
157	45.0	81.1	0.4573	1.1599	0.3298	5.282	3.032	0.1893	**314.6**
158	45.1	81.2	0.4596	1.1554	0.3218	5.154	3.108	0.1940	**316.4**
159	45.2	81.4	0.4620	1.1509	0.3140	5.029	3.185	0.1988	**318.2**
160	45.3	81.5	0.4644	1.1465	0.3063	4.906	3.265	0.2038	**320**
161	45.3	81.6	0.4668	1.1421	0.2989	4.789	3.345	0.2088	**321.8**
162	45.4	81.7	0.4692	1.1377	0.2920	4.677	3.425	0.2138	**323.6**
163	45.5	81.8	0.4715	1.1333	0.2855	4.571	3.503	0.2188	**325.4**
164	45.5	81.9	0.4739	1.1289	0.2792	4.469	3.582	0.2238	**327.2**
165	45.6	82.0	0.4763	1.1245	0.2729	4.368	3.664	0.2289	**329**
166	45.6	82.1	0.4786	1.1202	0.2666	4.268	3.751	0.2343	**330.8**
167	45.7	82.2	0.4810	1.1159	0.2603	4.168	3.842	0.2399	**332.6**
168	45.7	82.4	0.4833	1.1115	0.2540	4.070	3.937	0.2457	**334.4**
169	45.8	82.5	0.4857	1.1072	0.2480	3.975	4.032	0.2516	**336.2**
170	45.9	82.6	0.4880	1.1029	0.2423	3.883	4.127	0.2575	**338**
171	46.0	82.7	0.4903	1.0987	0.2368	3.794	4.223	0.2636	**339.8**
172	46.0	82.8	0.4926	1.0944	0.2314	3.709	4.322	0.2696	**341.6**
173	46.1	82.9	0.4949	1.0901	0.2262	3.626	4.421	0.2758	**343.4**
174	46.1	83.0	0.4972	1.0859	0.2212	3.545	4.521	0.2821	**345.2**
175	46.2	83.1	0.4995	1.0817	0.2164	3.467	4.621	0.2884	**347**
176	46.2	83.2	0.5018	1.0775	0.2117	3.391	4.724	0.2949	**348.8**
177	46.3	83.3	0.5041	1.0733	0.2072	3.318	4.826	0.3014	**350.6**
178	46.3	83.4	0.5064	1.0691	0.2027	3.247	4.933	0.3080	**352.4**
179	46.4	83.5	0.5087	1.0649	0.1983	3.177	5.04	0.3148	**354.2**
180	46.4	83.6	0.5110	1.0608	0.1941	3.109	5.15	0.3217	**356**
181	46.5	83.7	0.5133	1.0567	0.1899	3.041	5.27	0.3288	**357.8**
182	46.5	83.8	0.5156	1.0525	0.1857	2.974	5.38	0.3362	**359.6**
183	46.6	83.8	0.5178	1.0484	0.1817	2.911	5.50	0.3435	**361.4**
184	46.6	83.9	0.5201	1.0443	0.1778	2.849	5.62	0.3510	**363.2**
185	46.7	84.0	0.5224	1.0403	0.1740	2.787	5.75	0.3588	**365**
186	46.7	84.1	0.5246	1.0362	0.1702	2.727	5.88	0.3667	**366.8**
187	46.8	84.2	0.5269	1.0321	0.1666	2.669	6.00	0.3746	**368.6**
188	46.8	84.3	0.5291	1.0280	0.1632	2.614	6.13	0.3826	**370.4**
189	46.9	84.3	0.5314	1.0240	0.1598	2.560	6.26	0.3906	**372.2**
190	46.9	84.4	0.5336	1.0200	0.1565	2.507	6.39	0.3989	**374**

PROPERTIES OF

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
191	9612	13.068	185.87	193.3	347.9	471.5	848.7	424.5	764.2	**375.8**
192	9823	13.355	189.96	194.4	349.8	470.6	847.1	423.6	762.5	**377.6**
193	10038	13.647	194.11	195.4	351.7	469.8	845.6	422.8	761.0	**379.4**
194	10256	13.944	198.33	196.4	353.5	468.9	844.1	421.9	759.4	**381.2**
195	10479	14.247	202.64	197.5	355.4	468.1	842.5	421.0	757.7	**383**
196	10705	14.554	207.01	198.5	357.3	467.2	841.0	420.1	756.1	**384.8**
197	10934	14.866	211.45	199.5	359.2	466.4	839.5	419.2	754.6	**386.6**
198	11168	15.184	215.96	200.6	361.1	465.6	838.0	418.4	753.0	**388.4**
199	11406	15.507	220.56	201.6	362.9	464.7	836.4	417.4	751.3	**390.2**
200	11647	15.835	225.23	202.7	364.8	463.8	834.8	416.5	749.7	**392**
201	11893	16.169	229.98	203.7	366.7	462.9	833.3	415.6	748.1	**393.8**
202	12142	16.508	234.80	204.7	368.5	462.1	831.8	414.8	746.6	**395.6**
203	12395	16.852	239.71	205.8	370.4	461.2	830.2	413.8	744.9	**397.4**
204	12653	17.202	244.69	206.8	372.3	460.3	828.6	412.9	743.3	**399.2**
205	12915	17.558	249.75	207.9	374.1	459.4	827.0	412.0	741.6	**401**
206	13181	17.921	254.89	208.9	376.0	458.6	825.4	411.1	740.0	**402.8**
207	13452	18.289	260.13	210.0	377.9	457.7	823.8	410.2	738.3	**404.6**
208	13727	18.663	265.45	211.0	379.8	456.8	822.2	409.3	736.7	**406.4**
209	14006	19.042	270.85	212.0	381.6	455.9	820.6	408.4	735.1	**408.2**
210	14290	19.428	276.34	213.1	383.5	455.0	819.1	407.5	733.6	**410**
211	14578	19.820	281.91	214.1	385.4	454.1	817.4	406.6	731.9	**411.8**
212	14871	20.218	287.57	215.2	387.3	453.2	815.8	405.7	730.2	**413.6**
213	15168	20.622	293.31	216.2	389.2	452.4	814.3	404.9	728.7	**415.4**
214	15470	21.033	299.16	217.3	391.1	451.5	812.7	404.0	727.1	**417.2**
215	15778	21.452	305.10	218.3	392.9	450.6	811.0	403.1	725.4	**419**
216	16090	21.876	311.14	219.3	394.8	449.6	809.3	402.1	723.7	**420.8**
217	16406	22.306	317.26	220.4	396.7	448.7	807.7	401.2	722.1	**422.6**
218	16728	22.743	323.48	221.4	398.5	447.8	806.1	400.3	720.5	**424.4**
219	17055	23.188	329.81	222.5	400.4	446.9	804.5	399.4	718.9	**426.2**
220	17387	23.639	336.24	223.5	402.3	446.0	802.9	398.5	717.3	**428**

SATURATED STEAM (Concluded)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
191	47.0	84.5	0.5358	1.0160	0.1533	2.456	6.52	0.4072	**375.8**
192	47.0	84.6	0.5381	1.0120	0.1501	2.405	6.66	0.4158	**377.6**
193	47.0	84.6	0.5403	1.0080	0.1470	2.355	6.80	0.4246	**379.4**
194	47.0	84.7	0.5426	1.0040	0.1440	2.306	6.94	0.4336	**381.2**
195	47.1	84.8	0.5448	1.0000	0.1411	2.259	7.09	0.4426	**383**
196	47.1	84.9	0.5470	0.9961	0.1382	2.214	7.23	0.4516	**384.8**
197	47.2	84.9	0.5492	0.9922	0.1354	2.169	7.38	0.4610	**386.6**
198	47.2	85.0	0.5514	0.9882	0.1327	2.126	7.53	0.4704	**388.4**
199	47.3	85.1	0.5536	0.9843	0.1300	2.083	7.69	0.4801	**390.2**
200	47.3	85.1	0.5558	0.9804	0.1274	2.041	7.84	0.4900	**392**
201	47.3	85.2	0.5580	0.9765	0.1249	2.001	8.00	0.4998	**393.8**
202	47.3	85.2	0.5602	0.9727	0.1225	1.962	8.16	0.510	**395.6**
203	47.4	85.3	0.5624	0.9688	0.1201	1.923	8.33	0.520	**397.4**
204	47.4	85.3	0.5646	0.9650	0.1177	1.885	8.50	0.531	**399.2**
205	47.4	85.4	0.5668	0.9611	0.1153	1.847	8.67	0.541	**401**
206	47.5	85.4	0.5690	0.9572	0.1130	1.810	8.85	0.552	**402.8**
207	47.5	85.5	0.5712	0.9534	0.1108	1.774	9.03	0.564	**404.6**
208	47.5	85.5	0.5733	0.9496	0.1086	1.739	9.21	0.575	**406.4**
209	47.5	85.5	0.5755	0.9458	0.1065	1.705	9.39	0.587	**408.2**
210	47.5	85.5	0.5777	0.9420	0.1044	1.673	9.58	0.598	**410**
211	47.5	85.5	0.5799	0.9382	0.1024	1.640	9.77	0.610	**411.8**
212	47.5	85.6	0.5820	0.9344	0.1004	1.608	9.96	0.622	**413.6**
213	47.5	85.6	0.5842	0.9307	0.0984	1.577	10.16	0.634	**415.4**
214	47.5	85.6	0.5863	0.9269	0.0965	1.546	10.36	0.647	**417.2**
215	47.5	85.6	0.5885	0.9232	0.0947	1.516	10.56	0.660	**419**
216	47.5	85.6	0.5906	0.9195	0.0928	1.486	10.78	0.673	**420.8**
217	47.5	85.6	0.5927	0.9157	0.0910	1.458	10.99	0.686	**422.6**
218	47.5	85.6	0.5948	0.9120	0.0893	1.430	11.20	0.699	**424.4**
219	47.5	85.6	0.5969	0.9084	0.0876	1.403	11.41	0.713	**426.2**
220	47.5	85.6	0.5991	0.9047	0.0860	1.376	11.62	0.727	**428**

THERMODYNAMIC

Ammonia, NH_3

Temp. °F	Abs. press. sat. vap. lb./in.²	Abs. press. sat. vap. kg/cm²	Heat content abv. −40°F BTU/lb. Liq.	Heat content abv. −40°F BTU/lb. Vap.	Ht. of vaporiz. BTU/lb.	Heat content abv. −40°C g-cal./g Liq.	Heat content abv. −40°C g-cal./g Vap.	Ht. of vaporiz. g-cal./g	Temp. °C
−60	5.55	0.390	−21.2	589.6	610.8	−11.8	327.6	339.3	−51.11
−58	5.93	.417	−19.1	590.4	609.5	−10.6	328.0	338.6	−50.00
−56	6.33	.445	−17.0	591.2	608.2	− 9.44	328.4	337.9	−48.89
−54	6.75	.475	−14.8	592.1	606.9	− 8.22	328.9	337.2	−47.78
−52	7.20	.506	−12.7	592.9	605.6	− 7.06	329.4	336.4	−46.67
−50	7.67	0.539	−10.6	593.7	604.3	− 5.89	329.8	335.7	−45.56
−48	8.16	.574	− 8.5	594.4	602.9	− 4.7	330.2	334.9	−44.44
−46	8.68	.610	− 6.4	595.2	601.6	− 3.6	330.7	334.2	−43.33
−44	9.23	.649	− 4.3	596.0	600.3	− 2.4	331.1	333.5	−42.22
−42	9.81	.690	− 2.1	596.8	598.9	− 1.2	331.6	332.7	−41.11
−40	10.41	0.7319	0.0	597.6	597.6	0.0	332.0	332.0	−40.00
−38	11.04	.7762	+ 2.1	598.3	596.2	+ 1.2	332.4	331.2	−38.89
−36	11.71	.8233	4.3	599.1	594.8	2.4	332.8	330.4	−37.78
−34	12.41	.8725	6.4	599.9	593.5	3.6	333.3	329.7	−36.67
−32	13.14	.9238	8.5	600.6	592.1	4.7	333.7	328.9	−35.56
−30	13.90	0.9773	10.7	601.4	590.7	5.94	334.1	328.2	−34.44
−28	14.71	1.034	12.8	602.1	589.3	7.11	334.5	327.4	−33.33
−26	15.55	1.093	14.9	602.8	587.9	8.28	334.9	326.6	−32.22
−24	16.42	1.154	17.1	603.6	586.5	9.50	335.3	325.8	−31.11
−22	17.34	1.219	19.2	604.3	585.1	10.7	335.7	325.1	−30.00
−20	18.30	1.287	21.4	605.0	583.6	11.9	336.1	324.2	−28.89
−18	19.30	1.357	23.5	605.7	582.2	13.1	336.5	323.4	−27.78
−16	20.34	1.430	25.6	606.4	580.8	14.2	336.9	322.7	−26.67
−14	21.43	1.507	27.8	607.1	579.3	15.4	337.3	321.8	−25.56
−12	22.56	1.586	30.0	607.8	577.8	16.7	337.7	321.0	−24.44
−10	23.74	1.669	32.1	608.5	576.4	17.8	338.1	320.2	−23.33
− 8	24.97	1.756	34.3	609.2	574.9	19.1	338.4	319.4	−22.22
− 6	26.26	1.846	36.4	609.8	573.4	20.2	338.8	318.6	−21.11
− 4	27.59	1.940	38.6	610.5	571.9	21.4	339.2	317.7	−20.00
− 2	28.98	2.037	40.7	611.1	570.4	22.6	339.5	316.9	−18.89
0	30.42	2.139	42.9	611.8	568.9	23.8	339.9	316.1	−17.78
2	31.92	2.244	45.1	612.4	567.3	25.1	340.2	315.2	−16.67
4	33.47	2.353	47.2	613.0	565.8	26.2	340.6	314.3	−15.56
6	35.09	2.467	49.4	613.6	564.2	27.4	340.9	313.4	−14.44
8	36.77	2.585	51.6	614.3	562.7	28.7	341.3	312.6	−13.33
10	38.51	2.708	53.8	614.9	561.1	29.9	341.6	311.7	−12.22
12	40.31	2.834	56.0	615.5	559.5	31.1	341.9	310.8	−11.11
14	42.18	2.966	58.2	616.1	557.9	32.3	342.3	309.9	−10.00
16	44.12	3.102	60.3	616.6	556.3	33.5	342.6	309.1	− 8.89
18	46.13	3.243	62.5	617.2	554.7	34.7	342.9	308.2	− 7.78
20	48.21	3.390	64.7	617.8	553.1	35.9	343.2	307.3	− 6.67
22	50.36	3.541	66.9	618.3	551.4	37.2	343.5	306.3	− 5.56
24	52.59	3.697	69.1	618.9	549.8	38.4	343.8	305.4	− 4.44
26	54.90	3.860	71.3	619.4	548.1	39.6	344.1	304.5	− 3.33
28	57.28	4.027	73.5	619.9	546.4	40.8	344.4	303.6	− 2.22

PROPERTIES

Ammonia, NH_3

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Dens. liq. lb./ft.³	Entropy from −40°F BTU/lb./°F		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³		Liq.	Vap.	
−60	44.73	2.792	0.02235	0.3580	43.91	−0.0517	1.4769	−51.11
−58	42.05	2.625	.02378	.3809		− .0464	1.4713	−50.00
−56	39.56	2.470	.02528	.4049		− .0412	1.4658	−48.89
−54	37.24	2.325	.02685	.4301		− .0360	1.4604	−47.78
−52	35.09	2.191	.02850	.4565		− .0307	1.4551	−46.67
−50	33.08	2.065	0.03023	0.4842	43.49	−0.0256	1.4497	−45.56
−48	31.20	1.948	.03205	.5134		− .0204	1.4445	−44.44
−46	29.45	1.839	.03395	.5438		− .0153	1.4393	−43.33
−44	27.82	1.737	.03595	.5758		− .0102	1.4342	−42.22
−42	26.29	1.641	.03804	.6093		− .0051	1.4292	−41.11
−40	24.86	1.552	0.04022	0.6442	43.08	0.0000	1.4242	−40.00
−38	23.53	1.469	.04251	.6809		.0051	1.4193	−38.89
−36	22.27	1.390	.04489	.7190		.0101	1.4144	−37.78
−34	21.10	1.317	.04739	.7591		.0151	1.4096	−36.67
−32	20.00	1.249	.04999	.8007		.0201	1.4048	−35.56
−30	18.97	1.184	0.05271	0.8443	42.65	0.0250	1.4001	−34.44
−28	18.00	1.124	.05555	.8898		.0300	1.3955	−33.33
−26	17.09	1.067	.05850	.9371		.0350	1.3909	−32.22
−24	16.24	1.014	.06158	.9864		.0399	1.3863	−31.11
−22	15.43	0.9633	.06479	1.038		.0448	1.3818	−30.00
−20	14.68	0.9164	0.06813	1.091	42.22	0.0497	1.3774	−28.89
−18	13.97	.8721	.07161	1.147		.0545	1.3729	−27.78
−16	13.29	.8297	.07522	1.205		.0594	1.3686	−26.67
−14	12.66	.7903	.07898	1.265		.0642	1.3643	−25.56
−12	12.06	.7529	.08289	1.328		.0690	1.3600	−24.44
−10	11.50	0.7179	0.08695	1.393	41.78	0.0738	1.3558	−23.33
− 8	10.97	.6848	.09117	1.460		.0786	1.3516	−22.22
− 6	10.47	.6536	.09555	1.531		.0833	1.3474	−21.11
− 4	9.991	.6237	.1001	1.603		.0880	1.3433	−20.00
− 2	9.541	.5956	.1048	1.679		.0928	1.3393	−18.89
0	9.116	0.5691	0.1097	1.757	41.34	0.0975	1.3352	−17.78
2	8.714	.5440	.1148	1.839		.1022	1.3312	−16.67
4	8.333	.5202	.1200	1.922		.1069	1.3273	−15.56
6	7.971	.4976	.1254	2.009		.1115	1.3234	−14.44
8	7.629	.4763	.1311	2.100		.1162	1.3195	−13.33
10	7.304	0.4560	0.1369	2.193	40.89	0.1208	1.3157	−12.22
12	6.996	.4367	.1429	2.289		.1254	1.3118	−11.11
14	6.703	.4185	.1492	2.390		.1300	1.3081	−10.00
16	6.425	.4011	.1556	2.492		.1346	1.3043	− 8.89
18	6.161	.3846	.1623	2.600		.1392	1.3006	− 7.78
20	5.910	0.3690	0.1692	2.710	40.43	0.1437	1.2969	− 6.67
22	5.671	.3540	.1763	2.824		.1483	1.2933	− 5.56
24	5.443	.3398	.1837	2.943		.1528	1.2897	− 4.44
26	5.227	.3263	.1913	3.064		.1573	1.2861	− 3.33
28	5.021	.3135	.1992	3.191		.1618	1.2825	− 2.22

Ammonia, NH_3 (Continued)

Temp. °F	Abs. press. sat. vap.		Heat content abv. −40°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. −40°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
30	59.74	4.200	75.7	620.5	544.8	42.1	344.7	302.7	− 1.11
32	62.29	4.379	77.9	621.0	543.1	43.3	345.0	301.7	0.00
34	64.91	4.564	80.1	621.5	541.4	44.5	345.3	300.8	+ 1.11
36	67.63	4.755	82.3	622.0	539.7	45.7	345.6	299.8	2.22
38	70.43	4.952	84.6	622.5	537.9	47.0	345.8	298.8	3.33
40	73.32	5.155	86.8	623.0	536.2	48.2	346.1	297.9	4.44
42	76.31	5.365	89.0	623.4	534.4	49.4	346.3	296.9	5.56
44	79.38	5.581	91.2	623.9	532.7	50.7	346.6	295.9	6.67
46	82.55	5.804	93.5	624.4	530.9	51.9	346.9	294.9	7.78
48	85.82	6.034	95.7	624.8	529.1	53.2	347.1	293.9	8.89
50	89.19	6.271	97.9	625.2	527.3	54.4	347.3	292.9	10.00
52	92.66	6.515	100.2	625.7	525.5	55.67	347.6	291.9	11.11
54	96.23	6.766	102.4	626.1	523.7	56.89	347.8	290.9	12.22
56	99.91	7.024	104.7	626.5	521.8	58.17	348.1	289.9	13.33
58	103.7	7.291	106.9	626.9	520.0	59.39	348.3	288.9	14.44
60	107.6	7.565	109.2	627.3	518.1	60.67	348.5	287.8	15.56
62	111.6	7.846	111.5	627.7	516.2	61.94	348.7	286.8	16.67
64	115.7	8.135	113.7	628.0	514.3	63.17	348.9	285.7	17.78
66	120.0	8.437	116.0	628.4	512.4	64.44	349.1	284.7	18.89
68	124.3	8.739	118.3	628.8	510.5	65.72	349.3	283.6	20.00
70	128.8	9.056	120.5	629.1	508.6	66.94	349.5	282.6	21.11
72	133.4	9.379	122.8	629.4	506.6	68.22	349.7	281.4	22.22
74	138.1	9.709	125.1	629.8	504.7	69.50	349.9	280.4	23.33
76	143.0	10.05	127.4	630.1	502.7	70.78	350.1	279.3	24.44
78	147.9	10.40	129.7	630.4	500.7	72.06	350.2	278.2	25.56
80	153.0	10.76	132.0	630.7	498.7	73.33	350.4	277.1	26.67
82	158.3	11.13	134.3	631.0	496.7	74.61	350.6	275.9	27.78
84	163.7	11.51	136.6	631.3	494.7	75.89	350.7	274.8	28.89
86	169.2	11.90	138.9	631.5	492.6	77.17	350.8	273.7	30.00
88	174.8	12.29	141.2	631.8	490.6	78.44	351.0	272.6	31.11
90	180.6	12.70	143.5	632.0	488.5	79.72	351.1	271.4	32.22
92	186.6	13.12	145.8	632.2	486.4	81.00	351.2	270.2	33.33
94	192.7	13.55	148.2	632.5	484.3	82.33	351.4	269.1	34.44
96	198.9	13.98	150.5	632.6	482.1	83.61	351.4	267.8	35.56
98	205.3	14.43	152.9	632.9	480.0	84.94	351.6	266.7	36.67
100	211.9	14.90	155.2	633.0	477.8	86.22	351.7	265.4	37.78
102	218.6	15.37	157.6	633.2	475.6	87.56	351.8	264.2	38.89
104	225.4	15.85	159.9	633.4	473.5	88.83	351.9	263.1	40.00
106	232.5	16.35	162.3	633.5	471.2	90.17	351.9	261.8	41.11
108	239.7	16.85	164.6	633.6	469.0	91.44	352.0	260.6	42.22
110	247.0	17.37	167.0	633.7	466.7	92.78	352.1	259.3	43.33
112	254.5	17.89	169.4	633.8	464.4	94.11	352.1	258.0	44.44
114	262.2	18.43	171.8	633.9	462.1	95.44	352.2	256.7	45.56
116	270.1	18.99	174.2	634.0	459.8	96.78	352.2	255.4	46.67
118	278.2	19.56	176.6	634.0	457.4	98.11	352.2	254.1	47.78
120	286.4	20.14	179.0	634.0	455.0	99.45	352.2	252.8	48.89
122	294.8	20.73	181.4	634.0	452.6	100.8	352.2	251.4	50.00
124	303.4	21.33	183.9	634.0	450.1	102.2	352.2	250.1	51.11

PROPERTIES (Continued)

Ammonia, NH_3 (Continued)

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Dens. liq. lb./ft.³	Entropy from −40°F BTU/lb./°F		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³		Liq.	Vap.	
30	4.825	0.3012	0.2073	3.321	39.96	0.1663	1.2790	− 1.11
32	4.637	.2895	.2156	3.453		.1708	1.2755	0.00
34	4.459	.2784	.2243	3.593		.1753	1.2721	+ 1.11
36	4.289	.2678	.2332	3.735		.1797	1.2686	2.22
38	4.126	.2576	.2423	3.881		.1841	1.2652	3.33
40	3.971	0.2479	0.2518	4.033	39.49	0.1885	1.2618	4.44
42	3.823	.2387	.2616	4.190		.1930	1.2585	5.56
44	3.682	.2299	.2716	4.350		.1974	1.2552	6.67
46	3.547	.2214	.2819	4.515		.2018	1.2519	7.78
48	3.418	.2134	.2926	4.687		.2062	1.2486	8.89
50	3.294	0.2056	0.3036	4.863	39.00	0.2105	1.2453	10.00
52	3.176	.1983	.3149	5.044		.2149	1.2421	11.11
54	3.063	.1912	.3265	5.230		.2192	1.2389	12.22
56	2.954	.1844	.3385	5.422		.2236	1.2357	13.33
58	2.851	.1780	.3508	5.619		.2279	1.2325	14.44
60	2.751	0.1717	0.3635	5.823	38.50	0.2322	1.2294	15.56
62	2.656	.1658	.3765	6.031		.2365	1.2262	16.67
64	2.565	.1601	.3899	6.245		.2408	1.2231	17.78
66	2.477	.1546	.4037	6.466		.2451	1.2201	18.89
68	2.393	.1494	.4179	6.694		.2494	1.2170	20.00
70	2.312	0.1443	0.4325	6.928	38.00	0.2537	1.2140	21.11
72	2.235	.1395	.4474	7.166		.2579	1.2110	22.22
74	2.161	.1349	.4628	7.413		.2622	1.2080	23.33
76	2.089	.1304	.4786	7.666		.2664	1.2050	24.44
78	2.021	.1262	.4949	7.927		.2706	1.2020	25.56
80	1.955	0.1220	0.5115	8.193	37.48	0.2749	1.1991	26.67
82	1.892	.1181	.5287	8.469		.2791	1.1962	27.78
84	1.831	.1143	.5462	8.749		.2833	1.1933	28.89
86	1.772	.1106	.5643	9.039		.2875	1.1904	30.00
88	1.716	.1071	.5828	9.335		.2917	1.1875	31.11
90	1.661	0.1037	0.6019	9.641	36.95	0.2958	1.1846	32.22
92	1.609	.1004	.6214	9.954		.3000	1.1818	33.33
94	1.559	.09733	.6415	10.28		.3041	1.1789	34.44
96	1.510	.09427	.6620	10.60		.3083	1.1761	35.56
98	1.464	.09140	.6832	10.94		.3125	1.1733	36.67
100	1.419	0.08859	0.7048	11.29	36.40	0.3166	1.1705	37.78
102	1.375	.08584	.7270	11.65		.3207	1.1677	38.89
104	1.334	.08328	.7498	12.01		.3248	1.1649	40.00
106	1.293	.08072	.7732	12.39		.3289	1.1621	41.11
108	1.254	.07829	.7972	12.77		.3330	1.1593	42.22
110	1.217	0.07598	0.8219	13.17	35.84	0.3372	1.1566	43.33
112	1.180	.07367	.8471	13.57		.3413	1.1538	44.44
114	1.145	.07148	.8730	13.98		.3453	1.1510	45.56
116	1.112	.06942	.8996	14.41		.3495	1.1483	46.67
118	1.079	.06736	.9269	14.85		.3535	1.1455	47.78
120	1.047	0.06536	0.9549	15.30	35.26	0.3576	1.1427	48.89
122	1.017	.06349	.9837	15.76		.3618	1.1400	50.00
124	0.987	.0616	1.0132	16.229		.3659	1.1372	51.11

Carbon Dioxide, CO_2

Temp. °F	Abs. press. sat. vap.		Heat content abv. 32°F BTU/lb.		Heat of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g		Heat of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
−20	220.6	15.51	−23.96	102.0	126.0	−13.31	56.67	70.00	−28.89
−18	228.4	16.06	−23.13	102.1	125.2	−12.85	56.72	69.56	−27.78
−16	236.4	16.62	−22.30	102.2	124.5	−12.39	56.78	69.17	−26.67
−14	244.6	17.20	−21.46	102.2	123.7	−11.92	56.78	68.72	−25.56
−12	253.0	17.79	−20.61	102.3	122.9	−11.45	56.83	68.28	−24.44
−10	261.7	18.40	−19.76	102.3	122.0	−10.98	56.83	67.78	−23.33
− 8	270.6	19.03	−18.90	102.3	121.2	−10.50	56.83	67.33	−22.22
− 6	279.7	19.66	−18.04	102.3	120.3	−10.02	56.83	66.83	−21.11
− 4	289.1	20.33	−17.17	102.3	119.5	− 9.539	56.83	66.39	−20.00
− 2	298.7	21.00	−16.29	102.3	118.6	− 9.050	56.83	65.89	−18.89
0	308.6	21.70	−15.41	102.2	117.7	− 8.561	56.78	65.39	−17.78
2	318.7	22.41	−14.51	102.2	116.7	− 8.061	56.78	64.83	−16.67
4	329.1	23.14	−13.61	102.1	115.8	− 7.561	56.72	64.33	−15.56
6	339.8	23.89	−12.71	102.1	114.8	− 7.061	56.72	63.78	−14.44
8	350.7	24.66	−11.79	102.0	113.8	− 6.550	56.67	63.22	−13.33
10	361.8	25.44	−10.87	101.9	112.8	− 6.039	56.61	62.67	−12.22
12	373.3	26.25	− 9.934	101.8	111.7	− 5.519	56.56	62.06	−11.11
14	385.0	27.07	− 8.992	101.7	110.7	− 4.996	56.50	61.50	−10.00
16	397.1	27.92	− 8.038	101.5	109.6	− 4.466	56.39	60.89	− 8.89
18	409.4	28.78	− 7.076	101.4	108.5	− 3.931	56.33	60.28	− 7.78
20	422.0	29.67	− 6.102	101.2	107.3	− 3.390	56.22	59.61	− 6.67
22	434.9	30.58	− 5.117	101.0	106.1	− 2.843	56.11	58.94	− 5.56
24	448.1	31.50	− 4.121	100.8	104.9	− 2.289	56.00	58.28	− 4.44
25	454.8	31.98	− 3.618	100.7	104.3	− 2.010	55.94	57.94	− 3.89
27	468.5	32.94	− 2.601	100.5	103.1	− 1.445	55.83	57.28	− 2.78
29	482.5	33.92	− 1.570	100.2	101.8	− 0.8722	55.67	56.56	− 1.67
31	496.8	34.93	− 0.525	99.98	100.5	− 0.292	55.54	55.83	− 0.56
33	511.4	35.95	+ 0.531	99.69	99.16	+ 0.295	55.38	55.09	+ 0.56
35	526.4	37.01	1.604	99.38	97.77	0.8911	55.21	54.32	1.67
37	541.7	38.09	2.697	99.05	96.35	1.498	55.03	53.53	2.78
39	557.4	39.19	3.806	98.69	94.88	2.114	54.83	52.71	3.89
41	573.4	40.31	4.932	98.31	93.37	2.740	54.62	51.87	5.00
43	589.8	41.47	6.080	97.90	91.82	3.378	54.39	51.01	6.11
45	606.5	42.64	7.251	97.46	90.21	4.028	54.14	50.12	7.22
47	623.6	43.84	8.443	96.99	88.55	4.691	53.88	49.19	8.33
49	641.1	45.07	9.664	96.50	86.83	5.369	53.61	48.24	9.44
51	659.0	46.33	10.91	95.97	85.06	6.061	53.32	47.26	10.56
53	677.3	47.62	12.19	95.40	83.21	6.772	53.00	46.23	11.67
55	695.9	48.93	13.49	94.78	81.29	7.494	52.66	45.16	12.78
57	714.9	50.26	14.84	94.13	79.30	8.244	52.29	44.06	13.89
59	734.3	51.63	16.22	93.44	77.22	9.011	51.91	42.90	15.00
61	754.2	53.03	17.65	92.69	75.04	9.806	51.49	41.69	16.11
63	774.5	54.45	19.13	91.88	72.75	10.63	51.04	40.42	17.22
65	795.1	55.90	20.66	91.01	70.35	11.48	50.56	39.08	18.33
67	816.2	57.38	22.25	90.07	67.81	12.36	50.04	37.67	19.44
69	837.8	58.90	23.92	89.04	65.12	13.29	49.47	36.18	20.56
71	859.8	60.45	25.67	87.92	62.25	14.26	48.84	34.58	21.67
73	882.2	62.02	27.52	86.69	59.17	15.29	48.16	32.87	22.78
75	905.1	63.63	29.50	85.33	55.83	16.39	47.41	31.02	23.89
77	928.4	65.27	31.62	83.80	52.17	17.57	46.56	28.98	25.00
79	952.2	66.95	33.95	82.06	48.11	18.86	45.59	26.73	26.11
81	976.5	68.65	36.54	80.03	43.49	20.30	44.46	24.16	27.22
83	1001.0	70.377	39.53	77.60	38.07	21.96	43.11	21.15	28.33
85	1027.0	72.205	43.18	74.47	31.29	23.99	41.37	17.38	29.44
86	1039.0	73.049	45.45	72.46	27.00	25.25	40.26	15.00	30.00
87	1052.0	73.963	48.32	69.84	21.52	26.84	38.80	11.96	30.56
88	1065.0	74.877	52.78	65.62	12.84	29.32	36.46	7.133	31.11

Carbon Dioxide, CO_2

Temp. °F	Spec. vol. sat. vap. ft.³/lb.	Spec. vol. sat. vap. m³/kg	Density sat. vap. lb./ft.³	Density sat. vap. kg/m³	Dens. liq. lb./ft.³	Entropy from 32°F BTU/lb./°F Liq.	Entropy from 32°F BTU/lb./°F Vap.	Temp. °C
−20	0.4166	0.02601	2.401	38.46	64.34	−0.0514	0.2353	−28.89
−18	.4018	.02508	2.489	39.87	64.15	− .0495	.2342	−27.78
−16	.3876	.02420	2.580	41.33	63.94	− .0476	.2331	−26.67
−14	.3739	.02334	2.674	42.83	63.73	− .0458	.2319	−25.56
−12	.3608	.02252	2.772	44.40	63.49	− .0439	.2307	−24.44
−10	0.3482	0.02174	2.872	46.00	63.25	−0.0420	0.2296	−23.33
− 8	.3360	.02098	2.976	47.67	63.01	− .0401	.2284	−22.22
− 6	.3243	.02025	3.083	49.38	62.76	− .0382	.2273	−21.11
− 4	.3131	.01955	3.194	51.16	62.50	− .0362	.2261	−20.00
− 2	.3022	.01887	3.309	53.00	62.23	− .0343	.2249	−18.89
0	0.2918	0.01822	3.427	54.89	61.95	−0.0324	0.2237	−17.78
2	.2817	.01759	3.550	56.86	61.65	− .0304	.2225	−16.67
4	.2720	.01698	3.676	58.88	61.36	− .0285	.2213	−15.56
6	.2627	.01640	3.807	60.98	61.07	− .0266	.2201	−14.44
8	.2537	.01584	3.942	63.14	60.77	− .0246	.2189	−13.33
10	0.2450	0.01529	4.082	65.39	60.48	−0.0226	0.2176	−12.22
12	.2366	.01477	4.227	67.71	60.18	− .0206	.2164	−11.11
14	.2285	.01426	4.377	70.11	59.88	− .0186	.2151	−10.00
16	.2207	.01378	4.532	72.59	59.58	− .0166	.2139	− 8.89
18	.2131	.01330	4.692	75.16	59.27	− .0146	.2126	− 7.78
20	0.2058	0.01285	4.859	77.83	58.95	−0.0126	0.2113	− 6.67
22	.1987	.01240	5.031	80.59	58.64	− .0105	.2100	− 5.56
24	.1919	.01198	5.211	83.47	58.31	− .0085	.2087	− 4.44
25	.1886	.01177	5.303	84.94	58.14	− .0074	.2080	− 3.89
27	.1821	.01137	5.492	87.97	57.81	− .0053	.2066	− 2.78
29	0.1758	0.01097	5.688	91.11	57.47	−0.0032	0.2053	− 1.67
31	.1697	.01059	5.892	94.38	57.12	− .0011	.2039	− 0.56
33	.1639	.01023	6.103	97.76	56.77	+ .0011	.2025	+ 0.56
35	.1581	.009870	6.323	101.3	56.41	.0033	.2010	1.67
37	.1526	.009527	6.553	105.0	56.03	.0055	.1996	2.78
39	0.1472	0.009189	6.792	108.8	55.65	0.0077	0.1981	3.89
41	.1420	.008865	7.040	112.8	55.25	.0099	.1965	5.00
43	.1370	.008553	7.300	116.9	54.84	.0122	.1950	6.11
45	.1321	.008247	7.571	121.3	54.41	.0146	.1934	7.22
47	.1273	.007947	7.854	125.8	53.97	.0169	.1918	8.33
49	0.1227	0.007660	8.151	130.6	53.51	0.0193	0.1901	9.44
51	.1182	.007379	8.461	135.5	53.04	.0218	.1884	10.56
53	.1138	.007104	8.787	140.8	52.55	.0243	.1867	11.67
55	.1095	.006836	9.132	146.3	52.05	.0268	.1849	12.78
57	.1053	.006574	9.497	152.1	51.53	.0294	.1830	13.89
59	0.1012	0.006318	9.880	158.3	50.99	0.0321	0.1811	15.00
61	.0972	.00607	10.29	164.8	50.42	.0348	.1790	16.11
63	.0933	.00582	10.72	171.7	49.80	.0377	.1770	17.22
65	.0894	.00558	11.18	179.1	49.14	.0406	.1748	18.33
67	.0856	.00534	11.67	186.9	48.44	.0436	.1725	19.44
69	0.0819	0.00511	12.21	195.6	47.69	0.0468	0.1701	20.56
71	.0782	.00488	12.82	205.4	46.87	.0501	.1675	21.67
73	.0745	.00465	13.43	215.1	45.99	.0536	.1647	22.78
75	.0708	.00442	14.13	226.3	45.05	.0573	.1618	23.89
77	.0671	.00419	14.90	238.7	44.06	.0613	.1585	25.00
79	0.0633	0.00395	15.81	253.2	43.04	0.0656	0.1550	26.11
81	.0592	.00370	16.90	270.7	41.95	.0704	.1509	27.22
83	.0548	.00342	18.25	292.3	40.62	.0759	.1461	28.33
85	.0500	.00312	20.00	320.4	38.76	.0826	.1401	29.44
86	.0474	.00296	21.09	337.8	37.41	.0868	.1363	30.00
87	0.0446	0.00278	22.42	359.1	35.34	0.0921	0.1314	30.56
88	.0401	.00250	24.95	399.6	32.79	.1002	.1237	31.11

Sulfur Dioxide, SO_2

Temp. °F	Abs. press. sat. vap.		Heat content abv. −40°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. −40°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
−40	3.136	0.2205	0.00	178.61	178.61	0.00	99.228	99.228	−40.00
−30	4.331	.3045	2.93	179.90	176.97	1.63	99.945	98.317	−34.44
−20	5.883	.4136	5.98	181.07	175.09	3.32	100.59	97.272	−28.89
−10	7.863	.5528	9.16	182.13	172.97	5.09	101.18	96.095	−23.33
0	10.35	.7277	12.44	183.07	170.63	6.911	101.71	94.795	−17.78
2	10.91	0.7670	13.12	183.25	170.13	7.289	101.81	94.517	−16.67
4	11.50	.8085	13.78	183.41	169.63	7.656	101.89	94.239	−15.56
5	11.81	.8303	14.11	183.49	169.38	7.839	101.94	94.100	−15.00
6	12.12	.8521	14.45	183.57	169.12	8.028	101.98	93.956	−14.44
8	12.75	.8964	15.13	183.73	168.60	8.406	102.07	93.667	−13.33
10	13.42	0.9435	15.80	183.87	168.07	8.778	102.15	93.372	−12.22
12	14.12	.9927	16.48	184.01	167.53	9.156	102.23	93.072	−11.11
14	14.84	1.043	17.15	184.14	166.97	9.528	102.30	92.761	−10.00
16	15.59	1.096	17.84	184.28	166.44	9.911	102.38	92.467	− 8.89
18	16.37	1.1509	18.52	184.40	165.88	10.29	102.44	92.156	− 7.78
20	17.18	1.208	19.20	184.52	165.32	10.67	102.51	91.845	− 6.67
22	18.03	1.268	19.90	184.64	164.74	11.06	102.58	91.522	− 5.56
24	18.89	1.328	20.58	184.74	164.16	11.43	102.63	91.200	− 4.44
26	19.80	1.392	21.26	184.84	163.58	11.81	102.69	90.878	− 3.33
28	20.73	1.457	21.96	184.94	162.98	12.20	102.74	90.545	− 2.22
30	21.70	1.526	22.64	185.02	162.38	12.58	102.79	90.211	− 1.11
32	22.71	1.597	23.33	185.10	161.77	12.96	102.83	89.872	0.00
34	23.75	1.670	24.03	185.18	161.15	13.35	102.88	89.528	+ 1.11
36	24.82	1.745	24.72	185.25	160.53	13.73	102.92	89.183	2.22
38	25.95	1.824	25.42	185.31	159.89	14.12	102.95	88.828	3.33
40	27.10	1.905	26.12	185.37	159.25	14.51	102.98	88.472	4.44
42	28.29	1.989	26.81	185.42	158.61	14.89	103.01	88.117	5.56
44	29.52	2.075	27.51	185.46	157.95	15.28	103.03	87.750	6.67
46	30.79	2.165	28.21	185.50	157.29	15.67	103.06	87.383	7.78
48	32.10	2.257	28.92	185.54	156.62	16.07	103.08	87.011	8.89
50	33.45	2.352	29.61	185.56	155.95	16.45	103.09	86.639	10.00
52	34.86	2.451	30.31	185.58	155.27	16.84	103.10	86.261	11.11
54	36.31	2.553	31.00	185.59	154.59	17.22	103.11	85.883	12.22
56	37.80	2.658	31.72	185.61	153.89	17.62	103.12	85.495	13.33
58	39.33	2.765	32.42	185.61	153.19	18.01	103.12	85.106	14.44
60	40.93	2.878	33.10	185.59	152.49	18.39	103.11	84.717	15.56
62	42.58	2.994	33.79	185.57	151.78	18.77	103.09	84.322	16.67
64	44.27	3.112	34.49	185.55	151.06	19.16	103.08	83.922	17.78
66	46.00	3.234	35.19	185.53	150.34	19.55	103.07	83.522	18.89
68	47.78	3.359	35.88	185.50	149.62	19.93	103.06	83.122	20.00
70	49.62	3.489	36.58	185.46	148.88	20.32	103.03	82.711	21.11
72	51.54	3.624	37.28	185.42	148.14	20.71	103.01	82.300	22.22
74	53.48	3.760	37.97	185.37	147.40	21.09	102.98	81.889	23.33
76	55.48	3.901	38.67	185.31	146.64	21.48	102.95	81.467	24.44
78	57.56	4.047	39.36	185.24	145.88	21.87	102.91	81.045	25.56
80	59.68	4.196	40.05	185.17	145.12	22.25	102.87	80.622	26.67
82	61.88	4.351	40.73	185.09	144.36	22.63	102.83	80.200	27.78
84	64.14	4.509	41.43	185.01	143.58	23.02	102.78	79.767	28.89
86	66.45	4.672	42.12	184.92	142.80	23.40	102.73	79.333	30.00
88	68.84	4.840	42.80	184.82	142.02	23.78	102.68	78.900	31.11
90	71.25	5.009	43.50	184.72	141.22	24.17	102.62	78.456	32.22
92	73.70	5.182	44.19	184.61	140.42	24.55	102.56	78.011	33.33
94	76.30	5.364	44.86	184.49	139.62	24.92	102.49	77.567	34.44
96	79.03	5.556	45.54	184.37	138.83	25.30	102.43	77.128	35.56
98	81.77	5.749	46.22	184.25	138.03	25.68	102.36	76.683	36.67
100	84.52	5.942	46.90	184.10	137.20	26.06	102.28	76.222	37.78

Sulfur Dioxide, SO_2

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Dens. liq. lb./ft.³	Entropy from −40°F BTU/lb./°F		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³		Liq.	Vap.	
−40	22.42	1.400	0.04460	0.7144	95.79	0.00000	0.42562	−40.00
−30	16.56	1.034	.06039	0.9673	94.94	.00674	.41864	−34.44
−20	12.42	0.7754	.08119	1.301	94.10	.01366	.41192	−28.89
−10	9.44	.5893	.1025	1.642	93.27	.02075	.40544	−23.33
0	7.280	.4545	.1374	2.201	92.42	.02795	.39917	−17.78
2	6.923	0.4322	0.1444	2.313	92.25	0.02941	0.39794	−16.67
4	6.584	.4110	.1501	2.404	92.08	.03084	.39670	−15.56
5	6.421	.4009	.1558	2.496	92.00	.03155	.39609	−15.00
6	6.266	.3912	.1595	2.556	91.91	.03228	.39547	−14.44
8	5.967	.3725	.1676	2.685	91.74	.03373	.39426	−13.33
10	5.682	0.3547	0.1760	2.819	91.58	0.03519	0.39306	−12.22
12	5.417	.3382	.1846	2.957	91.41	.03664	.39185	−11.11
14	5.164	.3224	.1936	3.101	91.24	.03808	.39065	−10.00
16	4.926	.3075	.2030	3.252	91.07	.03953	.38946	− 8.89
18	4.701	.2935	.2127	3.407	90.89	.04098	.38827	− 7.78
20	4.487	0.2801	0.2228	3.569	90.71	0.04241	0.38707	− 6.67
22	4.287	.2676	.2332	3.735	90.53	.04385	.38589	− 5.56
24	4.096	.2557	.2441	3.910	90.33	.04528	.38471	− 4.44
26	3.915	.2444	.2559	4.099	90.15	.04671	.38354	− 3.33
28	3.744	.2337	.2671	4.278	89.96	.04814	.38237	− 2.22
30	3.581	0.2236	0.2800	4.485	89.76	0.04956	0.38119	− 1.11
32	3.437	.2146	.2909	4.660	89.58	.05099	.38003	0.00
34	3.283	.2050	.3046	4.879	89.39	.05242	.37887	+ 1.11
36	3.144	.1963	.3181	5.095	89.18	.05384	.37772	2.22
38	3.013	.1881	.3319	5.316	89.00	.05527	.37657	3.33
40	2.887	0.1802	0.3464	5.549	88.81	0.05668	0.37541	4.44
42	2.769	.1729	.3611	5.784	88.62	.05809	.37425	5.56
44	2.656	.1658	.3765	6.031	88.43	.05949	.37311	6.67
46	2.548	.1591	.3925	6.287	88.24	.06090	.37197	7.78
48	2.446	.1527	.4088	6.548	88.05	.06231	.37083	8.89
50	2.348	0.1466	0.4259	6.822	87.87	0.06370	0.36969	10.00
52	2.256	.1408	.4433	7.101	87.67	.06509	.36857	11.11
54	2.167	.1353	.4615	7.392	87.51	.06646	.36743	12.22
56	2.083	.1300	.4801	7.690	87.31	.06785	.36629	13.33
58	2.003	.1250	.4992	7.996	87.13	.06923	.36517	14.44
60	1.923	0.1202	0.5194	8.320	86.95	0.07060	0.36405	15.56
62	1.853	.1157	.5396	8.643	86.77	.07196	.36293	16.67
64	1.783	.1113	.5609	8.984	86.59	.07333	.36181	17.78
66	1.716	.1071	.5827	9.334	86.41	.07469	.36070	18.89
68	1.652	.1031	.6054	9.697	86.22	.07602	.35958	20.00
70	1.590	0.09926	0.6290	10.08	86.02	0.07736	0.35846	21.11
72	1.532	.09564	.6527	10.45	85.82	.07871	.35736	22.22
74	1.476	.09214	.6777	10.86	85.62	.08003	.35624	23.33
76	1.422	.08877	.7030	11.26	85.42	.08135	.35512	24.44
78	1.371	.08559	.7295	11.69	85.23	.08268	.35401	25.56
80	1.321	0.08247	0.7570	12.13	85.03	0.08399	0.35291	26.67
82	1.274	.07953	.7850	12.57	84.84	.08525	.35177	27.78
84	1.229	.07672	.8140	13.04	84.64	.08653	.35065	28.89
86	1.185	.07395	.8440	13.52	84.44	.08783	.34954	30.00
88	1.144	.07142	.8740	14.00	84.25	.08910	.34843	31.11
90	1.104	0.06892	0.9058	14.51	84.05	0.09038	0.34731	32.22
92	1.065	.06649	.9390	15.04	83.86	.09165	.34620	33.33
94	1.028	.06418	.9730	15.59	83.67	.09289	.34508	34.44
96	0.9931	.06200	1.007	16.13	83.47	.09411	.34397	35.56
98	0.9591	.05987	1.043	16.71	83.27	.09532	.34285	36.67
100	0.9262	0.05782	1.080	17.30	83.07	0.09657	0.34173	37.78

THERMODYNAMIC

Butane, $CH_3(CH_2)_2CH_3$

Temp. °F	Abs. press. sat. vap.		Heat content abv. 32°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
0	7.3	0.51	−17.2	153.3	170.5	− 9.56	85.17	94.72	−17.78
10	9.2	0.65	−11.7	156.8	168.5	− 6.50	87.11	93.61	−12.22
20	11.6	0.816	− 6.7	160.3	167.0	− 3.7	89.06	92.78	− 6.67
30	14.4	1.01	− 1.2	164.3	165.5	− 0.67	91.28	91.94	− 1.11
40	17.7	1.24	+ 4.3	167.8	163.5	+ 2.4	93.22	90.83	+ 4.44
50	21.6	1.52	9.8	171.3	161.5	5.4	95.17	89.72	10.00
60	26.3	1.85	15.8	175.3	159.5	8.78	97.39	88.61	15.56
70	31.6	2.22	21.3	178.8	157.5	11.8	99.33	87.50	21.11
80	37.6	2.64	27.3	182.3	155.0	15.2	101.3	86.11	26.67
90	44.5	3.13	33.8	185.8	152.0	18.8	103.2	84.44	32.22
100	52.2	3.67	39.8	189.3	149.5	22.1	105.2	83.06	37.78
110	60.8	4.27	46.3	193.3	147.0	25.7	107.4	81.67	43.33
120	70.8	4.98	52.8	196.3	143.5	29.3	109.1	79.72	48.89
130	81.4	5.72	59.3	199.8	140.5	32.9	111.0	78.06	54.44
140	92.6	6.51	66.3	203.8	137.5	36.8	113.2	76.39	60.00

Isobutane, $(CH_3)_3CH$

−20	7.50	0.527	−25.5	140.0	165.5	−14.2	77.78	91.94	−28.89
−10	9.28	0.652	−21.0	142.0	163.0	−11.7	78.89	90.56	−23.33
0	11.6	0.816	−16.5	144.0	160.5	− 9.17	80.00	89.17	−17.78
+10	14.6	1.03	−11.5	147.0	158.5	− 6.39	81.67	88.06	−12.22
20	18.2	1.28	− 6.5	149.5	156.0	− 3.6	83.06	86.67	− 6.67
30	22.3	1.57	− 1.0	152.5	153.5	− 0.56	84.72	85.28	− 1.11
40	26.9	1.89	+ 4.5	155.5	151.0	+ 2.5	86.39	83.89	+ 4.44
50	32.5	2.28	10.5	159.0	148.5	5.83	88.33	82.50	10.00
60	38.7	2.72	16.5	162.5	146.0	9.17	90.28	81.11	15.56
70	45.8	3.22	23.0	166.5	143.5	12.8	92.50	79.72	21.11
80	53.9	3.79	30.0	170.5	140.5	16.7	94.72	78.06	26.67
90	63.3	4.45	37.0	174.5	137.5	20.6	96.94	76.39	32.22
100	73.7	5.18	44.5	179.0	134.5	24.7	99.44	74.72	37.78
110	85.1	5.98	52.5	183.5	131.0	29.2	101.9	72.78	43.33
120	98.0	6.89	60.5	188.0	127.5	33.6	104.4	70.83	48.89
130	112.0	7.87	69.5	193.5	124.0	38.6	107.5	68.89	54.44
140	126.8	8.915	78.5	199.0	120.5	43.6	110.6	66.94	60.00

Propane, C_3H_8

−70	7.37	0.518	−55.2	134.3	189.5	−30.7	74.61	105.3	−56.67
−60	9.72	0.683	−50.2	136.8	187.0	−27.9	76.00	103.9	−51.11
−50	12.6	0.886	−44.7	139.8	184.5	−24.8	77.67	102.5	−45.56
−40	16.2	1.14	−39.7	141.8	181.5	−22.1	78.78	100.8	−40.00
−30	20.3	1.43	−34.2	144.8	179.0	−19.0	80.44	99.44	−34.44
−20	25.4	1.79	−29.2	146.8	176.0	−16.2	81.56	97.78	−28.89
−10	31.4	2.21	−23.7	149.8	173.5	−13.2	83.22	96.39	−23.33
0	38.2	2.69	−18.2	152.3	170.5	−10.1	84.61	94.72	−17.78
+10	46.0	3.23	−12.7	155.3	168.0	− 7.06	86.28	93.33	−12.22
20	55.5	3.90	− 7.2	157.8	165.0	− 4.0	87.67	91.67	− 6.67
30	66.3	4.66	− 1.2	160.8	162.0	− 0.67	89.33	90.00	− 1.11
40	78.0	5.48	+ 4.8	163.8	159.0	+ 2.7	91.00	88.33	+ 4.44
50	91.8	6.45	10.8	166.8	156.0	6.00	92.67	86.67	10.00
60	107.1	7.530	16.8	169.8	153.0	9.33	94.33	85.00	15.56
70	124.0	8.718	22.8	172.3	149.5	12.7	95.72	83.06	21.11
80	142.8	10.04	29.3	175.3	146.0	16.3	97.39	81.11	26.67
90	164.0	11.53	35.8	178.3	142.5	19.9	99.06	79.17	32.22
100	187.0	13.15	42.3	180.8	138.5	23.5	100.4	76.94	37.78
110	213.0	14.98	48.8	182.8	134.0	27.1	101.6	74.44	43.33
120	240.0	16.87	55.3	184.3	129.0	30.7	102.4	71.67	48.89

PROPERTIES (Continued)

Butane, $CH_3(CH_2)_2CH_3$

Temp. °F	Spec. vol. sat. vap.		Density of sat. vap.		Density of liq.		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	lb./ft.³	kg/m³	
0	11.1	0.693	0.0901	1.44	38.59	618.1	−17.78
10	8.95	.559	.112	1.79	38.24	612.5	−12.22
20	7.23	.451	.138	2.21	37.89	606.9	− 6.67
30	5.90	.368	.169	2.71	37.54	601.3	− 1.11
40	4.88	.305	.205	3.28	37.19	595.7	+ 4.44
50	4.07	.254	.246	3.94	36.82	589.8	10.00
60	3.40	.212	.294	4.71	36.45	583.9	15.56
70	2.88	.180	.347	5.56	36.06	577.6	21.11
80	2.46	.154	.407	6.52	35.65	571.0	26.67
90	2.10	.131	.476	7.62	35.24	564.5	32.22
100	1.81	.113	.552	8.84	34.84	558.1	37.78
110	1.58	.0986	.633	10.1	34.41	551.2	43.33
120	1.38	.0862	.725	11.6	33.96	544.0	48.89
130	1.21	.0755	.826	13.2	33.49	536.4	54.44
140	1.07	.0668	.934	15.0	32.98	528.3	60.00

Isobutane, $(CH_3)_3CH$

Temp. °F	Spec. vol. sat. vap.		Density of sat. vap.		Density of liq.		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	lb./ft.³	kg/m³	
−20	10.5	0.655	0.0952	1.52	38.35	614.3	−28.89
−10	8.91	.556	.112	1.79	37.95	607.9	−23.33
0	7.17	.448	.139	2.23	37.60	602.3	−17.78
+10	5.75	.359	.174	2.79	37.20	595.9	−12.22
20	4.68	.292	.214	3.43	36.80	589.5	− 6.67
30	3.86	.241	.259	4.15	36.40	583.1	− 1.11
40	3.22	.201	.311	4.98	36.00	576.6	+ 4.44
50	2.71	.169	.369	5.91	35.60	570.2	10.00
60	2.28	.142	.439	7.03	35.20	563.8	15.56
70	1.94	.121	.515	8.25	34.80	557.4	21.11
80	1.66	.104	.602	9.64	34.35	550.2	26.67
90	1.42	.0886	.704	11.3	33.90	543.0	32.22
100	1.23	.0768	.813	13.0	33.45	535.8	37.78
110	1.07	.0668	.935	15.0	33.00	528.6	43.33
120	0.926	.0578	1.08	17.3	32.50	520.6	48.89
130	0.811	.0506	1.23	19.7	32.00	512.6	54.44
140	0.716	.0447	1.32	21.1	31.80	509.4	60.00

Propane, C_3H_8

Temp. °F	Spec. vol. sat. vap.		Density of sat. vap.		Density of liq.		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	lb./ft.³	kg/m³	
−70	12.9	0.805	0.0775	1.24	37.40	599.1	−56.67
−60	9.93	.620	.111	1.78	37.00	592.7	−51.11
−50	7.74	.483	.129	2.07	36.60	586.3	−45.56
−40	6.13	.383	.163	2.61	36.19	579.7	−40.00
−30	4.93	.308	.203	3.25	35.78	573.1	−34.44
−20	4.00	.250	.250	4.00	35.37	566.6	−28.89
−10	3.26	.204	.307	4.92	34.96	560.0	−23.33
0	2.71	.169	.369	5.91	34.54	553.3	−17.78
+10	2.27	.142	.441	7.06	34.12	546.5	−12.22
20	1.90	.119	.526	8.43	33.67	539.3	− 6.67
30	1.60	.0999	.625	10.0	33.20	531.8	− 1.11
40	1.37	.0855	.730	11.7	32.73	524.3	+ 4.44
50	1.18	.0737	.847	13.6	32.24	516.4	10.00
60	1.01	.0631	.990	15.9	31.75	508.6	15.56
70	0.883	.0551	1.13	18.1	31.24	500.4	21.11
80	0.770	.0481	1.30	20.8	30.70	491.8	26.67
90	0.673	.0420	1.49	23.9	30.15	482.9	32.22
100	0.591	.0369	1.69	27.1	29.58	473.8	37.78
110	0.519	.0324	1.96	31.4	28.85	462.1	43.33
120	0.459	.0287	2.18	34.9	28.30	453.3	48.89

Difluorodichloromethane, CCl_2F_2 ("F-12")

Temp. °F	Abs. press. sat. vap. lb./in.²	Abs. press. sat. vap. kg/cm²	Heat content abv. −40°F BTU/lb. Liq.	Heat content abv. −40°F BTU/lb. Vap.	Ht. of vaporiz. BTU/lb.	Heat content abv. −40°C g-cal./g Liq.	Heat content abv. −40°C g-cal./g Vap.	Ht. of vaporiz. g-cal./g	Temp. °C
−40	9.32	0.655	0	73.50	73.50	0	40.83	40.83	−40.00
−30	12.02	0.845	2.03	74.70	72.67	1.13	41.50	40.37	−34.44
−20	15.28	1.074	4.07	75.87	71.80	2.26	42.15	39.89	−28.89
−10	19.20	1.350	6.14	77.05	70.91	3.41	42.81	39.39	−23.33
0	23.87	1.678	8.25	78.21	69.96	4.58	43.45	38.87	−17.78
+10	29.35	2.064	10.39	79.36	68.97	5.772	44.09	38.32	−12.22
20	35.75	2.513	12.55	80.49	67.94	6.972	44.72	37.74	− 6.67
30	43.16	3.034	14.76	81.61	66.85	8.200	45.34	37.14	− 1.11
40	51.68	3.633	17.00	82.71	65.71	9.444	45.95	36.51	+ 4.44
50	61.39	4.316	19.27	83.78	64.51	10.71	46.54	35.84	10.00
60	72.41	5.091	21.57	84.82	63.25	11.98	47.12	35.14	15.56
70	84.82	5.963	23.90	85.82	61.92	13.28	47.68	34.40	21.11
80	98.76	6.944	26.28	86.80	60.52	14.60	48.22	33.62	26.67
90	114.3	8.036	28.70	87.74	59.04	15.94	48.74	32.80	32.22
100	131.6	9.252	31.16	88.62	57.46	17.31	49.23	31.92	37.78
110	150.7	10.60	33.65	89.43	55.78	18.69	49.68	30.99	43.33
120	171.8	12.08	36.16	90.15	53.99	20.09	50.08	29.99	48.89

Carbon Disulfide, CS_2

Temp. °F	Abs. press. sat. vap. lb./in.²	Abs. press. sat. vap. kg/cm²	Heat content abv. 32°F BTU/lb. Liq.	Heat content abv. 32°F BTU/lb. Vap.	Ht. of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g Liq.	Heat content abv. 0°C g-cal./g Vap.	Ht. of vaporiz. g-cal./g	Temp. °C
0	1.10	0.0773	− 8.60	156.90	165.5	− 4.78	87.167	91.94	−17.78
10	1.46	.103	− 5.60	158.90	164.5	− 3.11	88.278	91.39	−12.22
20	1.89	.133	− 3.00	160.20	163.2	− 1.67	89.000	90.67	− 6.67
30	2.36	.166	− 0.50	161.70	162.2	− 0.28	89.833	90.11	− 1.11
40	3.03	.213	+ 2.05	163.25	161.2	+ 1.14	90.695	89.56	+ 4.44
50	3.90	.274	4.24	164.24	160.0	2.36	91.245	88.89	10.00
60	4.95	.348	7.20	166.40	159.2	4.00	92.445	88.44	15.56
70	5.85	.411	9.80	167.90	158.1	5.44	93.278	87.83	21.11
80	7.30	.513	11.70	168.60	156.9	6.500	93.667	87.17	26.67
90	9.15	.643	13.80	169.40	155.6	7.667	94.111	86.44	32.22
100	11.08	.7790	16.15	170.55	154.4	8.972	94.750	85.78	37.78
110	13.50	.9491	18.30	171.50	153.2	10.17	95.278	85.11	43.33
120	16.10	1.132	20.01	172.01	152.0	11.12	95.561	84.44	48.89

Carbon Tetrachloride, CCl_4

Temp. °F	Abs. press. sat. vap. lb./in.²	Abs. press. sat. vap. kg/cm²	Heat content BTU/lb. Liq.	Heat content BTU/lb. Vap.	Ht. of vaporiz. BTU/lb.	Heat content g-cal./g Liq.	Heat content g-cal./g Vap.	Ht. of vaporiz. g-cal./g	Temp. °C
20	0.40	0.028	− 2.00	92.45	94.45	− 1.11	51.36	52.47	− 6.67
30	0.60	.042	− 0.25	93.45	93.70	− 0.14	51.92	52.06	− 1.11
40	0.84	.059	+ 1.60	94.80	93.20	+ 0.889	52.67	51.78	+ 4.44
60	1.42	.100	5.95	98.15	92.20	3.31	54.53	51.22	15.56
70	1.85	.130	8.20	99.53	91.40	4.56	55.29	50.78	21.11
80	2.40	.169	9.80	99.87	90.07	5.44	55.48	50.04	26.67
90	3.12	.219	11.60	101.62	90.02	6.444	56.46	50.01	32.22
100	4.00	.281	13.40	102.80	89.40	7.444	57.11	49.67	37.78
110	4.89	.344	15.80	104.50	88.70	8.778	58.06	49.28	43.33
120	5.95	.418	18.06	105.90	87.90	10.03	58.83	48.83	48.89

Ethyl Ether, $(C_2H_5)_2O$

Temp. °F	Abs. press. sat. vap. lb./in.²	Abs. press. sat. vap. kg/cm²	Heat content BTU/lb. Liq.	Heat content BTU/lb. Vap.	Ht. of vaporiz. BTU/lb.	Heat content g-cal./g Liq.	Heat content g-cal./g Vap.	Ht. of vaporiz. g-cal./g	Temp. °C
0	1.3	0.091	−18.00	153.00	171.0	−10.00	85.000	95.00	−17.78
10	1.8	.13	−12.0	158.43	170.4	− 6.67	88.017	94.67	−12.22
20	2.5	.18	− 6.50	163.50	170.0	− 3.61	90.833	94.44	− 6.67
30	3.4	.24	− 1.50	167.90	169.4	− 0.833	93.278	94.11	− 1.11
40	4.4	.31	+ 4.00	172.40	168.4	+ 2.22	95.778	93.56	+ 4.44
50	5.5	.39	9.57	177.17	167.6	5.32	98.428	93.11	10.00
70	8.8	.62	20.04	185.44	165.4	11.13	103.02	91.89	21.11
80	10.9	.766	26.40	190.60	164.2	14.67	105.89	91.22	26.67
90	13.4	.942	31.50	194.50	163.0	17.50	108.06	90.56	32.22
100	16.0	1.12	36.50	197.50	161.5	20.28	109.72	89.72	37.78

PROPERTIES (Continued)

Difluorodichloromethane, CCl_2F_2 ("F-12")

Temp. °F	Spec. vol sat. vap.		Density of vap.		Dens. liq. lb./ft.³	Entropy from −40°F BTU/lb./°F		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³		Liq.	Vap.	
−40	3.911	0.2442	0.2557	4.096	94.58	0	0.17517	−40.00
−30	3.088	.1928	.3238	5.187	93.59	0.00471	.17387	−34.44
−20	2.474	.1544	.4042	6.474	92.58	.00940	.17275	−28.89
−10	2.003	.1250	.4993	7.998	91.57	.01403	.17175	−23.33
0	1.637	.1022	.6109	9.785	90.52	.01869	.17091	−17.78
+10	1.351	.08434	.7402	11.86	89.45	.02328	.17015	−12.22
20	1.121	.06998	.8921	14.29	88.37	.02783	.16949	− 6.67
30	0.939	.0586	1.065	17.06	87.24	.03233	.16887	− 1.11
40	.792	.0494	1.263	20.23	86.10	.03680	.16833	+ 4.44
50	.673	.0420	1.485	23.79	84.94	.04126	.16785	10.00
60	.575	.0359	1.740	27.87	83.78	.04568	.16741	15.56
70	.493	.0308	2.028	32.48	82.60	.05009	.16701	21.11
80	.425	.0265	2.353	37.69	81.39	.05446	.16662	26.67
90	.368	.0230	2.721	43.58	80.11	.05882	.16624	32.22
100	.319	.0199	3.135	50.22	78.80	.06316	.16584	37.78
110	.277	.0173	3.610	57.82	77.46	.06749	.16542	43.33
120	.240	.0150	4.167	66.75	76.02	.07180	.16495	48.89

Carbon Disulfide, CS_2

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	
0	53.76	3.356	0.0186	0.2979	−17.78
10	43.47	2.714	.0230	.3684	−12.22
20	34.84	2.175	.0287	.4597	− 6.67
30	29.49	1.841	.0339	.5430	− 1.11
40	23.52	1.468	.0425	.6808	+ 4.44
50	20.60	1.286	.0482	.7721	10.00
60	18.00	1.124	.0555	.8890	15.56
70	13.20	0.824	.0758	1.214	21.11
80	10.40	0.649	.0961	1.539	26.67
90	8.30	0.518	.1204	1.929	32.22
100	7.03	0.439	.1369	2.193	37.78
110	5.80	0.362	.1724	2.762	43.33
120	5.10	0.318	.1960	3.140	48.89

Carbon Tetrachloride, CCl_4

Temp. °F	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	Temp. °C
20	69.5	4.34	0.01438	0.2303	− 6.67
30	53.0	3.31	.01886	.3021	− 1.11
40	40.0	2.50	.02500	.4005	+ 4.44
60	24.0	1.50	.04166	.6673	15.56
70	19.5	1.22	.05128	.8214	21.11
80	16.0	0.999	.06345	1.016	26.67
90	13.0	0.812	.07692	1.232	32.22
100	10.0	0.624	.1000	1.602	37.78
110	8.5	0.53	.1176	1.884	43.33
120	7.5	0.47	.1333	2.135	48.89

Ethyl Ether, $(C_2H_5)_2O$

Temp. °F	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	Temp. °C
0	38.0	2.37	0.0263	0.4213	−17.78
10	32.5	2.03	.0332	.5318	−12.22
20	27.0	1.69	.0372	.5959	− 6.67
30	21.4	1.34	.0468	.7496	− 1.11
40	17.0	1.06	.0588	.9419	+ 4.44
50	13.2	0.824	.0757	1.213	10.00
70	7.8	0.49	.1280	2.050	21.11
80	6.2	0.39	.1620	2.595	26.67
90	5.1	0.32	.1960	3.140	32.22
100	4.5	0.28	.2220	3.556	37.78

THERMODYNAMIC

Methyl Chloride, CH_3Cl

Temp. °F	Abs. press. sat. vap. lb./in.²	Abs. press. sat. vap. kg/cm²	Heat content abv. 32°F BTU/lb. Liq.	Heat content abv. 32°F BTU/lb. Vap.	Ht. of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g Liq.	Heat content abv. 0°C g-cal./g Vap.	Ht. of vaporiz. g-cal./g	Temp. °C
−20	11.75	0.8261	−19.0	167.36	186.36	−10.6	92.978	103.53	−28.89
−10	15.0	1.055	−15.38	168.83	184.21	− 8.544	93.795	102.34	−23.33
− 5	16.79	1.180	−13.58	169.54	183.12	− 7.544	94.189	101.73	−20.56
0	18.8	1.32	−11.75	170.23	181.98	− 6.528	94.572	101.10	−17.78
+ 5	21.0	1.48	− 9.93	170.96	180.84	− 5.517	94.978	100.47	−15.00
10	23.3	1.64	− 8.06	171.58	179.65	− 4.478	95.322	99.806	−12.22
15	25.9	1.82	− 6.74	172.24	178.47	− 3.744	95.689	99.150	− 9.44
20	28.8	2.02	− 4.32	172.95	177.27	− 2.400	96.083	98.483	− 6.67
25	31.8	2.24	− 2.48	173.63	176.10	− 1.378	96.461	97.833	− 3.89
30	35.2	2.47	− 0.62	174.28	174.90	− 0.344	96.822	97.167	− 1.11
35	38.7	2.72	+ 1.75	174.92	173.77	+ 0.972	97.178	96.539	+ 1.67
40	42.6	3.00	3.15	175.57	172.42	1.75	97.539	95.789	4.44
45	46.9	3.30	5.04	176.20	171.16	2.80	97.889	95.089	7.22
50	51.5	3.62	6.88	176.78	169.90	3.82	98.211	94.389	10.00
55	56.4	3.97	8.80	177.45	168.65	4.89	98.583	93.695	12.78
60	61.6	4.33	10.70	178.05	167.35	5.944	98.917	92.972	15.56
65	67.3	4.73	12.62	178.64	166.02	7.011	99.245	92.233	18.33
70	73.3	5.15	14.52	179.17	164.65	8.067	99.539	91.472	21.11
75	79.2	5.57	16.46	179.78	163.28	9.144	99.878	90.711	23.89
80	85.3	6.00	18.36	180.24	161.88	10.20	100.13	89.933	26.67
85	94.1	6.62	20.12	180.74	160.48	11.18	100.41	89.156	29.44
90	102.1	7.178	22.13	181.22	159.09	12.29	100.68	88.383	32.22
95	110.3	7.755	24.07	181.76	157.70	13.37	100.98	87.611	35.00
100	118.8	8.352	26.06	182.36	156.30	14.48	101.31	86.833	37.78

Mercury, Hg

Temp. °F	Abs. press. sat. vap. lb./in.²	Abs. press. sat. vap. kg/cm²	Heat content abv. 32°F BTU/lb. Liq.	Heat content abv. 32°F BTU/lb. Vap.	Ht. of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g Liq.	Heat content abv. 0°C g-cal./g Vap.	Ht. of vaporiz. g-cal./g	Temp. °C
402	0.4	0.03	13.81	141.96	128.15	7.672	78.867	71.195	205.56
444	0.8	0.06	15.36	142.60	127.24	8.533	79.222	70.689	228.89
458	1.0	0.07	15.89	142.81	126.92	8.828	79.339	70.511	236.67
485	1.5	0.11	16.90	143.23	126.33	9.389	79.572	70.183	251.67
505	2.0	0.14	17.65	143.54	125.89	9.806	79.745	69.939	262.78
558	4.0	0.28	19.62	144.34	124.72	10.90	80.189	69.289	292.22
591	6.0	0.42	20.87	144.86	123.99	11.59	80.478	68.883	310.56
617	8.0	0.56	21.81	145.24	123.43	12.12	80.689	68.572	325.00
637	10.0	0.703	22.58	145.56	122.98	12.54	80.867	68.322	356.11
676	15.0	1.05	24.04	146.16	122.12	13.36	81.200	67.844	357.78
706	20.0	1.41	25.15	146.61	121.46	13.97	81.450	67.478	374.44
730	25.0	1.76	26.05	146.98	120.93	14.47	81.656	67.183	387.78
751	30.0	2.11	26.81	147.29	120.48	14.89	81.828	66.933	399.44
769	35.0	2.46	27.49	147.57	120.08	15.27	81.983	66.711	409.44
785	40.0	2.81	28.08	147.81	119.73	15.60	82.117	66.517	418.33
799	45.0	3.16	28.62	148.04	119.42	15.90	82.245	66.344	426.11
812	50	3.5	29.11	148.24	119.13	16.17	82.356	66.183	433.33
836	60	4.2	29.99	148.60	118.61	16.66	82.556	65.894	446.67
857	70	4.9	30.75	148.90	118.15	17.08	82.722	65.639	458.33
875	80	5.6	31.44	149.19	117.75	17.47	82.883	65.417	468.33
892	90	6.3	32.06	149.44	117.38	17.81	83.022	65.211	477.78
907	100	7.03	32.63	149.68	117.05	18.13	83.156	65.028	486.11
921	110	7.73	33.16	149.90	116.74	18.42	83.278	64.856	493.89
934	120	8.44	33.66	150.10	116.44	18.70	83.389	64.689	501.11
947	130	9.14	34.12	150.29	116.17	18.96	83.495	64.539	508.33
958	140	9.84	34.55	150.47	115.92	19.19	83.595	64.400	514.44
969	150	10.5	34.96	150.63	115.67	19.42	83.683	64.261	520.56
1000	180	12.7	36.09	151.10	115.01	20.05	83.945	63.894	537.78

PROPERTIES (Concluded)

Methyl Chloride, CH_3Cl

Temp. °F	Spec. vol. sat. vap.		Spec. vol. liq.		Density sat. vap.		Density of liq.		Temp. °C
	ft.³/lb.	m³/kg	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	lb./ft.³	kg/m³	
−20	8.09	.505	[illegible]	[illegible]	0.124	1.98	63.185	1012.1	−28.89
−10	6.46	.403	[illegible]	[illegible]	.155	2.48	62.560	1002.1	−23.33
− 5	5.80	.362	.016013	[illegible]	.172	2.76	62.450	1000.3	−20.56
0	5.18	.323	.016146	[illegible]	.193	3.09	61.936	992.09	−17.78
+ 5	4.68	.292	[illegible]	.001013	.214	3.42	61.623	987.08	−15.00
10	4.18	.261	.016310	[illegible]	[illegible]	3.83	61.311	982.08	−12.22
15	3.88	.242	[illegible]	.001023	[illegible]	4.13	61.022	977.45	− 9.44
20	3.41	.213	.016474	[illegible]	[illegible]	4.70	60.702	972.32	− 6.67
25	3.09	.193	.016552	[illegible]	.324	5.18	60.415	967.73	− 3.89
30	2.81	.175	.016645	[illegible]	.356	5.70	60.077	962.31	− 1.11
35	2.50	.156	.016746	[illegible]	[illegible]	6.41	59.715	956.51	+ 1.67
40	2.31	.144	[illegible]	[illegible]	.433	6.93	59.482	952.94	4.44
45	2.10	.131	[illegible]	[illegible]	.476	7.63	59.069	946.17	7.22
50	1.93	.120	.017023	[illegible]	.518	8.30	58.745	940.98	10.00
55	1.75	.109	.017118	[illegible]	.571	9.16	58.419	935.76	12.78
60	1.61	.101	.017219	.001075	.621	9.95	58.077	930.28	15.56
65	1.47	[illegible]	.017318	[illegible]	[illegible]	10.9	57.742	924.91	18.33
70	1.34	[illegible]	.017421	[illegible]	.746	12.0	57.403	919.48	21.11
75	1.24	.0774	.017526	[illegible]	[illegible]	12.9	57.058	913.96	23.89
80	1.14	.0712	.017632	.001101	.877	14.1	56.714	908.44	26.67
85	1.05	[illegible]	.017740	.001108	.952	15.3	56.369	902.92	29.44
90	0.98	.061	.017850	.001114	1.02	16.3	56.022	897.36	32.22
95	0.91	.057	.017961	.001121	1.10	17.6	55.675	891.80	35.00
100	0.85	.053	.018074	.001128	1.18	18.8	55.327	886.23	37.78

Mercury, Hg

Temp. °F	Spec. vol. sat. vap.		Density of sat. vap.		Entropy above 32°F BTU/lb. °F			Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	Liq.	Vap.	Evap.	
402	114.50	[illegible]	[illegible]	[illegible]	[illegible]	.1696	.1487	205.56
444	59.72	3.728	[illegible]	[illegible]	.0227	.1635	.1408	[illegible]
458	48.45	3.025	[illegible]	0.3306	[illegible]	[illegible]	[illegible]	[illegible]
485	33.14	[illegible]	[illegible]	0.4833	[illegible]	[illegible]	[illegible]	[illegible]
505	25.32	[illegible]	.03948	0.6324	[illegible]	[illegible]	[illegible]	[illegible]
558	13.26	[illegible]	[illegible]	1.208	[illegible]	[illegible]	[illegible]	292.22
591	[illegible]	[illegible]	[illegible]	1.7609	[illegible]	[illegible]	[illegible]	[illegible]
617	[illegible]	[illegible]	[illegible]	2.3003	[illegible]	.1439	.1147	[illegible]
637	[illegible]	[illegible]	[illegible]	2.8294	[illegible]	[illegible]	.1121	[illegible]
676	[illegible]	[illegible]	[illegible]	4.1152	[illegible]	[illegible]	[illegible]	[illegible]
706	[illegible]	[illegible]	[illegible]	5.369	[illegible]	[illegible]	.1042	[illegible]
730	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
751	[illegible]	[illegible]	[illegible]	7.802	[illegible]	[illegible]	[illegible]	[illegible]
769	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
785	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
799	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
812	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
836	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
857	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
875	[illegible]	[illegible]	1.1977	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
892	[illegible]	[illegible]	1.3323	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
907	[illegible]	[illegible]	1.4682	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
921	[illegible]	[illegible]	1.6020	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
934	[illegible]	[illegible]	1.7340	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
947	[illegible]	[illegible]	1.8656	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
958	[illegible]	[illegible]	1.9952	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
969	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HIGH AND LOW TEMPERATURES

Absolute zero, −273.18° C.

M.p. of helium	−272.2° C.
B.p. of helium	−268.9
M.p. of hydrogen	−259.18
B.p. of hydrogen	−252.8
B.p. of liquid air	−192

Industrial furnaces	1700° C.
Bunsen burner	1870
Oxy-hydrogen flame	2800
Tungsten tube furnace (Forsythe)	2800
Carbon arc furnace (Forsythe)	3200
Oxy-acetylene flame	3500° C.
Tungsten arc under pressure (Luckey)	4785
Cored carbon arc (Suits)	5500
Iron welding arc (Suits)	6020
Tungsten arc, max. (Suits)	6440
Exploding wires by high voltage discharge (Anderson)	19700

The Sun (Coblentz)	6000° K.
Stars, max. estimated	30000° K.

SCALE OF FUSIBILITY

Number	Mineral	Approximate fusing point	Notes
1	Stibnite	525° C	Fuses easily in a candle flame.
2	Chalcopyrite	800° C	Fuses slowly in a gas flame.
3	Almandite	1050° C	Only finest splinters rounded in a gas flame.
4	Actinolite	1200° C	Standard-size fragments are rounded easily before the blowpipe.
5	Orthoclase	1300° C	Standard-size fragments are rounded with difficulty before the blowpipe.
6	Bronzite	1400° C	Only finest splinters rounded on points with difficulty before the blowpipe.
7	Quartz	>1400° C	Entirely infusible before the blowpipe.

CONSTANT TEMPERATURE BATHS

The following substances may be utilized between the temperatures indicated (boiling points) by using pressures from 10 to 76 cm. The second temperature given is the boiling point at the latter pressure. Several of the liquids are inflammable and must be used with caution.

Substance	Temperature °C
Ethyl chloride	−31.3 to 12.2
Ethyl ether	−12.1 to 34.5
Carbon disulfide	−4.8 to 46.3
Acetone	7.5 to 56.1
Chloroform	9.7 to 61.2
Methyl alcohol	20.62 to 64.5
Ethyl alcohol	34.4 to 78.5
Benzene	25.8 to 79.8
Water	51.7 to 100.
Toluene	51.8 to 110.5
Chlorobenzene	70.3 to 132.1
Isoamyl acetate	142.5
Bromobenzene	90.7 to 156.2
Aniline	119.4 to 184.4
Naphthalene	144.3 to 217.9
Methyl salicylate	151. to 223.3
Isoamyl benzoate	262.
Diphenylamine	221. to 302.0
Benzophenone	224. to 305.4
Mercury	261.5 to 356.9
Sulfur	330.7 to 444.6
Zinc	758. to 907.

HYGROMETRIC AND BAROMETRIC TABLES

CONVERSION TABLE FOR BAROMETRIC READINGS

U. S. inches to cm.

Inches.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
27.0	68.580	.606	.631	.656	.682	.707	.733	.758	.783	.809
27.1	.834	.860	.885	.910	.936	.961	.987	*.012	*.037	*.063
27.2	69.088	.114	.139	.164	.190	.215	.241	.266	.291	.317
27.3	.342	.368	.393	.418	.444	.469	.495	.520	.545	.571
27.4	.596	.622	.647	.672	.698	.723	.749	.774	.799	.825
27.5	.850	.876	.901	.926	.952	.977	*.002	*.028	*.053	*.079
27.6	70.104	.130	.155	.180	.206	.231	.257	.282	.307	.333
27.7	.358	.384	.409	.434	.460	.485	.511	.536	.561	.587
27.8	.612	.638	.663	.688	.714	.739	.765	.790	.815	.841
27.9	.866	.892	.917	.942	.968	.993	*.018	*.044	*.069	*.095
28.0	71.120	.146	.171	.196	.222	.247	.273	.298	.323	.349
28.1	.374	.400	.425	.450	.476	.501	.527	.552	.577	.603
28.2	.628	.654	.679	.704	.730	.755	.781	.806	.831	.857
28.3	.882	.908	.933	.958	.984	*.009	*.035	*.060	*.085	*.111
28.4	72.136	.162	.187	.212	.238	.263	.289	.314	.339	.365
28.5	.390	.416	.441	.466	.492	.517	.543	.568	.593	.619
28.6	.644	.670	.695	.720	.746	.771	.797	.822	.847	.875
28.7	.898	.924	.949	.974	*.000	*.025	*.051	*.076	*.101	*.127
28.8	73.152	.178	.203	.228	.254	.279	.305	.330	.355	.38[illegible]
28.9	.406	.432	.457	.482	.508	.533	.559	.584	.609	.635
29.0	.660	.686	.711	.736	.762	.787	.813	.838	.863	.8[illegible]
29.1	.914	.940	.965	.990	*.016	*.041	*.067	*.092	* 117	*.143
29.2	74.168	.194	.219	.244	.270	.295	.321	.346	.371	.397
29.3	.422	.448	.473	.498	.524	.549	.575	.600	.625	.651
29.4	.676	.702	.727	.752	.778	.803	.829	.854	.879	.905
29.5	.930	.956	.981	*.006	*.032	*.057	*.083	*.108	*.133	*.159
29.6	75.184	.210	.235	.260	.286	.311	.337	.362	.387	.413
29.7	.438	.464	.489	.514	.540	.565	.591	.616	.641	.667
29.8	.692	.718	.743	.768	.794	.819	.845	.870	.895	.921
29.9	.946	.972	.997	*.022	*.048	*.073	*.099	*.124	*.149	*.175
30.0	76.200	.226	.251	.277	.302	.327	.353	.378	.404	.429
30.1	.454	.480	.505	.531	.556	.581	.607	.632	.658	.683
30.2	.708	.734	.759	.785	.810	.835	.861	.886	.912	.937
30.3	.962	.988	*.013	*.039	*.064	*.089	*.115	*.140	*.166	*.191
30.4	77.216	.242	.267	.293	.318	.343	.369	.394	.420	.445
30.5	.470	.496	.521	.547	.572	.597	.623	.648	.674	.699
30.6	.724	.750	.775	.801	.826	.851	.877	.902	.928	.953
30.7	.978	*.004	*.029	*.055	*.080	*.105	*.131	*.156	*.182	*.207
30.8	78.232	.258	.283	.309	.334	.359	.385	.410	.436	.461
30.9	.486	.512	.537	.563	.588	.613	.639	.664	.690	.715

TEMPERATURE CORRECTION FOR BAROMETER READINGS

Brass Scale—Metric Units

To reduce readings of a mercurial barometer with a brass scale to 0°C subtract the appropriate quantity as found in the table. These values are based on the coefficient of expansion of mercury $(181792 + 0.175t + 0.035116t^2) \times 10^{-9}$, and of brass 0.0000184 per °C. Corrections are in millimeters.

Temp. °C	Observed height in millimeters								
	620	630	640	650	660	670	680	690	700
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	.10	.10	.10	.11	.11	.11	.11	.11	.11
2	.20	.21	.21	.21	.22	.22	.22	.23	.23
3	.30	.31	.31	.32	.32	.33	.33	.34	.34
4	.40	.41	.42	.42	.43	.44	.44	.45	.46
5	0.51	0.51	0.52	0.53	0.54	0.55	0.56	0.56	0.57
6	.61	.62	.63	.64	.65	.66	.67	.68	.69
7	.71	.72	.73	.74	.75	.77	.78	.79	.80
8	.81	.82	.84	.85	.86	.87	.89	.90	.91
9	.91	.92	.94	.95	.97	.98	1.00	1.01	1.03
10	1.01	1.03	1.04	1.06	1.08	1.09	1.11	1.13	1.14
11	1.11	1.13	1.15	1.17	1.18	1.20	1.22	1.24	1.26
12	1.21	1.23	1.25	1.27	1.29	1.31	1.33	1.35	1.37
13	1.31	1.34	1.36	1.38	1.40	1.42	1.44	1.46	1.48
14	1.41	1.44	1.46	1.48	1.51	1.53	1.55	1.57	1.60
15	1.52	1.54	1.56	1.59	1.61	1.64	1.66	1.69	1.71
16	1.62	1.64	1.67	1.69	1.72	1.75	1.77	1.80	1.82
17	1.72	1.74	1.77	1.80	1.83	1.86	1.88	1.91	1.94
18	1.82	1.85	1.88	1.91	1.93	1.96	1.99	2.02	2.05
19	1.92	1.95	1.98	2.01	2.04	2.07	2.10	2.13	2.17
20	2.02	2.05	2.08	2.12	2.15	2.18	2.21	2.25	2.28
21	2.12	2.15	2.19	2.22	2.26	2.29	2.32	2.36	2.39
22	2.22	2.26	2.29	2.33	2.36	2.40	2.43	2.47	2.51
23	2.32	2.36	2.40	2.43	2.47	2.51	2.54	2.58	2.62
24	2.42	2.46	2.50	2.54	2.58	2.62	2.66	2.69	2.73
25	2.52	2.56	2.60	2.64	2.68	2.72	2.77	2.81	2.85
26	2.62	2.66	2.71	2.75	2.79	2.83	2.88	2.92	2.96
27	2.72	2.77	2.81	2.85	2.90	2.94	2.99	3.03	3.07
28	2.82	2.87	2.91	2.96	3.00	3.05	3.10	3.14	3.19
29	2.92	2.97	3.02	3.06	3.11	3.16	3.21	3.25	3.30
30	3.02	3.07	3.12	3.17	3.22	3.27	3.32	3.36	3.41
31	3.12	3.17	3.22	3.27	3.32	3.37	3.43	3.48	3.53
32	3.22	3.28	3.33	3.38	3.43	3.48	3.54	3.59	3.64
33	3.32	3.38	3.43	3.48	3.54	3.59	3.64	3.70	3.75
34	3.42	3.48	3.53	3.59	3.64	3.70	3.75	3.81	3.87
35	3.52	3.58	3.64	3.69	3.75	3.81	3.86	3.92	3.98

BRASS SCALE—METRIC UNITS

Temp. °C	Observed height in millimeters								
	710	720	730	740	750	760	770	780	790
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	.12	.12	.12	.12	.12	.12	.13	.13	.13
2	.23	.24	.24	.24	.25	.25	.25	.25	.26
3	.35	.35	.36	.36	.37	.37	.38	.38	.39
4	.46	.47	.48	.48	.49	.50	.50	.51	.52
5	0.58	0.59	0.60	0.60	0.61	0.62	0.63	0.64	0.64
6	.70	.71	.71	.72	.73	.74	.75	.76	.77
7	.81	.82	.83	.85	.86	.87	.88	.89	.90
8	.93	.94	.95	.97	.98	.99	1.01	1.02	1.03
9	1.04	1.06	1.07	1.09	1.10	1.12	1.13	1.15	1.16
10	1.16	1.17	1.19	1.21	1.22	1.24	1.26	1.27	1.29
11	1.27	1.29	1.31	1.33	1.35	1.36	1.38	1.40	1.42
12	1.39	1.41	1.43	1.45	1.47	1.49	1.51	1.53	1.55
13	1.50	1.53	1.55	1.57	1.59	1.61	1.63	1.65	1.67
14	1.62	1.64	1.67	1.69	1.71	1.73	1.76	1.78	1.80
15	1.74	1.76	1.78	1.81	1.83	1.86	1.88	1.91	1.93
16	1.85	1.88	1.90	1.93	1.96	1.98	2.01	2.03	2.06
17	1.97	1.99	2.02	2.05	2.08	2.10	2.13	2.16	2.19
18	2.08	2.11	2.14	2.17	2.20	2.23	2.26	2.29	2.32
19	2.20	2.23	2.26	2.29	2.32	2.35	2.38	2.41	2.44
20	2.31	2.34	2.38	2.41	2.44	2.47	2.51	2.54	2.57
21	2.43	2.46	2.50	2.53	2.56	2.60	2.63	2.67	2.70
22	2.54	2.58	2.61	2.65	2.69	2.72	2.76	2.79	2.83
23	2.66	2.69	2.73	2.77	2.81	2.84	2.88	2.92	2.96
24	2.77	2.81	2.85	2.89	2.93	2.97	3.01	3.05	3.08
25	2.89	2.93	2.97	3.01	3.05	3.09	3.13	3.17	3.21
26	3.00	3.04	3.09	3.13	3.17	3.21	3.26	3.30	3.34
27	3.12	3.16	3.20	3.25	3.29	3.34	3.38	3.42	3.47
28	3.23	3.28	3.32	3.37	3.41	3.46	3.51	3.55	3.60
29	3.35	3.39	3.44	3.49	3.54	3.58	3.63	3.68	3.72
30	3.46	3.51	3.56	3.61	3.66	3.71	3.75	3.80	3.85
31	3.58	3.63	3.68	3.73	3.78	3.83	3.88	3.93	3.98
32	3.69	3.74	3.79	3.85	3.90	3.95	4.00	4.05	4.11
33	3.81	3.86	3.91	3.97	4.02	4.07	4.13	4.18	4.23
34	3.92	3.98	4.03	4.09	4.14	4.20	4.25	4.31	4.[illegible]6
35	4.03	4.09	4.15	4.21	4.26	4.32	4.38	4.43	4.49

Standard Temperature of scale 62° F; of mercury, 32° F. Zero correction at 28.5° F; subtract corrections above, add below. Owing to the difference in the standard temperature of English and metric scales, readings taken in inches to be reduced to centimeters should *first* be corrected for temperature.

Temp. ° F	Observed height in inches								
	23.0 in.	23.5 in.	24.0 in.	24.5 in.	25.0 in.	25.5 in.	26.0 in.	26.5 in.	27.0 in.
0	+.060	+.061	+.063	+.064	+.065	+.067	+.068	+.069	+.070
2	.056	.057	.058	.060	.061	.062	.063	.065	.065
4	.052	.053	.054	.055	.056	.057	.058	.060	.061
6	.047	.048	.049	.051	.052	.053	.054	.055	.056
8	.043	.044	.045	.046	.047	.048	.049	.050	.051
10	.039	.040	.041	.042	.042	.043	.044	.045	.046
12	.035	.036	.036	.037	.038	.039	.039	.040	.041
14	.031	.031	.032	.033	.033	.034	.035	.035	.036
16	.026	.027	.028	.028	.029	.029	.030	.031	.031
18	.022	.023	.023	.024	.024	.025	.025	.026	.026
20	.018	.018	.019	.019	.020	.020	.020	.021	.021
22	.014	.014	.014	.015	.015	.015	.016	.016	.016
24	.010	.010	.010	.010	.011	.011	.011	.011	.011
26	.005	.006	.006	.006	.006	.006	.006	.006	.006
28	+.001	+.001	+.001	+.001	+.001	+.001	+.001	+.002	+.002
30	−.003	−.003	−.003	−.003	−.003	−.003	−.003	−.003	−.003
32	.007	.007	.007	.008	.008	.008	.008	.008	008
34	.011	.011	.012	.012	.012	.012	.013	.013	.013
36	.015	.016	.016	.016	.017	.017	.017	.018	.018
38	.020	.020	.020	.021	.021	.022	.022	.023	.023
40	.024	.024	.025	.025	.026	.026	.027	.027	.028
42	.028	.029	.029	.030	.030	.031	.032	.032	.033
44	.032	.033	.033	.034	.035	.036	.036	.037	.038
46	.036	.037	.038	.039	.039	.040	.041	.042	.043
48	.040	.041	.042	.043	.044	.045	.046	.047	.047
50	.045	.046	.046	.048	.048	.050	.050	.052	.052
52	.049	.050	.051	.052	.053	.054	.055	.056	.057
54	.053	.054	.055	.057	.057	.059	.060	.061	.062
56	.057	.058	.060	.061	.062	.063	.064	.066	.067
58	.061	.063	.064	.065	.066	.068	.069	.071	.072
60	.065	.067	.068	.070	.071	.073	.074	.076	.077
62	.069	.071	.073	.074	.076	.077	.079	.080	.082
64	.074	.075	.077	.079	.080	.082	.083	.085	.086
66	.078	.079	.081	.083	.085	.087	.088	.090	.091
68	.082	.084	.085	.088	.089	.091	.093	.095	.096
70	.086	.088	.090	.092	.094	.096	.097	.100	.101
72	.090	.092	.094	.096	.098	.100	.102	.104	.106
74	.094	.096	.098	.101	.103	.105	.107	.109	.111
76	.098	.101	.103	.105	.107	.110	.111	.114	.116
78	.103	.105	.107	.110	.112	.114	.116	.119	.120
80	.107	.109	.111	.114	.116	.119	.121	.123	.125
82	.111	.113	.116	.119	.121	.123	.125	.128	.130
84	.115	.118	.120	.123	.125	.128	.130	.133	.135
86	.119	.122	.124	.127	.130	.133	.135	.138	.140
88	.123	.126	.129	.132	.134	.137	.139	.143	.145
90	.127	.130	.133	.136	.138	.142	.144	.147	.150
92	.132	.134	.137	.141	.143	.146	.149	.152	.154
94	.136	.139	.142	.145	.147	.151	.153	.157	.159
96	.140	.143	.146	.150	.152	.155	.158	.161	.164
98	.144	.147	.150	.154	.156	.160	.163	.166	.169
100	.148	.151	.154	.158	.161	.164	.167	.171	.174

Brass Scale—English Units

Temp. °F	Observed height in inches								
	27.5 in.	28.0 in.	28.5 in.	29.0 in.	29.5 in.	30.0 in.	30.5 in.	31.0 in.	31.5 in.
0	.072	.073	.075	.076	.077	.078	.080	.081	.082
2	.067	.068	.069	.070	.072	.073	.074	.075	.077
4	.062	.063	.064	.065	.066	.067	.069	.070	.071
6	.057	.058	.059	.060	.061	.062	.063	.064	.065
8	.052	.053	.054	.054	.056	.056	.057	.058	.059
10	.047	.047	.048	.049	.050	.051	.052	.053	.054
12	.042	.042	.043	.044	.045	.045	.046	.047	.048
14	.037	.037	.038	.039	.039	.040	.041	.041	.042
16	.032	.032	.033	.033	.034	.034	.035	.036	.036
18	.027	.027	.028	.028	.029	.029	.030	.030	.031
20	.022	.022	.022	.023	.023	.024	.024	.024	.025
22	.017	.017	.017	.017	.018	.018	.018	.019	.019
24	.012	.012	.012	.012	.012	.013	.013	.013	.013
26	.007	.007	.007	.007	.007	.007	.007	.007	.008
28	+.002	+.002	+.002	+.002	+.002	+.002	+.002	+.002	+.002
30	−.003	−.003	−.004	−.004	−.004	−.004	−.004	−.004	−.004
32	.008	.009	.009	.009	.009	.009	.009	.009	.010
34	.013	.014	.014	.014	.014	.015	.015	.015	.015
36	.018	.019	.019	.019	.020	.020	.020	.021	.021
38	.023	.024	.024	.025	.025	.026	.026	.026	.027
40	.028	.029	.030	.030	.031	.031	.032	.032	.033
42	.033	.034	.035	.035	.036	.036	.037	.038	.038
44	.038	.039	.040	.040	.041	.042	.043	.043	.044
46	.043	.044	.045	.046	.047	.047	.048	.049	.050
48	.048	.049	.050	.051	.052	.053	.054	.054	.055
50	.053	.054	.055	.056	.057	.058	.059	.060	.061
52	.058	.059	.061	.061	.063	.064	.065	.066	.067
54	.063	.064	.066	.067	.068	.069	.070	.071	.073
56	.068	.069	.071	.072	.073	.074	.076	.077	.078
58	.073	.074	.076	.077	.079	.080	.081	.082	.084
60	.078	.080	.081	.082	.084	.085	.087	.088	.090
62	.083	.085	.086	.088	.089	.091	.092	.094	.095
64	.088	.090	.092	.093	.095	.096	.098	.099	.101
66	.093	.095	.097	.098	.100	.101	.103	.105	.107
68	.098	.100	.102	.103	.105	.107	.109	.110	.113
70	.103	.105	.107	.109	.111	.112	.115	.116	.118
72	.108	.110	.112	.114	.116	.118	.120	.122	.124
74	.113	.115	.117	.119	.121	.123	.126	.127	.130
76	.118	.120	.122	.124	.127	.128	.131	.133	.135
78	.123	.125	.128	.129	.132	.134	.137	.138	.141
80	.128	.130	.133	.135	.137	.139	.142	.144	.147
82	.133	.135	.138	.140	.143	.145	.148	.149	.152
84	.138	.140	.143	.145	.148	.150	.153	.155	.158
86	.143	.145	.148	.150	.153	.155	.159	.161	.164
88	.148	.150	.153	.155	.159	.161	.164	.166	.169
90	.153	.155	.158	.161	.164	.166	.170	.172	.175
92	.158	.160	.163	.166	.169	.172	.175	.177	.181
94	.163	.165	.169	.171	.175	.177	.180	.183	.186
96	.168	.170	.174	.176	.180	.182	.186	.188	.192
98	.172	.175	.179	.181	.185	.188	.191	.194	.197
100	.177	.180	.184	.187	.190	.193	.197	.200	.203

TEMPERATURE CORRECTION, GLASS SCALE

Metric

To reduce readings of a mercurial barometer with a glass scale to 0° C. subtract the appropriate quantity as found in table.

Temp. ° C.	Observed height in centimeters.								
	70 cm.	71 cm.	72 cm.	73 cm.	74 cm.	75 cm.	76 cm.	77 cm.	78 cm.
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	.012	.012	.013	.013	.013	.013	.013	.013	.014
2	.025	.025	.025	.026	.026	.026	.026	.027	.027
3	.036	.036	.037	.037	.038	.038	.039	.039	.040
4	.048	.049	.049	.050	.051	.051	.052	.053	.053
5	0.060	0.061	0.062	0.063	0.064	0.064	0.065	0.066	0.067
6	.073	.074	.074	.076	.077	.077	.078	.079	.080
7	.085	.086	.087	.088	.089	.091	.092	.093	.094
8	.096	.098	.099	.100	.101	.103	.104	.105	.107
9	.109	.110	.111	.113	.114	.116	.117	.119	.120
10	0.121	0.122	0.124	0.126	0.127	0.129	0.130	0.132	0.134
11	.133	.135	.137	.138	.140	.142	.144	.146	.147
12	.144	.146	.148	.150	.152	.154	.156	.158	.160
13	.157	.159	.161	.163	.165	.167	.169	.171	.174
14	.169	.171	.174	.176	.178	.180	.183	.185	.187
15	0.181	0.184	0.186	0.189	0.191	0.193	0.196	0.198	0.201
16	.194	.196	.199	.201	.204	.207	.209	.212	.214
17	.205	.208	.210	.213	.216	.219	.221	.224	.227
18	.217	.220	.223	.226	.229	.232	.235	.238	.241
19	.230	.233	.236	.239	.242	.245	.248	.251	.254
20	0.242	0.245	0.248	0.252	0.255	0.258	0.261	0.264	0.268
21	.254	.258	.261	.264	.268	.271	.275	.278	.281
22	.266	.269	.273	.276	.280	.283	.287	.290	.294
23	.278	.282	.285	.289	.293	.296	.300	.304	.308
24	.290	.294	.298	.302	.306	.310	.313	.317	.321
25	0.303	0.307	0.311	0.315	0.319	0.323	0.327	0.331	0.335
26	.315	.319	.323	.327	.332	.336	.340	.344	.348
27	.326	.331	.335	.339	.344	.348	.352	.357	.361
28	.339	.343	.348	.352	.357	.361	.366	.370	.375
29	.351	.356	.360	.365	.370	.374	.379	.384	.388
30	0.363	0.368	0.373	0.378	0.383	0.387	0.392	0.397	0.402

MASS OF WATER VAPOR IN SATURATED AIR

Mass in grams per cubic meter.

(From Smithsonian Tables.)

Temp. ° C.	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
−20	0.892	0.810	0.737	0.673	0.613	0.557	0.505	0.457	0.413	0.373
−10	2.154	1.978	1.811	1.658	1.519	1.395	1.282	1.177	1.079	0.982
− 0	4.835	4.468	4.130	3.813	3.518	3.244	2.988	2.752	2.537	2.340
+ 0	4.835	5.176	5.538	5.922	6.330	6.761	7.219	7.703	8.215	8.757
10	9.330	9.935	10.574	11.249	11.961	12.712	13.505	14.339	15.218	16.144
20	17.118	18.143	19.222	20.355	21.546	22.796	24.109	25.487	26.933	28.450
30	30.039	31.704	33.449	35.275	37.187	39.187	41.279	43.465	45.751	48.138

REDUCTION OF BAROMETER TO SEA LEVEL

The correction to be added to reduce barometric readings to "sea level" values depends principally on three factors: The temperature of the air column (assumed) from the station to sea level, the altitude of the station, and the value of the reading itself. Two tables are provided. Table I is entered with the altitude and assumed temperature and a factor "2000 m" taken out. Table II is entered with the above factor and the approximate barometer reading and the final correction taken out.

The correction is to be added. If B_0 is the corrected or sea level value; B the barometer reading at the station; C the correction,—

$$C = B_0 - B = B\,(10^m - 1)$$

The actual barometer reading at the station should be corrected for temperature of the mercury column by the usual methods before entering the tables or applying the sea level correction.

A complete explanation of the theory of the corrections and a more extended set of tables will be found in the Smithsonian Meteorological Tables.

Latitude Factor

The influence of the latitude on the value of the correction is usually negligible, being overshadowed by uncertainties in the assumed temperature of the air column. For cases where this correction is desirable the table below is provided. The value of the temperature-altitude factor "2000 m" obtained in Table I is corrected for latitude by subtracting for latitudes 0-45° and adding for latitudes from 45-90° the values found. With this corrected value of "2000 m" Table II is entered for the value of the correction.

LATITUDE FACTOR

To be used in connection with Tables I and II, either English or metric units, to obtain latitude corrections to temperature-altitude factor. For latitudes 0-45° subtract the correction. For latitudes 45-90° add the correction.

Temp.—Alt. from Table I	Latitude			
	0°	15°	30°	45°
100	0.3	0.2	0.1	0.0
200	0.5	0.5	0.3	0.0
300	0.8	0.7	0.4	0.0
	90°	75°	60°	45°

METRIC UNITS—TABLE I

Values of the temperature-altitude factor (2000 m.) for entering table II.

Altitude in meters	Assumed temperature of air column °C									
	−16°	−8°	0°	+4°	+8°	+12°	+16°	+20°	+24°	+28°
10	1.2	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0
50	5.8	5.6	5.4	5.3	5.2	5.2	5.1	5.0	4.9	4.9
100	11.5	11.2	10.8	10.7	10.5	10.3	10.2	10.0	9.9	9.7
150	17.3	16.7	16.2	16.0	15.7	15.5	15.3	15.0	14.8	14.6
200	23.0	22.3	21.6	21.3	21.0	20.7	20.3	20.0	19.7	19.5
250	28.8	27.9	27.0	26.6	26.2	25.8	25.4	25.0	24.7	24.3
300	34.5	33.5	32.5	32.0	31.5	31.0	30.5	30.1	29.6	29.2
350	40.3	39.0	37.9	37.3	36.7	36.2	35.6	35.1	34.6	34.0
400	46.0	44.6	43.3	42.6	42.0	41.3	40.7	40.1	39.5	38.9
450	51.8	50.2	48.7	47.9	47.2	46.5	45.8	45.1	44.4	43.8
500	57.5	55.8	54.1	53.3	52.4	51.6	50.9	50.1	49.4	48.6
550	63.3	61.4	59.5	58.6	57.7	56.8	55.9	55.1	54.3	53.5
600	69.0	66.9	64.9	63.9	62.9	62.0	61.0	60.1	59.2	58.3
650	74.8	72.5	70.3	69.2	68.2	67.1	66.1	65.1	64.2	63.2
700	80.6	78.1	75.7	74.6	73.4	72.3	71.2	70.1	69.1	68.1
750	86.3	83.7	81.1	79.9	78.7	77.5	76.3	75.1	74.0	72.9
800	92.1	89.2	86.5	85.2	83.9	82.6	81.4	80.1	79.0	77.8
850	97.8	94.8	92.0	90.5	89.2	87.8	86.4	85.2	83.9	82.7
900	103.6	100.4	97.4	95.9	94.4	93.0	91.5	90.2	88.8	87.5
950	109.3	106.0	102.8	101.2	99.6	98.1	96.6	95.2	93.8	92.4
1000	115.1	111.5	108.2	106.5	104.9	103.3	101.7	100.2	98.7	97.3
1050	120.8	117.1	113.6	111.8	110.1	108.4	106.8	105.2	103.6	102.1
1100	126.6	122.7	119.0	117.2	115.4	113.6	111.9	110.2	108.6	107.0
1150	132.3	128.3	124.4	122.5	120.6	118.8	117.0	115.2	113.5	111.8
1200	138.1	133.8	129.8	127.8	125.9	123.9	122.0	120.2	118.4	116.7
1250	143.8	139.4	135.2	133.1	131.1	129.1	127.1	125.2	123.4	121.6
1300	149.6	145.0	140.6	138.5	136.3	134.3	132.2	130.2	128.3	126.4
1350	155.3	150.6	146.0	143.8	141.6	139.4	137.3	135.2	133.2	131.3
1400	161.1	156.2	151.4	149.1	146.8	144.6	142.4	140.2	138.2	136.2
1450	166.8	161.7	156.8	154.5	152.1	149.7	147.[illegible]	145.3	143.1	141.0
1500	172.6	167.3	162.3	159.8	157.3	154.9	152.5	150.3	148.0	145.9
1550	178.3	172.9	167.7	165.1	162.6	160.1	157.6	155.3	153.0	150.7
1600	184.1	178.5	173.1	170.4	167.[illegible]	165.2	162.7	160.3	157.9	155.6
1650	189.8	184.0	178.5	175.7	173.0	170.4	167.8	165.3	162.8	160.5
1700	195.6	189.6	183.9	181.1	178.3	175.6	172.9	170.3	167.8	165.3
1750	201.4	195.2	189.3	186.4	183.5	180.7	178.0	175.3	172.7	170.2
1800	207.1	200.8	194.7	191.7	188.8	135.9	183.1	180.3	177.6	175.0
1850	212.9	206.3	200.1	197.0	194.0	191.0	188.1	185.3	182.6	17[illegible].9
1900	218.6	211.9	205.5	202.4	199.3	196.2	193.2	190.3	187.5	184.8
1950	224.4	217.5	210.9	207.7	204.5	201.4	198.3	195.3	192.4	189.6
2000	230.1	223.0	216.3	213.0	209.7	206.5	203.4	200.3	197.4	194.5
2050	235.9	228.6	221.7	218.3	215.0	211.7	208.5	205.3	202.3	199.3
2100	241.6	234.2	227.1	223.7	220.2	216.3	213.5	210.4	207.2	204.2
2150	247.4	239.8	232.5	229.0	225.5	222.0	218.6	215.4	212.2	209.1
2200	253.1	245.4	237.9	234.3	230.7	227.2	223.7	220.4	217.1	213.9
2250	258.9	250.9	243.4	239.6	235.9	232.3	228.8	225.4	222.0	218.8
2300	264.6	256.5	248.8	245.0	241.2	237.5	233.9	230.4	227.0	223.6
2350	270.4	262.1	254.2	250.3	246.4	242.7	239.0	235.4	231.9	228.5
2400	276.1	267.7	259.6	255.6	251.7	247.8	244.0	240.4	236.8	233.4
2450	281.9	273.2	265.0	260.9	256.9	253.0	249.1	245.4	241.8	238.2
2500	287.6	278.8	270.4	266.2	262.2	258.1	254.2	250.4	246.7	243.1
2550	293.4	284.4	275.8	271.6	267.4	263.[illegible]	259.3	255.4	251.6	247.9
2600	299.1	290.0	281.2	276.9	272.6	268.5	264.4	260.4	256.6	252.8
2650	304.9	295.5	286.6	282.2	277.9	273.6	269.5	265.4	261.5	257.7
2700	310.6	301.1	292.0	287.5	283.1	278.8	274.5	270.4	266.4	262.5
2750	316.4	306.7	297.4	292.9	288.4	283.9	279.6	275.4	271.4	267.4
2800	322.1	312.3	302.8	298.2	293.6	289.1	284.7	280.4	276.3	272.2
2850	327.9	317.8	308.2	303.5	298.8	294.3	289.8	285.4	281.2	277.1
2900	333.6	323.4	313.6	308.8	304.1	299.4	294.9	290.4	286.2	282.0
2950	339.4	329.0	319.0	314.2	309.3	304.6	299.9	295.5	291.1	286.8
3000	345.1	334.5	324.4	319.5	314.6	309.7	305.0	300.5	296.0	291.7

METRIC UNITS—TABLE II

Values of Correction to be Added

Temp.—alt.—factor	Barometer reading 780 mm	760 mm	740 mm	720 mm	700 mm	
1	0.9	0.9	0.9	0.8	0.8	
5	4.5	4.4	4.3	4.2	4.0	
10	9.0	8.8	8.6	8.3	8.1	
15	13.6	13.2	12.9	12.5	12.2	
20	18.2	17.7	17.2	16.8	16.3	
25	22.8	22.2	21.6	21.0	20.4	
30	27.4	26.7	26.0	25.3	24.6	
35	.....	31.2	30.4	29.6	28.8	
	760 mm	**740 mm**	**720 mm**	**700 mm**	**680 mm**	**660 mm**
40	35.8	34.9	33.9	33.0	32.0	31.1
45	40.4	39.3	38.3	37.2	36.2	35.1
50	45.0	43.8	42.7	41.5	40.3	39.1
55	49.7	48.4	47.1	45.8	44.5	43.1
60	.....	52.9	51.5	50.1	48.6	47.2
65	.....	57.5	55.9	54.4	52.8	51.3
70	.....	62.1	60.4	58.7	57.1	55.4
75	.....	66.7	64.9	63.1	61.3	59.5
	720 mm	**700 mm**	**680 mm**	**660 mm**	**640 mm**	
80	69.5	67.5	65.6	63.7	61.7	
85	74.0	72.0	69.9	67.9	65.8	
90	78.6	76.4	74.2	72.1	69.9	
95	83.2	80.9	78.6	76.3	74.0	
100	87.9	85.4	83.0	80.5	78.1	
105	.....	89.9	87.4	84.8	82.2	
110	.....	94.5	91.8	89.1	86.4	
115	.....	99.1	96.3	93.4	90.6	
120	.....	103.7	100.7	97.8	94.8	
125	.....	108.3	105.3	102.2	99.1	
	680 mm	**660 mm**	**640 mm**	**620 mm**	**600 mm**	
125	105.3	102.2	99.1	96.0	92.9	
130	109.8	106.6	103.3	100.1	96.9	
135	114.3	111.0	107.6	104.3	100.9	
140	118.9	115.4	111.9	108.4	104.9	
145	123.5	119.9	116.2	112.6	109.0	
150	128.2	124.4	120.6	116.9	113.1	
155	.....	128.9	125.0	121.1	117.2	
160	.....	133.5	129.4	125.4	121.4	
165	.....	138.1	133.9	129.7	125.5	
170	.....	142.7	138.4	134.0	129.7	

Temp.—alt.—factor	Barometer reading 640 mm	620 mm	600 mm	580 mm	560 mm
170	138.4	134.0	129.7	125.4	121.1
175	142.9	138.4	133.9	129.5	125.0
180	147.4	142.8	138.2	133.6	129.0
185	151.9	147.2	142.4	137.7	132.9
190	156.5	151.6	146.7	141.8	136.9
195	161.1	156.1	151.0	146.0	141.0
200	165.7	160.5	155.4	150.2	145.0
205	170.4	165.0	159.7	154.4	149.1
210	.....	169.6	164.1	158.6	153.2
215	.....	174.1	168.5	162.9	157.3
	620 mm	**600 mm**	**580 mm**	**560 mm**	**540 mm**
215	174.1	168.5	162.9	157.3	151.7
220	178.7	172.9	167.2	161.4	155.7
225	183.3	177.4	171.5	165.6	159.7
230	188.0	181.9	175.8	169.8	163.7
235	192.6	186.4	180.2	174.0	167.8
240	.....	191.0	184.6	178.2	171.9
245	.....	195.5	189.0	182.5	176.0
250	.....	200.1	193.4	186.8	180.1
255	.....	204.7	197.9	191.1	184.3
260	.....	209.4	202.4	195.4	188.4
	580 mm	**560 mm**	**540 mm**	**520 mm**	
260	202.4	195.4	188.4	181.5	
265	206.9	199.8	192.6	185.5	
270	211.5	204.2	196.9	189.6	
275	216.0	208.6	201.1	193.7	
280	220.6	213.0	205.4	197.8	
285	225.2	217.5	209.7	201.9	
290	229.9	222.0	214.0	206.1	
295	.....	226.5	218.4	210.3	
300	.....	231.0	222.8	214.5	
	560 mm	**540 mm**	**520 mm**	**500 mm**	**480 mm**
305	235.6	227.2	218.8	210.3	201.9
310	240.2	231.6	223.0	214.4	205.9
315	244.8	236.0	227.3	218.6	209.8
320	249.4	240.5	231.6	222.7	213.8
325	254.1	245.0	236.0	226.9	217.8
330	.....	249.6	240.3	231.1	221.8
335	.....	254.1	244.7	235.3	225.9
340	.....	258.7	249.1	239.6	230.0
345	.....	263.3	253.6	243.8	234.1

ENGLISH UNITS—TABLE I

Values of the temperature-altitude factor (2000 m.) for entering table II.

Altitude feet	Assumed temperature of air column °F									
	−20	0	+10	+20	+30	+40	+50	+60	+70	+80
200	7.4	7.1	6.9	6.8	6.6	6.5	6.3	6.2	6.1	6.0
400	14.8	14.1	13.8	13.5	13.2	13.0	12.7	12.4	12.2	11.9
600	22.2	21.2	20.7	20.3	19.9	19.5	19.0	18.6	18.2	17.9
800	29.6	28.3	27.7	27.1	26.5	25.9	25.4	24.8	24.3	23.8
1000	37.0	35.3	34.6	33.8	33.1	32.4	31.7	31.1	30.4	29.8
1200	44.3	42.4	41.5	40.6	39.7	38.9	38.1	37.3	36.5	35.8
1400	51.7	49.5	48.4	47.4	46.4	45.4	44.4	43.5	42.6	41.7
1600	59.1	56.5	55.3	54.1	53.0	51.9	50.8	49.7	48.7	47.7
1800	66.5	63.6	62.2	60.9	59.6	58.4	57.1	55.9	54.7	53.6
2000	73.9	70.6	69.1	67.7	66.2	64.8	63.4	62.1	60.8	59.6
2200	81.3	77.7	76.0	74.4	72.9	71.3	69.8	68.3	66.9	65.5
2400	88.7	84.8	82.9	81.2	79.5	77.8	76.1	74.5	73.0	71.5
2600	96.1	91.8	89.9	87.9	86.1	84.3	82.5	80.7	79.1	77.5
2800	103.5	98.9	96.8	94.7	92.7	90.8	88.8	87.0	85.1	83.4
3000	110.9	106.0	103.7	101.5	99.3	97.2	95.2	93.2	91.2	89.4
3200	118.2	113.0	110.6	108.2	106.0	103.7	101.5	99.4	97.3	95.3
3400	125.6	120.1	117.5	115.0	112.6	110.2	107.9	105.6	103.4	101.3
3600	133.0	127.2	124.4	121.8	119.2	116.7	114.2	111.8	109.5	107.2
3800	140.4	134.2	131.3	128.5	125.8	123.2	120.5	118.0	115.5	113.2
4000	147.8	141.3	138.2	135.3	132.4	129.6	126.9	124.2	121.6	119.2
4200	155.2	148.3	145.1	142.1	139.1	136.1	133.2	130.4	127.7	125.1
4400	162.6	155.4	152.0	148.8	145.7	142.6	139.6	136.6	133.8	131.1
4600	170.0	162.5	159.0	155.6	152.3	149.1	145.9	142.8	139.9	137.0
4800	177.3	169.5	165.9	162.3	158.9	155.6	152.2	149.0	145.9	143.0
5000	184.7	176.6	172.8	169.1	165.6	162.0	158.6	155.2	152.0	148.9
5200	192.1	183.7	179.7	175.9	172.2	168.5	164.9	161.5	158.1	154.9
5400	199.5	190.7	186.6	182.6	178.8	175.0	171.3	167.7	164.2	160.8
5600	206.9	197.8	193.5	189.4	185.4	181.5	177.6	173.9	170.3	166.8
5800	214.3	204.8	200.4	196.2	192.0	188.0	184.0	180.1	176.3	172.8
6000	221.7	211.9	207.3	202.9	198.7	194.4	190.3	186.3	182.4	178.7
6200	229.1	219.0	214.2	209.7	205.3	200.9	196.6	192.5	188.5	184.7
6400	236.4	226.0	221.1	216.4	211.9	207.4	203.0	198.7	194.6	190.6
6600	243.8	233.1	228.0	223.2	218.5	213.9	209.3	204.9	200.7	196.6
6800	251.2	240.1	235.0	230.0	225.1	220.4	215.7	211.1	206.7	202.5
7000	258.6	247.2	241.9	236.7	231.8	226.8	222.0	217.3	212.8	208.5
7200	266.0	254.3	248.8	243.5	238.4	233.3	228.4	223.5	218.9	214.4
7400	273.4	261.3	255.7	250.2	245.0	239.8	234.7	229.7	225.0	220.4
7600	280.8	268.4	262.6	257.0	251.6	246.3	241.0	235.9	231.1	226.4
7800	288.1	275.4	269.5	263.8	258.2	252.8	247.4	242.2	237.1	232.3
8000	295.5	282.5	276.4	270.5	264.8	259.2	253.7	248.4	243.2	238.3
8200	302.9	289.6	283.3	277.3	271.5	265.7	260.1	254.6	249.3	244.2
8400	310.3	296.6	290.2	284.0	278.1	272.2	266.4	260.8	255.4	250.2
8600	317.7	303.7	297.1	290.8	284.7	278.7	272.7	267.0	261.4	256.1
8800	325.1	310.7	304.0	297.6	291.3	285.2	279.1	273.2	267.5	262.1
9000	332.5	317.8	310.9	304.3	297.9	291.6	285.4	279.4	273.6	268.0

ENGLISH UNITS—TABLE II

Value of Correction to be Added.

Temp. alt. factor	Barometer reading					Temp. alt. factor	Barometer reading				
	31	30	29	28	27		26	25	24	23	22
	in.	in.	in.	in.	in.		in.	in.	in.	in.	in.
1	0.04	0.03	0.03	.....	.....	165	5.44	5.23	5.02		
5	0.18	0.17	0.17	.....	.....	170	5.62	5.40	5.19		
10	0.36	0.35	0.34	0.32	.....	175	.....	5.58	5.36		
15	0.54	0.52	0.51	0.49	.....	180	.....	5.76	5.53	5.30	
20	0.72	0.70	0.68	0.65	.....	185	.....	5.93	5.70	5.46	
25	.....	0.88	0.85	0.82	.....	190	.....	6.11	5.87	5.62	
30	.....	1.05	1.02	0.98	.....	195	.....	6.29	6.04	5.79	
35	.....	1.23	1.19	1.15	.....	200	.....	6.47	6.21	5.96	
40	.....	1.41	1.37	1.32	1.27	205	.....	.....	6.39	6.12	
45	.....	1.60	1.54	1.49	1.44	210	.....	.....	6.56	6.29	
50	.....	.....	1.72	1.66	1.60	215	.....	.....	6.74	6.46	
55	.....	.....	1.90	1.83	1.76	220	.....	.....	6.92	6.63	6.34
60	.....	.....	2.07	2.00	1.93	225	.....	.....	7.10	6.80	6.51
65	.....	.....	2.25	2.18	2.10	230	.....	.....	7.28	6.97	6.67
70	.....	.....	2.43	2.35	2.27	235	.....	.....	7.46	7.15	6.84
75	.....	.....	.....	2.53	2.43	240	.....	.....	.....	7.32	7.00
80	.....	.....	.....	2.70	2.60	245	.....	.....	.....	7.49	7 17
	28	27	26	25	24		23	22	21	20	
	in.	in.	in.	in.	in.		in.	in.	in.	in.	
75	2.53	2.43	2.34	.....	.....	250	7.67	7.34			
80	2.70	2.60	2.51	.....	.....	255	7.85	7.51			
85	2.88	2.78	2.67	.....	.....	260	8.03	7.68	7.33		
90	3.06	2.95	2.84	.....	.....	265	8.21	7.85	7.49		
95	3.24	3.12	3.01	.....	.....	270	8.39	8.02	7.66		
100	3.42	3.29	3.17	.....	.....	275	8.57	8.19	7.82		
105	3.60	3.47	3.34	3.21	.....	280	.....	8.37	7.99		
110	.....	3.65	3.51	3.38	.....	285	.....	8.54	8.16		
115	.....	3.82	3.68	3.54	.....	290	.....	8.72	8.32		
120	.....	4.00	3.85	3.70	.....	295	.....	8.90	8.49	8.09	
125	.....	4.18	4.02	3.87	.....	300	.....	9.08	8.66	8.25	
130	.....	4.36	4.20	4.04	.....	305	.....	9.26	8.83	8.41	
135	.....	4.54	4.37	4.20	.....	310	.....	9.44	9.01	8.58	
140	.....	.....	4.55	4.37	4.20	315	.....	9.62	9.18	8.74	
145			4.72	4.54	4.36	320	.....	9.80	9.35	8.91	
150			4.90	4.71	4.52	325	.....	.....	9.53	9.08	
155	.....	.....	5.08	4.88	4.69	330	.....	.....	9.71	9.24	
160	.....	.....	5.26	5.06	4.85						

REDUCTION OF BAROMETER TO GRAVITY AT SEA LEVEL

Metric Units

Correction to be subtracted given in millimeters

(From Smithsonian Physical Tables)

Height above sea level in meters	Observed Height of Barometer in Millimeters						
	500	550	600	650	700	750	800
100	.....	.....	.....	.....	.02	.02	.02
200	.....	.....	.....	.....	.04	.05	.05
300	.....	.....	.....	.....	.07	.07	.07
400	.....	.....	.....	.....	.09	.10	.10
500	.....	.....	.....	.....	.11	.12	.13
600	.....	.....	.....	.12	.13	.14	
700	.....	.....	.....	.14	.15	.16	
800	.....	.....	.....	.16	.18	.19	
900	.....	.....	.....	.18	.20	.22	
1000	.....	.18	.19	.20	.22	.24	
1100	.....	.19	.21	.22	.24		
1200	.....	.21	.23	.24	.26		
1300	.....	.22	.24	.26	.29		
1400	.....	.24	.26	.28	.31		
1500	.24	.26	.28	.30	.33		
1600	.25	.28	.30	.32			
1700	.27	.30	.32	.34			
1800	.28	.31	.34	.36			
1900	.30	.33	.36	.39			
2000	.31	.34	.38	.41			
2100	.33	.36	.40				
2200	.35	.38	.41				
2300	.36	.40	.43				
2400	.38	.42	.45				
2500	.39	.43	.47				

English Units

Height above sea level in feet	Observed Height in Inches						
	18	20	22	24	26	28	30
1000	.....	.....	.....	.....	.003	.003	.003
2000	.....	.....	.....	.004	.005	.005	.006
3000	.....	.....	.007	.007	.008	.008	
4000	.....	.....	.009	.009	.010		
4500	.....	.....	.010	.010	.011		
5000	.....	.010	.011	.011	.012		
5500	.....	.011	.012	.013			
6000	.....	.011	.013	.014			
6500	.011	.012	.014	.015			
7000	.012	.013	.015	.016			
7500	.013	.014	.016	.017			
8000	.014	.015	.017				
8500	.015	.016	.018				
9000	.016	.017	.019				
9500	.016	.018	.020				

REDUCTION OF BAROMETER TO LATITUDE 45°

METRIC SCALE

For latitudes below 45°, subtract the correction; for latitudes greater than 45° it is to be added. Corrections in cm.

(From Smithsonian Meteorological Tables.)

Latitude		Observed Height of Barometer in Centimeters					
		68	70	72	74	76	78
25°	65°	0.116	0.120	0.123	0.127	0.130	0.133
26	64	.111	.115	.118	.121	.125	.128
27	63	.106	.110	.113	.116	.119	.122
28	62	.101	.104	.107	.110	.113	.116
29	61	.096	.099	.102	.104	.107	.110
30	60	0.091	0.094	0.096	0.098	0.101	0.104
31	59	.085	.087	.090	.092	.095	.097
32	58	.079	.082	.084	.086	.089	.091
33	57	.074	.076	.078	.080	.082	.084
34	56	.068	.070	.072	.074	.076	.078
35	55	0.062	0.064	0.066	0.067	0.069	0.071
36	54	.056	.058	.059	.061	.063	.064
37	53	.050	.051	.053	.054	.056	.057
38	52	.044	.045	.046	.048	.049	.050
39	51	.038	.039	.040	.041	.042	.043
40	50	0.031	0.032	0.033	0.034	0.035	0.036
41	49	.025	.026	.027	.027	.028	.029
42	48	.019	.019	.020	.021	.021	.022
43	47	.013	.013	.013	.014	.014	.014
44	46	.006	.007	.007	.007	.007	.007

ENGLISH SCALE

Corrections in inches.

Latitude		Observed Height in Inches					
		25	26	27	28	29	30
25°	65°	0.043	0.044	0.046	0.048	0.050	0.051
26	64	.041	.043	.044	.046	.048	.049
27	63	.039	.041	.042	.044	.045	.047
28	62	.037	.039	.040	.042	.043	.045
29	61	.035	.037	.038	.039	.041	.042
30	60	0.033	0.035	0.036	0.037	0.039	0.040
31	59	.031	.032	.034	.035	.036	.037
32	58	.029	.030	.032	.033	.034	.035
33	57	.027	.028	.029	.030	.031	.032
34	56	.025	.026	.027	.028	.029	.030
35	55	0.023	0.024	0.025	0.025	0.026	0.027
36	54	.021	.021	.022	.023	.024	.025
37	53	.018	.019	.020	.021	.021	.022
38	52	.016	.017	.017	.018	.019	.019
39	51	.014	.014	.015	.015	.016	.017
40	50	0.012	0.012	0.012	0.013	0.013	0.014
41	49	.009	.010	.010	.010	.011	.011
42	48	.007	.007	.008	.008	.008	.008
43	47	.005	.005	.005	.005	.005	.006
44	46	.002	.002	.003	.003	.003	.003

RELATIVE HUMIDITY—DEW-POINT

The table gives the relative humidity of the air for temperature *t* and dew-point *d*.

(From Smithsonian Meteorological Tables.)

Depression of dew-point $t-d$ ° C.	Dew-point (d).				
	−10	0	+10	+20	+30
0.0	100%	100%	100%	100%	100%
0.2	98	99	99	99	99
0.4	97	97	97	98	98
0.6	95	96	96	96	97
0.8	94	94	95	95	96
1.0	92	93	94	94	94
1.2	91	92	92	93	93
1.4	90	90	91	92	92
1.6	88	89	90	91	91
1.8	87	88	89	90	90
2.0	86	87	88	88	89
2.2	84	85	86	87	88
2.4	83	84	85	86	87
2.6	82	83	84	85	86
2.8	80	82	83	84	85
3.0	79	81	82	83	84
3.2	78	80	81	82	83
3.4	77	79	80	81	82
3.6	76	77	79	80	82
3.8	75	76	78	79	81
4.0	73	75	77	78	80
4.2	72	74	76	77	79
4.4	71	73	75	77	78
4.6	70	72	74	76	77
4.8	69	71	73	75	76
5.0	68	70	72	74	75
5.2	67	69	71	73	75
5.4	66	68	70	72	74
5.6	65	67	69	71	73
5.8	64	66	69	70	72
6.0	63	66	68	70	71
6.2	62	65	67	69	71
6.4	61	64	66	68	70
6.6	60	63	65	67	69
6.8	60	62	64	66	68
7.0	59	61	63	66	68
7.2	58	60	63	65	67
7.4	57	60	62	64	66
7.6	56	59	61	63	65
7.8	55	58	60	63	65

RELATIVE HUMIDITY—DEW-POINT (Continued)

Depression of dew-point $t-d$ ° C.	Dew-point (d).				
	−10	0	+10	+20	+30
8.0	54	57	60	62	64
8.2	54	56	59	61	63
8.4	53	56	58	60	63
8.6	52	55	57	60	62
8.8	51	54	57	59	61
9.0	51	53	56	58	61
9.2	50	53	55	58	60
9.4	49	52	55	57	59
9.6	48	51	54	56	59
9.8	48	51	53	56	58
10.0	47	50	53	55	57
10.5	45	48	51	54	
11.0	44	47	49	52	
11.5	42	45	48	51	
12.0	41	44	47	49	
12.5	39	42	45	48	
13.0	38	41	44	46	
13.5	37	40	43	45	
14.0	35	38	41	44	
14.5	34	37	40	43	
15.0	33	36	39	42	
15.5	32	35	38	40	
16.0	31	34	37	39	
16.5	30	33	36	38	
17.0	29	32	35	37	
17.5	28	31	34	36	
18.0	27	30	33	35	
18.5	26	29	32	34	
19.0	25	28	31	33	
19.5	24	27	30	33	
20.0	24	26	29	32	
21.0	22	25	27		
22.0	21	23	26		
23.0	19	22	24		
24.0	18	21	23		
25.0	17	19	22		
26.0	16	18	21		
27.0	15	17	20		
28.0	14	16	19		
29.0	13	15	18		
30.0	12	14	17		

REDUCTION OF PSYCHROMETRIC OBSERVATION

For the reduction of observations with the wet and dry bulb thermometer. Assuming the relative velocity of the air to the thermometer bulbs is at least three meters per second; if t is the temperature of the air as indicated by the dry bulb, t_w, the temperature of the wet bulb, B, the barometric pressure, and E_w, the vapor tension of water corresponding to t_w, then the actual vapor tension is

$$E = E_w - 0.00066B(t - t_w)[1 + 0.00115(t - t_w)].$$

The value of the term

$$0.00066B(t - t_w)[1 + 0.00115(t - t_w)]$$

is given in the following table.

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

$t - t_w$	Barometric Pressure B in Centimeters							
	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0
°C	cm	cm	cm	cm	cm	cm	cm	cm
1	0.047	0.048	0.048	0.049	0.050	0.050	0.051	0.052
2	.093	.094	.096	.097	.098	.100	.101	.103
3	.139	.141	.143	.145	.147	.149	.152	.154
4	.186	.189	.191	.194	.197	.199	.202	.204
5	0.232	0.236	0.239	0.243	0.246	0.249	0.252	0.256
6	.279	.283	.287	.291	.295	.299	.303	.307
7	.326	.331	.336	.340	.345	.350	.354	.359
8	.373	.379	.384	.389	.395	.400	.405	.411
9	.421	.427	.432	.438	.444	.450	.456	.462
10	0.468	0.474	0.481	0.488	0.494	0.501	0.508	0.515
11	.515	.522	.530	.537	.544	.551	.559	.566
12	.562	.570	.578	.586	.594	.602	.611	.619
13	.610	.618	.627	.636	.645	.653	.662	.671
14	.658	.667	.676	.686	.695	.705	.714	.723
15	0.706	0.716	0.726	0.736	0.746	0.756	0.766	0.776
16	.754	.764	.775	.786	.796	.807	.818	.829
17	.802	.813	.824	.836	.847	.859	.870	.882
18	.850	.862	.874	.886	.898	.910	.922	.935
19	.898	.911	.923	.936	.949	.962	.975	.987
20	0.946	0.960	0.973	0.987	1.000	1.014	1.027	1.041

RELATIVE HUMIDITY

Approximate Relative Humidity from Wet and Dry Thermometer Reading

This table gives the relative humidity direct from the difference between the reading of the dry ($t°$ C.) and the wet ($t_1°$ C.) thermometer. It is computed for a barometer reading of 76 cm. The wet thermometer should be ventilated about 3 meters per second. From Smithsonian Tables

$t°$	Depression of wet-bulb thermometer, $t° - t_1°$																
	0.2°	0.4°	0.6°	0.8°	1.0°	1.2°	1.4°	1.6°	1.8°	2.0°	2.5°	3.0°	3.5°	4.0°	4.5°	5.0°	5.5°
−15	90	91	72	62	53	44	35	25	16	7	..	..	..	..	..	..	..
−12	92	85	77	69	62	54	47	39	32	25	7	..	..	..	..	..	..
−9	94	88	81	75	70	62	56	50	44	39	23	9	..	..	..	..	..
−6	95	89	85	80	74	69	54	59	54	49	36	25	13	2	..	..	..
−3	96	91	87	82	78	74	69	66	61	57	46	36	26	17	7	..	..
0	96	92	89	85	81	78	74	71	67	64	55	46	38	29	21	13	6
+3	97	94	91	87	84	81	78	75	72	69	62	54	46	40	32	25	18
	0.5°	1.0°	1.5°	2.0°	2.5°	3.0°	3.5°	4.0°	4.5°	5.0°	6.0°	7.0°	8.0°	9.0°	10°	11°	12°
+3	92	84	76	69	62	54	46	40	32	25	12	..	..	..	..	..	..
+6	94	87	80	73	66	60	54	47	41	35	23	11	..	..	..	..	..
+9	94	88	82	76	70	65	59	53	48	42	32	22	12	3	..	..	..
+12	94	89	84	78	73	68	63	58	53	48	38	30	21	12	4	..	..
+15	95	90	85	80	76	71	66	62	58	53	44	36	28	20	13	4	..
+18	95	90	86	82	78	73	69	65	61	57	49	42	35	27	20	13	6
+21	96	91	87	83	79	75	71	67	64	60	53	46	39	32	26	19	13
+24	96	92	88	85	81	77	74	70	66	63	56	49	43	37	31	26	21
+27	96	93	90	86	82	79	76	72	68	65	59	53	47	41	36	31	26
+30	96	93	90	86	82	79	76	73	70	67	61	55	50	44	39	35	30
+33	96	93	90	86	83	80	77	74	71	68	63	57	52	47	42	37	33
+36	97	93	90	87	84	81	78	75	72	70	64	57	54	50	45	41	36
+39	97	94	91	88	85	82	79	76	74	71	66	61	56	52	47	43	39

CONSTANT HUMIDITY

The following table shows the % humidity and the aqueous tension at the given temperature within a closed space when in contact with a saturated aqueous solution of the given solid phase.

Solid phase	t°C.	% humidity	Aq. tension
$H_3PO_4.\frac{1}{2}H_2O$	24	9	1.99
$ZnCl_2.1\frac{1}{2}H_2O$*	20	10	1.74
$KC_2H_3O_2$	168	13	738
$LiCl.H_2O$	20	15	2.60
$KC_2H_3O_2$	20	20	3.47
KF	100	22.9	174
NaBr	100	22.9	174
NaCl, KNO_3 and $NaNO_3$	16.39	30.49	4.23
$CaCl_2.6H_2O$	24.5	31	7.08
$CaCl_2.6H_2O$	20	32.3	5.61
$CaCl_2.6H_2O$	18.5	35	5.54
CrO_3	20	35	6.08
$CaCl_2.6H_2O$	10	38	3.47
$CaCl_2.6H_2O$	5	39.8	2.59
$Zn(NO_3)_2.6H_2O$	20	42	7.29
$K_2CO_3.2H_2O$	24.5	43	9.82
$K_2CO_3.2H_2O$	18.5	44	6.96
KNO_2	20	45	7.81
KCNS	20	47	8.16
NaI	100	50.4	383
$Ca(NO_3)_2.4H_2O$	24.5	51	11.6
$NaHSO_4.H_2O$	20	52	9.03
$Na_2Cr_2O_7.2H_2O$	20	52	9.03
$Mg(NO_3)_2.6H_2O$	24.5	52	11.9
$NaClO_3$	100	54	410
$Ca(NO_3)_2.4H_2O$	18.5	56	8.86
$Mg(NO_3)_2.6H_2O$	18.5	56	8.86
KI	100	56.2	427
$NaBr.2H_2O$	20	58	10.1
$Mg(C_2H_3O_2)_2.4H_2O$	20	65	11.3
$NaNO_2$	20	66	11.5
NH_4Cl and KNO_3	30	68.6	21.6
KBr	100	69.2	526
NH_4Cl and KNO_3	25	71.2	16.7
NH_4Cl and KNO_3	20	72.6	12.6
$NaClO_3$	20	75	13.0
$(NH_4)_2SO_4$	108.	75	754
$NaC_2H_3O_2.3H_2O$	20	76	13.2
$H_2C_2O_4.2H_2O$	20	76	13.2
$Na_2S_2O_3.5H_2O$	20	78	13.5
NH_4Cl	20	79.5	13.8

* Unstable form.

CONSTANT HUMIDITY (Continued)

Solid phase	t°C.	% humidity	Aq. tension
NH_4Cl	25	79.3	18.6
NH_4Cl	30	77.5	24.4
$(NH_4)_2SO_4$	20	81	14.1
$(NH_4)_2SO_4$	25	81.1	19.1
$(NH_4)_2SO_4$	30	81.1	25.6
KBr	20	84	14.6
Tl_2SO_4	104.7	84.8	768
$KHSO_4$	20	86	14.9
$Na_2CO_3.10H_2O$	24.5	87	20.9
$BaCl_2.2H_2O$	24.5	88	20.1
K_2CrO_4	20	88	15.3
$Pb(NO_3)_2$	103.5	88.4	760
$ZnSO_4.7H_2O$	20	90	15.6
$Na_2CO_3.10H_2O$	18.5	92	14.6
$NaBrO_3$	20	92	16.0
K_2HPO_4	20	92	16.0
$NH_4H_2PO_4$	30	92.9	29.3
$NH_4H_2PO_4$	25	93	21.9
$Na_2SO_4.10H_2O$	20	93	16.1
$NH_4H_2PO_4$	20	93.1	16.2
$ZnSO_4.7H_2O$	5	94.7	6.10
$Na_2SO_3.7H_2O$	20	95	16.5
$Na_2HPO_4.12H_2O$	20	95	16.5
NaF	100	96.6	734
$Pb(NO_3)_2$	20	98	17.0
$CaSO_4.5H_2O$	20	98	17.0
$TlNO_3$	100.3	98.7	759
$TlCl$	100.1	99.7	761

CORRECTION FOR CAPILLARY DEPRESSION OF MERCURY IN A GLASS TUBE

Correction to be added.

Diam. of tube.	Height of meniscus in centimeters.							
	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18
cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
0.4	0.083	0.122	0.154	0.198	0.237			
0.5	.047	.065	.086	.119	.145	0.180		
0.6	.027	.041	.056	.078	.098	.121	0.143	
0.7	.018	.028	.040	.053	.067	.082	.097	.113
0.8	....	.020	.029	.038	.046	.056	.065	0.077
0.9	....	0.015	0.021	0.028	0.033	0.040	0.046	0.052
1.0	....	.....	.015	.020	.025	.029	.033	.037
1.1	....	.....	.010	.014	.018	.021	.024	.027
1.2	....	.....	.007	.010	.013	.015	.018	.019
1.3	....	.....	.004	007	.010	.012	.013	.014

VELOCITY OF SOUND

Solids

Approximate values.
(From Smithsonian Tables.)

Substance.	Temp. ° C.	Veloc., meters per sec.	Veloc., feet per sec.	Observer.
Metals:				
Aluminum	....	5104	16740	Masson
Brass	....	3500	11480	Various
Cadmium	....	2307	7570	Masson
Cobalt	....	4724	15500	Masson
Copper	20	3560	11670	Wertheim
Copper	100	3290	10800	Wertheim
Copper	200	2950	9690	Wertheim
Gold, soft	20	1743	5717	Wertheim
Gold, hard	....	2100	6890	Various
Iron and soft steel	....	5000	16410	Various
Iron	20	5130	16820	Wertheim
Iron	100	5300	17390	Wertheim
Iron	200	4720	15480	Wertheim
Iron cast steel	20	4990	16360	Wertheim
Iron cast steel	200	4790	15710	Wertheim
Lead	20	1227	4026	Wertheim
Magnesium	....	4602	15100	Melde
Nickel	....	4973	16320	Masson
Palladium	....	3150	10340	Various
Platinum	20	2690	8815	Wertheim
Platinum	100	2570	8437	Wertheim
Platinum	200	2460	8079	Wertheim
Silver	20	2610	8553	Wertheim
Silver	100	2640	8658	Wertheim
Tin	....	2500	8200	Various
Zinc	....	3700	12140	Various
Various:				
Brick	....	3652	11980	Chladni
Clay rock	....	3480	11420	Gray and Milne
Cork	....	500	1640	Stefan
Granite	....	3950	12960	Gray and Milne
Marble	....	3810	12500	Gray and Milne
Paraffin	15	1304	4280	Warburg
Slate	....	4510	14800	Gray and Milne
Tallow	16	390	1280	Warburg
Glass, from	....	5000	16410	Various
Glass, to	....	6000	19690	Various
Ivory	....	3013	9886	Ciccone & Campanile
Vulcanized rubber	0	54	177	Exner
Wax	17	880	2890	Stefan
Woods:				
Ash, along the fiber	....	4670	15310	Wertheim
Ash, across the rings	....	1390	4570	Wertheim
Ash, along the rings	....	1260	4140	Wertheim
Beech, along the fiber	....	3340	10960	Wertheim
Elm, along the fiber	....	4120	13516	Wertheim
Fir, along the fiber	....	4640	15220	Wertheim
Maple, along the fiber	....	4110	13470	Wertheim
Oak, along the fiber	....	3850	12620	Wertheim
Pine, along the fiber	....	3320	10900	Wertheim
Poplar, along the fiber	....	4280	14050	Wertheim
Sycamore, along fiber	....	4460	14640	Wertheim

VELOCITY OF SOUND (Continued)

Liquids and Gases

(From Smithsonian Tables.)

Substance.	Temp. °C.	Veloc., meters per sec.	Veloc., feet per sec.	Observer.
Liquids:				
Alcohol, 95%	12.5	1241.	4072.	Dorsing, 1908
Alcohol	20.5	1213.	3890.	Dorsing, 1908
Ammonia, conc	16.	1663.	5456.	Dorsing, 1908
Benzine	17.	1166.	3826.	Dorsing, 1908
Carbon bisulphide	15.	1161.	3809.	Dorsing, 1908
Chloroform	15.	983.	3225.	Dorsing, 1908
Ether	15.	1032.	3386.	Dorsing, 1908
NaCl, 10% sol	15.	1470.	4823.	Dorsing, 1908
NaCl, 15% sol	15.	1530.	5020.	Dorsing, 1908
NaCl, 20% sol	15.	1650.	5414.	Dorsing, 1908
Turpentine oil	15.	1326.	4351.	Dorsing, 1908
Water, air-free	13.	1441.	4728.	Dorsing, 1908
Water, air-free	19.	1461.	4794.	Dorsing, 1908
Water, air-free	31.	1505.	4938.	Dorsing, 1908
Water, Lake Geneva	9.	1435.	4708.	Colladon-Sturm
Water, Seine River	15.	1437.	4714.	Wertheim
Water, Seine River	30.	1528.	5013.	Wertheim
Water, Seine River	60.	1724.	5657.	Wertheim
Gases:				
Air, dry, CO_2-free	0.	331.78	1088.5	Rowland
Air, dry,	0.	331.36	1087.1	Violle, 1900
Air, dry, CO_2-free	0.	331.92	1089.0	Thiesen, 1908
Air 1 atmosphere	0.	331.7	1088.	Mean
Air 25 atmospheres	0.	332.0	1089.	Mean (Witkowski)
Air 50 atmospheres	0.	334.7	1098.	Mean (Witkowski)
Air 100 atmospheres	0.	350.6	1150	Mean (Witkowski)
Air	20.	344.	1129.	
Air	100.	386.	1266.	Stevens
Air	500.	553.	1814.	Stevens
Air	1000.	700.	2297.	Stevens
Ammonia	0.	415.	1361.	Masson
Carbon monoxide	0.	337.1	1106.	Wullner
Carbon dioxide	0.	258.0	846.	Bückendahl, 1906
Carbon disulphide	0.	189.	606.	Masson
Chlorine	0.	205.3	674.	Strecker
Ethylene	0.	314.	1030.	Dulong
Hydrogen	0.	1269.5	4165.	Dulong
Illuminating gas	0.	490.4	1609.	Zoch
Methane	0.	432.	1417.	Masson
Nitric oxide	0.	325.	1066.	Masson
Nitrous oxide	0.	261.8	859.	Dulong
Oxygen	0.	317.2	1041.	Dulong
Vapors:				
Alcohol	0.	230.6	756.	Masson
Ether	0.	179.2	588.	Masson
Water	0.	401.	1315.	Masson
Water	100.	404.8	1328.	Treitz, 1903
Water	130.	424.4	1392.	Treitz, 1903

MUSICAL SCALES

Equal Tempered Chromatic Scale

$A_3 = 440$

Standard pitch. Adopted by the Music Industries Chamber of Commerce of the United States in 1925.

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C_{-1}	16.35	C_1	65.41	C_3	261.63	C_5	1046.50
$C\#_{-1}$	17.32	$C\#_1$	69.30	$C\#_3$	277.18	$C\#_5$	1108.73
D_{-1}	18.35	D_1	73.42	D_3	293.66	D_5	1174.66
$D\#_{-1}$	19.45	$D\#_1$	77.78	$D\#_3$	311.13	$D\#_5$	1244.51
E_{-1}	20.60	E_1	82.41	E_3	329.63	E_5	1318.51
F_{-1}	21.83	F_1	87.31	F_3	349.23	F_5	1396.91
$F\#_{-1}$	23.12	$F\#_1$	92.50	$F\#_3$	369.99	$F\#_5$	1479.98
G_{-1}	24.50	G_1	98.00	G_3	392.00	G_5	1567.98
$G\#_{-1}$	25.96	$G\#_1$	103.83	$G\#_3$	415.30	$G\#_5$	1661.22
A_{-1}	27.50	A_1	110.00	$\mathbf{A_3}$	**440.00**	A_5	1760.00
$A\#_{-1}$	29.14	$A\#_1$	116.54	$A\#_3$	466.16	$A\#_5$	1864.66
B_{-1}	30.87	B_1	123.47	B_3	493.88	B_5	1975.53
C_0	32.70	C_2	130.81	C_4	523.25	C_6	2093.00
$C\#_0$	34.65	$C\#_2$	138.59	$C\#_4$	554.37	$C\#_6$	2217.46
D_0	36.71	D_2	146.83	D_4	587.33	D_6	2349.32
$D\#_0$	38.89	$D\#_2$	155.56	$D\#_4$	622.25	$D\#_6$	2489.02
E_0	41.20	E_2	164.81	E_4	659.26	E_6	2637.02
F_0	43.65	F_2	174.61	F_4	698.46	F_6	2793.83
$F\#_0$	46.25	$F\#_2$	185.00	$F\#_4$	739.99	$F\#_6$	2959.96
G_0	49.00	G_2	196.00	G_4	783.99	G_6	3135.96
$G\#_0$	51.91	$G\#_2$	207.65	$G\#_4$	830.61	$G\#_6$	3322.44
A_0	55.00	A_2	220.00	A_4	880.00	A_6	3520.00
$A\#_0$	58.27	$A\#_2$	233.08	$A\#_4$	932.33	$A\#_6$	3729.31
B_0	61.74	B_2	246.94	B_4	987.77	B_6	3951.07
						C_7	4186.01

Equal Tempered Chromatic Scale

$A_3 = 435$

International Pitch, adopted 1891

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C_{-1}	16.17	C_1	64.66	C_3	258.65	C_5	1034.61
$C\#_{-1}$	17.13	$C\#_1$	68.51	$C\#_3$	274.03	$C\#_5$	1096.13
D_{-1}	18.15	D_1	72.58	D_3	290.33	D_5	1161.31
$D\#_{-1}$	19.22	$D\#_1$	76.90	$D\#_3$	307.59	$D\#_5$	1230.37
E_{-1}	20.37	E_1	81.47	E_3	325.88	E_5	1303.53
F_{-1}	21.58	F_1	86.31	F_3	345.26	F_5	1381.04
$F\#_{-1}$	22.86	$F\#_1$	91.45	$F\#_3$	365.79	$F\#_5$	1463.16
G_{-1}	24.22	G_1	96.89	G_3	387.54	G_5	1550.16
$G\#_{-1}$	25.66	$G\#_1$	102.65	$G\#_3$	410.59	$G\#_5$	1642.34
A_{-1}	27.19	A_1	108.75	$\mathbf{A_3}$	**435.00**	A_5	1740.00
$A\#_{-1}$	28.80	$A\#_1$	115.22	$A\#_3$	460.87	$A\#_5$	1843.47
B_{-1}	30.52	B_1	122.07	B_3	488.27	B_5	1953.08
C_0	32.33	C_2	129.33	C_4	517.31	C_6	2069.22
$C\#_0$	34.25	$C\#_2$	137.02	$C\#_4$	548.07	$C\#_6$	2192.26
D_0	36.29	D_2	145.16	D_4	580.66	D_6	2322.62
$D\#_0$	38.45	$D\#_2$	153.80	$D\#_4$	615.18	$D\#_6$	2460.73
E_0	40.74	E_2	162.94	E_4	651.76	E_6	2607.05
F_0	43.16	F_2	172.63	F_4	690.52	F_6	2762.08
$F\#_0$	45.72	$F\#_2$	182.89	$F\#_4$	731.58	$F\#_6$	2926.32
G_0	48.44	G_2	193.77	G_4	775.08	G_6	3100.33
$G\#_0$	51.32	$G\#_2$	205.29	$G\#_4$	821.17	$G\#_6$	3284.68
A_0	54.38	A_2	217.50	A_4	870.00	A_6	3480.00
$A\#_0$	57.61	$A\#_2$	230.43	$A\#_4$	921.73	$A\#_6$	3686.93
B_0	61.03	B_2	244.14	B_4	976.54	B_6	3906.17
						C_7	4138.44

MUSICAL SCALES (Continued)

Scientific or Diatonic Scale

$C_3 = 256$

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C_{-1}	16	C_1	64	C_3	**256**	C_5	1024
D_{-1}	18	D_1	72	D_3	288	D_5	1152
E_{-1}	20	E_1	80	E_3	320	E_5	1280
F_{-1}	21.33	F_1	85.33	F_3	341.33	F_5	1365.33
G_{-1}	24	G_1	96	G_3	384	G_5	1536
A_{-1}	26.67	A_1	106.67	A_3	426.67	A_5	1706.67
B_{-1}	30	B_1	120	B_3	480	B_5	1920
C_0	32	C_2	128	C_4	512	C_6	2048
D_0	36	D_2	144	D_4	576	D_6	2304
E_0	40	E_2	160	E_4	640	E_6	2560
F_0	42.67	F_2	170.67	F_4	682.67	F_6	2730.67
G_0	48	G_2	192	G_4	768	G_6	3072
A_0	53.33	A_2	213.33	A_4	853.33	A_6	3413.33
B_0	60	B_2	240	B_4	960	B_6	3840
						C_7	4096

SOUND ABSORPTION

The following tables relating to sound absorption are taken from Bulletin No. 172, Engineering Experiment Station, University of Illinois, by Floyd R. Watson.

Sound Absorbing Coefficients for Pitch 512

Material	Coefficient per sq. ft.
Open window	1.00
Akoustolith (artificial stone)	0.36
Ambler Sound Absorbing Plaster	0.14
Balsam Wool, bare, 1 in. thick, 0.26 lb. per sq. ft.	0.44
Brick wall	0.032
Brick wall, painted	0.017
Brick, set in cement	0.025
Calacoustic Plaster	0.16
Carpet, unlined	0.15
Carpet, lined	0.20
Carpet, with ½ in. Ozite hairfelt	0.25
Carpet rugs	0.20
Acousti-Celotex, type A, unpainted	0.25
Acousti-Celotex, type B, painted or unpainted	0.47
Acousti-Celotex, type BB, painted or unpainted	0.70
Acousti-Celotex, type C, painted or unpainted	0.30
Armstrong Cork Board, 1 in. thick, 0.875 lb. per sq. ft.	0.30
Armstrong Cork Board, sprayed with cold water paint	0.30
Armstrong Cork Board, 2 in. thick, 1.6 lb. per sq. ft.	0.35
Cork tile	0.03
Curtains in heavy folds	0.40–0.75
Fibroblock, unpainted	0.42
Flaxlinum, bare, 1 in. thick	0.61
Flaxlinum, 1 in. thick, with unpainted membrane	0.61
Gimco Rock Wool, bare	0.57
Glass, (single thickness)	0.027

SOUND ABSORPTION (Continued)

Sound Absorbing Coefficients for Pitch 512

Material	Coefficient per sq. ft.
Hairfelt, bare, 1 in. thick, 0.75 lb. per sq. ft.	0.58
Linoleum	0.03
Marble	0.01
Nashkote A, ½ in. thick	0.31
Nashkote A, ¾ in. thick	0.41
Nashkote B, ½ in. thick	0.37
Plaster on wood lath	0.034
Plaster on metal lath	0.033
Plaster on tile	0.025
Sabinite Acoustical Plaster	0.21
Stage opening, depending on stage furnishings	0.25–0.40
Ventilators	0.75
Wood, plain	0.06
Wood, varnished	0.03
Acoustic Zenitherm (cork granules cemented with plaster)	0.33

Individual Objects	Relative coefficient
Adult person	4.7
Plain wood seats	0.15
Church pews, per seat	0.2–0.5
Seats, upholstered seat and back	0.75–2.00
Seat cushions per seat	1.00–2.00

Sound Absorbing Coefficients of Various Materials

Material	Coefficient			
	Pitch = 256*	512	1024	2048
Open window (theoretical value)	1.00	1.00	1.00	1.00
Open window (experimental value)	0.945	0.98	1.08	0.985
Hairfelt, bare, 1 inch thick, 0.75 lb. per sq. ft.	0.34	0.58	0.80	0.84
Acousti-Celotex, type A, (felted bagasse fibres 13/16 in. thick, 1.11 lb. per sq. ft., perforated with 441 small holes per sq. ft. on back of material)	0.30	0.25	0.21	0.26
Acousti-Celotex, type B, ditto, with perforations exposed on front, painted or unpainted	0.24	0.47	0.49	0.60
Acousti-Celotex, type BB, ditto, 1¼ in. thick, 1.67 lb. per sq. ft. painted or unpainted	0.36	0.70	0.76	0.76
Acousti-Celotex, type C, ⅝ in. thick, 0.48 lb. per sq. ft., completely perforated, painted or unpainted.	0.12	0.30	0.48	0.55
Armstrong Cork Board, 1 in. thick, 0.875 lb. per sq. ft.	0.08	0.30	0.31	0.28
ditto, sprayed with cold water paint	0.07	0.30	0.28	0.29
ditto, 2 in. thick, 1.6 lb. per sq. ft.	0.17	0.35	0.27	0.34
Flaxlinum (felted flax fibres), bare, 1 in. thick, 1.17 lb. per sq. ft.	0.49	0.61	0.67	0.66
Flaxlinum, (ditto), with unpainted decorative membrane (0.1 lb. per sq. ft., mesh 10 to the inch) mounted ¾ in. in front of Flaxlinum	0.30	0.61	0.60	0.55
Gimco Rock Wool (silica fibres, felted between metal lath), 1¼ in. thick, 1.44 lb. per sq. ft.	0.46	0.57	0.56	0.72

* At pitch 256 the reverberation room had a resonance, so that materials capable of vibrating would have a somewhat greater coefficient than if the resonance were absent.

SOUND ABSORPTION (continued)

Sound Absorbing Coefficients for Range of Pitch

Material	Coefficient						Authority
	n = 128	256	512	1024	2048	4096	
Open window (theoretical)	1.00	1.00	1.00	1.00	1.00	1.00	
Acoustic Zenitherm (cork granules cemented into a porous stiff tile 1.14 in. thick, 2.07 lbs. per sq. ft.)	0.03	0.13	0.33	0.42	0.42	0.15	Watson, 1926
Akoustolith Tile (1 in. thick)	0.06	0.12	0.36	0.52	0.52	0.36	W. C. Sabine, 1914
Akoustolith Plaster, ½ in. thick on ¼ in. thick lime mortar	0.21	0.24	0.29	0.33	0.37	0.42	Swan, 1923
Rumford Tile, 1 in. thick	0.09	0.18	0.29	0.34	0.34	0.30	W. C. Sabine. 1914
Ambler Sound Absorbing Plaster	0.03	0.06	0.14	0.17	0.19	0.11	Watson, 1926
Calacoustic Plaster, 1 in. thick	0.13	0.12	0.16	0.17	0.20	0.26	Knudsen, 1927
Asbestos-Akoustikos Felt (a mixture of hair felt and asbestos, bare, ½ in. thick)	0.10	0.18	0.36	0.60	0.63	0.57	Swan, 1927
ditto, ¾ in. thick	0.18	0.30	0.54	0.64	0.63	0.57	Swan, 1927
Nashkote A (Asbestos-Akoustikos felt with muslin cemented to the felt and special paint applied, ½ in. thick)	0.10	0.20	0.31	0.40	0.39	0.32	Swan, 1927
ditto, ¾ in. thick	0.19	0.28	0.41	0.43	0.39	0.32	Swan, 1927
Nashkote B (same as A except that perforated oilcloth is glued to the felt, ½ in. thick)	0.10	0.20	0.37	0.57	0.63	0.53	Swan, 1927
Balsam Wool (loosely felted quilt of wood fiber, 1 in. thick)	....	0.18	0.44	0.62	0.66	....	Watson, 1927
Balsam Wool, covered with steel tile, perforated with 64 one-sixteenth in. holes per sq. in.	....	0.19	0.47	0.64	0.66	....	Watson, 1927
Sabinite Acoustical Plaster, ½ in. thick	....	0.166	0.214	0.29	0.34	....	P. E. Sabine, 1927

SPARK-GAP VOLTAGES

Based on results of the American Institute of Electric Engineers
Air at 760 mm, 25° C.

Peak voltage, kilovolts	Diameter of spherical electrodes, cm				Needle points
	2.5	5	10	25	
	Length of spark gap cm				
5	0.13	0.15	0.15	0.16	0.42
10	0.27	0.29	0.30	0.32	0.85
15	0.42	0.44	0.46	0.48	1.30
20	0.58	0.60	0.62	0.64	1.75
25	0.76	0.77	0.78	0.81	2.20
30	0.95	0.94	0.95	0.98	2.69
35	1.17	1.12	1.12	1.15	3.20
40	1.41	1.30	1.29	1.32	3.81
45	1.68	1.50	1.47	1.49	4.49
50	2.00	1.71	1.65	1.66	5.20
60	2.82	2.17	2.02	2.01	6.81
70	4.05	2.68	2.42	2.37	8.81
80	......	3.26	2.84	2.74	11.1
90	......	3.94	3.28	3.11	13.3
100	......	4.77	3.75	3.49	15.5
110	......	5.79	4.25	3.88	17.7
120	......	7.07	4.78	4.28	19.8
130	......	......	5.35	4.69	22.0
140	......	......	5.97	5.10	24.1
150	......	......	6.64	5.52	26.1
160	......	......	7.37	5.95	28.1
170	......	......	8.16	6.39	30.1
180	......	......	9.03	6.84	32.0
190	......	......	10.0	7.30	33.9
200	......	......	11.1	7.76	35.7
210	......	......	12.3	8.24	37.6
220	......	......	13.7	8.73	39.5
230	......	......	15.3	9.24	41.4
240	......	......	......	9.76	43.3
250	......	......	......	10.3	45.2
300	......	......	......	13.3	54.7

CORRECTIONS FOR TEMPERATURE AND PRESSURE

Values found in the above table may be corrected for temperature and pressure by multiplying the values given by the appropriate correction factor found below:

Temp. °C.	Pressure mm			
	720	740	760	780
0	1.04	1.06	1.09	1.12
10	1.00	1.02	1.05	1.08
20	0.96	0.99	1.02	1.04
30	0.93	0.96	0.98	1.01

SPECIFIC INDUCTIVE CAPACITY

Solids

Atmospheric temperatures except where noted.

(From Smithsonian Tables.)

Substance.	Wave length.	Specific inductive capacity.	Observer.
Asphalt	∞	2.68	v. Pirani, 1903
Caoutchouc	∞	2.22	Gordon, 1879
Calcspar:			
⊥ to axis	∞	8.49	Fallinger, 1902
‖ to axis	∞	7.56	Fallinger, 1902
Diamond	∞	16.5	v. Pirani, 1903
Ebonite	∞	2.72	Winklemann, 1889
Glass flint, extra heavy	∞	9.90	Hopkinson, 1891
hard crown	∞	6.96	Hopkinson, 1891
lead (Powell)	∞	5.4–8.0	Gray-Dobbie, 1898
Jena, barium	∞	7.8–8.5	Löwe, 1898
Gutta percha	.....	3.3–4.9	(submarine-data)
Ice −5° C	1200	2.85	Thwing, 1894
−18°	5000	3.16	Abegg, 1897
−190°	75	1.76–1.88	Behn-Kiebitz, 1904
Iodine, cryst	75	4.00	Schmidt, 1903
Marble, Carrara	75	8.3	Schmidt, 1903
Mica	∞	5.66–5.97	Elsas, 1891
Mica, Canadian amber	∞	3.0	E. Wilson
Paraffin	∞	2.10	Zietkowski, 1900
Phosphorus, yellow	75	3.60	Schmidt, 1903
Porcelain, hard (Royal Berlin)	∞	5.73	Starke, 1897
Quartz:			
⊥ to axis	∞	4.69	Fallinger, 1902
‖ to axis	∞	5.06	Fallinger, 1902
Selenium	∞	6.13	Vonwiller-Mason, 1907
Shellac	∞	3.10	Winkelmann, 1889
Sulphur, amorphous	∞	3.98	v. Pirani, 1903
Sulphur, cast, fresh	∞	4.22	v. Pirani, 1903
Wood, dry:			
red beech	∞	4.83–2.51	
red beech	∞	7.73–3.63	
oak	∞	4.22–2.46	
oak	∞	6.84–3.64	

SPECIFIC INDUCTIVE CAPACITY (Continued)

Gases

The specific inductive capacity of a vacuum is taken as unity. Wave lengths of the measuring current greater than 10,000 cm.

(Dielectric constant.)

Gas.	Temp. ° C.	Pressure in atmospheres.	Specific inductive capacity.	Observer.
Air	0	1	1.000590	Boltzmann, 1875
Air	19	20	1.0108	Tangl, 1907
Air	....	40	1.0218	Tangl, 1907
Air	....	60	1.0330	Tangl, 1907
Air	....	80	1.0439	Tangl, 1907
Air	....	100	1.0548	Tangl, 1907
Ammonia	20	1	1.00718	Bädeker, 1901
Carbon bisulphide	0	1	1.00290	Klemenčič
Carbon bisulphide	100	1	1.00239	Bädeker
Carbon dioxide	0	1	1.000985	Klemenčič
Carbon dioxide	15	10	1.008	Linde, 1895
Carbon dioxide	....	20	1.020	Linde, 1895
Carbon dioxide	....	40	1.060	Linde, 1895
Carbon monoxide	0	1	1.000690	Boltzmann
Ethylene	0	1	1.00131	Boltzmann
Hydrochloric acid	100	1	1.00258	Bädeker
Hydrogen	0	1	1.000264	Boltzmann
Methane	0	1	1.000944	Boltzmann
Nitrous oxide (N_2O)	0	1	1.00116	Boltzmann
Nitrous oxide (N_2O)	15	10	1.010	Linde, 1895
Nitrous oxide (N_2O)	....	20	1.025	Linde, 1895
Nitrous oxide (N_2O)	....	40	1.070	Linde, 1895
Sulphur dioxide	0	1	1.00993	Bädeker
Sulphur dioxide	0	1	1.00905	Klemenčič
Water vapor	145	4	1.00705	Bädeker

Liquids

Where the wave-length is not specified it is greater than 10,000 cm.

Liquid.	Temp. ° C.	Wave length, cm.	Specific inductive capacity.	Observer.
Acetic acid	18	∞	9.7	Francke, 1893
Acetone	0	∞	26.6	Abegg, 1897
Air	−191	∞	1.43	v. Pirani, 1903
Alcohol:				
amyl	0	∞	17.4	Abegg-Seitz, 1899
amyl	+20	∞	16.0	Abegg-Seitz, 1899
ethyl	frozen	∞	2.7	Abegg-Seitz, 1899
ethyl	−120	∞	54.6	Abegg-Seitz, 1899

SPECIFIC INDUCTIVE CAPACITY (Continued)

Liquids (Continued)

Liquid.	Temp. ° C.	Wave length, cm.	Specific inductive capacity.	Observer.
Alcohol:				
ethyl	−80	∞	44.3	Abegg-Seitz, 1899
ethyl	−40	∞	35.3	Abegg-Seitz, 1899
ethyl	0	∞	28.4	Abegg-Seitz, 1899
ethyl	+20	∞	25.8	Abegg-Seitz, 1899
ethyl	17	200	24.4	Drude, 1896
ethyl	17	75	23.0	Drude, 1896
ethyl	17	53	20.6	Marx, 1898
ethyl	17	4	8.8	Marx, 1898
ethyl	17	0.4	5.0	Lampa, 1896
methyl	0	∞	35.0	Abegg-Seitz, 1899
methyl	+20	∞	31.2	Abegg-Seitz, 1899
propyl	0	∞	24.8	Abegg-Seitz, 1899
propyl	+20	∞	22.2	Abegg-Seitz, 1899
Ammonia	−34	75	21–23	Goodwin-Thompson, 1899
Amyl acetate	19	∞	4.81	Löwe, 1898
Anilin	18	∞	7.316	Turner, 1900
Benzol (Benzene)	18	∞	2.288	Turner, 1900
Bromine	23	84	3.18	Schlundt
Carbon bisulphide	20	∞	2.626	Tangl, 1903
Carbon dioxide	−5	∞	1.60	Linde, 1895
Chlorine	−60	∞	2.15	Linde, 1895
Chloroform	18	∞	5.2	Turner, 1900
Ethyl ether	0	∞	4.68	Abegg, 1897
Ethyl ether	20	∞	4.30	Tangl, 1903
Glycerine	15	1200	56.2	Thwing, 1894
Hydrogen peroxide 46% in H_2O	18	75	84.7	Calvert, 1900
Hydrogen sulphide	10	∞	5.93	Eversheim, 1904
Nitrous oxide, N_2O	−88	∞	1.93	Hasenhörl, 1900
Oils:				
castor	11	∞	4.67	Arons-Rubens, 1892
cottonseed	14	∞	3.10	Salvioni, 1888
linseed	13	∞	3.35	Salvioni, 1888
olive	20	∞	3.11	Heinke, 1896
petroleum	....	2000	2.13	Marx
sperm	20	∞	3.17	Hopkinson, 1881
turpentine	20	∞	2.23	Hopkinson, 1881
Oxygen	−182	∞	1.49	Fleming-Dewar, 1896
Phenol	48	73	9.68	Drude, 1896
Sulphur dioxide	20	∞	14.0	Eversheim, 1904
Water	18	∞	81.07	Turner, 1900

SPARKING POTENTIAL OR DIELECTRIC STRENGTH

Various Insulators.

Potential to puncture in kilovolts per centimeter. 1 kilovolt = 1000 volts.

Substance.	Thickness used mm.	Kilovolts per cm
Air, liquid	....	40–90
Ebonite	....	300–1100
Fiber	....	20
Glass	....	300–1500
Guttapercha	....	80–200
Kerosene	1.0	164
Linen, varnished	....	100–200
Mica	0.1	1500–2200
Mica	1.0	300–700
Oils:		
castor	0.2	190
castor	1.0	130
cottonseed	....	70
lard	0.2	140
lard	1.0	40
linseed, raw	0.2	185
raw	1.0	90
boiled	0.2	190
boiled	1.0	80
lubricating	....	50
olive	0.2	170
olive	1.0	75
paraffin	0.2	215
paraffin	1.0	160
sperm, mineral	0.2	180
mineral	1.0	85
natural	0.2	195
natural	1.0	90
turpentine	0.2	160
turpentine	1.0	110
Papers:		
beeswaxed	....	770
blotting	....	150
Manilla	....	25
paraffined	....	500
varnished	....	100–250
Paraffin:		
melted	....	75
solid, melt. point 43°	....	350
solid, melt. point 70°	....	450
Rubber	....	160–500
Vaseline	....	90–130
Xylol	0.2	140
Xylol	1.0	80

ELECTROMOTIVE FORCE AND COMPOSITION OF VOLTAIC CELLS

Standard Cells
(From Smithsonian Tables.)

Name of cell.	Negative pole.	Solution.	Positive pole.	Depolarizer.	E.M.F. in volts.
Weston normal. .	Cadmium amalgam. . .	Saturated solution of $CdSO_4$.	Mercury. .	Paste of Hg_2SO_4 and $CdSO_4$	1.0183 at 20° C.
Clark standard. .	Zinc amalgam.	Saturated solution of $ZnSO_4$.	Mercury. .	Paste of Hg_2SO_4 and $ZnSO_4$.	1.4328 at 15° C.

Temperature equations:

Clark cell: $E_t = 1.4328[1 - 0.00119(t - 15) - 0.000007(t - 15)^2]$ volt

Weston cell: $E_t = 1.0183[1 - 0.0000406(t - 20) - 0.00000095(t - 20)^2 + 0.00000001(t - 20)^3]$ volt

Double Fluid Cells

Name of cell.	Negative pole.	Solution.	Positive pole.	Solution.	E.M.F. in volts.
Bunsen.	Amal. zinc.	1 part H_2SO_4 to 12 parts H_2O. . . .	Carbon. . .	Fuming nitric acid.	1.94
Bunsen.	Amal. zinc.	1 part H_2SO_4 to 12 parts H_2O. . . .	Carbon. . .	HNO_3, density, 1.38.	1.86
Bichromate.	Amal. zinc.	12 parts $K_2Cr_2O_7$ to 25 parts H_2SO_4 and 100 parts H_2O.	Carbon. . .	1 part H_2SO_4 to 12 parts H_2O	2.00
Bichromate.	Amal. zinc.	1 part H_2SO_4 to 12 parts H_2O. . . .	Carbon. . .	12 parts $K_2Cr_2O_7$ to 100 parts H_2O.	2.03
Daniell.	Amal. zinc.	1 part H_2SO_4 to 4 parts H_2O.	Copper. . .	Saturated solution of $CuSO_4 + 5H_2O$.	1.06
Daniell.	Amal. zinc.	5% solution of $ZnSO_4 + 6H_2O$. . . .	Copper. . .	Saturated solution of $CuSO_4 + 5H_2O$.	1.08
Daniell	Amal. zinc.	1 part NaCl to 4 parts H_2O.	Copper. . .	Saturated solution of $CuSO_4 + 5H_2O$.	1.05
Grove.	Amal. zinc.	1 part H_2SO_4 to 12 parts H_2O. . . .	Platinum .	Fuming nitric acid.	1.93
Grove.	Amal. zinc.	Solution of $ZnSO_4$.	Platinum .	HNO_3 density 1.33.	1.66

ELECTROMOTIVE FORCE AND COMPOSITION OF VOLTAIC CELLS (Continued)

Double Fluid Cells (Continued)

Name of cell.	Negative pole.	Solution.	Positive pole.	Solution.	E.M.F. in volts.
Grove	Amal. zinc	H_2SO_4 solution, density 1.136	Platinum	HNO_3 density 1.33	1.79
Grove	Amal. zinc	H_2SO_4 solution, density 1.14	Platinum	HNO_3 density 1.19	1.66
Grove	Amal. zinc	NaCl solution	Platinum	HNO_3 density, 1.33	1.88

Single Fluid Cells

Name of cell.	Negative pole.	Solution.	Positive pole.	E.M.F.
Dry cell	Zinc	Ammonium Chloride	Carbon with MnO_2	1.53
Leclanché	Amal. zinc	Solution of sal-ammoniac	Carbon, depolarizer: manganese peroxide with powd. carbon	1.46
Edison-Lalande	Amal. zinc	Solution of caustic potash	Copper, depolarizer, CuO	0.70
Chloride of silver	Zinc	23% sol. of sal-ammoniac	Silver, depolarizer: silver chloride	1.02

Storage Cells

Name of cell.	Negative pole.	Solution.	Positive pole.	E.M.F.
Lead accumulator	Lead	H_2SO_4 solution of density 1.1	PbO_2	2.2
Regnier (1)	Copper	$CuSO_4 + H_2SO_4$	PbO_2	1.68 to 0.85. average, 1.3
Regnier (2)	Amal. zinc	$ZnSO_4$ solution	PbO_2 in H_2SO_4	2.36
Main	Amal. zinc	H_2SO_4, density about 1.1	PbO_2	2.50
Edison	Iron	KOH, 20% solution	A nickel oxide	1.1, mean of full discharge

CONTACT POTENTIALS

Potential of metal at left minus potential of metal at top in volts. The values are given for room temperature and for pressures, indicated by the superscript. Figures indicate pressure in mm of Hg, $^{\text{vac.}}$, vacuum, $^{\text{atm.}}$, atmospheric pressure. The figures are for fresh surfaces.

	Brass	Platinum	Other metals
Aluminum	+1.04$^{\text{vac.}}$	+1.20	Fe, +0.87
	+0.19$^{\text{atm.}}$	......	Zn, +0.29
Antimony	+0.15$^{\text{atm.}}$	......	....
Bismuth	+0.07$^{\text{atm.}}$	+0.35	....
Cadmium	....	......	Hg, −0.22$^{.05}$
C* + NH_3	....	......	Cu, + 079
C + H_2	....	......	Cu, +.096
C + N_2	....	......	Cu, +.129
C + CO_2	....	......	Cu, +.130
C + NO	....	......	Cu, +.136
C + O_2	....	......	Cu, +.142
C + O_3	....	......	Cu, +.155
Copper	+0.10$^{\text{vac.}}$	+0.13	....
	−0.04$^{\text{atm.}}$	......	....
CuO	....	......	Li, −1.52

	Brass	Platinum	Other metals
CuO	....	......	Na, −2.52
Gold	−0.23$^{\text{atm}}$	......	....
Iron	+0.24$^{\text{vac.}}$	......	Zn, −0.06$^{\text{vac.}}$
Lead	−0.41$^{\text{atm}}$	......	....
Magnesium	+1.47$^{\text{vac.}}$	+1.05	....
Mercury	....	......	Sb, −0.26$^{.05}$
Nickel	+0.16$^{\text{atm}}$	......	Zn, +0.17$^{.05}$
Platinum	−0.32$^{\text{atm}}$	......	....
Potassium	....	+2.8	....
Silver	+0.05$^{\text{vac.}}$	......	....
	−0.35$^{\text{atm}}$	......	....
Sodium	....	+2.40	....
Tin	....	−0.62	....
Zinc	....	+0.90	....

* Coconut charcoal saturated with the gas named.

DIFFERENCE OF POTENTIAL BETWEEN METALS IN SOLUTIONS OF SALTS

The table gives the difference in potential in hundredths of a volt between zinc in a normal solution of sulphuric acid and the metal named at the head of the columns in the solution named at the side. The signs given refer to the external difference of potential.

(Magnanini.)

Strength of the solution in gramme molecules per liter.	Difference of potential in centivolts.					
	Zinc	Cadmium	Lead	Tin.	Copper.	Silver.
0.5 Sulphuric acid	0.0	36.6	51.3	51.3	100.7	121.3
1.0 Sodium hydroxide	−32.1	19.5	31.8	0.2	80.2	95.8
1.0 Potassium hydroxide	−42.5	15.5	32.0	−1.2	77.0	104.0
0.5 Sodium sulphate	1.4	35.6	50.8	51.4	101.3	120.9
1.0 Potassium nitrate	11.8	31.9	42.6	31.1	81.2	105.7
1.0 Sodium nitrate	11.5	32.3	51.0	40.9	95.7	114.8
0.5 Potassium bichromate	72.8	61.1	78.4	68.1	123.6	132.4
0.5 Potassium sulphate	1.8	34.7	51.0	40.9	95.7	114.8
0.2 Potassium chlorate	15.−10.	39.9	53.8	57.7	105.3	120.9
1.0 Ammonium chloride	2.9	32.4	51.3	50.9	81.2	101.7
1.0 Sodium chloride	......	31.9	51.2	50.3	80.9	101.3
1.0 Potassium chloride	......	32.1	51.6	52.6	81.6	107.6

PROPERTIES OF METALS AS CONDUCTORS

Metal.	Resistivity microhm-centimeters 20° C.	Temp. coefficient 20° C.	Specific gravity.	Tensile strength, lbs./in.	Melting point ° C.
Advance. See *constantan*					
Aluminum	2.824	0.0039	2.70	30,000	659
Antimony	41.7	.0036	6.6	....	630
Arsenic	33.3	.0042	5.73	....	....
Bismuth	120	.004	9.8	....	271
Brass	7	.002	8.6	70,000	900
Cadmium	7.6	.0038	8.6	....	321
Calido. See *nichrome*					
Climax	87	.0007	8.1	150,000	1250
Cobalt	9.8	.0033	8.71	....	1480
Constantan	49	.00001	8.9	120,000	1190
Copper: annealed	1.7241	.00393	8.89	30,000	1083
hard-drawn	1.771	.00382	8.89	60,000	....
Eureka. See *constantan*					
Excello	92	.00016	8.9	95,000	1500
Gas Carbon	5000	—.0005	......	....	3500
German silver, 18% Ni	33	.0004	8.4	150,000	1100
Gold	2.44	.0034	19.3	20,000	1063
Ideal. See *constantan*					
Iron, 99.98% pure	10	.005	7.8	....	1530
Lead	22	.0039	11.4	3,000	327
Magnesium	4.6	.004	1.74	33,000	651
Manganin	44	.00001	8.4	150,000	910
Mercury	95.783	.00089	13.546	0	—38.9
Molybdenum, drawn	5.7	.004	9.0	....	2500
Monel metal	42	.0020	8.9	160,000	1300
Nichrome	100	.0004	8.2	150,000	1500
Nickel	7.8	.006	8.9	120,000	1452
Palladium	11	.0033	12.2	39,000	1550
Phosphor bronze	7.8	.0018	8.9	25,000	750
Platinum	10	.003	21.4	50,000	1755
Silver	1.59	.0038	10.5	42,000	960
Steel, E. B. B.	10.4	.005	7.7	53,000	1510
Steel, B. B.	11.9	.004	7.7	58,000	1510
Steel, Siemens-Martin	18	.003	7.7	100,000	1510
Steel, manganese	70	.001	7.5	230,000	1260
Tantalum	15.5	.0031	16.6	....	2850
Therlo	47	.00001	8.2	....	....
Tin	11.5	.0042	7.3	4,000	232
Tungsten, drawn	5.6	.0045	19	500,000	3400
Zinc	5.8	.0037	7.1	10,000	419

RESISTIVITY

Giving the resistivity ρ for metals, including alloys and carbon. Temperature coefficients of resistance are given in a succeeding table.

Material	Temp. °C.	Resistivity ohm-cm	Authority
Advance,	0	47.—49.	
Aluminum, commercial Al 99.57, Si 0.29, Fe 0.14	20	2.828×10^{-6}	Bureau of Standards
pure	−189	.64	Niccolai, 1907
	−100	1.53	"
	0	2.63	"
	+100	3.86	"
	400	8.0	"
Aluminum bronze	0	12.—13.	Various
Cu 97, Al 3	0	8.26	Pecheux, 1909
Cu 90, Al 10	0	12.6	"
Cu 6, Al 94	0	3.1	"
Antimony	20	41.7	Bureau of Standards
	−190	10.5	Eucken, Gelhoff
liquid	+860	120.	de la Rive
Argentan Cu 56, Ni 26	15	42.	Matthiessen
Arsenic	0	35.	"
Bismuch	18	119.0	Jäger, Diesselhorst
	100	160.2	" "
	−200	34.8	Various
	−100	75.6	"
	+100	156.5	Northrup, 1914
	200	214.5	"
liquid	300	128.9	"
"	500	139.9	"
"	700	150.8	"
Brass various	0	6.4—8.4	Various
hard - drawn Cu 70.2, Zn 29.8	0	8.2	Siemens
annealed	0	7.0	"
Bronze Cu 88, Sn 12	20	18	
Cu 89, Sn 6, Zn 4	15	13.5	
Cadmium, drawn	18	7.54	Jäger, Diesselhorst
	100	9.82	" "
	−252.9	0.17	Euchen, Gehlhoff, 1912
	−200	1.66	" "
	−100	4.80	" "
	+300	16.50	Northrup, 1913
liquid	400	33.70	"
	500	35.12	"
	700	35.78	"
Caesium	0	19	Various
	−187	5.25	Guntz, Broniewski
	27	22.2	Hackspill
liquid	30	36.6	"
Calcium, Ca 99.57 %	20	4.6	Swisher, 1917
Calido,	0	110	
Carboloy	20	19.6	
Carbon	0	3500	
	500	2700	
	1000	2100	
	2000	1100	
	2500	900	

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Chromium	0	2.6×10^{-6}	Shukow
Climax,	20	87	Bureau of Standards
Cobalt, Co 99.8%	20	9.7	Reichardt, 1901
Constantan,	20	49	Bureau of Standards
Cu 60, Ni 40			
	−200	42.4	Niccolai
	−150	43.0	"
	−100	43.5	"
	−50	43.9	"
	0	44.1	"
	+100	44.6	"
	400	44.8	"
Copper, commercial			
annealed	20	1.7241*	Bureau of Standards
hard drawn	20	1.77	"
pure, annealed	20	1.692	Wolff, Dellinger 1910
	−258.6	.014	Niccolai
	−206.6	.163	"
	−150	.567	"
	−100	904	"
	+100	2.28	Northrup, 1914
	200	2.96	"
	500	5.08	"
	1000	9.42	"
liquid	1500	24.62	"
Copper-manganese			
Cu 96.5, Mn 3.5		15	Feussner, Lindeck 1895
Cu 92, Mn 8		28.4	" "
Cu 70, Mn 30	0	101	
Copper-manganese-iron			
Cu 91, Mn 7.1, Fe 1.9	0	20	Blood
Cu 70.6, Mn 23.2, Fe 6.2	0	77	"
Copper-manganese-nickel			
Cu 73, Mn 24, Ni 3	0	48	Feussner, Lindeck
Eureka	0	47	Drysdale, 1907
Excello	20	92	Bureau of Standards
Gallium	0	53	Guntz, Broniewski
German silver, Ni 18%	20	33	Bureau of Standards
Cu 60.16, Zn 25.37, Ni 14.03, Fe 0.3, Co and Mn trace	−200	27.9	Dewar, Fleming
	−100	29.3	
	+100	33.1	
Gold, pure, drawn	20	2.44	Jäger, Diesselhorst
	−252.8	.018	Niccolai
	−200	.601	"
99.9 pure	−183	.68	Dewar, Fleming
	−150	.997	Niccolai, 1907
	−100	1.400	"
	+100	2.97	Northrup, 1914

*Int. Ann. Cu. Std.

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Gold, 99.9 pure	200	3.83×10^{-6}	Northrop, 1914
	500	6.62	"
	1000	12.52	"
	1500	3.70	"
Gold-copper-silver			
Au 58.3, Cu 26.5, Ag 15.2	0	13.2	Matthiessen
Au 66.5, Cu 15.4, Ag 18.1	0	14.6	"
Au 7.4, Cu 78.3, Ag 14.3	0	3.6	"
Gold-silver			
Au 90, Ag 10	0	6.3	
Au 67, Ag 33	0	10.8	
Graphite	0	800	
	500	830	
	1000	870	
	2000	1000	
	2500	1100	
Ia — Ia			
Cu 60, Ni 40	0	50	Drysdale, 1907
Ideal, (*See constantan*)			
Illium		91.61	Knipp, Hall 1922
Indium	0	8.37	Erhardt, 1881
Invar (*See steel*)			
Iridium	−186	1.92	Broniewski, Hackspill
	0	6.10	" "
	100	3.30	" "
Iron 99.98% pure	20	10	Bureau of Standards
	−252.7	0.011	Niccolai
	−205.3	.652	Dewar, Fleming
	−200.	2.27	Niccolai
	−192.5	.844	"
	−100	5.92	"
	+100	16.61	"
	200	24.50	"
	400	43.29	"
(*See also under steel*)			
Lead	20	22.	Bureau of Standards
	−252.9	.59	Schimank, Nernst
	−203	4.42	" "
	−192.8	5.22	" "
	−103	11.8	
	+100	27.8	Northrup
	200	38	"
	319	50	"
liquid	333	95.0	"
"	400	98.3	"
"	600	107.2	"
"	800	116.2	"
cold pressed	−183	6.02	Dewar, Fleming
" "	−78	14.1	
" "	0	20.4	
" "	90.4	28.0	
" "	196.1	36.9	
Lithium	−187	1.34	Guntz, Broniewski
	0	8.55	" "
	99.3	12.7	" "

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Lithium liquid	230	45.2×10^{-6}	Bernini, 1905
Magnesium	20	4.6	Bureau of Standards
Zn free	−183	1.00	Dewar, Fleming
" "	−78	2.97	" "
" "	0	4.35	" "
" "	98.5	5.99	" "
pure	400	11.9	Niccolai, 1907
Manganese		5.0	Shukow
Manganese-copper Mn 30, Cu 70	0	100	Feussner, Lindeck
Manganin, Cu 84, Mn 12, Ni 4	20	44	Bureau of Standards
	22.5	45	Kimura, Sakamaki
	−200	37.8	Niccolai
	−100	38.5	"
	−50	38.7	"
	0	38.8	"
	100	38.9	"
	400	38.3	"
Mercury	20	95.783	Bureau of Standards
solid	−183.5	6.97	Dewar, Fleming
"	−102.9	15.04	" "
"	−50.3	12.3	" "
"	−39.2	25.5	" "
liquid	−36.1	80.6	" "
"	0	94.07	" "
"	50	98.50	Grimaldi
"	100	103.25	Vincentini, Omodei
"	200	114.27	" "
"	350	135.5	" "
"	100	103.1	Northrup
"	200	114.0	"
"	300	127.0	"
Molybdenum, drawn	20	5.7	Bureau of Standards
Monel metal	20	42	Bureau of Standards
Nichrome	20	100	Bureau of Standards
Nickel	20	7.8	Bureau of Standards
pure	−182.5	1.44	Fleming, 1900
"	−78.2	4.31	"
"	0	6.93	"
"	94.9	11.1	"
"	400	60.2	Niccolai, 1907
Nickel-copper-zinc Ni 12.84, Cu 30.59 Zn 6.57 by vol.	0	20.3	Matthiessen
Nickelin Ni 18.46, Cu 61.63 Zn 19.67, Fe 0.24 Co 0.19, Mn 0.18	0	33	Feussner, Lindeck
Osmium	20	60.2	Niccolai
Palladium	20	11	Bureau of Standards
	−183	2.78	Dewar, Fleming
	−78	7.17	" "
	0	10.21	" "
	98.5	13.79	" "
Patent nickel Ni 25.1, Cu 74.41 Fe 0.42, Zn 0.23 Mn 0.13, Co trace	0	34	Feussner, Lindeck
Phosphor bronze	0	5–10	Various

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Platinoid, Cu 62, Ni 15, Zn 22	−160	32.5×10^{-6}	Lees, 1908
	18	34.4	"
Platinum	20	10	Bureau of Standards
	−203.1	2.44	Dewar, Fleming
	−97.5	6.87	" "
	0	10.96	" "
	+100	14.85	" "
	400	26	Niccolai
	−265	.10	Nernst
	−253	.15	"
	−233	.54	"
	−153	4.18	"
	−73	7.82	"
	0	11.05	"
	+100	14.1	Pirrani
	200	17.9	"
	400	25.4	"
	800	40.3	"
	1000	47.0	"
	1200	52.7	"
	1400	58.0	"
	1600	63.0	"
Platinum-iridium			
P 90, Ir 10	0	24	Barnes, 1888
P 80, Ir 20	0	31	"
Platinum-rhodium	−200	14.49	Dewar, Fleming
Pt 90, Rh 10	−100	18.05	" "
	0	21.14	" "
	+100	24.20	" "
Platinum-silver Pt 67, Ag 33	0	24.2	
Platinite, nickel steel Ni 46–48%	0	45	
Potassium	−200	1.72	Guntz, Broniewski
	−100	3.72	" "
	−75	4.0	Hackspill
	0	6.1	"
	+55	8.4	"
liquid	100	15.31	Northrup
Rheotan Cu 53.28, Ni 25.31 Zn 16.80, Fe 4.46 Mn 0.37	0	53	Feussner, Lindeck
Rhodium	−186	0.7	Broniewski, Hackspill
	−78.3	3.09	" "
	0	4.69	" "
	+100	6.60	" "
Rose metal Bi 49, Pb 28, Sm 23	0	64	
Rubidium	−190	2.5	Hackspill
	0	11.6	
	+35	13.4	
liquid	40	19.6	
Silicium (silicon)	20	58.	
Silicium bronze	0	2.4	
Silver 99.98%	18	1.629	Jäger, Diesselhorst
electrolytic	−183	0.390	Dewar, Fleming
"	−78	1.021	" "

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Silver, 99.98 %	0	1.468×10^{-6}	Dewar, Fleming
electrolytic	+98.15	2.062	" "
"	192.1	2.608	" "
	−258.6	.009	Niccolai
	−200	.357	"
	−100	.916	"
	0	1.506	"
	+100	2.15	Northrup
	200	2.80	"
	400	3.46	"
	750	6.65	"
liquid	1000	11.3	"
"	1500	15.3	"
Sodium	−180	1.0	Hackspill
	−75	2.8	"
	0	4.3	"
	55	5.4	"
liquid	116	10.2	"
"	−200	0.605	Various
	140	10.34	Northrup
Sodium-amalgam Hg 98, Na 2	0	95	
Steel			
aluminum Al 5, C 0.2	20	64	Portevin, 1909
Al 15, C 09	20	88	"
chromium Cr 13, C oz	20	60	"
Cr 40, C 08	20	71	
invar 35% Ni	20	81	Bureau of Standards
manganese	20	70	" "
nickel			
Ni 10, C 0.1	20	29	
Ni 25, C 0.1	20	39	
Ni 80, C 0.1	20	82	Portevin, 1909
piano wire	0	11.8	Stronhal, Barnes
Siemens-martin	20	18	Bureau of Standards
silicon, Si 25%	20	45	
Si 4%	20	62	
tempered glass hard		45.7	Stronhal, Barnes
tempered yellow		27	" "
" blue		20.5	" "
" soft		15.9	" "
titanium Ti 2.5, C 0.15,	20	16	Portevin, 1909
tungsten W 5, C 0.2	20	20	"
W 20, C 0.2	20	24	"
vanadium V 5, C 1.1	20	121	"
Strontium	20	24.8	Matthiessen
Tantalium	20	15.5	Bureau of Standards
Tellurium	19.6	200,000.	Matthiessen
Thallium, pure	−183	4.08	Dewar, Fleming
	−78	11.8	" "
	0	17.60	" "
	+98.5	24.7	" "

RESISTIVITY (Concluded)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Therlo	20	47 $\times 10^{-6}$	Bolton, 1909
Thorium	15	40.1	Rentschler, Marden, 1925
"	20	18	Bureau of Standards
Tin	20	11.5	Bureau of Standards
	−184	3.40	Dewar, Fleming
	−78	8.8	" "
	0	13.0	" "
	+91.45	18.2	" "
	200	20.30	Northrup
	225	22.00	"
liquid	235	47.60	"
	750	61.22	"
Tin-bismuth			
Sn 90.5, Bi 9.5,	12	16	
Sn 2., Bi 98	0	244	
Tin-lead			
Sn 90, Pb 10	15	13.5	
Sn 33.3, Pb 66.7	15	16	Laport, 1897
Titanium		3.2	Shukow
Tungsten	20	5.51	Langmuir, 1916
	727	25.3	"
	1227	41.4	"
	1727	59.4	"
	2727	98.9	"
	3237	118	
Wood's metal			
Bi 56, Pb 14, Sn 14	0	52	
Zinc	−183	1.62	Dewar, Fleming
	−78	3.34	" "
	0	5.75	" "
	+92.5	8.00	
	191.5	10.37	
liquid	440	37.2	de la Rive
	100	7.95	Northrup
	300	13.25	"
	415	17.00	"
liquid	427	37.30	"
"	500	36.60	"
"	600	35.90	"
"	700	35.60	"
"	800	35.60	"
"	850	35.74	"

Material	Temp. °C.	Resistivity ohm-cm	Temperature coefficient
Alloy 193	0	87–96 $\times 10^{-6}$	0.000014–.0008
Alumel	0	33.3	0.0012
Chromel	0	70–110	0.00011–.000054
Copel	0	49.5	0.00000
Dowmetal	0	13–17	....
Duralumin	0	3.35	....
Nichrome II	0	109–111	0.00015
" III	0	90–97	0.00005–.00019
" IV	0	98–103	0.00018

TEMPERATURE COEFFICIENT OF RESISTIVITY

Giving the temperature coefficient of resistivity for degrees centigrade for various metals including alloys.

Material	T °C.	α	Authority
Advance (*See constantan*)			
Aluminum	18	0.0039	Jäger, Diesselhorst, 1900
	25	.0034	Somerville, 1910
	100	.0040	"
	500	.0050	"
annealed, highest purity	0–100	.00445	Holborn, 1921
Aluminum-bronze			
Cu 97, Al 3		.00102	
Cu 90, Al 10		.00320	
Cu 6, Al 94		.00380	
Antimony	20	.0036	
Arsenic		.0042	
Bismuth	20	.004	Bureau of Standards
	0–100	.00446	Holborn, 1921
Brass	20	.002	Bureau of Standards
Cu 66, Zn 34	15	.0020	
Cu 60, Zn 40	15	.0010	
Bronze			
Cu 88, Sn 12	20	.0005	
Cadmium	20	.0038	Bureau of Standards
drawn			
annealed, pure	0–100	.00424	Holborn, 1921
	0	.0042	
Carbon		−.0005	
Climax	20	+.0007	Bureau of Standards
Cobalt	0	.0033	
	0–100	.00658	Holborn, 1921
Constantan	12	.000008	Somerville, 1911
	25	.000002	"
	100	.000033	"
	200	.000020	"
	500	.000027	"
Copper, annealed	20	.00393	Bureau of Standards
hard drawn	20	.00382	" "
	100	.0038	Somerville, 1911
	400	.0042	"
	1000	.0062	"
electrolytic	0	.0041	
pure, annealed	0–100	.00433	Holborn, 1921
Copper-manganese			
Cu 96.5, Mn 3.5		.00022	Feussner, Lindeck
Cu 95, Mn 8		.000026	" "
Cu 70, Mn 30		.00004	" "
Copper-manganese-iron			
Cu 91, Mn 7.1, Fe 1.9	0	.000120	Blood
Cu 70.6, Mn 23.2, Fe 6.2	0	.000022	"
Copper-manganese-nickel			
Cu 73, Mn 24, Ni 3	0	−.00003	Feussner, Lindeck
Eureka	0	+.00005	Drysdale, 1907
Excello	20	.00016	Bureau of Standards
German-silver			
Ni 18%	20	.0004	Bureau of Standards
Cu 60, Zn 25, Ni 15	0	.00036	Feussner, Lindeck
Gold	20	.0034	Bureau of Standards
	100	.0025	Somerville, 1910
	500	.0035	"
	1000	.0049	"
	0–100	.00400	Holborn, 1921

TEMPERATURE COEFFICIENT OF RESISTIVITY
(Continued)

Material	T °C.	α	Authority
Gold-copper-silver			
Au 58.3, Cu 26.5, Ag 15.2	0	.000574	Matthiessen
Au 66.5, Cu 15.4, Ag 18.1	0	.000529	"
Au 7.4, Cu 78.3, Ag 14.3	0	.001830	"
Gold-silver			
Au 90, Ag 10	0	.0012	
Au 67, Ag 33	0	.00065	
Ia Ia			
Cu 60, Ni 40	0	−.00003	Drysdale, 1907
Illium		+.000479	Knipp-Hall, 1922
Indium	0	.0047	
Iridium	0–100	.00411	Holborn, 1921
Iron	20	.0050	Bureau of Standards
	0	.0062	Dewar, Fleming
	25	.0052	Somerville, 1910
	100	.0068	"
	500	.0147	"
	1000	.0050	"
	0–100	.00657	Holborn, 1912
Lead	18	.0043	Jäger, Diesselhorst
pure	0–100	.00422	Holborn, 1921
Lithium	0	.0047	
	230	.0027	
Magnesium	20	.004	Bureau of Standards
	0	.0038	Vincentini, Omodei
	25	.0050	Somerville, 1910
	100	.0045	"
	500	.0036	"
	600	.0100	"
Manganese-copper	0	.000040	Feussner-Lindeck
Mn 30, Cu 70			
Manganin			
Cu 84, Mn 12, Ni 4	12	.000006	Somerville, 1910
	25	.000000	"
	100	−.000042	"
	250	−.000052	"
	475	.000000	"
	500	+.00011	"
Mercury	20	.00089	Bureau of Standards
	0	.00088	Glazebrook
Molybdenum	25	.0033	Somerville
	100	.0034	"
	1000	.0048	"
	0–100	.00435	Holborn, 1921
Monel-metal	20	.0020	Bureau of Standards
Nichrome	20	.0004	Bureau of Standards
Nickel	20	.006	Bureau of Standards
	0	.006	Vincentini
	25	.0043	Somerville
	100	.0043	"
	500	.0030	"
	1000	.0037	"
pure, annealed	0–100	.00675	Holborn, 1912
Palladium	20	.0033	Bureau of Standards
pure	0–100	.00377	Holborn
"	0	.0035	Dewar, Fleming
Phosphor-bronze	0	.0040 — .0030	

TEMPERATURE COEFFICIENT OF RESISTIVITY
(Concluded)

Material	T °C.	α	Authority
Platinite, nickel steel, Ni 46–48%	0	.003	
	20	.003	Bureau of Standards
Platinum	0	.0037	Dewar, Fleming
	0–100	.00392	Holborn, 1921
Platinum-iridium			
Pt 90, Ir 18	0	.0012	Barnes, 1888
Pt 80, Ir 20	0	.0008	"
Platinum-rhodium			
Pt 90, Rh 10	0	.0013	Le Chatelier, 1900
Platinum-silver			
Pt 33, Ag 67	0	.00024	
Potassium	0	.0055	
liquid	100	.0042	
Rheotan	0	.0004	
Rhodium	0–100	.00443	Holborn
Rose metal	0	.0020	
Rubidium	0	.0060	
Silicium bronze	0	.0038–.0023	
Silver	20	.0038	Bureau of Standards
	25	.0030	Somerville, 1910
	100	.0036	"
	500	.0044	"
pure, annealed	0–100	.00410	Holborn, 1921
Sodium	0	.0044	
liquid	120	.0033	
Steel			
invar	0	.0020	
Ni 36, C 0.2			
piano wire	0	.0032	Strouhal, Barnes
Siemens-Martin	20	.003	Bureau of Standards
Silicon			
Si 4%	20	.0008	
tempered glass hard	0	.0016	Strouhal, Barnes
tempered blue	0	.0033	" "
Tantalum	20	.0031	Bureau of Standards
	0–100	.00347	Holborn, 1921
Thallium	0	.0040	
liquid	295	.00035	
Therlo	20	.00001	Bureau of Standards
Thorium	20-1800	.0021	Rentschler, Marden, 1925
Tin	20	.0042	Bureau of Standards
Tungsten	18	.0045	Jäger, Diesselhorst
	500	.0057	Somerville
	1000	.0089	"
pure, annealed	0–100	.00465	Holborn, 1921
Wood's metal	0	.0020	
Zinc	20	.0037	Bureau of Standards
	0	.0040	
	0–100	.00415	Holborn, 1921

RESISTANCE OF ELECTROLYTES

Resistance of aqueous solutions of various salts and acids in ohms per centimeter cube for a temperature of 18° C.

(From observations by Kohlrausch.)

Salt.	Number of grams of salt in 100 grams solution.							
	5	10	15	20	25	30	40	50
Acetic acid	..	654.	616.	622.5	658.	714.	925.	1351.
Ammonium chloride	10.89	5.63	3.86	2.97	2.48			
Copper nitrate	27.4	15.7	11.7	9.82	9.17			
sulphate	52.9	31.2	23.7					
Hydrochloric acid	2.54	1.59	1.34	1.31	1.38	1.51	1.94	
Potassium iodide	29.5	14.7	....	6.88	....	4.34	3.16	2.5
Silver nitrate	39.0	21.0	14.64	11.46	9.45	8.07	6.39	5.3
Sodium carbonate	22.2	14.2	12.0					
chloride	14.94	8.33	6.10	5.11	4.69			
hydroxide	5.08	3.20	2.89	3.06	3.68	4.95	8.61	
Sulphuric acid	4.79	2.55	1.84	1.53	1.39	1.35	1.47	1.85
Zinc chloride	20.70	13.75	..	10.96	....	10.80	11.53	15.87
sulphate	52.3	31.2	24.1	21.4	20.8	22.5		
(Concentration)	6.2	12.4	18.6	24.8	31.	37.2	43.4	
Nitric acid	3.2	1.84	1.45	1.30	1.28	1.32	1.43	
(Concentration)	8.4	12.6	16.8	21.	25.2	29.4	33.6	
Potassium hydroxide	3.67	2.66	2.19	1.96	1.85	1.84	1.91	

SAFE CARRYING CAPACITY OF COPPER WIRE

(From Collins' Design and Construction of Induction Coils, by permission.)

Brown & Sharpe gauge.	Diameter in mils.	Area in circular mils.	Number of amperes, exposed work.	Number of amperes, confined spaces.
18	40	1.624	5	3
17	45	2.048	6	4
16	51	2.583	8	6
15	57	3.257	10	8
14	64	4.106	16	12
13	72	5.178	19	14
12	81	6.530	23	17
11	91	8.234	27	21
10	102	10.380	32	25
9	114	13.090	39	29
8	128	16.510	46	33
7	144	20.820	56	39
6	162	26.250	65	45
5	182	33.100	77	53
4	204	41.740	92	63
3	229	52.630	110	75
2	258	66.370	131	88
1	289	83.690	156	105
0	325	105.500	185	125
00	365	133.100	220	150

CONDUCTIVITY OF STANDARD SOLUTIONS

Giving the conductivity in reciprocal ohms (mho) per cm. for NaCl, KCl, H_2SO_4 and $MgSO_4$ for various temperatures. Solutions are as follows:—

H_2SO_4,—maximum conductivity (18° C.); dissolve 378 g. of 97% acid in pure water and dilute to 1 liter. Density at 18° C., 1.223.

$MgSO_4$,—maximum conductivity (18° C.); dissolve in 1 liter of distilled water 552 g. of $MgSO_4 7H_2O$. Density at 18° C., 1.190.

NaCl,—solution saturated at all temperatures given. An excess of NaCl in distilled water, about 450 g. per liter. D = 1.2014 (18° C.).

KCl,—normal solution, 74.59 grams per liter of solution at 18° C. Dissolve 74.555 grams (weighed in air) of KCl and dilute to 1 liter. Density, 1.04492.

Solution.	0° C.	5°	10°	15°
H_2SO_4	0.5184	0.5792	0.6408	0.7028
$MgSO_4$	0.02877	0.03402	0.03963	0.04555
NaCl	0.1345	0.1555	0.1779	0.2014
KCl, normal	0.06541	0.07414	0.08319	0.09252
KCl, 1/10 normal	0.00715	0.00822	0.00933	0.01048
KCl, 1/100 normal	0.000776	0.000896	0.001020	0.001147

	16°	17°	18°	19°	20°
H_2SO_4	0.7151	0.7275	0.7398	0.7522	0.7645
$MgSO_4$	0.04676	0.04799	0.04922	0.05046	0.05171
NaCl	0.2062	0.2111	0.2160	0.2209	0.2259
KCl, n.	0.09441	0.09631	0.09822	0.10014	0.10207
KCl, 1/10 n.	0.01072	0.01095	0.01119	0.01143	0.01167
KCl, 1/100 n.	0.001173	0.001199	0.001225	0.001251	0.001278

	21°	22°	23°	24°	25°
H_2SO_4	0.7768	0.7890	0.8013	0.8135	0.8257
$MgSO_4$	0.05297	0.05424	0.05551	0.05679	0.05808
NaCl	0.2309	0.2360	0.2411	0.2462	0.2513
KCl, n.	0.10400	0.10594	0.10789	0.10984	0.11180
KCl, 1/10, n.	0.01191	0.01215	0.01239	0.01264	0.01288
KCl, 1/100 n.	0.001305	0.001332	0.001359	0.001386	0.001413

	26°	27°	28°	29°	30°
H_2SO_4	0.8378	0.8499	0.8620	0.8740	0.8860
$MgSO_4$	0.05937	0.06067	0.06197	0.06328	0.06459
NaCl	0.2565	0.2616	0.2669	0.2721	0.2774
KCl, n.	0.11377	0.11574	....	....	....
KCl, 1/10 n.	0.01313	0.01337	0.01362	0.01387	0.01412
KCl, 1/50 n.	0.002819	0.002873	0.002927	0.002981	0.003036

EQUIVALENT CONDUCTANCE OF AQUEOUS SOLUTIONS

The equivalent conductance is given in reciprocal ohms. Concentration is given in milli-equivalents of solute per liter of solution. Corrected for conductance of water except in case of the strong acids.

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Acetic acid	0.	347.	773.
	10.	14.50	25.1
	30.	8.50	14.7
	80.	5.22	9.05
	100.	4.67	8.10
*Ammonium acetate	0.	99.8	338.
	10.	91.7	300.
	25.	88.2	286.
*Ammonium chloride	0.	131.1	415.
	2.	126.5	399.
	10	122.5	382.
	30.	118.1	......
Ammonium hydroxide	0.	238.	647.
	10.	9.66	23.2
	30.	5.66	13.6
	100.	3.10	7.47
Barium ferrocyanide	0.	91.	521.
	2.	46.9	202.3
	12.5	30.4	129.8
Barium hydroxide	0.	222.	645.
	2.	215.	591.
	10.	207.	548.
	50.	191.1	478.
	100.	180.1	443.
Barium nitrate	0.	116.9	385.
	2.	109.7	352
	10.	101.	322.
	40.	88.7	280.
	80.	81.6	258.
	100.	79.1	249.
Calcium ferrocyanide	0.	88.	512.
	100.	21.9	84.3
	200.	20.6	77.5
	400.	202.	76.2
Calcium nitrate	0.	70.4	369.
	2.	66.5	346.5
	50.	55.6	276.8
	100.	51.9	255.5
	200.	48.3	234.4

* Values have been corrected for hydrolysis.

EQUIVALENT CONDUCTANCE OF AQUEOUS SOLUTIONS (Continued)

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Hydrochloric acid	0.	379.	850.
	2.	373.6	826.
	10.	368.1	807.
	80.	353.	762.
	100.	350.6	754.
Lanthanum nitrate	0.	75.4	413.
	2.	68.9	363.5
	12.5	61.4	311.2
	50.	54.	261.4
	100.	49.9	236.7
	200.	46.	210.8
Magnesium sulphate	0.	114.1	426.
	2.	94.3	302.
	10.	76.1	234.
	20.	67.5	190.
	40.	59.3	160.
	80.	52.	136.
	100.	49.8	130.
	200.	43.1	110.
Nitric acid	0.	377.	826.
	2.	371.2	806.
	10.	365.	786.
	50.	353.7	750.
	100.	346.4	728.
Phosphoric acid	0.	338.3	730.
	2.	283.1	498.
	10.	203.	308.
	50.	122.7	168.
	100.	95.7	128.
Potassium chloride	0.	130.1	414.
	2.	126.3	393.
	10.	122.4	377.
	80.	113.5	342.
	100.	112.	336.
Potassium citrate	0.	76.4	420.
	2.	71.	381.2
	5.	67.6	357.2
	50.	54.4	273.
	100.	50.2	247.5
	300.	43.5	209.5
Potassium nitrate	0.	80.8	384.
	2.	78.6	370.3
	12.5	75.3	351.5

EQUIVALENT CONDUCTANCE OF AQUEOUS SOLUTIONS (Continued)

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Potassium nitrate	50.	70.7	326.1
	100.	67.2	308.5
Potassium ferrocyanide	0.	98.4	527.
	2.	84.8	427.6
	50.	58.2	272.4
	100.	53.	245.
	206.	48.8	222.3
	400.	45.4	203.1
Potassium oxalate	0.	79.4	419.
	2.	74.9	389.3
	50.	63.	312.2
	100.	59.3	288.9
	200.	55.8	265.1
Potassium sulphate	0.	132.8	455.
	2.	124.8	402.
	10.	115.7	365.
	40.	104.2	320.
	80	97.2	294.
	100	95.	286.
Silver nitrate	0.	115.8	367.
	2.	112.2	353.
	10.	108.	337.
	20.	105.1	326.
	40.	101.3	312.
	80.	96.5	294.
	100.	94.6	289.
Sodium acetate	0.	78.1	285.
	2.	74.5	268.
	10.	71.2	253.
	80.	63.4	221.
Sodium chloride	0.	109.	362.
	2.	105.6	349.
	10.	102.	336.
	80.	93.5	301.
	100.	92.0	296.
Sodium hydroxide	0.	216.5	594.
	2.	212.1	582.
	20.	205.8	559.
	50.	200.6	540.
Sulphuric acid	0.	383.	891.
	2.	353.9	571.
	10.	309.	446.
	50.	253.5	384.
	100.	233.3	369.

THE EQUIVALENT CONDUCTANCE OF THE SEPARATE IONS

(From Smithsonian Physical Tables)

Ion.	0°	18°	25°	50°	75°	100°	128°	156°
K	40.4	64.6	74.5	115	159	206	263	317
Na	26.	43.5	50.9	82	116	155	203	249
NH_4	40.2	64.5	74.5	115	159	207	264	319
Ag	32.9	54.3	63.5	101	143	188	245	299
$\frac{1}{2}Ba$	33.	55.	65.	104	149	200	262	322
$\frac{1}{2}Ca$	30.	51.	60.	98	142	191	252	312
$\frac{1}{3}La$	35.	61.	72.	119	173	235	312	388
Cl	41.1	65.5	75.5	116	160	207	264	318
NO_3	40.4	61.7	70.6	104	140	178	222	263
$C_2H_3O_2$	20.3	34.6	40.8	67	96	130	171	211
$\frac{1}{2}SO_4$	41.	68.	79.	125	177	234	303	370
$\frac{1}{2}C_2O_4$	39.	63.	73.	115	163	213	275	336
$\frac{1}{3}C_6H_5O_7$	36.	60.	70.	113	161	214		
$\frac{1}{4}Fe(CN)_6$	58.	95.	111.	173	244	321		
H	240.	314.	350.	465	565	644	722	777
OH	105.	172.	192.	284	360	439	525	592

RESISTIVITY OF DIELECTRICS

Giving the volume resistivity ρ, the variation of the volume resistivity with temperature, given as the ratio of the value at 20° C. to that at 30° C., and the surface resistivity for various dielectrics. The surface resistivity is the resistance between the opposite edges of a centimeter square. A large part of the data are from Curtis, Bulletin of the Bureau of Standards 1915. Temperatures, unless otherwise stated, are 22° C. The numbers in parentheses refer to the source of information.

Material	Volume resistivity			Surface resistivity, ohm-cm	
	Temp. °C.*	ρ ohm-cm	ρ^{20}/ρ^{30}	Humidity 50 %	Humidity 90 %
Amberite	22	5×10^{16}		2×10^{15}	3×10^{12}
Amber		5×10^{16}		6×10^{14}	1×10^{11}
Bakelite†					
No. 1		2×10^{11}		3×10^{11}	2×10^{8}
140		2×10^{7}	2.4	3×10^{9}	2×10^{6}
150		4×10^{12}	3.6	3×10^{12}	4×10^{9}
190		1×10^{11}	3.6	1×10^{11}	5×10^{8}
L 558		2×10^{16}	2.6	8×10^{15}	8×10^{14}
G5074		4×10^{10}		3×10^{11}	5×10^{6}
5199RGRB		5×10^{12}		6×10^{12}	1×10^{10}
5200		4×10^{11}	5.3	1×10^{12}	5×10^{9}
Bakelite micarta		5×10^{10}	2.4	2×10^{10}	1×10^{8}
Beeswax					
yellow, unrefined		20×10^{14}	16.0	$**6 \times 10^{14}$	$**5 \times 10^{14}$
	20	8×10^{14} (1)			
white		6×10^{14}			
	22	5×10^{14} (1)			
Celluloid		2×10^{10}	1.8	5×10^{10}	2×10^{9}
	16	4×10^{10} (2)			
Ceresin		$> 5 \times 10^{18}$		$> **1 \times 10^{17}$	$> **1 \times 10^{17}$
Condensite					
black		4×10^{10}	2.9	6×10^{10}	8×10^{8}
yellow		4×10^{10}	2.9	3×10^{11}	6×10^{9}
Dielectrite		5×10^{12}	3.0	5×10^{11}	4×10^{7}
Duranoid		3×10^{15}		6×10^{12}	3×10^{8}
Electrose, No. 8		2×10^{16}		1×10^{15}	2×10^{12}
black		1×10^{14}	2.0	1×10^{12}	6×10^{9}
yellow		5×10^{15}	2.3	3×10^{14}	5×10^{8}
Fibre, hard		2×10^{10}	3.2	5×10^{9}	3×10^{7}
red		5×10^{9}	2.6	2×10^{10}	2×10^{8}
	20	1×10^{8} (3)			
Galalith,					
black		2×10^{10}		8×10^{10}	3×10^{9}
white		1×10^{10}		4×10^{10}	6×10^{8}
Glass, German		5×10^{13}	2.5	4×10^{11}	6×10^{8}
	18	5×10^{11} (4)			
Kavalier		8×10^{15}	4.5	4×10^{12}	1×10^{9}
	17	1×10^{16} (5)			
opal		1×10^{12}	2.8		
plate, commercial		2×10^{13}	3.2	5×10^{10}	2×10^{6}
ordinary	20	9×10^{13}			
Bohemian	20	6×10^{12}			
Glyptol		1×10^{16}	3.0		
Gummon		3×10^{12}	1.4	2×10^{12}	3×10^{8}
Halowax 1001		2×10^{13}	2.5	$*6 \times 10^{15}$	$*5 \times 10^{11}$
5055 B		2×10^{16}			

* Temperature is 22°C. except where otherwise stated.
† For composition of bakelite samples see table following.
** Leakage resistivity.

RESISTIVITY OF DIELECTRICS (Continued)

Material	Volume resistivity			Surface resistivity, ohm-cm	
	Temp. °C.	ρ ohm-cm	ρ^{20}/ρ^{30}	Humidity 50%	Humidity 90%
Hard Rubber		1×10^{18}		3×10^{15}	2×10^{9}
		2×10^{15} (6)			
		3×10^{16} (?)			
Hemit		1×10^{10}	1.2	1×10^{10}	3×10^{8}
Insulate		8×10^{15}	1.0	3×10^{14}	3×10^{11}
Ivory		2×10^{8}	1.5	5×10^{9}	1×10^{9}
Khotinsky Cement		2×10^{15}	11.0	$*7\times10^{14}$	$*5\times10^{11}$
Lavite		2×10^{10}		1×10^{11}	1×10^{8}
Marble					
Italian		1×10^{11}		3×10^{9}	2×10^{7}
		1×10^{10} (?)			
Pink Tennessee		5×10^{9}		5×10^{9}	3×10^{7}
Blue Vermont		1×10^{9}		8×10^{9}	1×10^{7}
Mica	20	9×10^{15} (6)			
black African		4×10^{13}		3×10^{12}	3×10^{9}
brown African		2×10^{15}	1.2	3×10^{11}	1×10^{8}
colorless		2×10^{17}	2.0	2×10^{13}	8×10^{9}
India ruby		5×10^{13}	2.7	1×10^{10}	9×10^{7}
stained		2×10^{13} (7)			
Indian ruby		5×10^{15}	1.0		
slightly stained		4×10^{13} (7)			
Moulded mica		1×10^{15}	1.2	5×10^{13}	3×10^{9}
Paraffin (special)		$>5\times10^{18}$		$*9\times10^{15}$	$*6\times10^{15}$
parowax		1×10^{16}	2.0		
		3×10^{18} (8)			
	17	5×10^{16} (5)			
Porcelain, unglazed		3×10^{14}	1.6	6×10^{11}	5×10^{8}
glazed				2×10^{13}	5×10^{8}
Quartz crystal					
‖ to axis	17	2×10^{14} (5)			
	20	1×10^{14} (6)			
⊥ to axis	17	2×10^{16} (5)			
	20	3×10^{16} (6)			
fused		$>5\times10^{18}$		3×10^{12}	2×10^{8}
cleaned with chromic acid				3×10^{14}	2×10^{12}
Redmonite		2×10^{14}	2.0	5×10^{13}	3×10^{10}
Rosin		5×10^{16}	3.6	5×10^{14}	2×10^{14}
	17	7×10^{15} (5)			
Sealing wax		8×10^{15}	0.9	2×10^{15}	9×10^{13}
	19	1×10^{15} (1)			
Shellac		1×10^{16}	1.5	5×10^{13}	6×10^{9}
		9×10^{15} (?)			
Slate		1×10^{8}		9×10^{6}	1×10^{6}
		2×10^{8} (?)			
Stabalite		3×10^{13}	1.6	2×10^{13}	4×10^{7}
Sulfur		1×10^{17}	4.9	7×10^{15}	1×10^{14}
	17	8×10^{15} (5)			
Tegit		2×10^{12}	1.4		
Tetrachlornaphthalene		5×10^{13}	2.9	$*1\times10^{14}$	$*1\times10^{14}$
Wood, paraffined					
mahogany		4×10^{13}		3×10^{12}	5×10^{9}
maple		3×10^{10}	3.6	8×10^{11}	2×10^{9}
poplar		5×10^{11}	3.6	1×10^{12}	1×10^{9}

* Leakage resistivity.

RESISTIVITY OF DIELECTRICS (Continued)

Description of Materials

Amberite is made by compressing scrap amber.

Bakelite. A phenol condensation product, with various fillers. The various samples were made as follows:

Number	Percent pure Bakelite	Filler	Phenolic Body	Condensing Agent
1		Paper	Cresols	Ammonia
140	50	Vegetable	Phenol	Caustic soda
150	50	Fiber	"	Ammonia
190	50	"	Cresols	"
5199	50	"	Phenol	"
5200	50	Fiber & clay	"	"
5074	35	Talc	"	Caustic soda
588	100	None	"	
1 Regular	100	None	Cresols	Ammonia

Ceresin is a waxy material refined from the mineral ozokerite, m.p. below 100° C. sp. gr. 0.91–0.97. Condensite is a phenol condensation product.

Hard fiber, soft cotton paper, treated with zinc chloride, dried and pressed.

Galalith is made from the casein of milk.

Kavalier glass is hard combustion tubing having a large potassium and calcium content.

Glyptol is an artificial resin resembling amber.

Gummon, hemit, and tegit are coal tar products.

Halowax, chlorinated naphthalenes.

Moulded mica is ground mica and asbestos with shellac.

Stabalite is a rubber compound.

References

1. Dietrich, 1909
2. Addenbrooke, 1911
3. Rayner, 1905
4. Campbell, 1913
5. Thornton, 1910
6. Curie, 1889
7. Wilson-Mitchell, 1905
8. Braum, 1887

Liquids

Resistance in ohms per centimeter cube.

Substance.	Temp. ° C.	Resistance, ohms.
Alcohol, ethyl	15	$.3 \times 10^6$
methyl	....	$.14 \times 10^6$
Oils, olive	....	5×10^{12}
paraffin	....	1×10^{16}
Petroleum	....	2×10^{16}
Water distilled	18	0.5×10^6

Fused Salts

(Poincaré.)

Substance.	Temp. ° C.	Resistance, ohms.
Calcium chloride	750	.862
Potassium bromide	750	.714
chlorate fused	355	2.20
Silver nitrate	350	.820
Sodium chloride fused	750	.294

STANDARD CALIBRATION TABLES FOR THERMOCOUPLES

The following tables which represent the Temperature-E. M. F. functions of various thermocouples should be used with appropriate correction curves if precise results are desired. These curves must be determined for each individual couple by plotting ΔE, the difference between the observed and the standard E. M. F., against the standard E. M. F. at three or more fixed temperature points. The value ΔE as shown by such a correction curve is then subtracted algebraically from the observed E. M. F. to give the true E. M. F. reading.

In the following tables the fixed or "cold junction" is at 0° C.; when the cold junction is not maintained at 0° C. the readings of the E. M. F. must be corrected as follows: $Et = E(_{t-tc}) + Etc$ where $E(_{t-tc})$ is the observed reading, Etc is the E. M. F. for the temperature corresponding to the cold junction temperature as read from the standard table and Et is the E. M. F. produced by the hot junction corrected to the value which would be obtained with the cold junction at 0° C. The temperature corresponding to Et is then obtained by reference to the standard table.

Since the E. M. F.-temperature function is not linear the cold junction should be maintained at a temperature very close to that at which the thermocouple was calibrated. Otherwise considerable error will result despite the above correction.

TEMPERATURE-E. M. F. VALUES FOR PLATINUM-PLATINUM (90%), RHODIUM (10%) THERMO-ELEMENTS

E. M. F. values are in millivolts; temperatures are in degrees centigrade (Computed from values in the International Critical Tables)

Degree C.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0°	0	0.06	0.11	0.17	0.24	0.30	0.36	0.43	0.50	0.57
100°	0.64	0.72	0.79	0.87	0.95	1.02	1.10	1.18	1.26	1.35
200°	1.43	1.52	1.60	1.69	1.78	1.86	1.95	2.04	2.13	2.22
300°	2.31	2.40	2.50	2.59	2.68	2.77	2.87	2.96	3.05	3.15
400°	3.24	3.34	3.44	3.53	3.63	3.73	3.82	3.92	4.02	4.12
500°	4.22	4.31	4.41	4.51	4.61	4.71	4.82	4.92	5.02	5.12
600°	5.22	5.32	5.43	5.53	5.63	5.74	5.84	5.94	6.05	6.16
700°	6.26	6.37	6.47	6.58	6.68	6.79	6.89	7.01	7.11	7.22
800°	7.33	7.44	7.55	7.66	7.77	7.88	7.99	8.10	8.21	8.32
900°	8.43	8.54	8.66	8.77	8.89	9.00	9.11	9.22	9.34	9.46
1000°	9.57	9.68	9.80	9.92	10.03	10.15	10.27	10.38	10.50	10.62
1100°	10.74	10.86	10.98	11.10	11.21	11.33	11.45	11.57	11.69	11.81
1200°	11.93	12.05	12.17	12.29	12.41	12.53	12.65	12.77	12.89	13.01
1300°	13.13	13.25	13.37	13.49	13.61	13.73	13.85	13.97	14.09	14.21
1400°	14.33	14.45	14.58	14.70	14.82	14.94	15.06	15.19	15.31	15.43
1500°	15.55	15.67	15.79	15.91	16.03	16.15	16.27	16.39	16.51	16.63
1600°	16.75	16.87	16.99	17.11	17.23	17.35	17.47	17.59	17.71	17.83
1700°	17.95	18.07	18.19	18.31	18.43	18.55	.....	.....	.....	.....

TEMPERATURE-E. M. F. VALUES FOR PLATINUM-PLATINUM (87%), RHODIUM (13%) THERMO-ELEMENTS

E. M. F. values are in millivolts; temperatures are in degrees centigrade (From values given in Bulletin No. 325, Charles Engelhard, Inc., New York)

Degree C.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0°	0	0.06	0.12	0.18	0.25	0.31	0.38	0.45	0.52	0.60
100°	0.67	0.75	0.83	0.90	0.99	1.07	1.15	1.23	1.32	1.40
200°	1.49	1.58	1.67	1.76	1.85	1.94	2.03	2.12	2.21	2.30
300°	2.40	2.49	2.59	2.68	2.77	2.87	2.98	3.08	3.19	3.29
400°	3.40	3.51	3.61	3.72	3.82	3.93	4.04	4.15	4.25	4.36
500°	4.47	4.58	4.69	4.81	4.92	5.03	5.14	5.26	5.37	5.49
600°	5.60	5.72	5.83	5.95	6.06	6.18	6.30	6.42	6.53	6.65
700°	6.77	6.89	7.01	7.13	7.25	7.37	7.49	7.62	7.74	7.87
800°	7.99	8.12	8.24	8.37	8.49	8.62	8.75	8.88	9.00	9.13
900°	9.26	9.39	9.52	9.66	9.79	9.92	10.05	10.18	10.32	10.45
1000°	10.58	10.72	10.85	10.99	11.12	11.26	11.40	11.54	11.67	11.81
1100°	11.95	12.09	12.23	12.38	12.52	12.66	12.80	12.94	13.09	13.23
1200°	13.37	13.52	13.66	13.81	13.95	14.10	14.25	14.40	14.54	14.69
1300°	14.84	14.99	15.14	15.30	15.45	15.60	15.75	15.90	16.06	16.21
1400°	16.36	16.52	16.67	16.83	16.98	17.14	17.30	17.46	17.61	17.77
1500°	17.93	18.09	18.25	18.42	18.58	18.74	18.90	19.06	19.23	19.39
1600°	19.55	19.71	19.88	20.04	20.21	20.37	.....	.....	.....	.....

TEMPERATURE-E. M. F. VALUES FOR CHROMEL-ALUMEL THERMO-ELEMENTS

E. M. F. values are in millivolts; temperatures are in degrees centigrade (Computed from values in the International Critical Tables)

Degree C.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0°	0	0.41	0.82	1.23	1.65	2.07	2.48	2.90	3.32	3.73
100°	4.15	4.56	4.98	5.39	5.79	6.19	6.59	6.99	7.39	7.79
200°	8.19	8.60	9.00	9.41	9.82	10.23	10.64	11.05	11.46	11.87
300°	12.29	12.70	13.12	13.54	13.96	14.38	14.79	15.21	15.63	16.06
400°	16.48	16.91	17.33	17.75	18.18	18.60	19.03	19.45	19.88	20.31
500°	20.74	21.17	21.59	22.02	22.44	22.87	23.30	23.73	24.15	24.58
600°	25.00	25.42	25.85	26.27	26.69	27.12	27.55	27.96	28.37	28.79
700°	29.21	29.62	30.03	30.44	30.85	31.26	31.66	32.07	32.47	32.88
800°	33.28	33.68	34.08	34.48	34.88	35.27	35.66	36.06	36.46	36.85
900°	37.25	37.64	38.04	38.43	38.82	39.21	39.60	39.98	40.37	40.81
1000°	41.13	41.51	41.89	42.26	42.64	43.01	43.38	43.75	44.12	44.48
1100°	44.85	45.21	45.57	45.93	46.29	46.65	47.01	47.36	47.71	48.07

TEMPERATURE-E. M. F. VALUES FOR CHROMEL-ALUMEL THERMO-ELEMENTS (Continued)

E. M. F. values are in millivolts; temperatures are in degrees centigrade
(From Catalog "G," Hoskins Manufacturing Co., Detroit)

Degree C.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0°	0	0.42	0.82	1.22	1.62	2.03	2.44	2.85	3.26	3.67
100°	4.08	4.49	4.90	5.32	5.73	6.14	6.55	6.95	7.36	7.76
200°	8.17	8.57	8.98	9.39	9.80	10.21	10.63	11.05	11.47	11.90
300°	12.32	12.73	13.15	13.56	13.97	14.38	14.79	15.12	15.55	15.98
400°	16.50	16.93	17.36	17.79	18.22	18.65	19.06	19.48	19.91	20.34
500°	20.76	21.19	21.62	22.05	22.48	22.90	23.33	23.75	24.18	24.60
600°	25.03	25.45	25.87	26.29	26.71	27.14	27.56	27.98	28.40	28.81
700°	29.22	29.62	30.03	30.44	30.86	31.28	31.70	32.10	32.50	32.91
800°	33.31	33.72	34.12	34.52	34.92	35.33	35.74	36.14	36.54	36.93
900°	37.32	37.70	38.09	38.48	38.87	39.26	39.64	40.02	40.40	40.78
1000°	41.16	41.54	41.92	42.29	42.67	43.06	43.42	43.79	44.15	44.52
1100°	44.89	45.26	45.63	46.00	46.37	46.74	47.09	47.44	47.79	48.14
1200°	48.49	48.84	49.19	49.54	49.90	50.25	50.60	50.94	51.28	51.62
1300°	51.96	52.31	52.65	53.00	53.34	53.68	54.02	54.36	54.69	55.02

TEMPERATURE-E. M. F. VALUES FOR COPPER-CONSTANTAN THERMO-ELEMENTS

E. M. F. values are in millivolts; temperatures are in degrees centigrade
(Computed from values in the International Critical Tables)

Degree C.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
−200°	−5.54	−5.69	......	......	......	......	......	......	......	......
−100°	−3.35	−3.62	−3.89	−4.14	−4.38	−4.60	−4.82	−5.02	−5.20	−5.38
−0°	0	−0.38	−0.75	−1.11	−1.47	−1.81	−2.14	−2.46	−2.77	−3.06
0°	0	0.40	0.80	1.20	1.61	2.03	2.47	2.91	3.36	3.81
100°	4.28	4.70	5.23	5.71	6.20	6.70	7.21	7.72	8.23	8.76
200°	9.29	9.82	10.44	10.90	11.46	12.01	12.57	13.14	13.71	14.28
300°	14.86	15.44	16.03	16.62	17.22	17.82	18.42	19.02	19.63	......

TEMPERATURE-E.M.F. VALUES FOR IRON-CONSTANTAN THERMO-ELEMENTS

E.M.F. values are in millivolts; temperatures are in degrees centigrade
(From values given in Bulletin No. 325, Charles Engelhard, Inc., New York)

Degree C.	E.M.F.	Degree C.	E.M.F.	Degree C.	E.M.F.
0°	0	500°	27.41	1000°	58.17
50°	2.61	550°	30.24	1050°	61.33
100°	5.28	600°	33.13	1100°	64.50
150°	8.01	650°	36.11	1150°	67.67
200°	10.77	700°	39.19	1200°	70.84
250°	13.54	750°	42.33	....	....
300°	16.30	800°	45.49	....	....
350°	19.06	850°	48.66	....	....
400°	21.83	900°	51.83	....	....
450°	24.61	950°	55.00	....	....

THERMOELECTRIC POWER

The table gives the thermoelectric power in microvolts per degree Centigrade difference in temperature when the cold junction is at 0°C.

The values given are with respect to lead except where noted. A is the thermoelectric power at 0°C, B is the coefficient of t in the equation for the thermoelectric power at any temperature t,—

$$Q = A + Bt.$$

The values are regarded as positive if the current flows from the metal listed to the reference metal (usually lead) at the cold junction.

Metal	Microvolts per °C		Temp. range °C
	A	*B*	
		$\times 10^{-2}$	
Aluminum, 99% pure	−0.4717	+0.2718	−200–+100
commercial	−0.38	−0.01	0–100
	−0.53	+0.21	0–100
Antimony, used in cast form, solid rods soldered end to end	+35.58	+14.50	0–100
Bismuth, commercial	−43.688	−46.47	−200–+100
electrolytic	−74.42	+3.2	0–100
Brass, 85.8 Cu, 14.22 Zn	+0.710	+0.56	−78–+100
66.3 Cu, 33.72 Zn	+0.699	+0.69	−78–+100
Cadmium	+3.059	+2.856	−200–+100
cold drawn	+2.85	+3.89	0–100
Calcium, 99.57% pure	−8.20	−2.9	0–400
Caesium	+0.66	−0.10	−183–0
	+7.735	−3.34	28–100
Carbon, filament	+11.056	+3.578	−200–+100
Cerium, 97.7% Ce, 1.2% Fe, remainder cerium oxide and cerium carbide	+4.39	−1.26	0–200
Cobalt	−10.7	−5.70	0–1200
Constantan, 60 Cu, 40 Ni	−38.105	−8.88	0–400
Copper, electrolytic	+2.705	+0.7866	−270–+200
pure, hard drawn	+2.76	+1.22	0–100
German silver, commercial	−10.861	−3.29	−200–+100
Germanium	+302.5	+72.5	−200–+125
Gold	+2.90	+0.68	−260–0
	+2.90	+0.934	0–200
Indium	+2.40	+0.190	0–100
Iridium, Heraeus made	+2.44	−0.28	−80–+100
Iron	−51.34	−20.4	−260–−200
transformer iron	+16.65	−2.966	−230–+100
Lithium	+14.37	+8.76	−200–+50
Magnesium	−0.2010	+0.2572	−200–+100
Heraeus made	−0.120	+0.193	0–200
Manganin, 84 Cu, 12 Mn, 4 Ni	+1.366	+0.083	0–100
Mercury	−8.8103	−3.333	0–200
Molybdenum	+5.892	+4.334	0–100
Nichrome, 58.5 Ni, 22.5 Fe 16 Cr, 3. Mn (Against Pt)	+25.0	....	0–420
Nickel	−19.067	−3.022	0–200
	−17.633	−5.016	−260–0
Nickel-chromium, 84 Ni, 16 Cr (Against Pt)	+30.22	....	600–1200
90 Ni, 10 Cr (Against Pt)	+30.3	0.0	0–1200
Palladium	−7.409	−3.922	−200–+100
Platinoid	−10.620	−2.77	−200–+100
Platinum	−3.038	−3.248	−200–+300
	−6.677	+0.1528	−260–0

Metal	Microvolts per °C A	Microvolts per °C B	Temp. range °C
		$\times 10^{-2}$	
Platinum			
Baker's platinum	− 1.788	− 3.460	0–100
Platinum-iridium, 85 Pt, 15 Ir	+ 14.083	+ 1.06	0–1200
90 Pt, 10 Ir	+ 13.208	+ 0.75	0–1200
Platinum-rhodium, 90 Pt, 10 Rh (Against Pt)	+ 7.013	+ 0.64	0–1600
85 Pt, 15 Rh (Against Pt)	+ 6.69	+ 1.07	0–1600
Potassium	− 11.33	− 3.76	−183–0
Rubidium	− 8.26	− 3.02	−183–0
	− 0.28	− 6.00	38–100
Silicon	−408.2	−46.96	−200–+350
Silver, annealed	+ 2.50	+ 1.15	0–100
electrolytic	+ 2.947	+ 0.6782	−200–+100
Sodium	− 4.16	− 1.44	−183–0
Steel (piano wire)	+ 10.763	− 1.56	−200–+100
Thallium	+ 1.659	− 0.268	0–100
Tin	+ 0.0684	+ 0.0038	−200–+100
	+ 0.230	− 0.134	0–100
Tungsten	+ 1.594	+ 3.41	0–100
Zinc	+ 3.096	+ 3.191	−260–0
	+ 3.047	− 0.99	0–100

HYSTERESIS

The dissipation of energy due to hysteresis in metals is expressed by Steinmetz by the following equation:

$$E = \eta B^{1.6}$$

Values of η as found by Steinmetz appear below. C. G. S. units.

Material	
Iron	
Norway iron	.00227
Wrought bar	.00326
Commercial ferrotype plate	.00548
Annealed " "	.00458
Thin tin plate	.00286
Medium thickness tin plate	.00425
Steel	
Soft galvanized wire	.00349
Annealed cast steel	.00848
Soft annealed cast steel	.00457
Very soft annealed cast steel	.00318
Same above tempered in cold water	.02792
Tool steel glass hard tempered in water	.07470
" " tempered in oil	.02670
" " annealed	.01899
Cast iron	
Gray cast iron	.01300
" " " "⅛% aluminum	.01365
" " " "½% "	.01459
Nickel	
Soft wire	.0122
Annealed wire	.0156
Hardened	.0385
Cobalt	
2% of iron	.0210
Iron Filings	
180 cycles per second	.0457
114 " " "	.0396
79–91 " " "	.0373

MAGNETIC CONSTANTS OF IRON

Permeability of Transformer Iron

Giving M, the total magneto motive force applied. M/l, the magneto motive force per unit length of iron circuit. B the total induction, B/a the induction per unit cross-section of iron, M/B, the magnetic reluctance of the iron circuit and Bl/Ma, the permeability; showing the typical relations of the magnetic constants for varying field.

(From Smithsonian Tables.)

M.	M/l.	B.	B/a.	Reluctance $M/B=K$.	Permeability $Bl/Ma = \mu$.
20	0.597	218×10^3	1406	0.917×10^{-4}	2360
40	1.194	587	3790	0.681	3120
60	1.791	878	5660	0.683	3180
80	2.388	1091	7040	0.734	2960
100	2.985	1219	7860	0.819	2640
120	3.582	1330	8580	0.903	2410
140	4.179	1405	9060	0.994	2186
160	4.776	1475	9510	1.090	2000
180	5.373	1532	9880	1.180	1850
200	5.970	1581	10200	1.270	1720
220	6.567	1618	10430	1.360	1590
260	7.761	1692	10910	1.540	1410

MAGNETIC PROPERTIES OF IRON AND STEEL

(From Gumlich, 1909.)

Sample.	Coercive force.	Residual B.	Maximum permeability.	B for H = 150.	$4\pi I$ for saturation.
Electrolytic iron	2.83	11400	1850	19200	21620
The same annealed	0.36	10800	14400	18900	21630
Cast steel	1.51	10600	3550	18800	21420
The same annealed	0.37	11000	14800	19100	21420
Steel hardened	52.4	7500	110	11700	18000
Cast iron	11.4	5100	240	10400	16400
The same annealed	4.6	5350	600	11000	16800
Electrical iron in sheets annealed	1.30	9400	3270	18200	20500

SATURATION CONSTANTS FOR MAGNETIC SUBSTANCES

Substance.	Field intensity. (For saturation.)	Induced magnetization. (For saturation.)	Substance.	Field intensity. (For saturation.)	Induced magnetization. (For saturation.)
Cobalt	9000	1300	Nickel, hard	8000	400
Iron, wrought	2000	1700	annealed	7000	515
cast	4000	1200	Vicker's steel	15000	1600
Manganese steel	7000	200			

MAGNETIC SUSCEPTIBILITY

The following tables give the specific susceptibility χ for various substances. The relation to volume susceptibility κ is shown by the equation $\chi = \kappa/d$, where d is the density of the substance. Unit of χ, 1×10^{-6} cgs electromagnetic units. Room temperature is to be understood where no other is stated. The values are positive for paramagnetic bodies, negative for diamagnetic.

Elements and Inorganic Compounds

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Aluminum	Al	−170 sol.	0.60	31
		18	0.65	16
		230	0.64	16
		500	0.57	16
		1000 liq.	0.57	16
Aluminum bromide	$AlBr_3$	19	−0.32	27
Aluminum chloride	$AlCl_3$	19	−0.60	27
Aluminum oxide	Al_2O_3	....	−0.098	45
Aluminum sulfate	$Al_2(SO_4)_3$	18	−0.48	27
Alum, ammonium, iron	$Fe_2(SO_4)_3 \cdot$	−258.4	598.	29
	$(NH_4)_2SO_4 \cdot$	−196	114.7	29
	$24H_2O$	17	30.4	29
Ammonia	NH_3	16 gas	−1.1	33
Ammonium chloroplatinate	$(NH_4)_2PtCl_6$	....	−0.42	11
Ammonium metavanadate	NH_4VO_3	15	−0.12	27
Antimony	Sb	18 sol.	−0.87	1
		800 liq.	−0.49	16
Antimony bromide	$SbBr_3$	....	−0.275	33
Antimony pentachloride	$SbCl_5$	....	−0.371	33
Antimony trichloride	$SbCl_3$	....	−0.364	33
Antimony trioxide	Sb_2O_3	14	−0.19	27
Argon	A	20 gas	−0.45	15
Arsenic	As	18	−0.31	1
Arsenous oxide	As_2O_3	18	−0.27	27
Arsenous sulfide	As_2S_3	18	−0.03	27
Barium	Ba	18	0.9	31
Barium bromide	$BaBr_2$	....	−0.39	27
	$BaBr_2 \cdot 2H_2O$	....	−0.371	8
Barium carbonate	$BaCO_3$	....	−0.298	33
Barium chloride	$BaCl_2$	....	−0.41	27
	$BaCl_2 \cdot 2H_2O$	....	−0.368	8
Barium hydroxide	$Ba(OH)_2$	18	−0.32	27
	$Ba(OH)_2 \cdot 8H_2O$	....	−0.497	33
Barium iodide	BaI_2	22	−0.39	24
	$BaI_2 \cdot 2H_2O$	19	−0.38	27
Barium nitrate	$Ba(NO_3)_2$	....	−0.254	33
Barium oxide	BaO	20	−0.13	27
Barium sulfate	$BaSO_4$	....	−0.306	33
Barium sulfide	BaS	18	−0.32	27
Beryllium	Be	20	−1.0	31
Beryllium chloride	$BeCl_2$	17	−0.60	27
Beryllium hydroxide	$Be(OH)_2$	....	−0.537	33
Beryllium oxide	BeO	16	0.0	27
Beryllium sulfate	$BeSO_4$	18	−0.46	27
	$BeSO_4 \cdot 4H_2O$	17	−0.51	27
Bismuth	Bi	−259	−1.55	30
		−100	−1.52	31
		18	−1.35	1
		150	−1.19	16
		260	−1.02	16
Bismuth bromide	$BiBr_3$	....	−0.328	12

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Bismuth iodide	BiI_3	20	−0.49	27
Bismuth nitrate	$Bi(NO_3)_3 \cdot 5H_2O$	....	−0.365	12
Bismuth sulfide	Bi_2S_3	....	−0.385	12
Bismuth trichloride	$BiCl_3$	....	−0.322	12
Bismuth trioxide	Bi_2O_3	....	−0.170	8
Boron	B	18	−0.69	1
Boric acid	H_3BO_3	....	−0.52	26
Boron oxide	B_2O_3	14	−0.55	27
Bromine	Br	−170 sol.	−0.40	31
		− 8	−0.40	31
		18 liq.	−0.39	1
Cadmium	Cd	18	−0.18	1
		400	−0.16	16
Cadmium bromide	$CdBr_2$	18	−0.38	27
Cadmium chloride	$CdCl_2$	18	−0.32	27
Cadmium iodide	CdI_2	18	−0.32	27
Cadmium oxide	CdO	15	−0.30	27
Caesium	Cs	18	−0.10	31
Caesium carbonate	Cs_2CO_3	....	−0.320	33
Caesium chloride	CsCl	....	−0.363	33
Caesium nitrate	$CsNO_3$	....	−0.412	33
Caesium sulfate	Cs_2SO_4	....	−0.322	33
Calcium	Ca	18	1.10	31
Calcium carbonate	$CaCO_3$	....	−0.382	33
Calcium chloride	$CaCl_2$	17	−0.49	27
	$CaCl_2 \cdot 6H_2O$	17	−0.54	27
Calcium hydroxide	$Ca(OH)_2$	16	−0.39	27
Calcium oxide	CaO	16	−0.27	27
Calcium sulfate	$CaSO_4$	....	−0.364	33
	$CaSO_4 \cdot H_2O$	....	−0.384	33
Carbon (diamond)	C	−170	−0.49	31
		20	−0.49	16
		200	−0.50	16
		400	−0.51	16
		900	−0.54	16
		1200	−0.56	16
Carbon (gas carbon)	C	20	−2.0	16
		100	−2.0	16
		500	−1.8	16
		850	−1.6	16
		1150	−1.5	16
Carbon (graphite)	C	−170	−6.0	31
		20	−3.5	31
		300	−2.7	31
		600	−2.0	31
		900	−1.4	31
		1000	−1.3	31
Carbon dioxide	CO_2	20 gas	−0.423	35
Carbon disulfide	CS_2	....	−0.54	26
Cerium	Ce	−170	38.	31
		−150	35.	31
		−100	26.	31
		18	15.	31
		100	12.	31
		200	11.	31
Ceric oxide	CeO_2	....	0.39	26
Cerous bromide	$CeBr_3$	18	6.0	5
Cerous chloride	$CeCl_3$	19	6.1	27
Cerous sulfate	$Ce_2(SO_4)_3$	....	7.8	39
Chlorine	Cl	−60 liq.	−0.57	33
Chromium	Cr	18	3.6	1
		500	3.8	16
		1100	4.2	16

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Chromic chloride	$CrCl_3$	19	44.3	17
Chromic oxide	Cr_2O_3	18	25.5	18
Chromic sulfate	$Cr_2(SO_4)_3$	21	29.5	19
Chromium trioxide	CrO_3	17	0.51	18
Chromous chloride	$CrCl_2$	....	84.	38
Chromous hydroxide	$Cr(OH)_2$	....	48.5	34
Chromous sulfate	$CrSO_4$	....	66.	2
Chromous sulfide	CrS	20	28.4	41
Cobaltic oxide	Co_2O_3	....	34.3	45
Cobalto cobaltic oxide	Co_3O_4	....	39 to 43.6	45
Cobaltous bromide	$CoBr_2$	....	46.8	9
Cobaltous chloride	$CoCl_2$	25	90.5	19
Cobaltous iodide	CoI_2	18	32.	25
Cobaltous nitrate	$Co(NO_3)_2{\cdot}6H_2O$	....	33.1	8
Cobaltous oxide	CoO	....	74.5	45
Cobaltous sulfate	$CoSO_4$	22	59.6	19
	$CoSO_4{\cdot}H_2O$	....	53.6	11
	$CoSO_4{\cdot}7H_2O$	19.9	37.0	21
Columbium	Cb	18	1.5	1
Copper	Cu	18	−0.086	1
		500	−0.075	16
		1050	−0.070	16
Cupric bromide	$CuBr_2$	31	3.10	19
Cupric chloride	$CuCl_2$	19	9.10	19
	$CuCl_2{\cdot}2H_2O$	17	8.35	11
Cupric nitrate	$Cu(NO_3)_2{\cdot}6H_2O$	....	5.50	8
Cupric oxide	CuO	....	3.8	45
Cupric sulfate	$CuSO_4$	....	8.6	11
	$CuSO_4{\cdot}5H_2O$	....	5.9	11
Cupric sulfide	CuS	17	−0.20	27
Cuprous oxide	Cu_2O	....	1.2	45
Cuprous sulfide	Cu_2S	18	−0.18	27
Dysprosium oxide	Dy_2O_3	16	229.	29
Erbium	Er	18	22.	18
Erbium chloride	$ErCl_3$	18	114.	5
Ebrium oxide	Er_2O_3	20	189.1	43
Erbium sulfate	$Er_2(SO_4)_3$	....	118.	40
Ferric bromide	$FeBr_3$	18	48.	2[illegible]
Ferric chloride	$FeCl_3$	20	86.2	19
Ferric hydroxide	$Fe(OH)_3$	....	157.	27
Ferric nitrate	$Fe(NO_3)_3{\cdot}6H_2O$	....	31.3	8
Ferric oxide	Fe_2O_3	18	20.6	18
Ferric sulfate	$Fe_2(SO_4)_3$	23	57.3	19
Ferrous ammonium sulfate	$FeSO_4{\cdot}(NH_4)_2$-$SO_4{\cdot}6H_2O$	−258.6	547.	21
		17.2	32.6	21
Ferrous chloride	$FeCl_2$	17	101.2	19
	$FeCl_2{\cdot}4H_2O$	19	60.1	19
Ferrous iodide	FeI_2	18	40.	25
Ferrous sulfate	$FeSO_4$	19	74.2	19
	$FeSO_4{\cdot}7H_2O$	16.5	41.5	21
Gadolinium chloride	$GdCl_3$	18	91.	5
Gadolinium oxide	Gd_2O_3	20	130.1	43
Gadolinium sulfate	$Gd_2(SO_4)_3$	....	92.6	11
Gallium	Ga	−170 sol.	−0.26	31
		18	−0.24	31
		30	−0.23	31
		100 liq.	−0.04	31
Germanium	Ge	−170 sol.	−0.30	31
		18	−0.12	31
		900 liq.	−0.30	31

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Gold	Au	18	−0.15	1
Gold chloride	$AuCl_3$	21	0.43	27
Hafnium oxide	HfO_2	....	−0.110	27
Helium	He	20 gas	−0.47	15
Holmium chloride	$HoCl_3$	....	172.	46
Holmium nitrate	$Ho(NO_3)_3$	....	123.6	46
Holmium oxide	Ho_2O_3	....	243.	46
Hydrochloric acid	HCl	22	−0.661	8
Hydrogen	H	20 gas	−1.97	1
Indium	In	20	−0.11	16
Indium trichloride	$InCl_3$	18	−0.39	27
Iodine	I	−100 sol.	−0.32	31
		−60	−0.33	31
		0	−0.35	31
		18	−0.36	1
		50	−0.37	16
		113 liq.	−0.39	16
		160	−0.33	16
Iridium	Ir	18	0.14	1
		200	0.17	16
		450	0.20	16
		850	0.26	16
		1150	0.31	16
Iron carbonyl	$Fe(CO)_5$	19	−0.40	32
Lanthanum	La	18	1.04	31
Lanthanum chloride	$LaCl_3$	15	5.6	27
Lanthanum sesquioxide	La_2O_3	24	−0.40	43
Lanthanum sulfate	$La_2(SO_4)_3$	....	−0.30	39
Lead	Pb	−170 sol.	−0.14	31
		−18	−0.12	1
		330 liq.	−0.08	16
Lead bromide	$PbBr_2$	20	−0.28	27
Lead chloride	$PbCl_2$	15	−0.32	27
Lead iodide	PbI_2	19	−0.33	27
Lead monoxide	PbO	18	−0.13	27
Lead nitrate	$Pb(NO_3)_2$	....	−0.248	37
Lead oxide (red)	Pb_3O_4	18	−0.24	27
Lithium	Li	16	0.50	31
Lithium carbonate	Li_2CO_3	....	−0.413	33
Lithium chloride	LiCl	....	−0.573	33
Lithium nitrate	$LiNO_3$	19	−0.48	27
Lithium oxide	Li_2O	20	−0.57	27
Lithium sulfate	Li_2SO_4	15	−0.38	27
Magnesium	Mg	18 sol.	0.55	16
		700 liq.	0.55	16
Magnesium bromide	$MgBr_2$	20	−0.57	27
Magnesium carbonate	$MgCO_3$	....	−0.51	27
	$MgCO_3 \cdot 3H_2O$	....	−0.525	33
Magnesium chloride	$MgCl_2$	18	−0.58	27
	$MgCl_2 \cdot 6H_2O$	18	−0.57	27
Magnesium oxide	MgO	17	−0.25	27
Magnesium sulfate	$MgSO_4$	....	−0.45	36
	$MgSO_4 \cdot 7H_2O$	....	−0.551	33
Manganese	Mn	18	9.9	1
Manganese bromide	$MnBr_2$	18	68.	25
Manganese chloride	$MnCl_2$	24	107.0	19
Manganese dioxide	MnO_2	21	38.4	18
Manganese hydroxide (ous)	$Mn(OH)_2$	....	49.	34
Manganese iodide	MnI_2	18	47.	25
Manganese nitrate	$Mn(NO_3)_2 \cdot 6H_2O$	....	45.5	8
Manganese oxide (ous)	MnO	21	75.9	18

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Manganese oxide (ic)	Mn_2O_3	21	69.0	18
Manganese oxide (ous-ic)	Mn_3O_4	20	55.8	18
Manganese phosphate	$MnPO_4$	....	69.	38
Manganese sulfate (ous)	$MnSO_4$	24	88.5	18
Manganese sulfide (ous)	MnS	10	44.32	41
Mercury	Hg	− 80 sol.	−0.15	31
		18 liq.	−0.19	1
		310	−0.193	16
Mercuric bromide	$HgBr_2$	15	−0.30	27
Mercuric chloride	$HgCl_2$	17	−0.19	27
Mercuric iodide	HgI_2	17	−0.33	27
Mercuric oxide	HgO	16	−0.24	27
Mercuric sulfide	HgS	16	−0.23	27
Mercurous chloride	HgCl	19	−0.23	27
Molybdenum	Mo	18	0.04	16
Molybdenum dioxide	MoO_2	20	0.33	41
Molybdenum trioxide	MoO_3	20	0.88	41
Molybdenum sesquioxide	Mo_2O_3	16	−0.35	27
Neodymium	Nd	18	36.	31
Neodymium oxide	Nd_2O_3	....	30.3	39
Neodymium sulfate	$Nd_2(SO_4)_3$	....	18.3	39
Neon	Ne	20 gas	−0.33	15
Nickel bromide	$NiBr_2$	18	19.	25
Nickel carbonyl	$Ni(CO)_4$	19	−0.481	32
Nickel chloride	$NiCl_2$	24	44.7	19
Nickel hydroxide (ous)	$Ni(OH)_2$	....	48.3	45
Nickel monoxide	NiO	....	53.7	45
Nickel nitrate	$Ni(NO_3)_2{\cdot}6H_2O$	....	13.6	8
Nickel sulfate	$NiSO_4$	15.9	26.7	21
	$NiSO_4{\cdot}6H_2O$	....	15.6	11
	$NiSO_4{\cdot}7H_2O$	19.1	16.0	21
Nitric acid	HNO_3	22	−0.467	8
Nitrogen	N	20 gas	−0.342	1
Nitrogen dioxide	NO	22 gas	48.66	35
Nitrogen monoxide	N_2O	12 liq.	−0.429	35
Nitrogen pentoxide	N_2O_5	16 sol.	−0.332	35
Nitrogen peroxide	N_2O_4	− 16 sol.	−0.276	35
	NO_2	135 gas	3.26	35
Nitrogen trioxide	N_2O_3	18 liq.	−0.206	35
Osmium	Os	18	0.05	1
Oxygen (1st modification)	O	−259 sol.	54.	30
		−240	60.	30
(2nd modification)	....	−240	118.	30
		−219	113.	30.
(liquid)	....	−219 liq.	310.	30
		−203	273.	30
		−196	260.	30
		20 gas	106.2	1
Palladium	Pd	−258	10.9	29
		−196	8.1	29
		−103	6.9	29
		0	5.4	31
		18	5.4	1
		200	4.6	16
		750	2.6	16
		1230	1.7	16
Phosphorus (white)	P	20 sol.	−0.90	1
Phosphorus (red)	P	20	−0.67	3
		45 liq.	−0.90	16
Phosphorus pentoxide	P_2O_5	18	−0.46	27
Platinum	Pt	−170	1.31	31

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Platinum (continued)	Pt	−100	1.20	31
		18	1.10	1
		250	0.66	16
		700	0.45	16
		1220	0.30	16
Platinum tetrachloride	$PtCl_4$	22	0.0	24
Potassium	K	18	0.52	1
Potassium acid fluoride	KHF_2	....	−0.428	8
Potassium bromide	KBr	....	−0.377	8
Potassium carbonate	K_2CO_3	....	−0.488	8
Potassium chlorate	$KClO_3$	....	−0.30	26
Potassium chloride	KCl	....	−0.516	33
Potassium chloroplatinate	K_2PtCl_6	....	−0.393	11
Potassium chloroplatinite	K_2PtCl_4	....	−0.356	11
Potassium cyanate	KCNO	....	−0.465	33
Potassium dichromate	$K_2Cr_2O_7$	....	0.129	8
Potassium ferricyanide	$K_3Fe(CN)_6$	21	7.08	19
Potassium ferrocyanide	$K_4Fe(CN)_6{\cdot}3H_2O$	....	−0.420	32
Potassium hydroxide	KOH	22	−0.33	24
Potassium iodide	KI	....	−0.422	8
Potassium nitrate	KNO_3	....	−0.326	33
Potassium permanganate	$KMnO_4$	21	0.175	19
Potassium sulfate	K_2SO_4	....	−0.403	33
Potassium tetrathionate	$K_2S_4O_6$	....	−0.412	33
Praseodymium	Pr	−170 sol.	90.	31
		−100	53	31
		20	25.	31
		200	14.	31
		600	8.	31
		900 liq.	7.	31
Praseodymium chloride	$PrCl_3$	19	17.	27
Praseodymium sulfate	$Pr_2(SO_4)_3$	....	13.7	28
Praseodymium trioxide	Pr_2O_3	....	15.6	28
Quartz (*see Silicon dioxide*)	SiO_2	....	....	.....
Rhodium	Rh	−180	0.90	31
		−40	1.05	31
		18	1.11	1
		280	1.31	16
		730	1.52	16
		1140	1.86	16
Rubidium	Rb	18	0.09	1
Rubidium carbonate	Rb_2CO_3	....	−0.321	33
Rubidium chloride	RbCl	....	−0.327	33
Rubidium nitrate	$RbNO_3$	....	−0.281	33
Rubidium sulfate	Rb_2SO_4	....	−0.331	33
Ruthenium	Ru	−170	0.55	31
		18	0.50	1
		750	0.65	16
		1100	0.75	16
Samarium oxide	Sa_2O_3	22	6.02	43
Scandium nitrate	$Sc(NO_3)_3$	21	0.0	27
Scandium oxide	Sc_2O_3	....	−0.018	26
Scandium sulfate	$Sc_2(SO_4)_3$	....	−0.33	39
Selenium	Se	18	−0.32	1
Selenious acid	H_2SeO_3	18	−0.36	27
Silicon	Si	18	−0.13	1
Silicochloroform	$SiHCl_3$	....	−0.515	33
Silicon dioxide	SiO_2	....	−0.493	33
Silicon tetrabromide	$SiBr_4$	....	−0.360	33
Silicon tetrachloride	$SiCl_4$	....	−0.537	33
Silver	Ag	−170 sol.	−0.16	31

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Silver (continued)	Ag	− 80	−0.18	31
		− 40	−0.19	31
		18	−0.20	31
		270	−0.23	16
		945	−0.26	16
		1000 liq.	−0.28	16
Silver bromide	$AgBr$	19	−0.33	27
Silver chloride	$AgCl$	17	−0.35	27
Silver iodide	AgI	19	−0.37	27
Sodium	Na	18	0.51	1
Sodium acetate	$NaC_2H_3O_2{\cdot}3H_2O$	....	−0.50	26
Sodium acid carbonate	$NaHCO_3$	....	−0.21	26
Sodium bromide	$NaBr$	18	−0.47	27
Sodium carbonate	Na_2CO_3	17	−0.24	27
	$Na_2CO_3{\cdot}10H_2O$	17	−0.58	27
Sodium chloride	$NaCl$	18	−0.499	19
Sodium fluoride	NaF	21	−0.51	27
Sodium hydroxide	$NaOH$	17	−0.59	27
Sodium iodide	$NaI{\cdot}2H_2O$	....	−0.402	8
Sodium nitrate	$NaNO_3$	....	−0.28	26
di-Sodium phosphate	Na_2HPO_4	....	−0.399	33
di-Sodium phosphite	Na_2HPO_3	....	−0.451	33
Sodium sulfate	$Na_2SO_4{\cdot}10H_2O$	....	−0.86	26
Sodium sulfite	$Na_2SO_3{\cdot}7H_2O$	....	−0.462	33
Sodium tetraborate	$Na_2B_4O_7{\cdot}10H_2O$	....	−0.59	26
Sodium thiosulfate (hypo)	$Na_2S_2O_3$	....	−0.391	33
Stannic bromide	$SnBr_4$	....	−0.354	33
Stannic chloride	$SnCl_4$	....	−0.442	33
Stannic hydroxide	$Sn(OH)_4$	....	−0.321	33
Stannic oxide	SnO_2	15	−0.050	27
Stannous chloride	$SnCl_2$	18	−0.37	27
Stannous oxide	SnO	17	−0.11	27
Stannous sulfate	$SnSO_4$	18	−0.29	27
Strontium	Sr	18	−0.2	31
Strontium bromide	$SrBr_2$	19	−0.39	27
Strontium carbonate	$SrCO_3$	....	−0.316	33
Strontium chloride	$SrCl_2$	20	−0.56	27
Strontium iodide	SrI_2	19	−0.44	27
Strontium oxide	SrO	20	−0.060	27
Strontium sulfate	$SrSO_4$	....	−0.315	33
Sulfur (rhombic)	S	−170 sol.	−0.49	16, 31
		18	−0.49	1
		112	−0.49	16, 31
		113 liq.	−0.49	16, 31
		220	−0.49	16, 31
Sulfur dioxide	SO_2	liq.	−0.285	33
Sulfur trioxide	SO_3	16	−0.289	33
Sulfuric acid	H_2SO_4	22	−0.441	8
Tantalum	Ta	−170	0.83	31
		18	0.87	1
		420	0.88	16
		820	0.77	16
Tellurium	Te	−160 sol.	−0.46	31
		− 60	−0.36	31
		0	−0.32	31
		18	−0.31	1
		130	−0.32	16
		436	−0.31	16
		470 liq.	−0.071	16
Tellurium dioxide	TeO_2	18	−0.14	27
Thallium	Tl	18	−0.24	1

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Thallium monochloride	$TlCl$	20	−0.19	27
Thallium sulfate (ous)	Tl_2SO_4	20	−0.25	27
Thallium trichloride	$TlCl_3$	20	−0.23	27
Thorium	Th	−170	0.05	31
		18	0.13	1
		150	0.23	16
		390	0.29	16
Thorium nitrate	$Th(NO_3)_4$	....	−0.14	27
Tin	Sn	18 sol.	0.025	1
(gray)	....	18	−0.35	16
		400 liq.	−0.036	16
Tin tetraethyl	$Sn(C_2H_5)_4$	....	−0.138	33
Tin tetramethyl	$Sn(CH_3)_4$	....	−0.218	33
Titanium	Ti	−170	1.6	31
		20	1.25	31
Titanium dioxide	TiO_2	....	0.066	40
Titanium sulfide	TiS_2	....	0.56	40
Tungsten	W	18	0.28	1
Tungsten trioxide	WO_3	15	0.81	41
Tungstic acid	H_2WO_4	18	−1.1	27
Uranium	U	18	2.6	31
Uranium dioxide	UO_2	17	7.5	41
Uranium oxide (ous-ic)	U_3O_8	15	0.95	41
Uranium tetrachloride	UCl_4	19	−0.40	27
Uranium trioxide	UO_3	16	1.08	41
Uranyl nitrate	$UO_2(NO_3)_2$	15	−0.44	27
Vanadium	V	18	1.4	1
Vanadium oxide	VO_2	13	3.73	41
Vanadium pentoxide	V_2O_5	15	0.85	41
Vanadium trioxide	V_2O_3	15	13.9	41
Water	H_2O	−120 to 0 sol.	−0.699	19
Ytterbium	Yb	−160	16.8	31
		20	5.3	31
Ytterbium chloride	$YbCl_3$	....	25.	5
Ytterbium oxide	Yb_2O_3	....	38.	27
Yttrium chloride	YCl_3	17	20.	27
Yttrium oxide	Y_2O_3	22	0.53	43
Yttrium sulfate	$Y_2(SO_4)_3$	....	−0.24	39
Zinc	Zn	18 sol.	−0.157	1
		450 liq.	−0.09	16
Zinc bromide	$ZnBr_2$	19	−0.40	27
Zinc chloride	$ZnCl_2$	22	−0.47	24
Zinc hydroxide	$Zn(OH)_2$	....	−0.487	45
Zinc oxide	ZnO	....	−0.362	8
Zinc sulfate	$ZnSO_4 \cdot 7H_2O$	....	−0.48	26
Zirconium	Zr	18	−0.45	1
Zirconium dioxide	ZrO_2	15	−0.112	27

Organic Compounds

Room temperature is to be understood where no other is stated.

Substance	Formula	Susceptibility 10^{-6} cgs	Observer
Acetaldehyde	C_2H_4O	−0.502	33
Acetamide	C_2H_5NO	−0.577	
Acetic acid	$C_2H_4O_2$	−0.526	
Acetic anhydride	$C_4H_6O_3$	−0.517	

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Susceptibility 10^{-6} cgs	Observer
Acetone	C_3H_6O	−0.581	
Acridine	$C_{13}H_9N$	−0.688	
n-Amyl alcohol	$C_5H_{12}O$	−0.766	26
iso-Amyl alcohol	$C_5H_{12}O$	−0.799	33
tert.-Amyl alcohol	$C_5H_{12}O$	−0.804	
iso-Amyl ether	$C_{10}H_{22}O$	−0.813	
Amyl nitrate	$C_5H_{11}NO_3$	−0.574	
Aniline	C_6H_7N	−0.692 (10°)	32
Anisole	C_7H_8O	−0.672	33
Anthracene	$C_{14}H_{10}$	−0.726	
Anthraquinone	$C_{14}H_8O_2$	−0.575	
Benzaldehyde	C_7H_6O	−0.573	
Benzene	C_6H_6	−0.712 (16.8°)	19, 20
Benzoic acid	$C_7H_6O_2$	−0.556	13, 14
Benzophenone	$C_{13}H_{10}O$	−0.594	33
Benzoyl chloride	C_7H_5ClO	−0.539 (20°)	
Benzyl alcohol	C_7H_8O	−0.705	
Bromobenzene	C_6H_5Br	−0.540 (−20°)	32
Bromoform	$CHBr_3$	−0.316	33
n-Butyl alcohol	$C_4H_{10}O$	−0.743	26
iso-Butyl alcohol	$C_4H_{10}O$	−0.798	33
iso-Butylamine	$C_4H_{11}N$	−0.843	
n-Butyric acid	$C_4H_8O_2$	−0.632	
iso-Butyric acid	$C_4H_8O_2$	−0.646	
Cacodylic acid	$C_2H_7AsO_2$	−0.579	
Camphor	$C_{10}H_{16}O$	−0.68	10
Camphoric acid	$C_{10}H_{16}O_4$	−0.746	13, 14
Carbon tetrabromide	CBr_4	−0.293	33
Carbon tetrachloride	CCl_4	−0.429	
Carbon tetraiodide	CI_4	−0.261	
Chloral	C_2HCl_3O	−0.459	
Chloroacetone	C_3H_5ClO	−0.550	
Chlorobenzene	C_6H_5Cl	−0.664 (−30°)	32
Chloroform	$CHCl_3$	−0.488	33
Chrysene	$C_{18}H_{12}$	−0.648	
Cinnamic aldehyde	C_9H_8O	−0.566	
Cyanogen	C_2N_2	−0.415	
Cyanuric acid	$C_3H_3N_3O_3$	−0.490	
Cyclohexane	C_6H_{12}	−0.810	
Cyclohexene	C_6H_{10}	−0.711	
Cymene	$C_{10}H_{14}$	−0.769	
Decane	$C_{10}H_{22}$	−0.876	
Diethylamine	$C_4H_{11}N$	−0.835	
m-Dinitrobenzene	$C_6H_4N_2O_4$	−0.398	
Diphenyl	$C_{12}H_{10}$	−0.677	
Diphenylamine	$C_{12}H_{11}N$	−0.634	
Ethyl acetate	$C_4H_8O_2$	−0.607 (−6°)	19, 20
Ethyl acetoacetate (fresh)	$C_6H_{10}O_3$	−0.576	33
Ethyl alcohol	C_2H_6O	−0.744	
Ethyl benzoate	$C_9H_{10}O_2$	−0.628	
Ethyl bromide	C_2H_5Br	−0.489	
Ethyl cinnamate	$C_{11}H_{12}O_2$	−0.610	
Ethyl ether	$C_4H_{10}O$	−0.766	26
Ethyl formate	$C_3H_6O_2$	−0.581	33
Ethyl iodide	C_2H_5I	−0.679	26
Ethylene	C_2H_4	−1.6	6, 7
Ethylene bromide	$C_2H_4Br_2$	−0.422	33
Ethylene chloride	$C_2H_4Cl_2$	−0.602	
Ethylene iodide	$C_2H_4I_2$	−0.381	
Ethylidene chloride	$C_2H_4Cl_2$	−0.580	
Eucalyptol	$C_{10}H_{18}O$	−0.754	
Eugenol and iso-eugenol	$C_{10}H_{12}O_2$	−0.622	
Fluorobenzene	C_6H_5F	−0.608	

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Susceptibility 10^{-6} cgs	Observer
Formaldehyde	CH_2O	−0.62	26
Formamide	CH_3NO	−0.486	33
Formic acid	CH_2O_2	−0.432	
Fumaric acid	$C_4H_4O_4$	−0.426	13, 14
Furfural	$C_5H_4O_2$	−0.492	33
Glycerol	$C_3H_8O_3$	−0.538	26
Glycol	$C_2H_6O_2$	−0.624	33
Hexachlorobenzene	C_6Cl_6	−0.518	
Hexane	C_6H_{14}	−0.888	
Iodobenzene	C_6H_5I	−0.471	
Maleic acid	$C_4H_4O_4$	−0.427	13, 14
Methane	CH_4	−2.5	6, 7
Methyl acetate	$C_3H_6O_2$	−0.590	33
Methyl alcohol	CH_4O	−0.65 (−3°)	19, 20
Methylamine	CH_5N	−0.870	33
Methyl benzoate	$C_8H_8O_2$	−0.602	
Methyl bromide	CH_3Br	−0.603	
Methyl chloride	CH_3Cl	−0.633	
Methyl ether	C_2H_6O	−0.716	22
Methyl formate	$C_2H_4O_2$	−0.518	33
Methyl iodide	CH_3I	−0.403	
Methyl propionate	$C_4H_8O_2$	−0.628	
Methyl salicylate	$C_8H_8O_3$	−0.580	
Methylene bromide	CH_2Br_2	−0.379	33
Methylene chloride	CH_2Cl_2	−0.549	
Methylene iodide	CH_2I_2	−0.349	
Naphthalene	$C_{10}H_8$	−0.717	
Naphthol	$C_{10}H_8O$	−0.673	
Nitrobenzene	$C_6H_5NO_2$	−0.499 (20°)	32
Nitroethane	$C_2H_5NO_2$	−0.472	33
Nitrosobenzene	C_6H_5NO	−0.514	
Octane	C_8H_{18}	−0.872	
Oleic acid	$C_{18}H_{34}O_2$	−0.742	
Paraldehyde	$C_6H_{12}O_3$	−0.652	
Phenetole	$C_8H_{10}O$	−0.692	
Phenol	C_6H_6O	−0.648	
Phenyl cyanide	C_7H_5N	−0.651	
Phthalic acid	$C_8H_6O_4$	−0.446	13, 14
Piperidine	$C_5H_{11}N$	−0.755	33
Propionic acid	$C_3H_6O_2$	−0.587	
Propyl alcohol	C_3H_8O	−0.766	
Pyridine	C_5H_5N	−0.623	
Quinoline	C_9H_7N	−0.662	
Quinone	$C_6H_4O_2$	−0.382	
Resorcinol	$C_6H_6O_2$	−0.617	
Stilbene	$C_{14}H_{12}$	−0.666	
Succinic acid	$C_4H_6O_4$	−0.461	13, 14
Terpineol	$C_{10}H_{18}O$	−0.725	33
Tetrabromethylene	C_2Br_4	−0.334	
Tetrachloroethylene	C_2Cl_4	−0.508	
Toluene	C_7H_8	−0.729	
o-Toluidine	C_7H_9N	−0.701	33
Trichlorobenzene	$C_6H_3Cl_3$	−0.587	
Trichloronitromethane	CCl_3NO_2	−0.458	
Triethylphosphine	$C_6H_{15}P$	−0.762	
Trinitrobenzene-1, 3, 5	$C_6H_3N_3O_6$	−0.352	
Urea	CH_4N_2O	−0.560	
o-Xylene	C_8H_{10}	−0.662 (−10°)	32
m-Xylene	C_8H_{10}	−0.743	33

MAGNETIC SUSCEPTIBILITY (Continued)

Miscellaneous

Substance	Susceptibility	Observer
Air, 20°C, 1 atm	24.16 gas	1
Celluloid	−0.13	23, 24
Ebonite	0.6	44
Glass (crown)	−0.90	23, 24
Glass (heavy flint)	−1.2	23, 24
Linseed oil	−0.74	10
Marble ($CaCO_3$)	−0.8	44
Paraffin	−0.6	44
Petroleum	−0.83	26
Shellac	−0.30	26
Wax (white)	−0.6	44
Wood	−0.3 to 0.7	44

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VARIATION OF RESISTANCE DUE TO A MAGNETIC FIELD

Bismuth

The table shows the proportional values of the resistance for values of the magnetic field from 0 to 35,000 and for different temperatures. The resistance at 0° C. and H =0 is taken as 1.

Proportional values of resistance.

(From Smithsonian Tables.)

H. Gauss.	−192°	−135°	−100°	−37°	0°	+18°	+60°	+100°	+183°
0	0.40	0.60	0.70	0.88	1.00	1.08	1.25	1.42	1.79
2000	1.16	0.87	0.86	0.96	1.08	1.11	1.26	1.43	1.80
4000	2.32	1.35	1.20	1.10	1.18	1.21	1.31	1.46	1.82
6000	4.00	2.06	1.60	1.29	1.30	1.32	1.39	1.51	1.85
8000	5.90	2.88	2.00	1.50	1.43	1.42	1.46	1.57	1.87
10000	8.60	3.80	2.43	1.72	1.57	1.54	1.54	1.62	1.89
12000	10.8	4.76	2.93	1.94	1.71	1.67	1.62	1.67	1.92
14000	12.9	5.82	3.50	2.16	1.87	1.80	1.70	1.73	1.94
16000	15.2	6.95	4.11	2.38	2.02	1.93	1.79	1.80	1.96
18000	17.5	8.15	4.76	2.60	2.18	2.06	1.88	1.87	1.99
20000	19.8	9.50	5.40	2.81	2.33	2.20	1.97	1.95	2.03
25000	25.5	13.3	7.30	3.50	2.73	2.52	2.22	2.10	2.09
30000	30.7	18.2	9.8	4.20	3.17	2.86	2.46	2.28	2.17
35000	35.5	20.35	12.2	4.95	3.62	3.25	2.69	2.45	2.25

Various Metals

The table gives the per cent. change in the resistance due to a field of 10,000 gauss with respect to the value at 0° C. and H =0.

(Grumach.)

Metal.	Per cent. change.	Metal.	Per cent. change.
Cadmium	+0.03	Palladium	+0.001
Cobalt	−0.53	Platinum	+0.0005
Copper	+0.004	Silver	+0.004
Gold	+0.003	Tantalum	+0.0003
Lead	+0.0004	Tin	+0.002
Nickel	−1.4	Zinc	+0.01

INTERNAL RESISTANCE OF VARIOUS VOLTAIC CELLS

The internal resistance is subject to large variations; the values given can be considered only approximate.

Cell.	Resistance, ohms.	Cell.	Resistance, ohms.
Edison-Lalande	0.03	Grove	0.1–0.2
Daniell	0.85	Bunsen	0.1–0.2
Gravity	1–5	Bichromate	0.08–0.40
Silver chloride	4.	Storage	0.004–0.02
Dry cell	0.05–0.10	Clark standard	20–50
Leclanché	0.4–0.2	Weston standard	20–50

HALL EFFECT

If a strip of metal of thickness t, in which a current i is flowing (longitudinally) is subjected to a transverse magnetic field H, a difference of potential E is produced at opposite points at the side of the strip. $E = R \times Hi/t$ where R is a constant specific with different metals and E, H, i and t in C. G. S. units. The table gives values obtained at ordinary room temperatures, 18–24° C. If the value of R is independent of the field, or nearly so, the field intensity is not given. The positive sign indicates that if a strip of metal were considered to be in the plane of this page with its long axis horizontal, the primary current flowing from left to right and the magnetic field directed away from the observer, normal to the plane of the strip, the upper edge of the strip would be at a higher potential than the lower.

Substance.	Field strength, gausses.	R.	Observer.
Aluminum.....	......	−.00038	Von Ettinghausen & Nernst, 1886
Antimony.....	1750	+0.219	Barlow, 1903
Bismuth.......	1650	−10.27	Von Ettinghausen & Nernst, 1886
Bismuth.......	11100	−4.95	Von Ettinghausen & Nernst, 1886
Cadmium.....	......	+.00055	Von Ettinghausen & Nernst, 1886
Carbon........	......	−.17	Von Ettinghausen & Nernst, 1886
Cobalt........	3463	+.24	Hall, 1885
Copper........	......	−.00052	Hall, 1885
Gold..........	......	−.00066	Hall, 1885
Iron..........	6290	+.0108	Zahn, 1904
Lead..........	......	.00009	Von Ettinghausen & Nernst, 1886
Magnesium....	......	−.00094	Von Ettinghausen & Nernst, 1886
Nickel........	10620	−.0047	Zahn, 1904
Platinum......	......	−.00024	Von Ettinghausen & Nernst, 1886
Silver.........	......	−.00083	Von Ettinghausen & Nernst, 1886
Tellurium.....	......	+530.	Von Ettinghausen & Nernst, 1886
Tin...........	......	−.00004	Von Ettinghausen & Nernst, 1886
Zinc..........	......	+.00033	Barlow, 1903

ELECTROCHEMICAL EQUIVALENTS

Grams per coulomb.

Element.	Valence.	Equiv.	Element.	Valence.	Equiv.
Aluminum .	3	$.0936 \times 10^{-3}$	Iron.......	3	$.1929 \times 10^{-3}$
Antimony..	3	.4153	Lead	2	1.0731
Antimony..	5	.2492	Magnesium.	2	.1260
Bismuth...	3	.7185	Mercury....	1	2.0788
Cadmium..	2	.5824	Mercury ...	2	1.0394
Chromium .	3	.1796	Nickel.....	2	.3040
Cobalt	2	.3055	Oxygen....	2	.0829
Copper....	1	.6588	Platinum...	2	1.0104
Copper....	2	.3294	Silver......	1	1.1180
Gold......	3	.6812	Tin........	2	.6166
Hydrogen..	1	.0105	Tin........	4	.3083
Iron......	2	.2893	Zinc.......	2	.3387

MAGNETIC INCLINATION OR DIP AND HORIZONTAL INTENSITY

The mean or limiting values are given for the territory covered by the State named. The horizontal intensity is given in gausses. The table is compiled from the results of the U. S. Coast and Geodetic Survey for 1911 and 1912.

State.	Dip, degrees.	Horizontal intensity.
Alabama	62. to 66.	.23 to .26
Alaska	67. 74.	.16 .21
Arizona	59.	.27
Arkansas	63. 65.	.24 .25
California	58. 62.	.25 .27
Colorado	67. 68.	.22 .23
Connecticut	72. 73.	17 .18
Delaware	70. 71.5	19 .20
Florida	57. 58.	27 .29
Georgia	62. 66.	.23 .26
Hawaii	39.	.29
Idaho	69.	.21
Indiana	69. 72.	.18 .21
Iowa	71. 73.	.18 .20
Kansas	67. 69.	.21 .23
Kentucky	68. 70.	.20 .22
Maine	74. 76.	.14 .16
Maryland	70	.20
Massachusetts	73.	.17
Michigan	73. 76.	.15 .18
Mississippi	61. 66.	.24 .26
Missouri	67. 71.	.20 .22
Montana	70. 72.	.18 .20
Nebraska	70. 71.	.20
New Hampshire	73. 74.	.16 .17
New Jersey	71.	.19
New Mexico	63. 65.	.24 .25
New York	74.	.16 .17
North Carolina	66. 68.	.21 .23
North Dakota	74. 77.	.15 .16
Ohio	71. 73.	.18 .20
Oklahoma	63. 67.	.23 .25
Oregon	68. 69.	.21
Pennsylvania	71. 72.	.18 .19
Philippines	0. 23.	.37 .39
Porto Rico	49. 50.	.29 .30
South Carolina	66. 67.	.23
South Dakota	71. 74.	.17 .19
Tennessee	66. 68.	.22 .23
Texas	57. 63.	.25 .29
Utah	66. 67.	.22 .23
Vermont	73. 75.	.16 .17
Virginia	68. 70.	.20 .21
Washington	71.	.19
West Virginia	70.5	.20
Wisconsin	74. 76.	.15 .17
Wyoming	68. 72.	.19 .22

MAGNETIC DECLINATION

(Selected from tables of the U. S. Coast and Geodetic Survey)

State.	Station.	Magnetic declination in degrees and tenths					
		1870 °	1880 °	1890 °	1900 °	1910 °	1920 °
Ala.	Ashland	4.7 E	4.1 E	3.4 E	3.0 E	2.9 E	3.0 E
	Tuscaloosa	6.1 E	5.5 E	4.8 E	4.4 E	4.4 E	4.6 E
Alas.	Sitka	29.0 E	29.3 E	29.5 E	29.7 E	30.2 E	30.4 E
	Kodiak	25.7 E	25.2 E	24.8 E	24.5 E	24.2 E	24.2 E
	Unalaska	20.1 E	19.6 E	19.0 E	18.3 E	17.5 E	17.2 E
	St. Michael	......	24.7 E	23.1 E	22.1 E	21.5 E	21.0 E
Ariz.	Holbrook	13.8 E	13.6 E	13.4 E	13.5 E	14.1 E	14.5 E
	Prescott	13.7 E	13.7 E	13.6 E	13.7 E	14.4 E	14.9 E
Ark.	Augusta	7.1 E	6.5 E	5.9 E	5.5 E	5.6 E	5.8 E
	Danville	8.6 E	8.1 E	7.6 E	7.2 E	7.4 E	7.7 E
Calif.	Bagdad	14.3 E	14.4 E	14.4 E	14.6 E	15.3 E	15.7 E
	Mojave	14.6 E	14.9 E	14.9 E	15.1 E	15.8 E	16.3 E
	Modesto	16.1 E	16.1 E	16.2 E	16.6 E	17.3 E	17.7 E
	Redding	18.1 E	18.2 E	18.3 E	18.7 E	19.4 E	19.7 E
Colo.	Pueblo	13.7 E	13.5 E	13.0 E	12.8 E	13.3 E	13.7 E
	Ouray	15.2 E	15.0 E	14.6 E	14.6 E	15.1 E	15.5 E
Conn.	Hartford	8.7 W	9.4 W	9.8 W	10.4 W	11.2 W	12.1 W
Del.	Dover	4.7 W	5.3 W	5.9 W	6.5 W	7.2 W	8.0 W
D. C.	Washington	2.4 W	3.0 W	3.6 W	4.2 W	4.9 W	5.6 W
Fla.	Miami	3.3 E	2.7 E	2.2 E	1.7 E	1.5 E	1.5 E
	Bartow	3.2 E	2.6 E	2.1 E	1.6 E	1.4 E	1.3 E
	Jacksonville	3.0 E	2.4 E	1.8 E	1.3 E	1.1 E	0.9 E
	Tallahassee	4.2 E	3.6 E	3.0 E	2.5 E	2.4 E	2.4 E
Ga.	Millen	2.7 E	2.1 E	1.5 E	0.9 E	0.7 E	0.5 E
	Americus	4.1 E	3.5 E	2.9 E	2.4 E	2.2 E	2.2 E
Haw.	Honolulu	9.6 E	9.8 E	10.1 E	10.4 E	10.7 E	11.1 E
Idaho.	Pocatello	18.0 E	17.9 E	17.8 E	17.9 E	18.5 E	18.8 E
	Boise	18.8 E	18.8 E	18.6 E	18.8 E	19.5 E	19.8 E
	Pierce	21.2 E	21.1 E	21.2 E	21.4 E	22.0 E	22.2 E
Ill.	Kankakee	5.3 E	4.8 E	4.1 E	3.5 E	3.3 E	3.1 E
	Rushville	7.0 E	6.4 E	5.7 E	5.2 E	5.1 E	5.1 E
Ind.	Indianapolis	3.3 E	2.7 E	2.1 E	1.5 E	1.1 E	0.9 E
Iowa.	Walker	8.2 E	7.5 E	6.8 E	6.2 E	6.2 E	6.2 E
	Sac City	10.2 E	9.6 E	8.8 E	8.4 E	8.6 E	8.6 E
Kans.	Emporia	11.2 E	10.8 E	10.2 E	9.9 E	10.1 E	10.3 E
	Ness City	12.2 E	11.9 E	11.3 E	11.2 E	11.4 E	11.7 E
Ky.	Manchester	1.6 E	1.0 E	0.3 E	0.3 W	0.6 W	0.8 W
	Louisville	3.2 E	2.5 E	1.9 E	1.5 E	1.3 E	1.2 E
	Princeton	5.5 E	4.8 E	4.2 E	3.9 E	3.7 E	3.8 E
La.	Winfield	8.2 E	7.6 E	7.1 E	6.8 E	7.0 E	7.4 E
Me.	Eastport	18.5 W	18.8 W	19.0 W	19.3 W	20.0 W	21.0 W
	Bangor	15.9 W	16.4 W	16.7 W	17.1 W	17.8 W	18.8 W
	Portland	13.1 W	13.6 W	14.1 W	14.5 W	15.3 W	16.3 W
Md.	Baltimore	3.8 W	4.4 W	5.0 W	5.6 W	6.3 W	7.0 W
Mass.	Boston	11.0 W	11.5 W	12.0 W	12.6 W	13.4 W	14.4 W
	Pittsfield	9.3 W	10.0 W	10.4 W	11.0 W	11.8 W	12.7 W
Mich.	Marquette	4.7 E	3.8 E	3.0 E	2.4 E	2.1 E	1.7 E
	Lapeer	0.3 E	0.5 W	1.2 W	1.8 W	2.3 W	2.8 W
	Grand Haven	3.1 E	2.4 E	1.6 E	1.1 E	0.7 E	0.3 E
Minn.	St. Paul	10.9 E	10.3 E	9.5 E	8.9 E	8.8 E	8.7 E
	Marshall	11.0 E	10.5 E	9.8 E	9.3 E	9.4 E	9.4 E
	Hibbing	9.7 E	9.0 E	8.2 E	7.6 E	7.7 E	7.5 E
	Bagley	12.3 E	11.7 E	11.0 E	10.4 E	10.6 E	10.5 E
Miss.	Meridian	6.5 E	5.9 E	5.2 E	4.8 E	4.9 E	5.1 E
	Vicksburg	7.6 E	7.1 E	6.4 E	6.0 E	6.1 E	6.4 E
Mo.	Hermann	8.3 E	7.7 E	7.0 E	6.5 E	6.5 E	6.6 E

MAGNETIC DECLINATION (Continued)

(Selected from tables of the U. S. Coast and Geodetic Survey)

State.	Station.	Magnetic declination in degrees and tenths.					
		1870 °	1880 °	1890 °	1900 °	1910 °	1920 °
Mo.	Sedalia	9.3 E	8.7 E	8.0 E	7.6 E	7.8 E	8.0 E
Mont.	Miles City	17.7 E	17.4 E	16.9 E	16.9 E	17.3 E	17.6 E
	Lewistown	20.1 E	19.9 E	19.6 E	19.6 E	20.1 E	20.4 E
	Ovando	21.2 E	21.1 E	20.9 E	21.1 E	21.6 E	22.0 E
Nebr.	Albion	12.5 E	12.0 E	11.4 E	11.0 E	11.2 E	11.5 E
	Valentine	13.9 E	13.4 E	12.8 E	12.6 E	12.8 E	13.1 E
	Alliance	15.3 E	14.8 E	14.3 E	14.2 E	14.5 E	14.8 E
Nev.	Elko	17.7 E	17.7 E	17.6 E	17.8 E	18.4 E	18.9 E
	Hawthorne	16.8 E	17.0 E	17.0 E	17.3 E	18.0 E	18.4 E
N. H.	Hanover	11.1 W	11.6 W	12.0 W	12.6 W	13.2 W	14.2 W
N. J.	Trenton	6.0 W	6.7 W	7.2 W	7.8 W	8.6 W	9.4 W
N. Mex.	Santa Rosa	12.7 E	12.4 E	12.0 E	11.9 E	12.5 E	12.9 E
	Laguna	13.6 E	13.4 E	13.0 E	13.0 E	13.6 E	14.1 E
N. Y.	Albany	9.2 W	10.0 W	10.3 W	10.9 W	11.6 W	12.5 W
	Elmira	5.4 W	6.3 W	7.0 W	7.5 W	8.2 W	9.0 W
	Buffalo	3.8 W	4.7 W	5.4 W	5.9 W	6.5 W	7.2 W
N. C.	Newbern	1.0 W	1.7 W	2.3 W	2.9 W	3.4 W	4.0 W
	Greensboro	1.0 E	0.3 E	0.3 W	0.8 W	1.3 W	1.8 W
	Asheville	2.0 E	1.3 E	0.7 E	0.2 E	0.2 W	0.5 W
N. D.	Jamestown	13.7 E	13.2 E	12.5 E	12.2 E	12.4 E	12.5 E
	Bismarck	16.1 E	15.6 E	15.0 E	14.7 E	15.0 E	15.2 E
	Dickinson	17.5 E	17.1 E	16.5 E	16.3 E	16.7 E	16.9 E
Ohio	Canton	0.0	0.7 W	1.3 W	1.9 W	2.5 W	3.1 W
	Urbana	2.4 E	1.8 E	1.1 E	0.5 E	0.1 E	0.3 W
Okla.	Okmulgee	9.8 E	9.5 E	9.1 E	8.7 E	8.9 E	9.2 E
	Enid	11.0 E	10.6 E	10.2 E	9.8 E	10.1 E	10.5 E
Ore.	Sumpter	20.0 E	20.2 E	20.2 E	20.4 E	21.1 E	21.4 E
	Detroit	20.1 E	20.3 E	20.5 E	20.8 E	21.6 E	21.9 E
Pa.	Wilkes-Barre	5.3 W	6.0 W	6.6 W	7.2 W	8.0 W	8.8 W
	LockHaven	4.3 W	5.0 W	5.6 W	6.3 W	7.0 W	7.7 W
	Indiana	2.0 W	2.6 W	3.3 W	3.9 W	4.6 W	5.2 W
P. R.	San Juan	......	......	......	1.0 W	2.0 W	3.4 W
R. I.	Newport	10.3 W	10.8 W	11.3 W	11.9 W	12.7 W	13.7 W
S. C.	Marion	0.9 E	0.3 E	0.4 W	1.0 W	1.4 W	1.8 W
	Aiken	2.5 E	1.9 E	1.3 E	0.7 E	0.4 E	0.1 E
S. D.	Huron	12.7 E	12.3 E	11.7 E	11.2 E	11.5 E	11.7 E
	Murdo	14.7 E	14.3 E	13.7 E	13.4 E	13.7 E	13.9 E
	Rapid City	16.3 E	15.8 E	15.3 E	15.1 E	15.4 E	15.7 E
Tenn.	Knoxville	1.8 E	1.1 E	0.5 E	0.0	0.3 W	0.5 W
	Shelbyville	4.9 E	4.3 E	3.7 E	3.2 E	3.0 E	2.9 E
	Huntingdon	6.1 E	5.5 E	4.9 E	4.4 E	4.3 E	4.4 E
Tex.	Houston	8.9 E	8.4 E	7.9 E	7.7 E	8.1 E	8.6 E
	San Antonio	9.5 E	9.2 E	8.7 E	8.7 E	9.2 E	9.7 E
	Pecos	11.0 E	10.8 E	10.4 E	10.3 E	10.8 E	11.3 E
	Wytheville	0.8 E	0.1 E	0.5 W	1.1 W	1.5 W	1.9 W
Utah	Manti	16.8 E	16.7 E	16.4 E	16.5 E	17.1 E	17.5 E
Vt.	Rutland	10.5 W	11.2 W	11.6 W	12.1 W	12.8 W	13.8 W
Va.	Richmond	1.8 W	2.5 W	3.1 W	3.7 W	4.2 W	4.9 W
	Lynchburg	0.7 W	1.4 W	2.0 W	2.6 W	3.1 W	3.7 W
	Stanley	7.8 E	7.1 E	6.3 E	5.8 E	5.6 E	5.4 E
Wash.	Wilson Creek	21.8 E	21.9 E	22.1 E	22.4 E	23.0 E	23.3 E
	Seattle	22.0 E	22.2 E	22.4 E	22.8 E	23.5 E	23.8 E
W. Va.	Sutton	0.4 W	1.1 W	1.8 W	2.4 W	2.9 W	3.4 W
Wis.	Shawamo	5.9 E	5.0 E	4.3 E	3.7 E	3.4 E	3.1 E
	Floydada	11.2 E	10.9 E	10.4 E	10.3 E	10.7 E	11.1 E
Wyo.	Douglas	16.0 E	15.8 E	15.3 E	15.2 E	15.7 E	16.0 E
	Green River	17.0 E	16.8 E	16.5 E	16.6 E	17.2 E	17.5 E

RADIATIONS

α-RAYS

The α-rays are thought to be positively charged particles, moving with a high velocity. They are only slightly deviable by a strong magnetic or electric field and have small penetrating power. The initial velocity has been found to be about 2×10^9 cm/s. The mass of each particle is 6.2×10^{-24} g (Rutherford and Geiger, 1910). The charge carried by each, as measured by the same authors, is 9.3×10^{-10} electrostatic units.

β-RAYS

The β-rays are similar to the cathode rays produced by an electric discharge in a vacuum tube. They are judged to be negatively charged particles moving with high velocity. They are much more penetrating than the α-rays, and are strongly deviated by a magnetic or electric field. The velocity of the moving particle is in the neighborhood of that of light, about 2×10^{10} cm/s. The charge on each particle is approximately 4.7×10^{-10} electrostatic units.

γ-RAYS

The γ-rays, emitted by radium and other radioactive substances are similar to the X-rays and are not deviable by magnetic or electric fields. They are more penetrating than either the α or β-rays.

X-RAYS OR RÖNTGEN RAYS

X-rays are emitted from a substance when it is bombarded by a stream of electrons at a sufficiently high velocity. Secondary X-rays are emitted from substances which are themselves receiving a primary X-ray radiation.

Scale of Hardness

The "radiochrometer" of Benoist consists of a disk of silver 0.11 mm thick, which is surrounded by 12 sectors of aluminum ranging in thickness from 1 to 12 millimeters. The sector which shows the same absorption as the central disk gives the degree of hardness according to Benoist. The relation of this to other scales is shown below.

Benoist	2	3	4	5	6	7	8
Wehnelt	1.8–2	5	6.5	7.5	8	9	10–11
Walter	2.0–3	4–5	5–6	6	6–7	7	7–8

The absorption of rays is very nearly proportional to the mass of substance penetrated.

IONIZATION DUE TO RÖNTGEN RAYS IN VARIOUS GASES

From Smithsonian Physical Tables

Gas	Relative ionization		Density
	Soft rays, Strutt	Hard rays, Eve	
Hydrogen	0.11	0.42	0.069
Air	1.00	1.00	1.00
Oxygen	1.39	......	1.11
Carbon dioxide	1.60	......	1.53
Cyanogen	1.05	......	1.86
Sulphur dioxide	7.97	2.3	2.19
Chloroform	31.9	4.6	4.32
Methyl iodide	72.0	13.5	5.05
Carbon tetrachloride	45.3	4.9	5.31
Hydrogen sulphide	......	0.9	1.18

GRATING SPACE IN CRYSTALS

Calcite	3.02904×10^{-8}cm.	Millikan
Potassium ferrocyanide	8.408	Siegbahn
Rock salt, plane parallel to face	2.81	Bragg
Calcium fluoride	5.455 (Cu radiation)	Gerlach
	5.478 (Ni radiation)	"
Mica	9.845 (1st order)	Davis, Terrill
	9.958 (7th order)	" "
Silicon	5.415 (Cu radiation)	Gerlach
	5.410 (Ni radiation)	"
Zinc blende	5.90 (Cu radiation)	"

MEAN ABSORPTION COEFFICIENTS

(From Smithsonian Physical Tables)

If I_0 be the intensity of a parallel beam of homogeneous radiation incident normally on a plate of absorbing material of thickness t, then $I = I_0 e^{-\lambda x}$ gives the intensity I at the depth x. Because of the great homogeneity of the secondary X-rays they were used in the determination of the following coefficients. The coefficients λ have been divided by the density d.

Radiator	Absorber C.	Mg.	Al.	Fe.	Ni.	Cu.	Zn.	Ag.	Sn.	Pt.	Au.
Cr.	15.3	126.	136.	104.	129.	143.	170.	580.	714.	(517.)	(507.)
Fe.	10.1	80.	88.	66.	84.	95.	112.	381.	472.	340.	367.
Co.	80.0	64.	72.	67.	67.	75.	92.	314.	392.	281.	306.
Ni.	6.6	52.	59.	314.	56.	62.	74.	262.	328.	236.	253.
Cu.	5.2	41.	48.	268.	63.	53.	61.	214.	272.	194.	210.
Zn.	4.3	35.	39.	221.	265.	56.	50.	175.	225.	162.	178.
As.	2.5	19.	22.	134.	166.	176.	204.	105.	132.	106.	106.
Se.	2.0	16.	19.	116.	141.	150.	175.	88.	112.	93.	100.
Ag.	.4	2.2	2.5	17.	23.	24.	27.	13.	16.	56.	61.

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS

Radiation traversing a layer of substance is reduced in intensity by a constant fraction μ per centimeter. After penetrating to a depth x the intensity is $I = I_0 e^{-\mu x}$ where I_0 is the intensity at the surface. μ/ρ is the mass absorption coefficient where ρ is the density of the material.

Values of μ/ρ for λ = .005 Å to λ = 44.6 Å. Where two values of μ/ρ for one value of λ occur they represent the maximum and minimum values at an absorption discontinuity.

Compiled by S. J. M. Allen

λ = 44.6 – 2.74 Å

λ, Å	He	C	N	O	Ne	Al	S	Cl	A
44.6	3600	2170	3850	5765	13100	....	....	....	45700
11.88	....	......	......	......	6850	850	....	....	.....
9.87	....	1063	1796	2540	4310	500	1320	1570	1860
8.32	....	656	1109	1585	2750	330	794	962	1160
7.94	....	......	......	......	.....	280 3700	....	....	.....
6.97	....	390	645	976	1727	2800	500	610	748
5.39	....	185	312	476	865	1450	249	310	360
5.17	....	160	273	413	763	1350	221	277	324
5.01	....	......	......	......	.....	....	210 2260	....	.....
4.38	....	......	......	......	.....	....	....	178 1830	.....
4.36	....	97.8	166	258	478	815	1570	1800	202
4.15	....	84.6	144	222	416	720	1350	1476	174
3.93	....	71.0	121	189	356	635	1175	1256	153
3.87	....	......	......	......	.....	....	....	....	148 1460
3.69	....	......	......	......	.....	....	....	....	.....
3.59	....	55.2	96	150	279	500	928	966	1215
3.51	....	......	......	......	.....	....	....	....	.....
3.38	....	46.0	79.5	117	231	425	795	880	1025
3.35	....	43.0	......	......	.....	417	780	870	1015
3.24	....	......	......	......	.....	....	....	....	.....
3.03	....	35.0	......	84.0	175	323	595	670	760
2.74	....	25.0	......	60.0	135	250	454	520	600

λ, Å	Fe	Ni	Cu	Zn	Kr	Ag	Sn	Xe	Pt	Au
44.6	...	....	....	...	31800	....	...	6740	....	12500
11.88	...	6900	7550	...	.....	....	...	....	....	.....
9.87	...	4540	5030	...	.....	2700	...	....	2440	.....
8.32	...	3140	3450	...	.....	1800	...	....	1560	.....
7.94	...	....	....	...	.....	....	...	....	....	.....
6.97	...	2000	2130	...	.....	1300	...	....	1190	.....
5.39	...	1250	1290	...	.....	845	...	....	1645	.....
5.17	...	1150	1190	...	.....	790	...	....	....	.....
5.01	...	....	....	...	.....	....	...	....	....	.....
4.38	...	....	....	...	.....	....	...	....	....	.....
4.36	610	715	760	910	.....	535	640	....	....	.....
4.15	540	630	690	820	.....	461	550	....	1290	.....
3.93	470	555	610	715	.....	408	490	....	....	.....
3.87	...	....	....	...	.....	....	...	....	....	.....
3.69	...	....	....	...	.....	354 1410	...	....	....	.....
3.59	375	450	495	575	.....	1360	...	....	1370	....
3.51	...	....	....	...	.....	1300 1510	...	....	....	.....
3.38	320	380	....	495	.....	....	...	....	....	.....
3.35	312	375	404	480	.....	1310	...	....	1120	.....
3.24	...	....	...	...	.....	1230 1440	...	....	....	.....
3.03	245	290	315	375	.....	1290	...	....	939	.....
2.74	185	239	262	283	.....	925	...	....	756	.....

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

$\lambda = 2.50 - .900$ Å

λ, Å	H	Li	Be	B	C	N	O	Ne	Na
2.50	.52	4.0	6.1	9.1	17.8	.....	44.5	100	128
2.29	...	....	....	....	15.0	.....	36.4	75.5	.....
1.93	.50	2.10	3.05	4.7	8.75	14.0	21.7	49.0	61.3
1.74	...	....	....	....	.....	.....	.....	.....	.....
1.656	...	....	....	....	.....	.....	.....	.....	.....
1.539	.48	1.10	1.60	2.45	4.52	7.45	11.1	24.0	32.1
1.484	...	....	....	....	.....	.....	.....	.....	.....
1.432	...	....	....	....	.....	.....	.....	.....	.....
1.389	.47	.86	1.25	1.87	3.35	5.50	8.1	17.0	23.4
1.377	...	....	....	....	.....	.....	.....	.....	.....
1.293	...	....	....	....	.....	.....	.....	.....	.....
1.280	...	....	....	....	.....	.....	.....	.....	.....
1.235	.46	.67	.95	1.35	2.42	3.95	5.7	12.4	17.1
1.104	...	....	....	....	.....	.....	.....	.....	.....
1.071	...	....	....	....	.....	.....	.....	.....	.....
1.038	...	....	....	....	.....	.....	.....	.....	.....
1.000	.45	.43	.55	.76	1.36	2.10	3.13	6.5	8.8
.980	...	....	....	....	.....	.....	.....	.....	.....
.949	...	....	....	....	1.20	.....	.....	.....	.....
.932	...	....	....	....	.....	.....	.....	.....	.....
.900	...	....	....	....	1.05	.....	.....	.....	.....

λ, Å	Mg	Al	S	Cl	A	Ca	Fe	Ni	Cu
2.50	161	193	355	400	475	620	147	180	197
2.29	.....	150	285	315	355	480	115	137	153
1.93	77.2	93.5	173	198	235	306	71.2	89.5	96.2
1.74	.....	83.0	.....	.....	.....	...	54	.....	.....
							465		
1.656	.....	60.7	110	126	143	195	410	59.2	63.5
1.539	40.8	49.0	91	103	114	163	325	48.0	50.9
1.484	.....	......	.....	.....	.....	...	.....	40.5	.....
								338	
1.432	.....	40.0	75	85	93	130	285	325	42
1.389	31.5	36.8	68.5	76.7	85.7	125	252	275	38.5
1.377	.....	......	.....	.....	.....	...	.....	.....	37.0
									307
1.293	.....	29.8	55.3	60	72	102	212	233	260
1.280	.....	28.8	.....	.....	.....	...	.....	225	252
1.235	21.4	26.3	49.5	55.5	62.5	90	181	208	230
1.104	.....	18.6	38.0	44	50	67	135	155	175
1.071	.....	......	.....	.....	.....	...	.....	.....	.....
1.038	.....	......	.....	.....	.....	...	.....	.....	.....
1.000	11.8	14.12	26.7	29.7	34.5	49	100	121	130
.980	.....	......	.....	.....	.....	...	.....	.....	.....
.949	.....	12.0	22.0	24.5	.....	42	86	99	114
.932	.....	......	.....	.....	.....	...	.....	.....	.....
.900	.....	10.4	.....	.....	.....	...	74.5	86.5	98.5

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = 2.50 – .900 Å

λ, Å	Zn	Br	Mo	Ag	Sn	I	W	Pt	Au	Pb
2.50	228	...	..	710	850	...	...	596	.....	...
2.29	180	...	..	550	670	...	...	480	.....	...
1.93	110	...	..	405	470	...	300	358	385	428
1.74	.....	...	..	.....	.....	...	...	.....	.....	...
1.656	72.5	...	..	285	.....	...	...	228	.....	...
1.539	58.6	89	..	217	247	290	176	202	213	230
1.484	.....	...	..	.....	.....	...	...	.....	.....	...
1.432	49.3	...	..	192	220	...	130	172	179	202
1.389	45.2	...	..	174	209	...	...	155	166	185
1.377	.....	...	..	.....	.....	...	...	.....	.....	...
1.293	39	...	..	146	176	...	...	132	138	154
1.280	36	...	..	127	146	...	...	.....	.....	...
	287									
1.235	250	...	..	125	140	...	95	115	122	137
1.104	208	...	..	96.5	115	...	...	99	107	120
1.071	.....	...	..	.....	.....	...	...	77.5	.....	...
								198		
1.038	.....	...	..	.....	.....	...	...	.....	76.5	...
									194	
1.000	145	...	52	73.0	86.0	...	...	165	174	75
.980	.....	...	..	.....	.....	...	...	155	168	73
.949	129	...	..	63.0	75.5	...	...	146	156	68
										168
.932	.....	...	..	.....	.....	...	...	136	148	159
								184		
.900	112	150	..	54.2	65.0	...	...	168	134	145
									182	

λ = .892 – .184 Å

λ, Å	H	Li	Be	B	C	N	O	Ne	Na	Mg	Al
.892	....	....	....	....	....	....	....	....	....	....	....
.880	.440	.350	.425	.580	.990	1.50	2.20	4.55	6.10	8.34	9.75
.862	....	....	....	....	....	....	....	....	....	....	....
.850	....	....	....	....	.907	....	....	....	....	....	8.85
.814	....	....	....	....	.814	....	....	....	....	....	7.85
.780	....	....	....	....	.750	....	....	....	....	....	6.86
.710	.435	.260	.315	.365	.598	.870	1.22	2.50	3.30	4.30	5.22
.680	....	....	....	....	.550	....	....	....	....	....	4.52
.631	.435	.225	.255	.305	.467	.610	.900	1.80	2.30	3.0	3.73
.618	....	....	....	....	....	....	....	....	....	....	....
.560	....	....	....	....	.370	....	....	....	....	....	2.60
.497	.435	.198	.210	.220	.315	.400	.520	.930	1.18	1.52	1.90
.485	....	....	....	....	.308	....	....	....	....	....	1.77
.476	.430	....	....	.215	.304	....	.485	....	....	....	1.74
.424	....	....	....	....	....	....	....	....	....	....	1.23
.417	.390	.180	.185	.198	.256	.310	.372	.580	.750	.940	1.170
.380	...	....	....	....	.230	....	....	....	....	....	.950
.331	....	....	....	....	....	....	....	....	....	....	....
.260	.385	.156	.166	.175	.185	.200	.210	.270	.305	.343	.402
.220	....	....	....	....	.178	....	....	....	....	....	.300
.200	.375	.151	.160	.165	.175	.180	.183	.210	.225	.250	.270
.184	....	....	....	....	.166	....	....	....	....	....	.246

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = .892 − .184 A

λ, Å	S	Cl	A	Ca	Fe	Ni	Cu	Zn	Br	Sr	Mo
.892	....	....	....	....	....	....	....	....	....	....	....
.880	18.2	20.7	24.0	34.8	69.5	82	91.2	103	....	....	36.0
.862	....	....	....	....	....	....	....	....	....	....	....
.850	....	....	....	....	63.5	74	84.5	96.5	....	....	....
.814	....	....	....	....	57	66	75.7	86	....	....	28
.780	....	....	....	....	50.5	59.5	67.5	77	....	....	....
.710	9.90	11.6	13.0	18.6	38.5	48.1	51.0	59.0	80	106.	19.9
.680	....	....	....	....	32.7	41	45.3	52.7	....	....	....
.631	6.90	8.40	9.80	13.3	27.0	34	36.2	41.0	56.8	72.5	15.0
.618	....	....	....	....	....	....	....	....	....	....	12.5
											88.0
.560	....	....	....	....	18.2	24	25.5	30.7	....	....	....
.497	3.50	4.20	5.0	6.60	13.9	17.9	18.4	21.0	32.0	40.5	50.2
.485	....	....	....	....	12.4	15.4	16.9	19.5	....	....	....
.476	....	....	....	....	....	....	16.6	....	....	....	42
.424	....	....	....	....	....	....	....	....	....	....	....
.417	2.10	2.47	2.95	3.97	8.45	10.5	11.45	12.3	19.0	24.0	30.0
.380	....	....	....	....	6.32	7.70	8.42	9.95	....	....	22
.331	....	....	....	....	....	....	....	....	....	....	....
.260	.650	.750	.850	1.10	2.28	2.89	3.16	3.58	5.30	6.50	8.20
.220	....	....	....	....	1.42	1.80	2.00	2.32	....	....	....
.200	.400	.445	.500	.630	1.10	1.45	1.55	1.78	2.4	3.32	4.30
.184	....	....	....	....	....	1.24	....	....	....	....	....

λ, Å	Ag	Sn	I	Ba	Ta	W	Pt	Au	Pb	Bi	U
.892	....	....	....	....	....	....	165	178	142	....	....
							201				
.880	50	60	....	....	....	....	195	170	135	....	....
.862	....	....	....	....	....	....	185	163	130	....	....
								193			
.850	46	56	....	....	....	....	179	186	124	....	....
.814	41	49.5	....	....	....	....	160	167	111	....	....
									150		
.780	36	44.5	....	....	....	....	144	150	136	....	....
									166		
.710	27.5	34.0	38.5	42.0	100	104	115	120	136	....	....
.680	23.5	28.4	....	....	....	....	102	108	120	....	....
.631	19.6	23.0	26.4	31.1	72	75	84.5	87	98	....	....
.618	....	....	....	....	....	....	....	....	....	....	....
.560	13.3	16.2	....	....	....	....	62	66	75	....	....
.497	10.5	11.8	15.6	17.8	36	38	47	48.5	52.8	....	....
.485	9.8	11.1	....	....	....	....	....	....	....	....	....
	62.5										
.476	60	....	....	....	....	....	42	....	47.5	....	....
.424	43.5	8.0	....	....	....	....	....	....	....	....	....
		46.6									
.417	41	45	9.2	10.5	21.5	22.5	27.4	28.4	32.0	....	....
.380	31.2	34	....	....	....	17.3	21.1	22	26.4	27.8	....
.331	21.7	24.5	....	5.4	....	....	....	....	18.1	19.5	....
				28.0							
.260	11.4	12.8	14.2	16.1	6.7	6.85	8.0	8.3	10.0	11.0	....
.220	7.05	7.80	....	....	....	4.25	5.25	5.50	5.92	6.4	....
.200	5.48	6.20	7.0	8.0	3.4	3.50	4.25	4.40	4.90	5.1	5.40
.184	4.45	....	....	....	2.8	....	3.45	3.60	4.05	4.2	....
					11.8						

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = .178 – .005 A

λ, Å	H	Li	Be	B	C	N	O	Ne	Na	Mg	Al
.178	....	....	....	....	.164	....	....	....	....	....	.235
.175	.360	.144	.150	.155	.163	.166	.169	.185	.195	.205	.228
.158	....	....	....	....	.160	....	....	....	....	....	.208
.155	....	....	....	....	....	....	....	....	....	....	....
.146	.340	....	....	....	.155	....	.162	....	.170	.176	.195
.142	.330	....	....	....	.153	....	....	....	....	....	.191
.130	.320	.132	....	.149	.152	....	.157	....	.160	.168	.186
.120	....	....	....	....	.150	....	.154	....	....	.163	.172
.113	.310	....	....	....	.147	....	.153	....	.155	.160	.166
.107	....	....	....	....	....	....	....	....	....	....	....
.098	.280	.125	....	.138	.142	....	.144	....	.150	.152	.156
.080	.255	....	....	....	.137	....	....	....	....	....	.146
.072	.250	.118	....	.132	.136	....	.137	....	.139	.140	.143
.064	.245	.110	....	.126	.130	....	.130	....	.130	.130	.130
.050	....	....	....	....	....	.120	....	....	....	....	.115
.040	.205	....	....	....	.110	....	....	....	....	....	.105
.030	.180	....	....	....	.095	....	....	....	....	....	.093
.024	.165	....	....	....	.080	....	....	....	....	....	.079
.010	.117	....	....	....	.059	....	....	....	....	....	.058
.005	.078	....	....	....	.0385	....	....	....	....	....	.0380

λ, Å	S	Cl	A	Ca	Fe	Ni	Cu	Zn	Br	Sr	Mo
.178	....	....	....	....	....	....	1.15	....	....	....	....
175	.335	.341	.400	.460	.800	1.05	1.12	1.26	1.90	2.24	2.95
.158	....	....	....	....	.640	.815	.862	.990	....	....	....
.155	....	....	....	....	....	....	....	....	....	....	....
.146	.249	.280	....	.345	.520	....	.680	....	....	....	....
.142	....	....	....	....	.515	.630	.670	.780	....	....	1.55
.130	.220	.230	....	.290	.424	....	.551	....	....	....	....
.120	.200	....	....	....	.368	.430	.455	.537	....	....	....
.113	.189	.195	....	.230	.337	....	.422	....	....	....	....
.107	....	....	....	....	....	....	....	....	....	....	....
.098	.166	.176	....	.200	.265	....	.325	....	....	....	.790
.080	....	.164	....	....	.235	.264	.268	.308	....	....	....
.072	.150	.158	....	.180	.202	....	.232	....	....	....	....
.064	.139	.142	....	.155	.178	....	.198	....	....	....	.413
.050	....	....	....	....	.140	....	.155	....	....	....	....
.040	....	....	....	....	.118	....	.126	....	....	....	....
.030	....	....	....	....	.095	....	.100	....	....	....	....
.024	....	....	....	....	.080	....	.081	....	....	....	....
.010	....	....	....	....	.058	....	.057	....	....	....	....
.005	....	....	....	....	....	....	.0380	....	....	....	....

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = .178 – .005 A

λ, Å	Hg	Sn	I	Ba	Ta	W	Pt	Au	Pb	U
.178	.....	......	....	....	.....	2.7	3.16	3.30	3.55	.....
						11.3				
.175	3.96	4.50	5.10	5.70	10.0	10.5	2.97	3.13	3.48	3.95
.158	3.00	3.40	....	....	.....	8.6	2.45	2.43	2.60	.....
							9.40			
.155	.....	......	....	....	.....	.....	....	2.30	......	.....
								8.80		
.146	2.48	2.66	....	....	6.75	.....	7.60	7.85	2.35	2.70
.142	2.31	2.64	....	....	.....	6.75	7.20	7.33	2.10	.....
									7.75	
.130	1.97	2.12	....	....	5.10	.....	6.30	6.40	6.55	2.20
.120	1.61	1.77	....	2.20	.....	4.60	4.92	4.98	5.20	1.90
.113	1.47	1.60	....	....	3.80	.....	4.40	4.50	4.75	.....
.107	.....	......	....	....	.....	.....	....	....	......	1.62
										4.65
.098	1.05	1.17	....	....	2.80	.....	3.15	3.21	3.50	3.90
.080	.73	.79	....	....	.....	2.30	2.40	2.42	2.50	2.70
.072	.584	.614	....	....	1.75	.....	2.00	2.05	2.10	2.25
.064	.465	.490	....	....	1.35	.....	1.52	1.55	1.64	1.80
.050	.....	.320	....	....	.....	.....	.86	.88	1.00	.....
.040	.....	.21	....	....	.....	.....	....	....	.62	.....
.030	.....	.13	....	....	.....	.....	....	....	.38	.....
.024	.....	.10	....	....	.....	.....	....	....	.21	.....
.010	.....	.060	....	....	.....	.....	....	....	.071	.082
.005	.....	.0385	....	....	.....	.....	....	....	.0425	.044

ATOMIC ABSORPTION COEFFICIENTS

$$\frac{\mu}{\nu} = \frac{\mu}{\rho} \times \frac{W}{N}$$

The values are multiplied by 10^{23}

A.U.	H 1	Li 3	C 6	N 7	O 8	Al 13	Fe 26	Cu 29	Mo 42	Ag 47	Pb 82	H_2O (H)
.025	..	....	.....	....	.....	.317	.625	.....	......	......	2.60	.....
.100	..	....	.285	....	.....	.724	....	3.3	......	......	......	.....
.125	.04	....	.305	....	.385	.792	3.67	4.8	21.3	......	103.	.478
.150	.05	....	.323	.376	.430	.889	5.38	8.3	31.0	......	53.6	.534
.175	.06	....	.329	.395	.459	1.04	7.55	11.8	44.7	66.5	86.1	.578
.20	.05	....	.343	.409	.482	1.19	9.75	16.4	63.5	107.	157.	.591
.25	.05	....	.370	.446	.546	1.62	17.3	29.0	117.	203.	290.	.650
.30	.04	.197	.400	.518	.641	2.34	28.4	47.2	201.	323.	485.	.730
.35	.04	.215	.433	.580	.763	3.31	43.9	72.9	302.	483.	772.	.840
.40	.05	.238	.475	....	.886	4.56	64.5	106.	422.	686.	1150.	.992
.50	.08	.280	.602	....	1.29	8.44	127.	197.	769.	204.	2070.	1.458
.60	.09	.350	.780	....	1.92	14.0	208.	332.	1277.	348.	......	2.11
.70	.10	.462	1.052	....	2.85	22.1	325.	512.	297.	......	......	3.04
.80	.17	....	1.40	....	4.03	32.4	466.	.....	430.	......	......	4.38
1.00	..	....	2.51	....	.....	61.6	830.	.....	838.	2000.	......	8.01

X-RAY SPECTRA

Compiled by J. M. Cork

Emission Wave-Lengths in the K and L Series, $\lambda \times 10^{-8}$ cm.

For calcite d = 3.02904×10^{-8} cm.

At. No.	Element	K Series				L Series								
		α_2	α_1	β_1	β_2	l	α_2	α_1	η	β_1	β_4	β_3	β_2	γ_1
11	Sodium	11.885		11.594										
12	Magnesium	9.869		9.539										
13	Aluminum	8.320		7.965										
14	Silicon	7.111		6.7545										
15	Phosphorus	6.142		5.7921										
16	Sulphur	5.3637	5.3613	5.0211										
17	Chlorine	4.7212	4.7182	4.3942										
18	Argon	......	......	......										
19	Potassium	3.7371	3.7337	3.4468										
20	Calcium	3.3549	3.3517	3.0834										
21	Scandium	3.0284	3.0250	2.7739										
22	Titanium	2.7468	2.7432	2.5090										
23	Vanadium	2.5021	2.4984	2.2797	......	......	24.3		......					
24	Chromium	2.2889	2.2850	2.0806	......	......	21.52		......	21.19				
25	Manganese	2.1015	2.0975	1.9062	......	......	19.39		......	19.04				
26	Iron	1.9310	1.9321	1.7530	......	20.12	17.58		19.65	17.22	15.61			
27	Cobalt	1.7892	1.7853	1.6174	......	18.20	15.94		17.77	15.62	.....			
28	Nickel	1.6584	1.6545	1.4970	1.4856	16.55	14.53		16.17	14.24	13.14			
29	Copper	1.5412	1.5374	1.3894	1.3782	15.19	13.306		14.83	13.03	12.10			
30	Zinc	1.4360	1.4322	1.2926	1.2811	13.95	12.23		13.61	11.95	11.16			
31	Gallium	1.3409	1.3372	1.2052	1.1938	12.89	11.27		12.56	11.01	.....			
32	Germanium	1.2552	1.2513	1.1267	1.1146	11.922	10.415		11.587	10.153				

X-RAY SPECTRA (Continued)

Emission Wave-Lengths in the K and L Series, $\lambda \times 10^{-8}$ cm.

At. No.	Element	K Series				L Series								
		α_2	α_1	β_1	β_2	l	α_2	α_1	η	β_1	β_4	β_3	β_2	γ_1
33	Arsenic	1.1774	1.1734	1.0551	1.0428	11.048	9.652		10.711	......				
34	Selenium	1.1065	1.1025	.99013	.97791	10.272	8.972		9.939	8.718				
35	Bromine	1.0417	1.0376	.93087	.91853	9.564	8.358		9.235	8.109				
37	Rubidium	.9278	.9236	.82696	.81476	....	....		....	......	6.801	6.769		
38	Strontium	.8776	.8734	.78130	.76921	7.822	6.849		7.506	6.610	6.392	6.358		
39	Yttrium	.8313	.8271	.73919	.72713	....	6.436		7.031	6.204	6.008	5.974	......	....
40	Zirconium	.7885	.7843	.70028	.68850	6.899	6.057		6.594	5.824	5.652	5.619	5.574	5.374
41	Columbium	.7489	.7446	.66438	.65280	6.510	5.718	5.712	6.196	5.480	5.330	5.297	5.226	5.024
42	Molybdenum	.71210	.70783	.63098	.61970	....	5.401	5.395	5.836	5.166	5.041	5.005	4.910	....
44	Ruthenium	.64606	.64174	.57131	.56051	5.486	4.843	4.836	....	4.611	4.513	4.476	4.362	4.173
45	Rhodium	.61637	.61202	.54449	.53396	5.2070	4.5956	4.5878	4.9112	4.3640	4.2802	4.2447	4.1221	3.9357
46	Palladium	.58860	.58422	.51961	.50928	4.9396	4.3666	4.3585	4.6502	4.1373	4.0623	4.0257	3.9007	3.7164
47	Silver	.56265	.55824	.49622	.48607	4.6976	4.1538	4.1456	4.4101	3.9266	3.8611	3.8245	3.6938	3.5149
48	Cadmium	.53831	.53388	.47413	.46429	4.4713	3.9564	3.9478	4.1875	3.7301	3.6743	3.6364	3.5064	3.3280
49	Indium	.51547	.51104	.45365	.44408	4.2593	3.7724	3.7637	3.9761	3.5478	3.4990	3.4619	3.3312	3.1513
50	Tin	.49404	.48961	.43430	.42507	4.0633	3.6011	3.5922	3.7818	3.3779	3.3363	3.2989	3.1679	2.9949
51	Antimony	.47394	.46943	.41630	.40715	3.8803	3.4408	3.4318	3.5996	3.2184	3.1843	3.1451	3.0166	2.8451
52	Tellurium	.45496	.45045	.39928	.39043	3.7101	3.2910	3.2820	....	3.0700	3.0400	3.0013	2.8761	2.7065
53	Iodine	.43698	.43246	.38315	.37466	3.5497	3.1509	3.1417	....	2.9309	2.9059	2.8682	2.7461	2.5775
54	Xenon	....	....	....	....	....	....	....	....	....	....	....	....	....
55	Caesium	.40404	.39953	.35362	.34516	3.2596	2.8956	2.8861	2.9833	2.6778	2.6605	2.6299	2.5064	2.3425
56	Barium	.38891	.38438	.34022	.33222	3.1287	2.7790	2.7696	2.8571	2.5622	2.5498	2.5110	2.3993	2.2366
57	Lanthanum	.37463	.37000	.32726	.31966	3.0000	2.6688	2.6597	2.7340	2.4533	2.4438	2.4053	2.2980	2.1372
58	Cerium	.36103	.35642	.31501	.30770	2.8857	2.5651	2.5560	2.6147	2.3510	2.3442	2.3059	2.2041	2.0443
59	Praesodymium	.34805	.34340	.30360	.29625	2.7781	2.4676	2.4577	2.5070	2.2539	2.2501	2.2124	2.1148	1.9568

X-RAY SPECTRA (Continued)

Emission Wave-Lengths in the K and L Series, $\lambda \times 10^{-8}$ cm.

At. No.	Element	K Series α_2	K Series α_1	K Series β_1	K Series β_2	L Series l	L Series α_2	L Series α_1	L Series η	L Series β_1	L Series β_4	L Series β_3	L Series β_2	L Series γ_1
60	Neodymium	.33596	.33128	.29275	.28573	2.6703	2.3756	2.3653	2.4042	2.1622	2.1622	2.1222	2.0314	1.8738
62	Samarium	.31311	.30844	.27250	.26575	2.4770	2.2057	2.1950	2.2140	1.9936	1.9964	1.9580	1.8781	1.7231
63	Europium	.30267	.29795	.26307	.25645	2.3903	2.1273	2.1163	......	1.9163	1.9221	1.8827	1.8082	1.6543
64	Gadolinium	.29251	.28778	.25394	.24762	2.3071	2.0526	2.0419	......	1.8425	1.8493	1.8109	1.7419	1.5886
65	Terbium	.28294	.27820	.24551	.23912	2.2290	1.9823	1.9715	......	1.7727	1.7814	1.7425	1.6790	1.5266
66	Dysprosium	.27369	.26895	.23710	.23128	2.1540	1.9156	1.9046	1.8922	1.7066	1.7167	1.6777	1.6198	1.4697
67	Holmium	.26499	.26030	......	......	2.0821	1.8521	1.8410	1.8220	1.6435	1.6553	1.6160	1.5637	1.4142
68	Erbium	.25669	.25198	.22215	.21671	2.0151	1.7914	1.7804	1.7548	1.5834	1.5964	1.5579	1.5106	1.3623
69	Thulium	.24861	.24387	.21487	......	1.9511	1.7339	1.7228	1.6923	1.5268	1.5412	1.5023	1.4602	1.3127
70	Ytterbium	.24099	.23625	.20834	.20322	1.8900	1.6789	1.6678	1.6310	1.4725	1.4882	1.4494	1.4128	1.2648
71	Lutecium	.23358	.22882	.20171	.19649	1.8318	1.6264	1.6155	1.5738	1.4207	1.4372	1.3982	1.3672	1.2203
72	Hafnium	.22653	.22173	.19515	.19042	1.7774	1.5770	1.5661	1.5197	1.3711	1.3893	1.3497	1.3235	1.1765
73	Tantalum	.21973	.21488	.18911	.18451	1.7249	1.5298	1.5188	1.4679	1.3242	1.3431	1.3041	1.2819	1.1356
74	Tungsten	.21345	.20862	.18422	.17898	1.6750	1.4844	1.4734	1.4181	1.2792	1.2988	1.2599	1.2420	1.0963
76	Osmium	.20131	.19645	.17361	.16875	......	1.3987	1.3886	......	1.1949	......	......	1.1688	1.0229
77	Iridium	.19550	.19065	.16850	.16376	......	1.3598	1.3485	1.2817	1.1554	1.1771	1.1385	1.1329	.98876
78	Platinum	.19004	.18523	.16370	.15887	1.4964	1.3215	1.3103	1.2403	1.1176	1.1398	1.1016	1.0997	.95599
79	Gold	.18483	.17996	.15902	.15426	1.4569	1.2850	1.2737	1.2003	1.0813	1.1042	1.0655	1.0680	.9246
80	Mercury	......	......	......	......	1.4184	1.2495	1.2386	1.1616	1.0465	1.0692	1.0305	1.0377	.8946
81	Thalium	.17466	.16980	.15011	.14539	1.3819	1.2163	1.2049	1.1254	1.0130	1.0370	.9985	1.0082	.8657
82	Lead	.17004	.16516	.14606	.14125	1.3474	1.1841	1.1726	1.0900	.9808	1.0056	.9672	.9808	.8380
83	Bismuth	.16525	.16041	.14025	......	1.3137	1.1530	1.1415	1.0565	.9500	.9750	.9367	.9532	.8114
90	Thorium	.1368	.1323	.1169	.1134	1.1128	.9658	.9540	.8528	.7636	.7919	.7532	.7919	.6517
92	Uranium	.1309	.1264	.1119	.1084	1.0649	.9206	.9087	.8035	.7185	.7464	.7088	.7531	.6136

Wave-lengths in Ångstrom units as determined by Crystal.

X-RAY SPECTRA (Continued)

Emission Wave-Lengths in the M Series, $\lambda \times 10^{-8}$ cm.

Atomic Number	Element	α_2	α_1	β	γ
58	Cerium	......	14.030	13.755	11.511
59	Praesodymium	......	......	......	10.975
60	Neodymium	......	12.650	12.375	10.483
62	Samarium	11.475	11.406	11.238	9.580
63	Europium	11.003	10.932	10.723	9.192
64	Gadolinium	10.428	10.394	10.233	8.826
65	Terbium	9.946	9.917	9.772	8.468
66	Dysprosium	9.555	9.524	9.345	8.127
67	Holmium	9.165	9.143	8.947	7.849
68	Erbium	8.794	8.783	8.576	7.530
70	Ytterbium	8.138	8.122	7.893	7.009
71	Lutecium	......	7.824	7.585	6.748
72	Hafnium	......	7.524	7.289	6.530
73	Tantalum	......	7.237	7.008	6.299
74	Tungsten	......	6.969	6.743	6.076
75	Rhenium	......	6.715	6.491	5.875
76	Osmium	......	6.477	6.254	5.670
77	Iridium	6.262	6.249	6.025	5.490
78	Platinum	6.045	6.034	5.816	5.309
79	Gold	5.842	5.828	5.612	5.135
81	Thalium	5.461	5.450	5.239	4.815
82	Lead	5.288	5.274	5.065	4.665
83	Bismuth	5.119	5.108	4.899	4.522
90	Thorium	4.143	4.130	3.934	3.672
92	Uranium	3.916	3.902	3.708	3.473

X-RAY SPECTRA AND ATOMIC NUMBERS

(From Smithsonian Physical Tables)

Kaye has shown that an element excited by sufficiently rapid cathode rays emits characteristic Röntgen radiations. These have been analyzed and the wave lengths obtained by Moseley (Phil. Mag. 27, p. 703, 1914) using a crystal of potassium ferrocyanide as a grating. The "K" series of elements shows 2 lines α and β, the "L" series several. The wave lengths of the α and β lines of each series are given in the following table. $Q_K = (v/\tfrac{3}{4}\,v_0)^{\frac{1}{2}}$; $Q_L = (v/\tfrac{5}{36}\,v_0)^{\frac{1}{2}}$ where v is the frequency of the α line and v_0 the fundamental Rydberg frequency. The atomic number for the K series = $Q_K + 1$; for the L series = $Q_L + 7.4$ approximately. $v_0 = 3.29 \times 10^{15}$

Element	α line $\lambda \times 10^8$ cm.	Q_K	Atomic number N	β line $\lambda \times 10^8$ cm.	Element	α line $\lambda \times 10^8$ cm.	Q_L	Atomic number N	β line $\lambda \times 10^8$ cm.
Al.	8.364	12.0	13	7.912	Zr.	6.091	32.8	40	
Si.	7.142	13.0	14	6.729	Cb.	5.749	33.8	41	5.507
Cl.	4.750	16.0	17		Mo.	5.423	34.8	42	5.187
K.	3.759	18.0	19	3.463	Ru.	4.861	36.7	44	4.660
Ca.	3.368	19.0	20	3.094	Rh.	4.622	37.7	45	
Ti.	2.758	21.0	22	2.524	Pd.	4.385	38.7	46	4.168
V.	2.519	22.0	23	2.297	Ag.	4.170	39.6	47	
Cr.	2.301	23.0	24	2.093	Sn.	3.619	42.6	50	
Mn.	2.111	24.0	25	1.818	Sb.	3.458	43.6	51	3.245
Fe.	1.946	25.0	26	1.765	La.	2.676	49.5	57	2.471
Co.	1.798	26.0	27	1.629	Ce.	2.567	50.6	58	2.360
Ni.	1.662	27.0	28	1.506	Pr.	(2.471)	51.5	59	2.265
Cu.	1.549	28.0	29	1.402	Md.	2.382	52.5	60	2.175
Zn.	1.445	29.0	30	1.306	Sa.	2.208	54.5	62	2.008
Yt.	0.838	38.1	39		Eu.	2.130	55.5	63	1.925

X-RAY SPECTRA AND ATOMIC NUMBERS

(From Smithsonian Physical Tables)

Element	α line $\lambda \times 10^8$ cm.	Q_K	Atomic number N	β line $\lambda \times 10^8$ cm.	Element	α line $\lambda \times 10^8$ cm.	Q_L	Atomic number N	β line $\lambda \times 10^8$ cm.
Zr	0.794	39.1	40		Gd	2.057	56.5	64	1.853
Cb	0.750	40.2	41		Ho	1.914	58.6	66	1.711
Mo	0.721	41.2	42		Er	1.790	60.6	68	1.591
Ru	0.638	43.6	44		Ta	1.525	65.6	73	1.330
Pd	0.584	45.6	46		W	1.486	66.5	74	
Ag	0.560	46.6	47		Os	1.397	68.5	76	1.201
					Ir	1.354	69.6	77	1.155
					Pt	1.316	70.6	78	1.121
					Au	1.287	71.4	79	1.092

Moseley's summary condensed is as follows: Every element from Al to Au is characterized by an integer N which determines its X-ray spectrum; N is identified with the number of positive units of electricity in its atomic nucleus. The order of these atomic numbers (N) is that of the atomic weights except where the latter disagrees with the order of the chemical properties. Known elements correspond with all the numbers between 13 and 79 except 3. There are here 3 possible elements still undiscovered. The frequency of any line in the X-ray spectrum is approximately proportional to $A(N-b)^2$, **where A and b are constants. All X-ray spectra of each series are similar in structure differing only in wave lengths.**

X-RAY CRYSTALLOGRAPHIC DATA

Compiled with the collaboration of John G. Albright

The following table presents crystallographic data for about 1300 compounds. For convenience they have been separated into; elements, inorganic compounds, minerals, metal-organic compounds and organic compounds. Alloys will be found among the inorganic compounds under one or the other of the metal constituents.

The crystal system is given using abbreviations indicated below. The type of structure is indicated by reference to certain characteristic compounds. The space group is indicated by the symbols of the Shoenflies system. The dimensions of the unit cell *a*, *b*, and *c* in angstrom units are given in order followed in some cases by axial angles. The last column indicates the number of molecules per unit cell.

For an explanation of the space group symbols, structure types or other details of crystallographic data see Wyckoff: The Structure of Crystals.

Abbreviations: b.c., body centered; c.p., close packed; cub., cubic; dia., diamond; f.c., face centered, hex., hexagonal; monocl., monoclinic; rhbdr., rhombohedral; rhomb., rhombic; tetr., tetragonal; tricl., triclinic.

The Elements

Substance	System, struct. type	Space group	Lattice constants *a*, *b*, *c*, Ax. ang.	Mol.
A (−253°C)	cub., f.c., Cu	O_h^5	5.43	4
Ag	cub., f.c., Cu	O_h^5	4.0776	4
Al	cub., f.c., Cu	O_h^5	4.0402	4
As	hex., rhbdr.	D_{3d}^5	4.151, $\omega = 53° 49'$	2
	rhbdr., f.c.	....	5.599, $\omega = 84° 18'$	8
Au	cub., f.c., Cu	O_h^5	4.0702	4
Ba	cub., b.c., W	O_h^9	5.015	2
Be	hex., c.p., Mg	D_{6h}^4	2.283, ..., 3.607 2.2679, ..., 3.5942 (Neuburger, 1933)	2
Bi	hex., rhbdr., As	D_{6h}^5	4.749, $\omega = 57° 16'$	2
	rhbdr., f.c.	....	6.578, $\omega = 87° 34'$	8
C (diamond, 18°C)	cub., f.c.	O_h^7	3.5597	8
C (graphite)	hex.	D_{6h}^4	2.48, ..., 6.78	4
Ca	cub., f.c., Cu	O_h^5	5.56	4
Cb (Nb)	cub., b.c., W	O_h^9	3.03	2
Cd	hex., c.p., Mg	D_{6h}^4	2.973, ..., 5.606	2
Ce (α)	hex., c.p., Mg	D_{6h}^4	3.65, ..., 5.91	2
Ce (β)	cub., f.c., Cu	O_h^5	5.12	4
Co (α)	hex., c.p., Mg	D_{6h}^4	2.514, ..., 4.105	2
Co (β)	cub., f.c., Cu	O_h^5	3.554	4
Cr (α)	cub., b.c., W	O_h^9	2.878	2
Cr (β)	hex., c.p., Mg	D_{6h}^4	2.717, ..., 4.418	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Cr (γ)	cub., b.c.,	T_d^3	8.717	58
Cs (−173°C)	cub., b.c., W	O_h^9	6.05	2
Cu	cub., f.c.	O_h^5	3.608	4
Er	hex., c.p., Mg	D_{6h}^4	3.74, ..., 6.09	2
Fe (α)	cub., b.c., W	O_h^9	2.86106	2
Fe (β) (800°C)	cub., b.c.	....	2.90	2
Fe (γ) (1100°C)	cub., f.c.	O_h^5	3.63	4
Fe (δ) (1425°C)	cub., b.c.	....	2.93	2
Ga	tetr. (simple)	D_{4h}^{18}	4.51, ..., 7.51	8
Ge	cub., f.c., Dia.	O_h^7	5.647	8
H_2 (−271°C)	hex.	....	3.75, ..., 6.11	4
Hg (−46°C)	rhbdr.	D_{3d}^5	2.997, ω = 70° 32′	1
	rhbdr. f.c.	....	4.578, ω = 98° 13′	4
Hf	hex., c.p., Mg	D_{6h}^4	3.200, ..., 5.077	2
I_2	rhomb., $4I_2$ groups	V_h^{18}	4.795, 7.255, 9.780	8
In	tetr., f.c.	D_{4h}^{17}	4.583, ..., 4.936	4
Ir	cub., f.c., Cu	O_h^5	3.823	4
K	cub., b.c., W	O_h^9	5.333	2
Kr (−252.5°C)	cub., f.c., Cu	O_h^5	5.59	4
La	hex., c.p., Mg	D_{6h}^4	3.72, ..., 6.06	2
La (β)	cub., f.c.	....	5.296	
Li (−173°C)	cub., b.c., W	O_h^9	3.46	2
Mg	hex., c.p.	D_{6h}^4	3.203, ..., 5.196	2
Mn (α)	cub., b.c.	T_d^3	8.894	58
Mn (β)	cub.	O^6 or O^7	6.300	20
Mn (γ)	tetr., f.c., In	D_{4h}^{17}	3.774, ..., 3.526	4
Mo	cub., b.c., W	O_h^9	3.1401	2
N_2 (α) (−252°C)	cub.	T^4	5.66 ($4N_2$)	8
Na (−173°C)	cub., b.c., W	O_h^9	4.24	2
Ne (−268°C)	cub., f.c., Cu	O_h^5	4.52	4
Ni (α)	hex., c.p. Mg	D_{6h}^4	2.66, ..., 4.29	2
Ni (β)	cub., f.c., Cu	O_h^5	3.517	4
O_2 (−252°C)	rhomb., b.c.	....	5.50, 3.82, 3.44	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Os	hex., c.p., Mg	D_{6h}^4	2.724, ..., 4.314	2
P (metallic)	hex., rhbdr., As	D_{3d}^5	5.14, ω = 34° 7′	2
	rhbdr., f.c.	....	5.96, ω = 60° 47′	8
P (white, −35°C)	cub.	....	7.17 ($4P_4$)	16
Pb	cub., f.c., Cu	O_h^5	4.941	4
Pd	cub., f.c., Cu	O_h^5	3.879	4
Pt	cub., f.c., Cu	O_h^5	3.9142	4
Rb (−173°C)	cub., b.c., W	O_h^9	5.62	2
Re	hex., c.p., Mg	D_{6h}^4	2.765, ..., 4.470	2
Rh	cub., f.c., Cu	O_h^5	3.7944	4
Ru	hex., c.p., Mg	D_{6h}^4	2.695, ..., 4.273	2
S	rhomb., f.c.	V_h^{24}	10.61, 12.87, 24.56	128
Sb	hex., rhbdr., As	D_{3d}^5	4.501, ω = 57° 5′	2
	rhbdr., f.c.	....	6.226, ω = 87° 24′	8
Se	hex.	D_3^4 or D_3^6	4.337, ..., 4.944	3
Se	monocl.	C_{2h}^2	11.50, 8.98, 8.977, β = 90° 57′ ($4Se_8$)	32
Si	cub., f.c., Dia	O_h^7	5.418	8
Sn (α, gray)	cub., f.c., Dia.	O_h^7	6.46	8
Sn (β, white)	tetr., double b.c.	D_{4h}^{19}	5.818, ..., 3.174	4
Sr	cub., f.c., Cu	O_h^5	6.075	4
Ta	cub., b.c., W	O_h^9	3.281	2
Te	hex., Se	D_3^4 or D_3^6	4.495, ..., 5.912	3
Th	cub., f.c., Cu	O_h^5	5.074	4
Ti	hex., c.p., Mg	D_{6h}^4	2.951, ..., 4.692	2
Tl (α)	hex., c.p., Mg	D_{6h}^4	3.450, ..., 5.520	2
Tl (β, stab. > 230°C)	cub., f.c., Cu	O_h^5	4.841	4
U	cub., b.c., W	O_h^9	3.43	2
U	monocl. (Wilson, 1933)	C_{2h}^3	2.829, 4.887, 3.308	2
V	cub., b.c., W	O_h^9	3.011	2
W (α)	cub., b.c.	O_h^9	3.1583	2
W (β)	cub.	O^2 or O_h^3	5.04	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Xe (−173°C)	cub., f.c., Cu	O_h^5	6.18	4
Zn	hex., c.p. Mg	D_{6h}^4	2.649, ..., 4.930	2
Zr	hex., c.p., Mg	D_{6h}^4	3.223, ..., 5.123	2
Inorganic Compounds				
Ag_3Al	cub., β-Mn	. . . .	6.920	5
Ag_3AsO_4	cub., Ag_3PO_4	T_d^4	6.12	2
AgBr	cub., NaCl	O_h^5	5.755	4
$AgBrO_3$	tetr., $AgClO_3$	V_d^{11} or D_{4h}^{17}	8.59, ..., 8.01	8
AgCN	hex.	C_{3v}^5	4.60, α = 81° 14′	
AgCd (β-phase)	cub., CsCl	O_h^1	3.33	1
Ag_5Cd_8	cub., Cu_5Zn_8	T_d^3	9.96	4
AgCl	cub., NaCl	O_h^5	5.545	4
$AgClO_3$	tetr.	V_d^{11} or D_{4h}^{17}	8.47, ..., 7.90	8
$AgClO_4$ (200°C)	cub., $KClO_4$	T_d^2	6.92	4
AgF	cub., NaCl	O_h^5	4.92	4
Ag_2F	hex., CdI_2	D_{3d}^3	3.0, ..., 5.74	1
Ag_3Hg_4	cub.	O_h^9	10.09	4
Ag_2HgI_4	tetr.	V_d^1	6.340	
Ag_2HgI_4 (α, > 50°C)	cub.	T_d^2	6.383	1
AgI	hex., ZnO	C_{6v}^4	4.59, ..., 7.50	2
AgI	cub., ZnS	T_d^2	6.49	4
$AgIO_4$	tetr.	C_{4h}^6	5.368, ..., 12.013	4
$AgK(CN)_2$	hex.	D_{3d}^2	7.384, ..., 17.55	
AgMg	cub., CsCl	O_h^1	3.28	
$AgMnO_4$	monocl.	C_{2h}^5	5.66, 8.27, 7.12, β = 92° 29′	4
Ag_2MoO_4	cub., $MgAl_2O_4$	O_h^7	9.26	8
$AgNO_3$	rhomb.	$V^1 - V^4$	6.97, 7.34, 10.14	8
Ag_2O	cub., Cu_2O	O_h^4	4.72	2
Ag_3PO_4	cub.	O_h^3	5.99	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$AgRhO_4$	tetr.	C_{4h}^6	5.349, ..., 11.916	4
$Ag_2SO_4.4NH_3$	tetr.	V_4^d	8.44, ..., 6.35	2
$Ag(Sb, Bi)S_2$	tricl.	....	5.67, 5.69, 5.62	2
Ag_3SbS_3	hex., (rhbdr.)	....	7.07, α = 104° 1′	2
AgZn	cub., CsCl	O_h^1	3.156	1
Ag_5Zn_8	cub., Cu_5Zn_8	T_d^3	9.33	4
AlAs	cub., ZnS	T_d^2	5.62	
$AlCl_3$	hex.	....	3.475, ..., 8.51	1
$AlCl_3.6H_2O$	hex., (rhbdr.)	D_{3d}^6	7.85	2
AlCu	hex.	....	3.89, α = 94° 36′	4
$AlCu_3$	cub., $AlCu_3$, f.c.	....	3.47	4
Al_2Cu	tetr., b.c.	D_{4h}^{18}	6.04, ..., 4.86	4
Al_4Cu_9	cub., Cu_5Zn_8	T_d^3	8.70	4
$AlCu_2Mn$	cub., $AlCu_3$	....	5.950	4
AlF_3	hex.	D_3^7	4.914, ..., 12.46	6
	rhbdr.	....	5.029, α = 58° 31′	2
Al_3Mg_4	cub.	....	4.80	1
AlN	hex., ZnO	C_{6v}^4	3.11, ..., 4.98	2
Al_2O_3 (α, corundum)	hex., (rhbdr.), Fe_2O_3	D_{3d}^6	5.12, α = 55° 17′	2
Al_2O_3 (β)	hex.	....	5.56, ..., 22.55	
$Al_2O_3.H_2O$	rhomb.	....	4.38, 9.35, 2.82	
$Al(OH)_3$	monocl.	C_{2h}^5	8.6236, 5.06021, 9.699, β = 85° 26′	8
AlP	cub., ZnS	T_d^2	5.42	
$Al(PO_3)_3$	cub.	T_d^6	13.63	16
AlSb	cub., ZnS	T_d^2	6.13	4
$(Al, Sc)_2O_3$	cub.	O_i^{10}	9.22	16
Al_2SiO_5 (cyanite)	tricl.	C_i^1	7.09, 7.72, 5.56, β = 101° 2′	4
AsI_3	hex.	C_3^1	7.187, ..., 21.39	6
AsI_3	rhbdr.	C_{3i}^2	r = 8.25, α = 51° 20′	2
As_2O_3	cub., As_2O_3	O_i^7	11.06	16
AuCu	tetr.	....	3.98, ..., 3.72	
$AuCu_3$	cub.	....	3.75	1
$AuSb_2$	cub., FeS_2	T_h^6	6.636	4
AuSn	hex., NiAs	C_{6v}^4 or D_{6h}^4	4.307, ..., 5.494	2
AuZn	cub., CsCl	O_h^1	3.19	1

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$AuZn_3$ (α)	cub.	....	7.88	8
Au_5Zn_8	cub., Cu_5Zn_8	T_d^3	9.27	4
$BAsO_4$	....	S_4^2	4.458, ..., 6.796	2
B_2H_6	hex.	D_{6h}^4	4.54, ..., 8.69	2
$B_{10}H_{14}$	rhomb.	V_h^{21}	14.46, 20.85, 5.69	
BN	hex., graphite	D_{6h}^4	2.51, ..., 6.69	4
BPO_4	tetr.	S_4^2	4.332, ..., 6.64	2
BaC_2	tetr., f.c., CaC_2	D_{4h}^{17}	4.39, ..., 7.04	2
$BaCO_3$	rhomb., KNO_3	V_h^{16}	5.29, 8.88, 6.41	4
BaF_2	cub., CaF_2	O_h^5	6.184	4
$BaMoO_4$	tetr., $CaWO_4$	C_{4h}^6	5.56, ..., 12.76	4
$Ba(N_3)_2$	monocl.	C_{2h}^1 or C_{2h}^2	6.22, 29.29, 7.02, β = 105° 14′	10
$Ba(NO_3)_2$	cub., $Ba(NO_3)_2$	T_h^6	8.11	4
BaO	cub., NaCl	O_h^5	5.50	4
BaS	cub., NaCl	O_h^5	6.35	4
$BaSO_4$	rhomb.	V_h^{16}	8.85, 5.44, 7.13	4
BaSe	cub., NaCl	O_h^5	6.62	4
BaTe	cub., NaCl	O_h^5	6.986	4
$BaTiO_3$	cub., $CaTiO_3$	....	3.97	
$BaWO_4$	tetr., $CaWO_4$	C_{4h}^6	5.60, ..., 12.69	4
BeO	hex., ZnO	C_{6v}^4	2.70, ..., 4.39	2
BeS	cub., ZnS	T_d^2	4.85	
$BeSO_4.4H_2O$	tetr.	D_{2d}^{10} or D_{4h}^{18}	8.03, ..., 10.75	
BeSe	cub., ZnS	T_d^2	5.07	
Be_2SiO_4 (phenacite)	rhbdr.	C_{3i}^2	7.68	6
$BeSiO_3.AlO_2H$	....	C_{2h}^2	4.63, 14.30, 4.71, β = 100° 16′	4
$Be_2SiW_{12}O_{40}.31H_2O$	cub.	O_h^7	23.3	8
BeTe	cub., ZnS	T_d^2	5.54	
BiF_3	cub.	....	5.85	4
BiI_3	hex., AsI_3	C_3^1	7.498, ..., 20.67	6
CBr_4 (abv. 47°)	cub.	T_h^6	11.34	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
CBr_4	monocl.	C_{2h}^3 or C_{2h}^6	12.10, 3.41, 10.20, $\beta = 125° 3'$	8
CI_4	cub.	T_h^6	11.62	8
CO (temp. liq. H_2)	cub., $\alpha - N_2$	T^4	5.63	4
CO_2 (−190°C)	cub.	T_h^6	5.575	4
COS (temp. liq. air)	hex., (trig.)	C_3^4 or C_{3v}^5	4.08	1
CS_2 (−185°C)	tetr.	....	8.12, ..., 3.77	
$Ca_3Al_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.840	8
CaB_6	cub.	....	4.145	1
CaB_2O_4	rhomb.	V_h^{14}	6.19, 11.60, 4.28	4
CaC_2	tetr.	O_{4h}^{17}	3.87, ..., 6.37	2
$CaCN_2$	hex., $CsCl_2I$	D_{3d}^5	5.11, $\alpha = 43° 50'$	1
$CaCO_3$ (aragonite)	rhomb., KNO_3	V_h^{16}	4.94, 7.94, 5.72	4
$CaCO_3$ (calcite)	rhbdr., $NaNO_3$	D_{3d}^6	6.361, $\alpha = 46° 6'$	2
$CaCO_3$ (vaterite)	hex.	....	4.120, ..., 8.556	2
$CaCrO_4$	tetr.	D_{4h}^{19}	7.25, 6.34	
$CaCrO_4.H_2O$	rhomb.	V_h^{15}	7.99, 12.77, 8.11	8
$CaCrO_4.2H_2O$	rhomb.	V_h^{11}	16.02, 11.39, 5.60	8
$Ca_3Cr_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.950	8
CaF_2 (fluorite)	cub.	O_h^5	5.451	4
$Ca_3Fe_2Si_3O_{12}$	cub., b.c.	O_h^{10}	12.026	8
CaI_2	hex.	....	4.48, ..., 6.96	
$CaIn_2O_4$	tetr., Mn_3O_4	D_{4h}^{19}	6.201, ..., 9.822	4
Ca (Mg, Fe) $(CO_3)_2$	hex.	C_{3h}^2	6.02, $\alpha = 47° 7'$	1
$CaMoO_4$	tetr., $CaWO_4$	C_{4h}^6	5.23, ..., 11.44	4
$Ca(NO_3)_2$	cub., $Ba(NO_3)_2$	T_h^6	7.60	4
CaO	cub., NaCl	O_h^5	4.797	4
3CaO Al_2O_3	cub., b.c.	O_h^1	7.624	3
$5CaO.3Al_2O_3$	cub.	O_h^1	10.08	3
$Ca(OH)_2$	hex., CdI_2	D_{3d}^3	3.582, ..., 4.904	1
$CaPb_3$	cub.	....	4.891	
CaS	cub., NaCl	O_h^5	5.68	4
$CaSO_4$ (anhydrite)	rhomb.	V_h^{17}	6.22, 6.96, 6.97	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$CaSO_4.2H_2O$	monocl.	C_{2h}^3	10.47, 15.15, 6.51, β = 151° 33′	4
$CaSO_4.4CO(NH_2)_2$	tricl.	....	14.74, 14.95, 6.47, α = 91° 26′, γ = 86° 50′	4
CaSe	cub., NaCl	O_h^5	5.91	4
$CaSi_2$	hex. (rhbdr.)	D_{3d}^5	10.4, α = 21° 30′	2
$CaSiO_3BO_2H$	....	C_{2h}^5	9.64, 7.62, 4.82, β = 90° 9′	4
$CaSn_3$	cub.	....	4.732	
$CaSnO_3$	cub.(?), $CaTiO_3$	....	3.92	
CaTe	cub., NaCl	O_h^5	6.345	4
$CaTl_3$	cub.	....	4.794	
$CaWO_4$ (scheelite)	tetr.	C_{4h}^6	5.24, ..., 11.38	4
$CaZrO_3$	cub.(?), $CaTiO_3$	....	3.99	
CbC	cub., NaCl	O_h^5	4.40	4
CbN	cub., NaCl	O_h^5	4.41	4
CbO_2	tetr., SnO_2	D_{4h}^{14}	4.77, ..., 2.96	2
Cd_3As_2	cub., Zn_3As_2	....	6.29	2
$CdBr_2$	hex., $CdCl_2$	D_{3d}^5	6.63, α = 34° 42′	1
$CdCO_3$	hex., $NaNO_3$	D_{3d}^6	6.112, α = 47° 24′	2
$CdCl_2$	hex. (rhbdr.)	D_{3d}^5	6.35, α = 36° 40′	1
$CdCr_2O_4$	cub., $MgAl_2O_4$	....	8.59	
CdF_2	cub., CaF_2	O_h^5	5.40	4
$CdFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.73	8
CdI_2	hex., CdI_2	C_{3d}^3	4.24, ..., 6.84	4
$CdIn_2O_4$	tetr., Mn_3O_4	D_{4h}^{19}	6.117, ..., 9.875	4
CdO	cub., NaCl	C_h^5	4.689	4
$CdO.Fe_2O_3$	cub.	....	8.67	8
$Cd(OH)_2$	hex., CdI_2	D_{3d}^3	3.47, ..., 4.64	1
Cd(OH)Cl	hex.	C_{6v}^4	3.66, ..., 10.27	2
Cd_3P_2	cub., Zn_3As_2	....	6.06	2
CdS (α)	hex., ZnO	C_{6v}^4	4.14, ..., 6.72	2
CdS (β)	cub., ZnS	T_d^2	5.82	4
CdSb	rhomb.	....	6.52, 8.60, 4.16	4
CdSe	hex., ZnO	C_{6v}^4	4.30, ..., 7.02	2
CdTe	cub., ZnS	T_d^2	6.41	
$CdTiO_3$	cub.(?)	....	3.75	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
CeC_2	tetr., CaC_2	D_{4h}^{17}	3.87, ..., 6.48	2
CeF_3	hex.	D_6^6	7.114, ..., 7.273	6
CeO_2	cub., CaF_2	O_h^5	5.41	4
Ce_2O_3	hex., La_2O_3	D_{3d}^3	3.880, ..., 6.057	1
$CePb_3$	cub.	....	4.864	
$CeSn_3$	cub.	....	4.711	
$CoAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.059	8
CoAsS	cub.	T^4	5.60	4
$CoBr_2$	hex., CdI_2	D_{3d}^3	3.685, ..., 6.120	1
$CoCO_3$	hex. (rhbdr.), $NaNO_3$	D_{3d}^6	5.67, $\alpha = 48° 14'$ (5.91, $\alpha = 103° 22'$)	2 (4)
$CoCl_2$	hex., $CdCl_2$	D_{3d}^5	6.14, $\alpha = 33° 36'$	1
$CoCr_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.319	8
CoF_2	tetr., SnO_2	D_{4h}^{14}	4.69, ..., 3.19	2
$CoFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.35	8
CoI_2	hex., CdI_2	D_{3d}^3	3.96, ..., 6.65	1
$[Co.4NH_3.2H_2O]Co(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.02, $\alpha = 95° 51'$	1
$[Co.5NH_3.H_2O]ClO_3.SO_4$	cub., $(NH_4)_2PtCl_6$	....	10.73	
$[Co.5NH_3.H_2O](ClO_4)_3$	cub., $(NH_4)_3FeF_6$		11.32	
$[Co.5NH_3.H_2O]ClO_4.SO_4$	cub., $(NH_4)_2PtCl_6$	....	10.89	
$[Co.5NH_3.H_2O]Co(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.18, $\alpha = 96° 49'$	1
$[Co.5NH_3.H_2O]Fe(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.18, $\alpha = 96° 53'$	1
$[Co.5NH_3.H_2O]I_3$	cub., $(NH_4)_3FeF_6$	....	10.81	
$[Co.5NH_3.H_2O]SO_4Br$	cub., $(NH_4)_2PtCl_6$	....	10.45	
$[Co.5NH_3.H_2O]SO_4I$	cub., $(NH_4)_2PtCl_6$	....	10.62	
$[Co.5NH_3.H_2O]SeO_4Br$	cub., $(NH_4)_2PtCl_6$	....	10.63	
$[Co.6NH_3]ClO_3.SO_4$	cub., $(NH_4)_2PtCl_6$	....	10.80	
$[Co.6NH_3](ClO_4)_3$	cub., $(NH_4)_3FeF_6$	....	11.39	
$[Co.6NH_3]ClO_4.SO_4$	cub., $(NH_4)_2PtCl_6$	....	10.95	
$[Co.6NH_3]Co(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.24, $\alpha = 97° 28'$	1
$[Co.6NH_3]Cr(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.40, $\alpha = 97° 48'$	1
$[Co.6NH_3]I_3$	cub., $(NH_4)_3FeF_6$	....	10.88	
$[Co.6NH_3]SO_4Br$	cub., $(NH_4)_2PtCl_6$	....	10.51	
$[Co.6NH_3]SO_4I$	cub., $(NH_4)_2PtCl_6$	....	10.71	
$[Co.6NH_3]SeO_4I$	cub., $(NH_4)_2PtCl_6$	....	10.79	
CoO	cub., NaCl	O_h^5	4.24	4
Co_3O_4	cub., $MgAl_2O_4$	O_h^7	8.110	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$Co_2C_3.2Fe_2O_3$	cub.	....	8.35	
$Co(OH)_2$	hex., CdI_2	D^3_{3d}	3.19, ..., 4.66	1
CoS	hex., NiAs	C^4_{6v} or D^4_{6h}	3.37, ..., 5.14	2
CoS_2	cub., FeS_2	T^6_h	5.64	4
Co_3S_4	cub., $MgAl_2O_4$	O^7_h	9.36	8
$CoSO_4.7H_2O$	monocl., $FeSO_3.7H_2O$	C^6_{2h}	15.45, 13.08, 20.04, $\beta = 104° 40'$	16
CoSb	hex., NiAs	C^4_{6v}	3.866, ..., 5.188	2
CoSe	hex., NiAs	C^4_{6v} or D^4_{6h}	3.614, ..., 5.278	2
$CoSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C^2_{3i}	6.26, $\alpha = 96° 1'$	1
Co_2SnO_4	cub., $MgAl_2O_4$	O^7_h	8.60	8
CoTe	hex., NiAs	C^4_{6v} or D^4_{6h}	3.886, ..., 5.360	2
Cr_3C_2	rhomb.	....	2.82, 5.52, 11.46	4
Cr_4C	cub.	....	10.64	24
Cr_7C_3	hex.	....	13.98	80
$CrCl_3$	hex., (rhbdr.)	D^3_3 or D^5_3	6.02, ..., 17.3	6
$CrCl_3.6H_2O$	hex., (rhbdr.)	D^6_{3d}	7.98	2
CrN	cub., NaCl	O^5_h	4.140	4
$[Cr.5NH_3.H_2O](ClO_4)_3$	cub., $(NH_4)_3FeF_6$	....	11.47	
$[Cr.5NH_3.H_2O]SO_4Br$	cub., $(NH_4)_2PtCl_6$	....	10.535	
$[Cr.6NH_3](ClO_4)_3$	cub., $(NH_4)_3FeF_6$	....	11.545	
Cr_2O_3	hex., Fe_2O_3	D^6_{3d}	5.35, $\alpha = 54° 58'$	2
CrS	hex., NiAs	C^4_{6v} or D^4_{6h}	3.44, ..., 5.67	2
CrSb	hex., NiAs	C^4_{6v} or D^4_{6h}	4.107, ..., 5.468	2
CrSe	hex., NiAs	C^4_{6v} or D^4_{6h}	3.59, ..., 5.80	2
CrTe	hex., NiAs	C^4_{6v} or D^4_{6h}	3.981, ..., 6.211	2
$CsAl(SO_4)_2.12H_2O$	cub.	T^6_h	12.31	4
CsBr	cub., CsCl	O^1_h	4.287	1
$CsBr_2I$	rhomb.	V^{16}_h	6.57, 9.18, 10.66	4
$CsCdBr_3$	cub.(?), $CaTiO_3$	....	5.33	
$CsCdCl_3$	cub.(?), $CaTiO_3$	....	5.20	
CsCl	cub.	O^1_h	4.110	1
$CsCl_2I$	hex.	D^5_{3d}	5.46, $\alpha = 70° 42'$	1
$CsClO_4$ (250°C)	cub., $KClO_4$	....	7.96	1
$CsClO_4$	rhomb., $BaSO_4$	V^{16}_h	9.82, 6.00, 7.79	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$Cs_3Co(NO_2)_6$	cub.	....	11.15	4
CsF	cub., NaCl	O_h^5	6.01	4
$Cs_3Fe(CN)_6$	rhomb.	....	11.8, 10.1, 7.0	2
Cs_2GeF_6	cub., $(NH_4)_2PtCl_6$	O_h^5	8.99	4
$CsHgBr_3$	cub.(?), $CaTiO_3$	....	5.77	
$CsHgCl_3$	cub.(?), $CaTiO_3$	....	5.44	
CsI	cub., CsCl	O_h^1	4.562	1
CsI_3	rhomb.	V_h^{16}	6.82, 9.94, 11.01	4
$CsIBr_2$	....	V_h^{16}	6.57, 9.18, 10.66	4
$CsICl_2$	rhbdr.	D_{3d}^5	....	1
$CsIO_3$	cub.(?), $CaTiO_3$	....	4.66	
Cs_2PtCl_6	cub.	O_h^5	10.15	4
Cs_2SO_4	rhomb., K_2SO_4	V_h^{16}	6.24, 10.92, 8.22	4
$Cs_2S_2O_6$	hex.	....	6.326, ..., 11.535	2
$CuAl_2$	tetr.	D_{4h}^{18}	6.052, ..., 4.878	4
Cu_9Al_4	cub.	T_d^1	8.70	52
$CuAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.070	8
CuBr	cub., ZnS	T_d^2	5.681	4
CuCl	cub., ZnS	T_d^2	5.407	4
$CuCo_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.039	8
$CuCo_2S_4$	cub., $MgAl_2O_4$	O_h^7	9.458	8
$CuFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.445	8
CuH	hex., ZnO	C_{6v}^4	2.893, ..., 4.614	2
Cu_2HgI_4	tetr.	....	6.08, ..., 6.135	
Cu_2HgI_4 (α) (abv. 70°C)	cub.	T^2	6.103	1
Cu_2HgI_4 (β)	....	....	6.041, ..., 6.115	
CuI	cub., ZnS	T_d^2	6.047	4
$CuMg_2$	hex.	....	5.281, ..., 18.29	8
Cu_2Mg	cub.	O_h^7	7.029	8
Cu_2MnSn	cub., $AlCu_3$	....	6.167	4
CuO	tricl.	....	3.74, 4.67, 4.67, α = 85° 21′, β = 86° 25′, γ = 93° 35′	4
Cu_2O (cuprite)	cub.	O_h^4	4.26	2
CuPd	cub., CsCl	O_h^1	2.988	1
Cu_3Pd	cub., $AuCu_3$	....	3.69	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
CuPt	hex.	....	3.779, $\alpha = 90° 54'$	1
Cu_3Pt	cub., $AuCu_3$	....	3.71	1
CuS	hex.	D_{6h}^4	3.802, ..., 16.43	6
Cu_2S	cub., CaF_2	O_h^5	5.59	4
$CuSO_4.5H_2O$	tricl.	....	6.07, 10.78, 5.89, $\alpha = 82° 5'$, $\beta = 107° 8'$, $\gamma = 102° 41'$	2
Cu_2Sb	tetr.	....	3.99, ..., 6.17	2
Cu_3Sb	....	....	2.78, ..., 4.37	
Cu_2Se	cub., CaF_2	O_h^5	5.75	4
CuSn	hex., NiAs	C_{6v}^4 or D_{6h}^4	4.190, ..., 5.086	2
Cu_3Sn	hex.	....	2.75, ..., 4.32	
$Cu_{31}Sn_8$	cub.	....	8.955	
CuZn	cub., CsCl	O_h^1	2.945	1
Cu_2Zn_3	cub.	....	4.01	
Cu_5Zn_8	cub.	T_d^3	8.85	52
Dy_2O_3	cub., Tl_2O_3	T_h^7	10.63	16
Er_2O_3	cub., Tl_2O_3	T_h^7	10.54	16
Eu_2O_3	cub., Tl_2O_3	T_h^7	10.84	16
$FeAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.12	8
$Fe_3Al_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.497	8
FeAs (η)	rhomb.	....	3.366, 6.016, 5.428	4
$FeAs_2$	rhomb.	V_h^{12} or V_h^{13}	6.35, 4.86, 5.80	
Fe_2As (ϵ)	tetr.	....	3.627, ..., 5.973	2
FeB	rhomb.	V_h^{16}	5.495, 4.053, 2.946	4
Fe_2B	tetr.	V_d^{11}	5.078, ..., 4.233	4
$FeBr_2$	hex., CdI_2	D_{3d}^3	3.740, ..., 6.171	1
Fe_3C	rhomb.	V_h^{16}	4.518, 5.069, 6.736	4
$[Fe(CN)_2]_3$	cub.	....	15.9	16
$FeCO_3$	hex., $NaNO_3$	D_{3d}^6	5.82, $\alpha = 47° 45'$	2
$Fe(CO)_4$	monocl.	C_{2h}^6	13.00, 11.41, $\beta = 85° 35'$	
$Fe_2(CO)_9$	hex.	C_{6h}^4 or D_{6h}^4	6.45, ..., 15.8	2
$FeCl_2$	hex., $CdCl_2$	D_{3d}^6	6.20, $\alpha = 33° 33'$	1
$FeCl_3$	hex.	C_{3i}^2	5.92, ..., 17.26	6
(Fe,Co)S	hex.	C_{6v}^4	3.36, ..., 5.29	2
FeF_2	tetr., SnO_2	D_{4h}^{14}	4.670, ..., 3.297	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
FeI_2	hex., CdI_2	D^3_{3d}	4.04, ..., 6.75	1
Fe_3Mo_2	hex.	....	4.743, ..., 25.63	8
Fe_3N (ϵ')	hex.	D^6_6	2.695, ..., 4.362	
Fe_4N	cub.	....	3.789	1
FeO	cub., NaCl	O^5_h	4.294	4
Fe_2O_3 (hematite)	hex.	D^6_{3d}	5.42, $\alpha = 55° 17'$	2
Fe_2O_3 (magnetic)	cub.	....	8.30	
$Fe_2O_3.H_2O$	rhomb., $Al_2O_3.H_2O$	....	4.55, 9.90, 3.01	2
Fe_3O_4	cub., $MgAl_2O_4$	O^7_h	8.37	8
FeOCl	rhomb.	V^{13}_h	3.75, 7.95, 3.4	2
$Fe(OH)_2$	hex., CdI_2	D^3_{3d}	3.24, ..., 4.47	1
Fe_2P (ζ)	hex.	D^2_3	5.852, ..., 3.453	3
Fe_3P (ϵ)	tetr.	S^2_4	9.09, ..., 4.446	8
FeS	hex.	C^4_{6v}	3.43, ..., 5.79	2
FeS_2 (marcasite)	rhomb., $FeAs_2$	V^{12}_h	3.35, 4.40, 5.35	2
FeS_2 (pyrite)	cub.	T^6_h	5.404	4
$FeSO_4.7H_2O$	monocl.	C^6_{2h}	15.34, 12.98, 20.02, $\beta = 104° 15'$	16
$FeSO_4.(NH_4)_2SO_4.6H_2O$	monocl.	C^5_{2h}	9.28, 12.58, 6.22, $\beta = 106° 50'$	
FeS + S_x	hex.	C^4_{6v}	3.43, ..., 5.68	2
Fe (S, Se)	hex.	C^4_{6v}	3.54, ..., 5.91	2
FeSb	hex., NiAs	C^4_{6v} or D^4_{6h}	4.06, ..., 5.13	2
$FeSb_2$ (ζ)	rhomb.	V^{12}_h or V^{13}_h	3.189, 5.819, 6.520	
FeSe	hex., NiAs	C^4_{6v}	3.61, ..., 5.87	2
FeSe + Se_x	hex.	C^4_{6v}	3.51, ..., 5.55	
FeSi	cub.	T^4	4.467	4
$FeSi_2$	tetr.	....	2.69, ..., 5.08	1
$FeSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C^2_{3i}	6.42, $\alpha = 96° 59'$	1
$FeTa_2O_6$ (tapiolite)	tetr.	D^{14}_{4h}	4.74, ..., 9.21	2
FeTe	hex., NiAs	C^4_{6h} or D^4_{6h}	3.800, ..., 5.651	2
Fe_2W	hex.	....	4.727, ..., 7.704	4
Fe_3W_2	hex.	....	4.731, ..., 25.76	8
Fe_3Zn_{10}	cub.	O^9_h	8.93	52
GaAs	cub., ZnS	T^2_d	5.635	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$(Ga, In)_2O_3$	cub.	O_h^{10}	9.76	16
Ga_2O_3	hex., Fe_2O_3	D_{3d}^6	5.281 $\alpha = 55° 35'$	2
GaP	cub., ZnS	T_d^2	5.436	
GaSb	cub. ZnS	T_d^2	6.118	
Gd_2O_3	cub., Tl_2O_3	T_h^7	10.79	16
$GdPMo_{12}O_{40}.30H_2O$	cub.	O_h^7	23.1	8
GeI_4	cub., SnI_4	T_h^6	11.89	8
GeO_2	hex., αSiO_2	D_3^4	4.98, ..., 5.64	3
GeS	rhomb.	V_h^{16}	4.29, 10.42, 3.64	4
HCl (−168°C)	cub., HCl	....	5.50	4
HI	cub., HCl	....	6.18	4
HIO_3	rhomb.	$V^1 - V^4$	5.53, 5.92, 7.75	4
$H_4N_4S_4$	rhomb.	V_h^1	12.08, 6.76, 7.86	4
H_2O (ice)	hex.	D_{6h}^4	4.535, ..., 7.41	4
$H_3PMo_{12}O_{40}.30H_2O$	cub.	O_h^7	23.1	8
$H_3[P(W_3O_{10})_4].5H_2O$	cub.	O_h^4	12.14	2
H_2S	cub.	O_h^5	5.79	
H_2Se (−170°C)	cub.	O_h^5	6.020	4
$HgBr_2$	....	C_{2v}^{12}	4.67, 6.85, 12.45	4
Hg_2Br_2	tetr., Hg_2Cl_2	D_{4h}^{17}	4.65, ..., 11.10	2
$Hg(CN)_2$	tetr.	V_d^{12}	9.67, ..., 8.92	8
$HgCl_2$	rhomb.	V_h^{16}	4.307, 5.936, 12.67	4
Hg_2Cl_2	tetr.	D_{4h}^{17}	4.47, ..., 10.89	2
HgI_2	tetr.	D_{4h}^{15}	4.356, ..., 12.34	2
Hg_2I_2	tetr., Hg_2Cl_2	D_{4h}^{17}	4.92, ..., 11.61	2
HgO	rhomb.	....	3.296, 3.513, 5.504	4
HgS (cinnabar)	hex.	D_3^4 or D_3^6	4.14, ..., 9.49	3
HgS (metacinnabarite)	cub., ZnS	T_d^2	5.84	4
HgSe	cub., ZnS	T_d^2	6.07	
HgTe	cub., ZnS	T_d^2	6.36	
HfO_2	cub., CaF_2	O_h^5	5.115	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Ho_2O_3	cub., Tl_2O_3	T_h^7	10.58	16
In_2O_3	cub., Tl_2O_3	T_h^7	10.12	16
InSb	cub., ZnS	T_d^2	6.45	
IrO_2	tetr., SnO_2	D_{4h}^{14}	4.49, ..., 3.14	
$KAl(SO_4)_2$	hex.	D_3^2	4.706, ..., 7.960	1
$KAl(SO_4)_2\ 12H_2O$	cub.	T_h^6	12.11	4
$KAlSi_3O_8$	monocl.	C_{2h}^3	8.57, 13.01, 7.23, β = 116° 7′	4
$K_2Ba[Co(NO_2)_6]$	cub.	....	10.45	4
$K_2Ba[Ni(NO_2)_6]$	cub.	....	10.67	4
KBr	cub., NaCl	O_h^5	6.578	4
$KBrO_3$	hex.	C_{3v}^5	4.403, α = 86° 0′	1
KCN	cub., NaCl	O_h^5	6.55	4
KCNO	tetr., KN_3	D_{4h}^{18}	6.070, ..., 7.030	4
KCNS	rhomb.	V_h^{11}	6.67, 6.65, 7.54	4
$K_2Ca[Co(NO_2)_6]$	cub.	....	10.17	4
$K_2Ca[Ni(NO_2)_6]$	cub.	....	10.29	4
$KCbO_3$	cub. (?), $CaTiO_3$	....	4.01	
$K_2Cd(CN)_4$	cub., $MgAl_2O_4$	O_h^7	12.84	8
KCl	cub., NaCl	O_h^5	6.28	4
$KCl.MgCl_2.6H_2O$	rhomb.	V_h^6	9.53, 16.08, 22.25	12
$KClO_3$	monocl.	C_{2h}^2	4.647, 5.585, 7.085, β = 109° 38′	2
$KClO_4$ (340°C)	cub.	T_d^2 or T^2	7.47	
$KClO_4$	rhomb., $BaSO_4$	V_h^{16}	8.834, 5.650, 7.240	
$K_3Co(NO_2)_6$	cub.	....	10.44	4
$K_3Co(NO_2)_6.1\frac{1}{2}H_2O$	cub.	....	10.32	
$K_4Co(NO_2)_6$	cub.	....	10.32	
$K_3Cr(CN)_6$	rhomb.	V_h^{14}	13.55, 10.60, 8.60	4
K_2CrO_4	rhomb., K_2SO_4	V_h^{16}	5.92, 10.40, 7.61	4
$K_2Cr_2O_7$ (α)	tricl.	....	7.50, 7.38, 13.40, α = 82° 0′, β = 96° 13′, γ = 90° 51′	4
$K_2Cr_2O_7$ (β)	monocl.	....	7.47, 7.35, 12.97, β = 91° 55′	4
$KCr(SO_4)_2$	hex., $KAl(SO_4)_2$	D_3^2	4.737. ...., 8.030	1
$KCr(SO_4)_2.12H_2O$	cub.	T_h^6	12.14	4
$K_2CuCl_4.2H_2O$	tetr., $(NH_4)_2CuCl_4.2H_2O$	O_{4h}^{14}	7.45, ..., 7.88	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
KF	cub., NaCl	O_h^5	5.33	4
$K_3Fe(CN)_6$	monocl.	C_{2h}^5	13.42, 10.40, 8.38	4
KHC_2	tetr., CaC_2	....	4.28, ..., 8.42	4
KHF_2	tetr., KN_3	D_{4h}^{18}	5.67, ..., 6.81	4
KH_2PO_4	tetr., KH_2PO_4	V_h^{12}	7.43, ..., 6.97	4
$K_2Hg(CN)_4$	cub., $MgAl_2O_4$	O_h^7	12.76	8
KI	cub., NaCl	O_h^5	7.052	4
KI_3	monocl.	....	9.36, $b = c = a$ approx., $\beta = 90° \pm$	4
KIO_3	cub.(?), $CaTiO_3$	....	4.46	
KIO_4	tetr., $CaWO_4$	C_{4h}^6	8.13, ..., 12.63	4
$K_3Ir(CN)_6$	rhomb.	V_h^{14}	13.70, 10.53, 8.34	4
$KLiSO_4$	hex.	C_6^6	5.13, ..., 8.60	2
$KMgF_3$	cub.(?), $CaTiO_3$	....	4.00	
$K_3Mn(CN)_6$	rhomb.	V_h^{14}	13.56, 10.60, 8.50	4
$KMnO_4$	rhomb., $BaSO_4$	V_h^{16}	9.10, 5.69, 7.40	4
KN_3	tetr.	D_{4h}^{18}	6.094, ..., 7.056	4
KNO_3	rhomb.	V_h^{16}	5.43, 9.17, 6.45	4
$K_3Na(SO_4)_2$	hex.	D_{3d}^3	5.65, ..., 7.29	1
$KNiF_3$	cub.(?), $CaTiO_3$	....	4.008	
$K_4Ni(NO_2)_6$	cub.	....	10.49	
$KOsNO_3$	tetr.	C_{4h}^6	....	4
$K_2OsO_2Cl_4$	....	D_{4h}^{17}	9.90, ..., 8.75	2
$K_2PbCo(NO_2)_6$	cub.	....	10.49	4
$K_2PbCu(NO_2)_6$	cub.	....	10.52	4
$K_2PbNi(NO_2)_6$	cub.	....	10.55	4
K_2PdCl_4	tetr., K_2PtCl_4	D_{4h}^1	7.04, ..., 4.10	1
K_2PtBr_6	cub., $(NH_4)_2PtCl_6$	O_h^5	10.35	4
K_2PtCl_4	tetr.	D_{4h}^1	6.99, ..., 4.13	1
K_2PtCl_6	cub., $(NH_4)_2PtCl_6$	O_h^5	9.73	4
$K_2Pt(SCN)_6$	hex.	D_{3d}^1	6.77, ..., 10.45	1
$KReO_4$	tetr., $CaWO_4$	C_{4h}^6	5.615, ..., 12.50	4
K_2SO_4	rhomb.	V_h^{16}	5.731, 10.008, 7.424	4
$K_2S_2O_5$	monocl.	C_{2h}^2	6.95, 6.19, 7.55	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$K_2S_2O_6$	hex.	D_3^2	9.756, ..., 6.274	3
$K_2S_2O_8$	tricl.	....	5.11, 6.51, 5.48, α = 96° 45′, β = 90° 10′, γ = 95° 15′	
K_2SeBr_6	cub	....	10.363	
K_2SeO_4	rhomb.	V_h^{16}	6.02, 10.40, 7.60	4
K_2SnCl_6	cub., $(NH_4)_2PtCl_6$	O_h^5	9.96	4
$K_2Sn(OH)_6$	hex., (rhbdr.)	D_{3d}^5	5.67, α = 70° 1′	1
$K_2Sr[Co(NO_2)_6]$	cub.	....	10.23	4
$K_2Sr[Ni(NO_2)_6]$	cub.	....	10.49	4
$K_2Zn(CN)_4$	cub., $MgAl_2O_4$	O_h^7	12.54	8
$KZnF_3$	cub.(?), $CaTiO_3$	....	4.050	
$LaAl_4$	....	....	13.2, (?) ...., 10.2 (?)	16
$LaAlO_3$	cub.(?), $CaTiO_3$	....	3.78	
LaC_2	tetr., CaC_2	D_{4h}^{17}	3.92, ..., 6.55	2
LaF_3	hex., CeF_3	D_6^6	7.163, ..., 7.329	6
$LaGaO_3$	cub.(?), $CaTiO_3$	....	3.89	
La_2O_3	hex.	D_{3d}^2	3.945, ..., 6.151	1
Li_2BeF_4	hex.	....	8.15, α = 107° 40′	
LiBr	cub., NaCl	O_h^5	5.49	4
$LiCbO_3$	hex., $MgTiO_3$	C_{3i}^2	5.47, α = 55° 43′	2
LiCd	cub.	....	3.32	
$LiCd_3$	cub.	....	8.62	8
LiCl	cub., NaCl	O_h^5	5.14	4
$LiCl.H_2O$	tetr.	....	3.81, ..., 3.88	1
LiF	cub., NaCl	O_h^5	4.01	4
LiH	cub., NaCl	O_h^5	4.10	4
LiI	cub., NaCl	O_h^5	6.00	4
$LiI.3H_2O$	hex.	C_{6v}^4	7.45, ..., 5.45	2
$LiIO_3$	hex.	D_6^6	5.469, ..., 5.155	2
$LiKSO_4$	hex.	C_6^6	5.13, ..., 8.00	2
Li_2MoO_4	hex., Be_2SiO_4	....	8.77, α = 108° 10′	
Li_3N	cub.	....	5.50	
$LiNO_3$	hex., $NaNO_3$	D_{3d}^5	5.74, α = 48° 3′	2
$LiNaCO_3$	hex.	D_{3h}^1 or D_{3h}^3	8.22, ..., 3.27	3
Li_2O	cub., CaF_2	O_h^5	4.61	4
LiOH	tetr.	D_{4h}^7	3.549, ..., 4.334	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Li_2S	cub., CaF_2	O_h^5	5.70	4
Li_2SO_4	monocl.	C_{2h}^5	8.25, 4.95, 8.44, β = 107° 54′	4
Li_2WO_4	hex., Be_2SiO_4	C_{3i}^2	8.77, α = 108° 10′	
Lu_2O_3	cub., Tl_2O_3	O_h^{10}	10.37	16
$MgAl_2O_4$	cub.	O_h^7	8.090	8
$Mg_3Al_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.510	8
Mg_3As_2	cub., Zn_3As_2	....	6.10	2
$MgBr_2$	hex., CdI_2	D_{3d}^3	3.815, ..., 6.256	1
$MgBr_2.6H_2O$	monocl.	....	10.25, 7.40, 6.30, β = 93° 30′	2
$MgCO_3$	hex., $NaNO_3$	D_{3d}^6	5.61, α = 48° 12′	2
$MgCl_2$	hex., $CdCl_2$	D_{3d}^5	6.22, α = 33° 36′	1
$MgCl_2.6H_2O$	monocl.	C_{2h}^3	9.90, 7.15, 6.10, β = 94°	2
$MgCo_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.107	8
$MgCr_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.290	8
$MgCrO_4.7H_2O$	rhomb., $MgSO_4.7H_2O$	V^4	11.89, 12.01, 6.89	4
MgF_2	tetr., SnO_2	D_{4h}^{14}	4.66, ..., 3.08	2
$MgFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.342	8
Mg_3N_2	cub.	....	9.93	12
$MgO.Fe_2O_3$	cub.	....	8.36	8
$Mg(OH)_2$	hex., CdI_2	D_{3d}^3	3.11, ..., 4.74	1
MgI_2	hex.	....	4.14, ..., 6.88	
Mg_3N_2	cub., b.c.	....	9.93	12
MgO	cub., NaCl	O_h^5	4.203	4
Mg_3P_2	cub., Zn_3As_2	....	5.92	2
Mg_2Pb	cub., CaF_2	O_h^5	6.75	4
$MgPr$	cub.	....	3.88	1
$MgPt(CN)_4.7H_2O$	tetr.	D_{4h}^{17}	14.6, ..., 6.26	2
MgS	cub., NaCl	O_h^5	5.190	4
$MgSO_4.7H_2O$	rhomb.	V^4	11.91, 12.02, 6.87	4
$MgSO_4.(NH_4)_2SO_4.6H_2O$	monocl.	C_{2h}^5	9.28, 12.57, 6.20, β = 107° 6′	2
$MgSe$	cub., NaCl	O_h^5	5.451	4
Mg_2Si	cub., CaF_2	O_h^5	6.39	4
$MgSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.43, α = 96° 3′	1
$Mg_2SiMo_{12}O_{40}$ 31H_2O	cub.	O_h^7	23.04	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants: a, b, c, Ax. ang.	Mol.
Mg_2Sn	cub., CaF_2	O_h^5	6.78	4
$MgSnF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.56, α = 96° 20′	1
Mg_2SnO_4	cub., $MgAl_2O_4$	O_h^7	8.58	8
MgTe	hex., ZnO	C_{6v}^4	4.52, ..., 7.33	2
$MgTiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.52, α = 96° 57′	1
$MgTiO_3$	hex.	C_{3i}^2	5.40, α = 55° 1′	2
$MgWO_4$	monocl.	....	4.67, 5.66, 4.92, β = 89° 35′	2
MgZn	hex.	....	10.66, ..., 17.16	
$MgZn_2$	hex.	D_{6h}^4	5.15, ..., 8.48	4
$MgZn_5$	hex.	....	9.92, ..., 16.48	
$MnAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.263	8
$Mn_3Al_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.603	8
MnAs	hex., NiAs	D_{6h}^4	3.716, ..., 5.704	2
$MnBr_2$	hex., CdI_2	D_{3d}^3	3.82, ..., 6.19	1
$MnCO_3$	hex., $NaNO_3$	D_{3d}^6	5.84, α = 47° 45′	2
$MnCl_2$	hex., $CdCl_2$	D_{3d}^5	6.20, α = 34° 35′	1
$(Mn, Co)(Co, Mn)_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.268	8
$MnCr_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.487	8
MnF_2	tetr., SnO_2	D_{4h}^{14}	4.865, ..., 3.284	2
$MnFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.572	8
MnI_2	hex., CdI_2	D_{3d}^3	4.16, ..., 6.82	1
$MnMn_2O_4$	tetr., Mn_3O_4	D_{4h}^{19}	5.75, ..., 9.42	4
Mn_4N	cub.	....	3.860	1
MnO	cub., NaCl	O_h^5	4.435	4
MnO_2	tetr., SnO_2	D_{4h}^{14}	4.44, ..., 2.89	2
Mn_2O_3	cub., Tl_2O_3	T_h^7	9.41	16
$Mn_2O_3.H_2O$	rhomb.	....	4.46, 5.28, 2.88	
$Mn(OH)_2$	hex., CdI_2	D_{3d}^{m}	3.34, ..., 4.68	1
MnS	cub., NaCl	O_h^5	5.21	4
MnS_2	cub., FeS_2	T_h^6	6.10	4
MnSb	hex., NiAs	D_{6h}^4	4.120, ..., 5.784	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants *a*, *b*, *c*, Ax. ang.	Mol.
MnSe	cub., NaCl	O_h^5	5.448	4
$MnSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.45, α = 96° 53′	1
MnTe	hex., NiAs	D_{6h}^4	4.124, ..., 6.698	2
$MnTe_2$	cub., FeS_2	T_h^6	6.943	4
MoO_2	tetr., SnO_2	D_{4h}^{14}	4.86, ..., 2.79	2
MoO_3	....	Q_h^{16}	3.92, 13.94, 3.66	4
MoS_2	hex.	D_{6h}^4	3.15, ..., 12.30	2
$MoSi_2$	tetr.	D_{2h}^{17}	3.20, ..., 7.86	2
NH_3 (−80°C)	cub.	T^4	5.15	4
$(NH_4)_3AlF_6$	cub., $(NH_4)_3FeF_6$	T_h^6	8.40	4
$NH_4Al(SO_4)_2$	hex., $KAl(SO_4)_2$	D_3^2	4.724, ..., 8.225	1
$NH_4Al(SO_4)_2.12H_2O$	cub.	T_h^6	12.18	4
NH_4Br	cub., CsCl	O_h^1	4.047	1
NH_4Br (250°C)	cub., NaCl	O_h^5	6.90	4
NH_4Cl (250°C)	cub., NaCl	O_h^5	6.53	4
NH_4Cl	cub., CsCl	O_h^1	3.866	1
NH_4ClO_4 (270°C)	cub., $KClO_4$	....	7.63	1
NH_4ClO_4	rhomb.	V_h^{16}	9.202, 5.816, 7.449	4
$(NH_4)_3Co(NO_2)_6$	cub.	....	10.81	4
$(NH_4)_2Cr_2O_7$	monocl.	....	7.78, 7.54, 13.27, β = 93° 42′	4
$(NH_4)_2CuCl_4.2H_2O$	tetr.	D_{4h}^{14}	7.58, ..., 7.95	2
NH_4F	hex., ZnO	C_{6v}^4	4.39, 7.02	2
$(NH_4)_3FeF_6$	cub.	O_h^5	9.10	4
$NH_4Fe(SO_4)_2$	hex., $KAl(SO_4)_2$	D_3^2	4.825, ..., 8.310	1
$NH_4Fe(SO_4)_2.12H_2O$	cub.	T_h^6	12.14	4
NH_4HF_2	rhomb.	V_h^7	8.33, 8.14, 3.68	4
$NH_4(H_2PO_2)$	rhomb.	V_h^{21}	3.98, 7.57, 11.47	4
$(NH_4)H_2PO_4$	tetr., KH_2PO_4	V_d^{12}	7.530, ..., 7.542	4
$(NH_4)_3HfF_7$	cub.,	O_h^4	9.400	4
NH_4I (−17°C)	cub., CsCl	O_h^1	4.37	1
NH_4I	cub., NaCl	O_h^5	7.244	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
NH_4IO_4	tetr., $CaWO_4$	C_{4h}^6	5.94, ..., 12.80	4
$(NH_4)_3MoO_3F_3$	cub., $(NH_4)_3FeF_6$	O_h^6	9.10	4
NH_4NO_3	rhomb.	V_h^{13}	4.928, 5.434, 5.732	2
$(NH_4)_2PbCl_6$	cub., $(NH_4)_2PtCl_6$	O_h^5	10.14	4
$(NH_4)_2PdCl_4$	tetr., K_2PtCl_4	D_{4h}^1	7.21, ..., 4.26	1
$(NH_4)_2PtCl_6$	cub.	O_h^5	9.84	4
$(NH_4)_2Pt(SCN)_6$	hex., $K_2Pt(SCN)_6$	D_{3d}^1 or D_{3d}^3	6.77, ..., 10.45	1
$(NH_4)_2SO_4$	rhomb., K_2SO_4	V_h^{16}	5.951, 10.560, 7.729	4
$(NH_4)_2SiF_6$	cub., $(NH_4)_2PtCl_6$	O_h^5	8.38	4
$(NH_4)_2SnCl_6$	cub., $(NH_4)_2PtCl_6$	O_h^5	10.05	4
$(NH_4)_3ZrF_7$	cub.	O_h^4	9.353	4
$N_2H_6Cl_2$	cub., FeS_2	T_h^6	7.89	4
NO_2	cub.	T^5	7.77	6
N_2O	cub., CO_2	T^4	5.77	4
N_4S_4	rhomb.	V_h^1	8.87, 8.47, 7.20	4
Na_3AlF_6	monocl.	C_{2h}^1 or C_{2h}^2	5.39, 5.59, 7.76, β = 90° 11′	2
NaBr	cub., NaCl	O_h^5	5.94	4
$NaBrO_3$	cub., $NaClO_3$	T^4	6.71	4
$Na_2Ca(CO_3)_2$	hex.	. . . .	20.3, ..., 12.02	32
Na_2CaSiO_4	cub.	. . . .	7.497	4
$Na_4Ca(SiO_3)_3$	cub.(?)	. . . .	7.547	
$NaCbO_3$	cub., $CaTiO_3$	O_h^1	3.89	1
NaCl	cub.	O_h^5	5.628	4
$NaClO_3$	cub.	T^4	6.570	4
$NaClO_4$ (380°C)	cub	. . . .	7.25	
$NaClO_4$	rhomb., $CaSO_4$	V_h^{17}	6.48, 7.06, 7.08	4
NaF	cub., NaCl	O_h^5	4.62	4
$NaHC_2$	tetr., CaC_2	D_{4h}^{17}	3.82, ..., 8.17	2
$NaHCO_3$	monocl.	C_{2h}^5	7.51, 9.70, 3.53, β = 93° 19′	4
$NaHF_2$	hex., (rhbdr.), $CsCl_2I$	D_{3d}^5	5.17, α = 39° 44′	1
NaI	cub., NaCl	O_h^5	6.46	4
$NaIO_3$	rhomb.	V_h^{19}	5.75, 6.37, 4.05	2
$NaIO_4$	tetr., $CaWO_4$	C_{4h}^6	5.32, ..., 11.93	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax ang.	Mol.
$NaIO_4.3H_2O$	hex.	C_3^4	5.58, α = 65° 1′	1
$Na_2Mg(CO_3)_2$	hex.	C_3^1	4.95, ..., 16.50	6
NaN_3	hex., (rhbdr), $CsCl_2I$	D_{3d}^5	5.48, α = 38° 43′	1
$NaNO_2$	rhomb.	....	3.55, 5.56, 5.37	2
$NaNO_3$	hex.	D_{3d}^6	6.32, α = 47° 15′	
Na_4Pb or $Na_{31}Pb_8$	cub.	....	13.27	2 (78 atoms)
Na_2S	cub., CaF_2	O_h^5	6.53	4
Na_2SO_3	hex.	....	5.441, 6.133	2
Na_2SO_4	rhomb.	V_h^{24}	5.85, 12.29, 9.75	8
$NaSb(AlO_3)_2$	hex.	D_{6h}^4	5.40, ..., 8.81	2
NdAl	cub.	....	3.73	1
NdC_2	tetr., CaC_2	D_{4h}^{17}	3.82, ..., 6.23	2
NdF_3	hex , CeF_3	D_6^6	7.021, ..., 7.196	6
Nd_2O_3	hex., La_2O_3	D_{3d}^3	3.841, ..., 6.009	1
$NdPMo_{12}O_{40}.30H_2O$	cub.	O_h^7	23.1	8
NiAl	cub., CsCl	O_h^1	2.82	1
$NiAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.045	8
NiAs	hex.	D_{6h}^4	3.61, ..., 5.03	2
NiAsS	cub., CoAsS	T^4	5.68	4
$NiBr_2.6NH_3$	cub., $(NH_4)_2PtCl_6$	O_h^5	10.48	4
Ni_3C	hex.	....	2.646, ..., 4.329	
$NiCl_2$	hex., $CdCl_2$	D_{3d}^5	6.13, α = 33° 36′	1
$NiCl_2$ $6NH_3$	cub., $(NH_4)_2PtCl_6$	O_h^5	10.09	4
$(Ni, Co)(Co, Ni)_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.112	8
NiF_2	tetr., SnO_2	D_{4h}^{14}	4.710, ..., 3.118	2
(Ni, Fe)S (synthetic)	hex.	C_{6v}^4	3.408, ..., 5.434	2
$NiFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.340	8
$Ni(OH)_2$	....	....	3.114, ..., 4.167	
$NiI_2.6NH_3$	cub., $(NH_4)_2PtCl_6$	O_h^6	11.01	4
$Ni(NH_3)_6(NO_3)_2$	cub., $(NH_4)_2PtCl_6$	T_h^6	10.96	4
NiO	cub., NaCl	O_h^5	4.172	4
$Ni(OH)_2$	hex., CdI_2	D_{3d}^3	3.07, ..., 4.605	1

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
NiS (synthetic)	hex., NiAs	D_{6h}^4	3.42, ..., 5.30	2
NiS_2	cub., FeS_2	T_h^6	5.74	4
Ni_3S_2	cub.(?)	....	4.08	1
$NiSO_4.7H_2O$	rhomb., $MgSO_4.7H_2O$	V^4	11.86, 12.08, 6.81	4
NiSb	hex., NiAs	D_{6h}^4	3.94, ..., 5.14	2
NiSbS	cub., CoAsS	T^4	5.91	4
NiSe	hex., NiAs	D_{6h}^4	3.66, ..., 5.33	2
$NiSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.21, $\alpha = 96° 20'$	1
$Ni_2SiMo_{12}O_{40}.31H_2O$	cub	O_h^7	23.0	8
Ni_2SiO_4	rhomb.	....	4.705, 10.11, 5.914	
NiSn	hex., NiAs	D_{6h}^4	4.081, ..., 5.174	2
$NiSnCl_6.6H_2O$	hex., (rhbdr.)	C_{3i}^2	7.09, $\alpha = 96° 45'$	1
NiTe	hex., NiAs	D_{6h}^4	3.957, ..., 5.354	2
$NiTiO_3$	hex., $MgTiO_3$	C_{3i}^2	5.448, $\alpha = 55° 0'$	2
OsO_2	tetr., SnO_2	D_{4h}^{14}	4.51, ..., 3.19	2
OsS_2	cub., FeS_2	T_h^6	5.64	4
$OsSe_2$	cub., FeS_2	T_h^6	5.933	4
$OsTe_2$	cub., FeS_2	T_h^6	6.369	4
PH_4I	tetr., PbO	D_{4h}^7	6.34, ..., 4 62	2
$P_3N_3Cl_6$	rhomb.	V_h^{16}	....	4
$P_4N_4Cl_8$	tetr.	C_{4h}^4	10.79, ..., 5.93	2
P_2O_5	hex.	....	11.12, ..., 1.12	12
$PbBr_2$	rhomb.	V_h^{16}	4.71, 8.02, 9.48	4
$PbCO_3$	rhomb., KNO_3	V_h^{16}	5.14, 8.45, 6.10	4
$PbCl_2$	rhomb., $HgCl_2$	V_h^{16}	4.496, 7.667, 9.153	4
$PbCrO_4$	monocl.	C_{2h}^5	6.82, 7.48, 7.16, $\beta =$ 102° 33′	4
PbF_2	....	....	3.80, 6.41, 7.61	4
PbF_2 (β)	cub., CaF_2	O_h^5	5.93	4
PbI_2	hex., CdI_2	D_{3d}^3	4.54, ..., 6.86	1
$PbMoO_4$	tetr., $CaWO_4$	C_{4h}^6	5.41, ..., 12.08	4
$Pb(NO_3)_2$	cub., $Ba(NO_3)_2$	T_h^6	7.84	4
PbO (red)	tetr., PbO	D_{4h}^7	3.98, ..., 5.01	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants *a*, *b*, *c*, Ax. ang.	Mol.
PbO (yellow)	rhomb.	V_h^{19}	5.50, 4.72, 5.88	4
PbO_2	tetr., SnO_2	D_{4h}^{14}	4.97, ..., 3.40	2
Pb_2O	cub., Cu_2O	O_h^4	5.38	2
$Pb_3(PO_4)_2$	hex.	....	9.66, ..., 7.11	3
PbS	cub., NaCl	O_h^5	5.97	4
$PbSO_4$	rhomb., $BaSO_4$	V_h^{16}	8.45, 5.38, 6.93	4
PbSe	cub., NaCl	O_h^5	6.14	4
PbTe	cub., NaCl	O_h^5	6.34	4
$PbWO_4$	tetr., $CaWO_4$	C_{4h}^6	5.44, ..., 12.01	4
$PdAs_2$	cub., FeS_2	T_h^6	5.970	4
PdO	tetr., PbO	D_{4h}^7	3.209, ..., 5.314	2
PdSb	hex., NiAs	D_{6h}^4	4.070, 5.582	2
$PdSb_2$	cub., FeS_2	T_h^6	6.439	4
PdTe	hex., NiAs	D_{6h}^4	4.127, ..., 5.663	2
$PdTe_2$	hex., CdI_2	D_{3d}^3	4.028, ..., 5.118	1
PrC_2	tetr., CaC_2	D_{4h}^{17}	3.85, ..., 6.38	2
PrF_3	hex., CeF_3	D_6^6	7.061, ..., 7.218	6
PrO_2	cub., CaF_2	O_h^5	5.36	4
Pr_2O_3	hex., La_2O_3	D_{3d}^3	3.851, ..., 5.996	1
Pr_6O_{11}	cub.	....	10.98	
$PtAs_2$	cub., FeS_2	T_h^6	5.957	4
$PtBr_2$	cub., f.c.	....	10.35	4
PtP_2	cub., FeS_2	T_h^6	5.683	4
PtS_2	hex., CdI_2	D_{3d}^3	3.537, ..., 5.019	1
PtSb	hex., NiAs	D_{6h}^4	4.130, ..., 5.472	2
$PtSb_2$	cub., FeS_2	T_h^6	6.428	4
$PtSe_2$	hex., CdI_2	D_{3d}^3	3.724, ..., 5.062	1
PtSn	hex., NiAs	D_{6h}^4	4.103, ..., 5.428	2
$PtTe_2$	hex., CdI_2	D_{3d}^3	4.010, ..., 5.201	1
$RbAl(SO_4)_2.12H_2O$	cub.	T_h^6	12.20	4
RbBr	cub., NaCl	O_h^5	6.868	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$RbCl$	cub., NaCl	O_h^5	6.571	4
$RbClO_4$	rhomb., $BaSO_4$	V_h^{16}	9.27, 5.81, 7.53	4
$RbClO_4$ (320°C)	cub.	T_d^2	7.65	
$Rb_3Co(NO_2)_6$	cub.	....	10.73	4
$Rb_2CuCl_4.2H_2O$	tetr., $(NH_4)_2CuCl_4.2H_2O$	D_{4h}^{14}	7.81, ..., 8.00	2
RbF	cub., NaCl	O_h^5	5.63	4
RbI	cub., NaCl	O_h^5	7.325	4
$RbIO_3$	cub., $CaTiO_3$	O_h^1	4.52	1
RbN_3	tetr., KN_3	D_{4h}^{18}	6.36, ..., 7.41	4
$Rb(NO_3)$	rhomb.	C_{3v}^2	18.08, 10.45, 7.38	18
	or appr. hex.	....	10.45, ..., 7.38	9
Rb_3N	tetr.	D_{4h}^1	4.497, ..., 3.707	1
Rb_2PtCl_6	cub.	O_h^5	9.83	4
$Rb_2Pt(SCN)_6$	hex., $K_2Pt(SCN)_6$	D_{3d}^1 or D_{3d}^3	6.75, ..., 10.47	1
Rb_2SO_4	rhomb., K_2SO_4	V_h^{16}	5.949, 10.391, 7.780	4
$Rb_2S_2O_6$	hex.	D_3^2	10.144, ..., 6.409	3
Rh_2O_3	hex., Fe_2O_3	D_{3d}^6	5.47, $\alpha = 55° 40'$	2
RhS_2	cub., FeS_2	T_h^6	5.574	4
RuO_2	tetr., SnO_2	D_{4h}^{14}	4.51, ..., 3.11	2
RuS_2	cub., FeS_2	T_h^6	5.57	4
$RuSe_2$	cub., FeS_2	T_h^6	5.921	4
$RuTe_2$	cub., FeS_2	T_h^6	6.360	4
SaF_3	hex., CeF_3	D_6^6	6.98, ..., 7.15	6
Sa_2O_3	cub., Tl_2O_3	T_h^7	10.85	16
SbI_3	hex., AsI_3	C_3^1	7.466, ..., 20.89	6
Sb_2O_3	cub., As_2O_3	O_h^7	11.06	16
Sb_2S_3	rhomb.	V_h^{16}	11.39, 11.48, 3.89	4
SbSn (43-55% Sb)	cub., NaCl	O_h^5	6.130	4
Sb_2Tl_7	cub.	....	11.59	6
$(Sc, In)_2O_3$	cub.	O_h^{10}	9.90	16
ScN	cub., NaCl	O_h^5	4.44	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants *a*, *b*, *c*, Ax. ang.	Mol.
Sc_2O_3	cub., Tl_2O_3	T_h^7	9.79	16
SiC, (I.)	hex.	C_{3v}^5	12.78, $\alpha = 13° 55'$	15
SiC, (II.)	hex.	C_{6v}^4	3.095, ..., 15.17	6
SiC, (III.)	hex.	C_{6v}^4	3.095, ..., 10.10	4
SiC, (IV.)	cub., ZnS	T_d^2	4.348	
SiC, (V.)	hex.	....	43.15, $\alpha = 4° 6'$	51
SiI_4	cub.	T_h^6	11.99	8
SiO_2 (β cristobalite) (290°C)	cub.	O_h^7	7.12	8
SiO_2 (α quartz)	hex.	D_3^4 or D_3^6	4.903, ..., 5.393	3
SiO_2 (β quartz) (600°C)	hex.	D_6^4 or D_6^5	5.01, ..., 5.47	
SiO_2 (α tridymite)	rhomb.	D_{6h}^4	9.88, 17.1, 16.3	64
SiO_2 (β tridymite)	hex.	D_{6h}^4	5.03, ..., 8.22	64
$SiO_4ZnO_2H_2$	....	C_{2v}^{20}	8.41, 5.14, 10.73, β = 90°	4
$SmPMo_{12}O_{40}.30H_2O$	cub.	O_h^7	23.1	8
SnAs	cub., NaCl	O_h^5	5.708	4
Sn_8Cu_{31}	cub.	....	17.91	
SnI_4	cub.	T_h^6	12.23	8
SnO	tetr., PbO	D_{4h}^7	3.77, ..., 4.77	2
SnO_2	tetr.	D_{4h}^{14}	4.72, 3.16	2
SnS_2	hex., CdI_2	D_{3d}^3	3.639, ..., 5.868	1
SnTe	cub., NaCl	O_h^5	6.285	4
SrC_2	tetr., CaC_2	D_{4h}^{17}	5.81, ..., 6.68	2
$SrCO_3$	rhomb., KNO_3	V_h^{16}	5.13, 8.42, 6.10	4
$SrCl_2$	cub., CaF_2	O_h^5	7.00	4
$SrCl_2.6H_2O$	hex.	C_{3i}^2	7.906, ..., 4.07	1
SrF_2	cub., CaF_2	O_h^5	5.86	4
$Sr(NO_3)_2$	cub., $Ba(NO_3)_2$	T_h^6	7.81	4
SrO	cub., NaCl	O_h^5	5.10	4
$SrO_2.8H_2O$	tetr.	....	6.32, ..., 5.56	1
$Sr(OH)_2.8H_2O$	tetr.	D_{4h}^1	6.41, ..., 5.807	1
$SrMoO_4$	tetr., $CaWO_4$	C_{4h}^6	5.36, ..., 11.94	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$SrPb_3$	tetr.	....	4.955, ..., 5.025	
SrS	cub., NaCl	O_h^5	5.87	4
$SrSO_4$	rhomb., $BaSO_4$	V_h^{16}	8.36, 5.36, 6.84	4
SrSe	cub., NaCl	O_h^5	6.23	4
SrTe	cub., NaCl	O_h^5	6.48	4
$SrTiO_3$	cub., $CaTiO_3$	O_h^1	3.92	1
$SrZrO_3$	cub., $CaTiO_3$	O_h^1	4.09	1
TaC	cub., NaCl	....	4.53	4
TaN	hex., ZnO	C_{6v}^4	3.05, ..., 4.94	2
Tb_2O_3	cub., Tl_2O_3	T_h^7	10.70	16
Tb_4O_7	cub.	....	10.55	
TeO_2	tetr., SnO_2	D_{4h}^{14}	4.79, ..., 3.77	2
$Te(OH)_6$	cub.	O_h^8	15.48	32
ThB_6	cub.	....	4.32	1
ThC_2	tetr.	....	5.85, ..., 5.28	4
ThO_2	cub., CaF_2	O_h^5	5.59	4
$TiBr_4$	cub.	....	11.25	
TiC	cub., NaCl	O_h^5	4.311	4
TiI_4	cub.	....	12.00	
TiN	cub , NaCl	O_h^5	4.40	4
TiO	cub., NaCl	O_h^5	4.235	4
TiO_2 (anatase)	tetr.	D_{4h}^{19}	3.73, ..., 9.37	4
TiO_2 (brookite)	rhomb.	V_h^{15}	9.166, 5.436, 5.135	8
TiO_2 (rutile)	tetr., SnO_2	D_{4h}^{14}	4.58, ..., 2.95	2
Ti_2O_3	hex., Fe_2O_3	D_{3d}^6	5.37, α = 56° 48′	2
$TiSe_2$	hex., CdI_2	D_{3d}^3	5.995, ..., 3.533	1
TiS_2	hex., CdI_2	D_{3d}^3	5.691, ..., 3.397	1
$TiTe_2$	hex., CdI_2	D_{3d}^3	6.539, ..., 3.774	1
$TlAl(SO_4)_2.12H_2O$	cub.	T_h^6	12.21	4
TlBi	cub., CsCl	O_h^1	3.98	1
TlBr	cub., CsCl	O_h^1	3.97	1
TlCNS	rhomb.	V_h^{11}	6.80, 6.78, 7.52	4
TlCl	cub., CsCl	O_h^1	3.84	1

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$TlClO_4$	rhomb., $BaSO_4$	V_h^{16}	9.42, 5.88, 7.50	4
$TlClO_4$ (280°C)	cub, $KClO_4$	T_d^2	7.61	
$Tl_3Co(NO_2)_6$	cub.	....	10 72	4
$TlHF_2$	cub.	....	8.58	8
TlI	cub., CsCl	O_h^1	4.198	1
Tl_2O_3	cub.	T_h^7	10.57	16
TlSb (Tl in excess)	cub., CsCl	O_h^1	3.84	1
Tm_2O_3	cub., Tl_2O_3	T_h^7	10.52	16
UO_2	cub., CaF_2	O_h^5	5.47	4
$UO_2(NO_3)_2.6H_2O$	rhomb.	V_h^{17}	11.42, 13.15, 8.02	4
VC (ϵ)	cub., NaCl	O_h^5	4.30	4
VN	cub., NaCl	O_h^5	4.28	4
VO_2	tetr., SnO_2	D_{4h}^{14}	4.54, ..., 2.88	2
V_2O_3	hex., Fe_2O_3	D_{3d}^6	5.43, α = 53° 53′	2
WC	hex.	....	2 901, ..., 2.830	1
$W_2C(\beta)$ (2600°C)	hex.	....	2.99, ..., 4.72	1
WO_2	tetr., SnO_2	D_{4h}^{14}	4.86, ..., 2.77	2
WS_2	hex., MoS_2	D_{6h}^4	3.18, ..., 12.5	2
WSi_2	tetr.	D_{4h}^{17}	3.212, ..., 7.880	2
$YAlO_3$	cub., $CaTiO_3$	O_h^1	3.67	1
$(Y,Bi)_2O_3$	cub.	O_h^{10}	10.72	16
$YCbO_4$	tetr.	....	7.76, ..., 11.32	8
YF_3	cub.	....	5.49	4
Y_2O_3	cub., Tl_2O_3	T_h^7	10.60	16
YPO_4	tetr., $ZrSiO_4$	D_{4h}^{19}	6.88, ..., 6.03	4
$YTaO_4$	tetr.	....	7.75, ..., 11.41	8
$(Y,Tl)_2O_3$	cub.	O_h^{10}	10.53	16
$Y(VO_3)_3$	....	D_{4h}^{19}	7.126, ..., 6.197	4
Yb_2O_3	cub., Tl_2O_3	T_h^7	10.39	16
$ZnAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.099	8
Zn_3As_2	cub., Zn_3As_2	....	5.81	2
$Zn(BrO_3)_2.6H_2O$	cub., $(NH_4)_2PtCl_6$	T_h^6	10.31	4
$ZnCO_3$	hex., $NaNO_3$	D_{3d}^6	5.704, α = 48° 6′	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$ZnCl_2$	hex., $CdCl_2$	D_{3d}^5	6.31, α = 34° 48′	1
$ZnCo_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.108	8
$ZnCr_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.323	8
ZnF_2	tetr., SnO_2	D_{4h}^{14}	4.715, ..., 3.131	2
$ZnFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.403	8
ZnO	hex.	C_{6v}^4	3.25, ..., 5.23	2
$ZnO.Fe_2O_3$	cub.	....	8.41	8
$Zn(OH)_2$	rhomb.	V^4	5.16, 8.53, 4.92	4
Zn_3P_2	cub., Zn_3As_2	....	5.68	2
ZnS(α) (wurzite)	hex. ZnO	C_{6v}^4	3.84, ..., 6.28	2
ZnS(β) (blende)	cub.	T_d^2	5.43	4
$ZnSO_4$	rhomb.	....	8.58, 6.73, 4.76	4
$ZnSO_4.7H_2O$	rhomb., $MgSO_4.7H_2O$	V^4	11.85, 12.09, 6.83	4
$ZnSO_4.(NH_4)_2SO_4.6H_2O$	monocl.	C_{2h}^5	9.20, 12.47, 6.23, β = 106° 52′	2
ZnSe	cub., ZnS	T_d^2	5.65	4
$ZnSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.27, α = 96° 5′	1
$ZnSnF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.54, α = 95° 51′	1
$ZnSnO_3$	cub.	....	8.650	
Zn_2SnO_4	cub., $MgAl_2O_4$	O_h^7	8.65	8
ZnTe	cub., ZnS	T_d^2	6.07	4
$ZnTiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.41, α = 96° 20′	1
$ZnTiO_3$	cub.	....	8.460	
Zn_2TiO_4	cub., $MgAl_2O_4$	O_h^7	8.46	8
$ZnZrF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.57, α = 96° 5′	1
ZrC	cub., NaCl	O_h^5	4.73	4
$ZrCl_4$	cub., SnI_4	T_h^6	10.32	8
ZrN	cub., NaCl	O_h^5	4.61	4
ZrO_2	monocl.	....	5.21, 5.26, 5.37, β = 80° 32′	4
ZrO_2	tetr.	....	5.07, ..., 5.16	4
ZrO_2	cub., CaF_2	O_h^5	5.07	4
ZrO_2	hex.	....	3.598, ..., 5.875	
ZrS_2	hex., CdI_2	D_{3d}^3	3.68, ..., 5.85	1
$ZrSe_2$	hex., CdI_2	D_{3d}^3	3.79, ..., 6.18	1
$ZrSi_2$	rhomb.	V_h^{17}	3.72, 14.61, 3.67	4
ZrW_2	cub., f.c.	....	7.61	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

MINERALS

Name	Formula	Crystal system	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Actinolite	$H_2Ca_2(Mg,Fe)_5(SiO_3)_8$	monocl.	....	9.8, 17.9, 5.27, β = ca 74°	
Aenigmatite	....	tricl.	....	18.3, 18.3, 10.6, α = 96° 30′, β = 96° 30′, γ = 113° 30′	
Analcite	$NaAlSi_2O_6.H_2O$	cub.	....	13.64	
Andalusite	Al_2SiO_5	rhomb.	V_h^{12}	7.76, 7.90, 5.56	4
Anhydrite	$CaSO_4$	rhomb.	V_h^{17}	6.22, 6.96, 6.97	4
Anthophyllite	$H_2Mg_7(SiO_3)_8$	rhomb.	....	18.52, 18.04, 5.27	
Apatite	$Ca(F,Cl)Ca_4(PO_4)_3$	hex.	C_{6h}^2	9.37, ..., 6.88	2
Apophyllite	$4(Si_2O_5H_2.CaO_2H_2)KF(?)$	tetr.	....	12.71, ..., 15.86	
Aragonite	$CaCO_3$	rhomb.	V_h^{16}	4.94, 7.94, 5.72	4
Atopite	$(Ca,Mn,Na)_2Sb_2(O,OH,F)_7$	cub.	....	10.27	8
Babingtonite	....	tricl.	....	6.73, 7.54, 12.43, α = 112° 22′, β = 93° 48′, γ = 86° 9′	
Bastnäsite	$(Ce,La)FCO_3$	hex.	D_{3h}^3	7.094, ..., 4.859	3
Benitoite	$BaTiSi_3O_9$	hex.	....	6.60, ..., 9.71	
Beryl	$Be_3Al_2(SiO_3)_6$	hex.	D_{6h}^2	9.21, ..., 9.17	2
Berzeliite	$NaCa_2Mn_2As_3O_{12}$	cub.	....	12.36	
Bixbyite	$(Fe,Mn)_2O_3$	cub.	T_h^7	9.365	16
Boracite	$Mg_6Cl_2B_{14}O_{26}$	rhomb.	....	16.97, 16.97, 12.00	8
Bornite	Cu_5FeS_4	cub.	....	10.91	
Calcite	$CaCO_3$	rhbdr.	D_{3d}^6	6.361, α = 46° 6′	2
Cancrinite	$3SiO_4AlNa.CaCO_3(?)$	hex	....	12.60, ..., 5.18	
Chalcopyrite	$CuFeS_2$	tetr.	V_d^5	3.726, ..., 5.194	1
Chondrodite	$Mg_3[Mg(F,OH)]_2(SiO_4)_2$	monocl.	C_{2h}^5	4.733, 10.27, 7.87, α = 109° 2′	2
Chromite	$(Fe,Mg)Cr_2O_4$	cub.	O_h^7	8.35	8
Chrysoberyl	$BeAl_2O_4$	rhomb.	V_h^{16}	4.420, 9.390, 5.470	4
Chrysotile	$H_4Mg_3Si_2O_9$	rhomb.	....	14.66, 18.5, 5.33, β = 93° 16′	
Cinnabar	HgS	hex.	D_3^4 or D_3^6	4.14, ..., 9.49	3
Clinohumite	$Mg_7[Mg(F,OH)]_2(SiO_4)_4$	monocl.	C_{2h}^5	4.745, 10.27, 13.68, α = 100° 50′	2
Columbite	$(Fe,Mn)(Cb,Ta)_2O_6$	rhomb.	....	5.082, 14.24, 5.730	
Cordierite	$Mg_2Si_5O_{12}.2Al_2O_3$	rhomb.	....	9.78, 17.1, 9.33	
Covellite	....	hex.	D_{6h}^4	3.802, ..., 16.43	6
Cryolithionite	$Na_3Al_2Li_3F_{12}$	cub.	....	12.10	
Cumengeite	$PbCl_2CuO_2H_2(?)$	tetr.	....	15.17, ..., 24.71	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Name	Formula	Crystal system	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Cyanite..........	Al_2SiO_5	tricl.	C_i^1	7.09, 7.72, 5.56, β = 101° 2′	4
Danburite........	$CaB_2Si_2O_8$	rhomb.	....	8.75, 8.01, 7.72	
Datolite..........	$CaSiO_3.HBO_2$	monocl.	....	9.64, 7.62, 4.82, β = 90° 9′	
Davynite..........	$3SiO_4AlNa.Ca(SO_4,Cl_2)$	hex.	....	12.80, ..., 5.35	
Dietzeite.........	$Ca(IO_3)_2.CaCrO_4$	monocl.	....	10.16, 7.30, 14.03, β = 106° 32′	4
Diopside..........	$CaMg(SiO_3)_2$	monocl.	C_{2h}^6	9.71, 8.89, 5.24, β = 74° 10′	
Dioptase..........	CuH_2SiO_4	hex.	....	14.66, ..., 7.83	
Dolomite..........	$CaMg(CO_3)_2$	hex., (rhbdr.)	C_{3i}^2	6.02, α = 47° 30′	1
Dysanalyte.......	$(CaTiO_3,NaCbO_3)$	cub.	....	3.826	
Enstatite.........	$MgSiO_3$	rhomb.	....	18.20, 8.86, 5.20	
Epididymite......	$NaBeSi_3O_7(OH)$	rhomb.	....	12.71, 7.33, 13.62	
Euclase...........	$BeSiO_3.HAlO_2$	monocl.	....	4.63, 14.30, 4.71, β = 100° 16′	
Eudialyte.........	$(Na,Ca,Fe)_6ZrSi_6O_{18}(OH,Cl)$	hex.	....	13.01, α = 66° 44′	
Eudidymite.......	$NaBeSi_3O_7(OH)$	monocl.	....	12.62, 7.37, 13.99, β = 103° 43′	
Finnemanite......	$9PbO.3As_2O_3.PbCl_2$	hex.	....	10.21, ..., 6.97	1
Fluorite..........	CaF_2	cub.	O_h^5	5.451	4
Garnet...........	$(Fe'',Mn'')_3Al_2(SiO_4)_3$	cub.	O_h^{10}	11.40	8
Gehlenite.........	....	tetr.	....	11.11, ..., 5.06	
Granerite.........	$H_2Fe_7(SiO_3)_8$	monocl.	....	9.4, 17.9, 5.27, β = *ca* 74°	
Granite...........	$Al_2Ca_3(SiO_4)_3$	cub.	O_h^{10}	11.83	8
Haematophanite...	$Pb(Cl,OH)_2.4PbO.2Fe_2O_3$	tetr.	....	7.80, ..., 15.23	3
Hardystonite	$Ca_2ZnSi_2O_7$	tetr.	....	7.83, ..., 4.99	
Haüynite.........	cub.	....	....	9.04	
Helvite...........	$Be_3(Mn,Fe)_3(SiO_4)_3MnS$	cub.	....	8.25	
Hematite.........	Fe_2O_3	hex.	D_{3d}^6	5.42, α = 55° 17′	2
Hemimorphite....	$Zn_2SiO_4.H_2O$	rhomb.	....	8.41, 5.14, 10.73	
Heulandite.......	$H_4CaAl_2Si_6O_{18}.3H_2O$	monocl.	....	7.54, 17.97, 15.91, β = 83° 34′	
Hornblende.......	$H_2(Ca,Na,K)_{2-3}(Mg,Fe,Al)_5[(Si,Al)O_3]_8$	monocl.	....	*ca* 9.8, 17.9, 5.28, β = *ca* 74°	
Humite...........	$Mg_5[Mg(F,OH)]_2(SiO_4)_3$	rhomb.	V_h^{16}	4.738, 10.23, 20.86	4
Ice..............	H_2O	hex.	D_{6h}^4	4.535, ..., 7.41	4
Ilmenite..........	$FeTiO_3$	rhbdr.	C_{3i}^2	5.40	2
Jacobsite.........	$(Mg,Mn,Fe)Fe_2O_4$	cub.	O_h^7	8.42	8
Kaliophilite.......	$KAlSiO_4$	hex.	....	15.59, ..., 8.59	
Kupfferite........	$H_2Mg_7(SiO_3)_8$	monocl.	....	9.7, 17.8, 5.25, β = *ca* 74°	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Name	Formula	Crystal system	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Lautarite	$Ca(IO_3)_2$	monocl.	C^5_{2h}	7.18, 11.38, 7.32, β = 106° 22′	4
Magneto-plumbite	$2(Pb,Mn)O.3Fe_2O_3$	hex.	....	6.06, ..., 23.69	4
Marcasite	FeS_2	rhomb.	V^{12}_h	3.35, 4.40, 5.35	2
Mauzeliite	$(Ca_8,Na_2)(Sb_8,Ti_2)O_{31}F_4$	cub.	....	12.30	
Melilite	$(Ca,Na)_2(Mg,Al)(Si,Al)_2O_7$	tetr.	....	7.73, ..., 5.01	
Meliphanite	$(Ca,Na)_2Be(Si,Al)_2(O,F)_7$	tetr.	....	7.47, ..., 4.92	
Metacinnabar	HgS	cub.	T^2_d	5.84	4
Metavoltine	$K_5H_7(SO_4)_6.3FeO_3H_3.H_2O$	hex.	....	19.43, ..., 18.60	8
Miersite	4AgI.CuI	cub.	T^2_d	6.35	4
Millerite	NiS	hex., (rhbdr.)	C^5_{3v}	5.655, α = 116° 36′	3
Mimetite	$9PbO.3As_2O_5.PbCl_2$	hex.	....	10.01, ..., 7.28	1
Monticellite	$CaMgSiO_4$	rhomb.	....	4.815, 11.08, 6.37	
Mossite	$Fe(Cb,Ta)_2O_6$	tetr.	D^{14}_{4h}	4.71, ..., 9.12	2
Muscovite	$KH_2Al_2Si_3AlO_{12}$	monocl.	....	5.18, 9.02, 20.04, β = 95° 30′	
Natrolite	$Na_2Al_2Si_3O_{10}.2H_2O$	rhomb.	C^{19}_{2v}	18.19, 18.62, 6.58	8
Nephelite	$NaAlSiO_4$	hex.	....	10.09, ..., 8.49	
Neptunite	$Na_2FeSi_2O_6.Si_2TiO_6$	monocl.	....	16.54, 12.64, 10.04, β = 115° 38′	
Norbergite	$Mg(F,OH)_2Mg_2SiO_4$	rhomb.	V^{16}_h	4.70, 10.2, 8.72	4
Olivine	$(Mg,Fe'')_2SiO_4$	rhomb.	V^5_h	4.77, ..., 6.00	4
Pentlandite	(Ni,Fe)S	cub.	O^5_h	10.00	32
Perovskite	$CaTiO_3$	cub.	O^1_h	3.80	1
Petalite	$LiAlSiO_4.3SiO_2$	monocl.	....	11.77, 5.13, 15.17, β = 112° 44′	
Phenacite	Be_2SiO_4	hex.	....	7.684, α = 108° 1′	
Plumboferrite	$PbO.2Fe_2O_3$	hex.	....	11.86, ..., 47.14	42
Polydymite	Ni_3S_4	cub.	O^7_h	9.65	8
Pseudo-boleite	$5PbCl_2.4CuO.6H_2O$	tetr.	....	15.4, ..., 31.2	12
Pseudobrookite	Fe_2TiO_5	rhomb.	....	9.78, 9.80, 3.65	4
Quartz (α)	SiO_2	hex.	D^4_3 or D^6_3	4.903, ..., 5.393	3
Pyrite	FeS_2	cub.	T^6_h	5.404	4
Rhodonite	$Mn_4Ca(SiO_3)_5$	tricl.	....	7.77, 12.45, 6.74, α = 85° 10′, β = 94° 4′, γ = 111° 29′	
Rutile	TiO_2	tetr.	D^{14}_{4h}	4.58, ..., 2.95	2
Scapolite	$nNa_4Al_3Si_9O_{24}Cl + m\,Ca_4Al_6Si_6O_{25}$	tetr.	C^5_{4h}	12.72, ..., 7.66	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Name	Formula	Crystal system	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Scheelite	$CaWO_4$	tetr.	C_{4h}^6	5.24, ..., 11.38	4
Sillimanite	$Al_2O_3.SiO_2$	rhomb.	....	7.43, 7.58, 5.74	
Skutterudite	$CoAs_3$	cub.	T_h^5	8.18	8
Sodalite	$Na_4Al_3Si_3O_{12}Cl$	cub.	....	8.87	
Spinel	Al_2MgO_4	cub.	O_h^7	8.09	8
Spodumene	$Li_2O.Al_2O_3.4SiO_2$	monocl.	....	9.50, 8.30, 5.24, β = 69° 40′	4
Staurolite	$Fe(OH)_2.2Al_2SiO_5$	rhomb.	V_h^{17}	7.82, 16.52, 5.63	4
Sulvanite	Cu_3VS_4	cub.	T_d^2	5.370	1
Tetrahedrite	Cu_3SbS_3	cub.	....	10.32	
Thortveitite	$Sc_2Si_2O_7$	monocl.	....	6.56, 8.58, 4.74, β = 103° 8′	
Titanite	$CaTiSiO_5$	monocl.	....	6.55, 8.70, 7.43, β = 119° 43′	
Topaz	$Al_2F_2SiO_4$	rhomb.	V_h^{16}	4.64, 8.78, 8.37	4
Tourmaline	....	hex.	C_{3v}^1	16.23, ..., 7.26	
Tremolite	$H_2Ca_2Mg_5(SiO_3)_8$	monocl.	....	9.78, 17.8, 5.26, β = 73° 58′	
Tridymite (α)	SiO_2	rhomb.	D_{6h}^4	9.88, 17.1, 16.3	64
" (β)	SiO_2	hex.	D_{6h}^4	5.03, ..., 8.22	64
Trimerite	$Be(Ca,Mn)SiO_4$	hex.	....	16.11, ..., 7.60	
Tysonite	$(Ce, La....)F_3$	hex.	D_{6h}^3	7.124, ..., 7.280	6
Vaterite	$CaCO_3$	hex.	....	4.120, ..., 8.556	2
Vesuvianite	....	tetr.	....	22.03, ..., 11.89	
Voltaite	....	cub.	....	27.33	20
Willemite	Zn_2SiO_4	hex.	....	8.63, α = 107° 45′	
Wollastonite	$CaSiO_3$	monocl.	....	15.31, 7.35, 7.08, β = 95° 25′	
Wurtzite	....	C_{6v}^4	....	3.811, ..., 6.234	
Zircon	$ZrSiO_4$	tetr.	D_{4h}^{19}	6.58, ..., 5.93	4

Metal-organic Compounds

Substance	System, struct type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Aluminum acetylacetone	monocl.	C_{2h}^5	14.1, 7.42, 16.5, β = 98° 54′	4
Ammonium chlorofumarate	monocl.	C_2^2	9.30, 6.70, 6.735, β = 108° 25′	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Ammonium				
hydrogen fumarate	tricl.	C_i^1	7.00, 7.44, 6.56, α = 107° 1′, β = 117° 58′, γ = 69° 16′	2
oxalate + $1H_2O$	rhomb.	V^3	8.06, 10.34, 3.82	2
Barium				
formate	rhomb.	V^4	6.78, 8.89, 7.68	4
Beryllium				
oxalate + $3H_2O$	rhomb.	V_h^{16}	6.37, 7.53, 12.45	4
oxyacetate	cub.	T_h^4	15.72	8
oxypivalate	monocl.	C_{2h}^6	19.3, 12.4, 35.4, β = 91° 21′	8
oxypropionate	monocl.	....	16.00, 9.76, 9.15, β = 116° 7′	2
Bismuth				
chloride thiourea	hex.	C_3^4	14.81, α = 111° 54′	1
cobalticyanide thiourea	hex.	D_{3d}^5	9.13, α = 100° 30′	1
Calcium				
formate	rhomb.	V_h^{15}	10.16, 13.38, 6.26	8
Chromium				
acetylacetone	monocl.	C_{2h}^5	14.2, 7.62, 16.5, β = 99° 8′	4
Cobalt				
acetylacetone	monocl.	C_{2h}^5	14.2, 7.50, 16.4, β = 98° 38′	4
Cupric				
formate + $2H_2O$	monocl.	C_{2h}^5	8.952, 6.726, 8.235	4
Gallium				
acetylacetone (α)	monocl.	C_{2h}^5	14.0, 7.63, 16.3, β = 99° 12′	4
" (β)	rhomb.	C_{2v}^7	8.20, 13.1, 16.3	4
" (γ)	rhomb.	C_{2v}^9	15.71, 13.74, 32.76	16
Germanium				
tetraphenyl	tetr.	V_d^4	11.60, ..., 6.85	2
Indium				
acetylacetone	rhomb.	C_{2v}^7	8.24, 13.4, 16.5	4
Iron				
acetylacetone	rhomb.	C_{2v}^9	15.74, 13.68, 33.0	16
Lead				
formate	rhomb.	V^4	6.52, 8.75, 7.41	4
tetraphenyl	tetr.	V_d^4	12.06, ..., 6.50	2
Lithium				
acetate	rhomb.	....	12.80, 11.63, 7.43	12
butyrate	hex.	....	27.7, ..., 10.1	48
iso-butyrate	tetr.	....	19.75, ..., 9.25	24
caprylate	hex.	....	42.1, ..., 10.9	72
crotonate	hex.	....	24.8, ..., 10.7	48

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Lithium				
formate	monocl.	....	7.61, 6.03, 4.87, β = 95° 42′	4
" + H_2O	rhomb.	C_{2v}^{9}	6.49, 10.01, 4.85	4
heptylate	tetr.	....	27.4, ..., 9.3	32
laurate	tetr.	....	28.3, ..., 11.7	24
nonylate	tetr.	....	36.6, ..., 9.3	48
oleate	hex.	....	64.6, ..., 9.5	72
oxalate	rhomb.	....	6.58, 7.74, 6.61	4
propionate	rhomb.	....	16.98, 12.15, 9.45	16
stearate	hex.	....	62.5, ..., 9.8	72
trimethylacetate	cub.	....	18.56	36
undecylate	tetr.(?)	....	41.8, ..., 9.2	48
undecylenate	hex.(?)	....	52.6, ..., 9.5	72
valerate	tetr.(?)	....	24.5, ..., 9.4	32
iso-valerate	rhomb.(?)	....	11.7, 8.70, 6.93	4
Manganese				
acetylacetone	monocl.	....	14.1, 7.68, 16.5, β = 99° 24′	4
Potassium				
acid chloromaleate	rhomb.	V_h^{16}	7.62, 15.74, 10.95	8
bitartrate	....	....	7.614, 10.70, 7.80	4
chlorosulfoacetate	rhomb.	V_h^{14}	8.58, 8.60, 23.76	8
mesotartrate + $2H_2O$	tricl.	....	7.02, 6.90, 11.02, α = 95° 44′, β = 102° 52′, γ = 61° 46′	2
rhodium oxalate	hex.	D_3^4 or D_3^6	11.28, ..., 20.25	6
Rubidium				
tartrate	hex.	D_3^4 or D_3^6	7.17, ..., 13.19	3
Scandium				
acetylacetone	rhomb.	C_{2v}^7 or V_h^{13}	8.20, 13.52, 16.15	4
Silicon				
tetraphenyl	tetr.	V_d^4 or D_{4h}^9	11.50, 6.97	2
Sodium				
acid acetate	cub.	T_h^7	15.9	24
uranylacetate	cub.	T^4	10.69	4
Strontium				
formate	rhomb.	V^4	6.86, 8.72, 7.24	4
" + $2H_2O$	rhomb.	V^4	7.30, 11.99, 7.13	4
Thallium				
mesotartrate	tricl.	....	13.26, 16.12, 7.63, α = 75° 54′, β = 86° 37′, γ = 82° 14′	4
Tin				
tetraphenyl	tetr.	V_d^4	11.83, ..., 6.42	2
ORGANIC COMPOUNDS				
Acenaphthene	rhomb.	....	8.32, 14.15, 7.26	4
Acetaldehyde ammonia	hex.	D_{3d}^6	8.18, α = 84° 50′	6

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Acetamide	hex.	C_{3v}^{6}	8.05, $\alpha = 91° 17'$	6
Acetonyl pyrrole	tetr.	C_4^2 or C_4^4	10.09, ..., 23.85	4
Acetylenedicarboxylic acid	monocl.	....	7.88, 9.04, 6.62, $\beta = 111° 6'$	4
Adipic acid	monocl.	C_{2h}^{5}	10.27, 5.16, 10.02, $\beta = 137° 5'$	2
Aminoazobenzene (*p*)	monocl.	....	13.69, 5.604, 14.18, $\beta = 81° 49'$	4
Aminophenol (*o*)	rhomb.	V_h^{15}	7.26, 7.71, 19.51	8
" (*m*)	rhomb.	C_{2v}^{4}	6.14, 11.10, 8.38	4
" ($\alpha - p$)	rhomb.	C_{2v}^{5}	8.25, 5.32, 13.06	4
" ($\beta - p$)	rhomb.	C_{2v}^{1}	12.07, 11.85, 5.82	6
Anthracene	monocl.	C_s^4	8.58, 6.02, 11.18, $\beta = 125°$	2
Anthraquinone	rhomb.	....	12.05, 15.05, 2.69	2
Arabinose	....	V^4	6.48, 19.30, 4.81	4
Azelaic acid (α)	monocl.	C_{2h}^{5}	9.72, 4.83, 27.14, $\beta = 129° 30'$	4
" " (β)	monocl.	C_{2h}^{2}	5.61, 9.58, 27.20, $\beta = 136° 30'$	4
Azobenzene	monocl.	C_{2h}^{5}	12.65, 6.06, 15.60, $\beta = 114° 24'$	4
Azotoluene (*o*)	....	C_{2h}^{5}	13.93, 6.604, 14.55, $\beta = 101° 4'$	4
Behenolic acid	monocl.	C_{2h}^{4} or C_{2h}^{5}	9.551, 4.686, 59.10, $\beta = 53° 30'$	4
Benzene (−20°C)	rhomb.	V_h^{15}	9.76, 7.39, 6.85	4
Benzene hexabromide	monocl.	C_{2h}^{4}	8.44, 4.04, 17.3, $\beta = 116° 30'$	2
" hexachloride	monocl.	C_{2h}^{4}	8.10, 3.86, 16.68, $\beta = 116° 50'$	2
Benzil	hex.	D_3^4 or D_3^6	8.15, ..., 13.46	3
Benzoic acid	monocl.	....	5.44, 5.18, 21.6, $\beta = 97° 5'$	4
Brassylic acid	monocl.	C_{2h}^{5}	9.63, 4.82, 37.95, $\beta = 128° 20'$	4
Bromostearic acid	monocl.	C_{2h}^{4} or C_{2h}^{5}	11.039, 4.904, 52.84, $\beta = 43° 17'$	4
Catechol	monocl.	C_{2h}^{3}	17.46, 10.74, 5.48, $\beta = 94° 15'$	8
Cellobiose (*d*)	monocl.	C_2^2	5.00, 13.2, 11.1, $\beta = 90°$	2
Cellulose	tetr.	....	7.79, ..., 10.26	4
" hydrate	monocl.	....	8.14, 10.3, 9.14, $\beta = 62°$	4
" natural	monocl.	....	8.3, 10.3, 7.9, $\beta = 84°$	
Chlorobromobenzene (*p*)	monocl.	....	15.15, 4.12, 5.81, $\beta = 113° 9'$	2
Chloronaphthalene tetrachloride (α)	monocl.	....	8.245, 10.1, 15.78, $\beta = 116° 12'$	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Cinnamic acid (*trans*)	monocl.	....	11.65, 14.10, 4.26, β = 98° 36′	4
Cyclohexane-α-diol-1, 2	rhomb.	V_h^{15}	7.62, 8.55, 19.57	8
Cyclohexane-β-diol-1, 4	monocl.	C_{2h}^5	6.32, 21.2, 7.27, β = 96.0°	6
Cyclohexane-γ-diol-1, 2	monocl.	C_{2h}^6	19.13, 9.92, 7.23, β = 103.9°	8
Cyclohexyl diacetate-1, 4 (β)	monocl.	C_{2h}^5	13.56, 5.83, 6.72, β = 107.4°	2
Dibenzalpentaerythritol	hex.	D_6^4	6.03, ..., 36.7	3
Dibenzyl	monocl.	C_{2h}^5	12.82, 6.18, 7.74, β = 116°	2
Dibromobenzene (*p*)	monocl.	....	15.46, 4.11, 5.80, β = 112° 38′	2
Dibromotetramethylethane (*sym.*)	tetr.	....	10.45, ..., 8.14	4
Dichlorobenzene (*p*)	monocl.	....	14.83, 4.10, 5.88, β = 112° 30′	2
Dichloronaphthalene tetrachloride	monocl.	C_s^4	7.8, 12.3, 13.9, β = 116° 14′	4
Dicyanodiamide	monocl.	C_{2h}^3	13.8, 4.4, 6.2, β = 90° 35′	4
Diethyl phthalyl ketone	tetr.	D_{4h}^{10}	7.25, ..., 20.47	4
Dimesityl	monocl.	C_{2h}^5	8.21, 8.58, 22.25, β = 96° 30′	4
Dimethyldiethyl ammonium chlorostannate	tetr.	....	9.06, ..., 14.12	2
Dimethylethyl sulfonium chlorostannate	cub.(?)	....	12.80	
Dimethylurea (1, 2)	rhomb.	C_{2v}^7	4.53, 10.9, 5.14	2
Dinitrobenzene (*o*)	monocl.	C_{2h}^6	7.95, 13.0, 7.45, β = 112° 7′	4
" (*m*)	rhomb.	V_h^{16}	13.3, 14.2, 3.82	4
" (*p*)	monocl.	C_{2h}^5	11.3, 5.55, 5.8, β = 92° 18′	2
4, 6-Dinitro-1, 3-xylol	monocl.	C_{2h}^2	11.5, 5.49, 7.2, β = 98°	2
Diphenic acid	rhomb.	....	14.12, 11.90, 13.75	8
Diphenyl	monocl.	C_{2h}^5	8.11, 5.67, 9.57, β = 94° 30′	2
Diphenylbenzene (*p*)	monocl.	....	8.08, 5.60, 13.59, β = 91° 55′	2
Diphenylbutadiene	....	C_{2h}^2	7.71, 11.70, 13.31/sin β, β = 97°	
Distearin (α, α')	hex.(?)	....	81.5, ..., 10.8	48
Dulcitol	....	C_{2h}^5	8.61, 11.60, 9.05, β = 113° 45′	4
Durene	monocl.	C_{2h}^5	11.57, 5.77, 7.03, β = 113.3°	2
Elaidic acid	tetr. (?)	....	26.5, ..., 10.3	16
Ephedrine hydrobromide (*d*)	rhomb.	V^4	24.68, 6.93, 6.78	
" " (*l*)	monocl.	C_2^2	12.74, 6.20, 7.62, β = 100° 48′	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Ephedrine hydrochloride (*d*)	rhomb.	V^4	25.49, 6.48, 6.91	
" " (*l*)	monocl.	C_2^2	12.64, 6.15, 7.34, β = 102° 6′	
" hydroiodide (*d*)	rhomb.	V^4	11.39, 6.83, 15.62	
" " (*l*)	rhomb.	V^3	25.66, 7.33, 19.14	
Erythritol (*i*)	tetr.	C_{4h}^6	12.76, ..., 6.83	8
Ethane	hex.	D_{6h}^4	4.46, ..., 8.19	2
Ethylene diamine sulfate	tetr.	D_4^4 or D_4^8	5.96, ..., 17.99	4
Ethylene oxide dicarboxylic acid (*cis.*)	monocl.	C_{2h}^6	21.50, 6.90, 6.89, β = 91° 10′	8
Eulytine	cub.	T_d^6	10.272	4
Fluorene	monocl.	C_{2h}^5	8.48, 5.73, 19.24, β = 101° 53′	4
Fructose (*d*)	rhomb.	V^4	8.06, 10.06, 9.12	4
Fumaric acid	monocl.	C_{2h}^5	7.60, 15.11, 6.61, β = 111° 5′	6
Glucose (*d*)	rhomb.	V^4	10.40, 14.89, 4.99	4
Glutaric acid (α)	monocl.	C_{2h}^6	10.34, 5.08, 32.9, β = 129°	8
" " (β)	monocl.	C_{2h}^6	10.06, 4.87, 17.4, β = 132° 35′	4
Glycine	monocl.	C_{2h}^5	5.1, 11.9, 5.43, β = 111° 38′	4
Glyoxaline	monocl.	C_{2h}^1	7.67, 5.44, 5.12, β = 63° 11′	2
" -4-sulfonic acid	tetr.	V_d^4	11.08, ..., 9.22	8
Guanidine carbonate	tetr.	D_4^4 or D_4^8	6.95, ..., 19.45	4
Harmine	rhomb.	....	19.22, 9.57, 5.78	4
Hexaminobenzene	....	O_h^3	15.14	16
Hexabromobutylene	monocl.	C_{2h}^5	11.5, 6.40, 10.0, β = 44° 27′	2
Hexachlorobenzene	monocl.	C_{2h}^5	8.07, 3.84, 16.61, β = 116° 52′	2
Hexachloroethane	rhomb.	V_h^{16}	11.51, 10.14, 6.39	4
Hexadecanedicarboxylic acid	monocl.	C_{2h}^5	9.76, 4.92, 25.10, β = 131° 10′	2
Hexahydrobenzene hexabromide (β)	cub.	T_h^6	10.49	4
Hexahydrobenzene hexachloride (β)	cub.	T_h^6	10.07	4
Hexamethylbenzene	triel.	C_i^1	9.01, 8.926, 5.344, α = 44° 27′, β = 116° 43′, γ = 119° 34′	1
Hexamethylenetetramine	cub.	T_d^4	7.02	2
Hexane (α-*n*)	rhomb.	....	3.51, 4.26, 11.6	1
" (β-*n*)	monocl.	....	3.87, 4.61, 12.0, β = 120°	1
Hydrazobenzene	rhomb.	....	11.10, 9.93, 9.33	4
Hydrobenzoin, *iso*-	monocl.	C_2^2	12.40, 7.92, 5.81, β = 92° 53′	2

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Hydrocinnamic acid	monocl.	....	12.90, 9.20, 6.98, β = 103° 36′	4
Hydroquinol	monocl.	....	13.58, 5.22, 8.13, β = 107°	4
Iodobenzoic acid (o)	monocl.	C_{2h}^5	11.30, 15.17, 4.336, β = 90° 43′ 47″	4
" " (m)	monocl.	C_{2h}^5	6 206, 4.683, 25.14	4
Iodoform	hex.	C_6^6 or C_{6h}^2	6.87	2
Iodosuccinimide	tetr.	C_4^2 or C_4^4	6.29, ..., 15.55	4
Inositol (i)	monocl.	C_{2h}^5	6.64, 12.0, 19.7, β = 105.8°	8
" (l)	monocl.	C_2^2	6.17, 9.11, 6.83, β = 106.6°	2
" dihydrate (i)	monocl.	C_{2h}^5	8.98, 16.59, 6.49, β = 109.8°	4
Lauric acid	monocl.	C_{2h}^1	9.76, 4.98, 36.9, β = 48° 6′	4
Malachite	monocl.	C_{2h}^5	9.38, 11.95, 3.18, β = 91° 3′	4
Maleic acid	monocl.	C_{2h}^5	7.49, 10.14, 7.12, β = 117° 7′	4
" anhydride	rhomb.	....	6.58, 11.43, 5.90	4
Malonic acid	tricl.	C_i^1	8.36, 5.33, 5.14, α = 94° 56′, β = 103° 56′, γ = 71° 30′	2
" " (α)	rhomb.	....	8.70, 11.53, 17.05, β = 90°	16
Mannitol (d)	rhomb.	V^4	8.66, 16.58, 5.501	4
Mannose	....	Q_4	7.62, 18.18, 5.67	4
Metaldehyde	tetr.	C_4^5	10.36, 4.10	8
Methane	cub.	T_d^2	5.89	4
Methylbixin	monocl.	C_{2h}^5	10.56, 13.4, 20.62	4
Methyl glycoside (α)	rhomb.	....	10.80, 14.60, 5.61	4
" oxalate	monocl.	C_{2h}^2	3.93, 11.84, 6.17, β = 103° 22′	2
" urea	rhomb.	V^4	6.89, 6.96, 8.45	4
" xyloside (β-d)	monocl.	C_2^2	7.82, 6.89, 7.74, β = 113° 10′	2
Monoamyl ammonium bromide (n)	tetr.	....	5.00, ..., 16.95	
" " chloride (n)	tetr.	....	5.01, ..., 16.69	
" " iodide (n)	tetr.	....	5.18, ..., 17.42	
Monobutyl ammonium bromide (n)	tetr.	....	5.02, ..., 15.23	
" " chloride (n)	tetr.	....	5.02, ..., 14.85	
" " iodide (n)	tetr.	....	5.18, ..., 15.30	
Monodecyl ammonium iodide (n)	tetr.	....	5.18, ..., 28.09	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Monoethyl ammonium bromide	monocl.	....	8.32, 6.24, 4.63. β = 86° 59′	
" " chloroplatinate	hex.	....	7.13, ..., 8.53	
Monoethyl ammonium chlorostannate	hex.	....	7.24, ..., 8.41	
Monoethyl ammonium iodide	monocl.	....	8.68, 6.63, 4.81, β = 87° 54′	
Monoheptyl ammonium chloride (n)	tetr.	....	4.96, ..., 21.09	
Monoheptyl ammonium iodide (n)	tetr	....	5.18, ..., 21.82	
Monohexyl ammonium bromide (n)	tetr.	....	4.93, ..., 19.78	
" " chloride (n)	tetr.	....	4.98, ..., 19.55	
" " iodide (n)	tetr.	....	5.18, ..., 19.50	
Monomethyl ammonium aluminum alum	cub.	....	12.44	
Monomethyl ammonium bromide	tetr.	....	5.09, ..., 8.76	
" " chloride	tetr.	....	4.28, ..., 5.13	
" " chloroplatinate	hex.	....	8.31, α = 48° 46′	
Monomethyl ammonium chlorostannate	hex.	....	8.42, α = 50° 14′	
Monomethyl ammonium iodide	tetr.	....	5.11, ..., 8.97	
" triethyl ammonium chlorostannate	cub.	....	13.51	
Monomethyl triethyl phosphonium chlorostannate	cub.	....	13.93	
Monooctyl ammonium iodide (n)	tetr.	....	5.18, ..., 23.70	
Monopropyl ammonium bromide (n)	tetr.	....	4.57, ..., 7.36	
Monopropyl ammonium chloride (n)	tetr.	....	4.48, ..., 7.40	
Monopropyl ammonium iodide (n)	tetr.	....	4.85, ..., 7.33	
Myristic acid	hex.	....	57.4, ..., 11.4	72
Naphthalene	monocl.	C_{2h}^5	8.34, 5.98, 8.68, β = 122° 44′	2
" tetrabromide	monocl.	C_2^4	10.75, 8.97, 13.25, β = 112° 57′	4
" tetrachloride	monocl.	C_s^4	7.88, 10.30, 14.20, β = 112° 40′	4
Naphthol (α)	monocl.	....	13.1, 4.9, 13.4, β = 117° 10′	4
" (β)	monocl.	....	11.70, 4.28, 17.4, β = 119° 48′	4
Nitroaniline (o)	rhomb.	V_h^{17}	10.09, 29.44, 8.52	16
" (m)	rhomb.	C_{2v}^5	19.23, 6.48, 5.06	4
Nitrotoluene (p)	rhomb.	V_h^1	10.1, 11.18, 12.3	8
Nonicosane	rhomb.	V_h^{16}	7.45, 4.97, 77.2	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Octane ($\alpha - n$)	rhomb.	....	3.50, 4.36, 15.0	1
" ($\beta - n$)	monocl.	....	3.87, 4.72, 14.4, β = 120°	1
Oxalic acid	rhomb.	C_{2h}^5	6.10, 3.61, 12.05, β = 106° 12′ (Wood: 1927)	2
" " + $2H_2O$	monocl.	C_{2h}^5	6.05, 3.57, 11.9, β = 106° 12′	2
Palmitic acid (α)	....	....	9.41, 5.00, 45.9, β = 50° 50′	4
Pentabromofluorethane	rhomb.	V_h^{16}	11.84, 10.75, 6.55	4
Pentaerythritol	tetr.	C_{4v}^9	6.16, ..., 8.76	2
" tetraacetate	tetr.	C_{4h}^4	12.18, ..., 5.58	2
" tetraformate	rhomb.	V_h^{15}	19.80, 9.90, 11.70	8
" tetranitrate	tetr.	V_d^4	9.38, ..., 6.69	2
Pentamethylethanol	rhomb.	C_{2v}^{21}	21.35, 10.77, 7.84	8
Pentane ($\alpha - n$)	rhomb.	....	3.35, 4.31, 10.3	1
" ($\beta - n$)	monocl.	....	3.86, 4.61, 10.0, β = 120°	1
Pentatriacontane	rhomb.	V_h^{16}	7.43, 4.97, 46.2	2
Phenanthrene	monocl.	....	8.60, 6.11, 19.24, β = 98° 15′	4
Phenylacetic acid	monocl.	C_{2h}^5	14.2, 4.90, 10 1, β = 101°	4
Phenylaminoacetic acid (*act.*)	rhomb.	C_{2v}^5	15.2, 5.05, 9.66	4
Phenylbutyric acid (γ)	monocl.	C_{2h}^5	17.8, 4.90, 10.3, β = 98° 30′	4
Phenylpropionic acid (β) (hydrocinnamic acid)	monocl.	C_{2h}^5	32.2, 9.83, 5.54, β = 101° 13′	8
Phenylvaleric acid (δ)	monocl.	....	(?), 7.13, 11.32	4
Phenylene diamine (*o*)	monocl.	C_{2h}^4	7.74, 7.56, 11.76, β = 121° 10′	4
" " (*m*)	rhomb.	V_h^1	11.97, 8.14, 23.61	16
" " (*p*)	monocl.	C_{2h}^2	8.29, 5.93, 24.92, β = 112° 58′	8
Phthalic acid (*o*)	monocl.	....	9.33, 7.13, 5.10, β = 94° 36′	2
" anhydride (*o*)	rhomb.	....	7.74, 13.66, 5.86	4
Picric acid	rhomb.	C_{2v}^5	9.25, 19.08, 9.68	8
Pimelic acid	monocl.	C_{2h}^5	9.93, 4.82, 22.12, β = 130° 40′	4
Quaterphenyl	monocl.	C_{2h}^5	8.14, 5.64, 18.4, β = 97°	2
Quercitol	monocl.	....	6.83, 8.53, 6.45, β = 110° 57′	2
Quinol (α)	hex.	C_{3i}^1	22.07, ..., 5.62	18
" (β)	hex.	C_3^1	16.24, ..., 5.53	9

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Quinol (γ)	monocl.	C_{2h}^5	13.24, 5.20, 8.11, β = 73°	4
Quinone (α)	monocl.	....	11.40, 6.43, 6.85, β = 93° 20′	4
Rhamnose hydrate	....	C_2^2	7.84, 7.84, 6.61	2
Resorcinol	rhomb.	....	9.56, 10.5, 5.68	4
Saccharose	monocl.	....	10.65, 8.70, 8.00, β = 105° 44′	2
Salicylic acid	monocl.	....	11.56, 11.22, 4.93, β = 91° 22′	4
Sebacic acid	monocl.	C_{2h}^5	10.05, 4.96, 15.02, β = 133° 50′	2
Sorbose	....	V^4	6.12, 18.24, 6.43	4
Stearic acid	monocl.	C_{2h}^4 or C_{2h}^5	5.546, 7.381, 48.84, β = 63° 38′	4
" " (β)	....	....	5.68, 7.39, 50.7, β = 60°	4
Stearolic acid	monocl.	C_{2h}^4 or C_{2h}^5	9.551, 4.686, 49.15, β = 53° 4′	4
Stilbene	monocl.	C_{2h}^5	12.42, 5.73, 16.0, β = 114°	4
"	pseud. rhomb.	....	12.20, 5.72, 29.0	
Strychnine	rhomb.	V^4	11.92, 12 13, 11.30	4
Suberic acid	monocl.	C_{2h}^5	10.12, 5.06, 12.58, β = 135° 0′	2
Succinic acid (α)	monocl.	C_{2h}^3	5.70, 26.2, 7.57, β = 115° 45′	8
" " (β)	monocl.	C_{2h}^2	5.06, 8.81, 7.57, β = 133° 37′	2
" anhydride	rhomb.	C_{2v}^1 or V_h^1	6.95, 11.66, 5.41	4
Succinimide	rhomb.	V_h^1	7.50, 9.60, 12.75	8
Tartaric acid (dl)	tricl.	C_i^1	7.18, 9.71, 4.98, α = 82° 20′, β = 118° 0′, γ = 72° 58′	2
" " " + H_2O	tricl.	C_i^1	8.09, 10.03, 4.81	2
" " (d)	monocl.	C_2^2	7.70, 6.04, 6.20, β = 100° 17′	2
" " (meso-)	tricl.	....	9.24, 6.33, 5.45, α = 70° 30′, β = 78° 0′, γ = 79° 30′	2
Tetrabromodimethylethane	tetr.	....	8.806, ..., 11.27	4
	rhomb.	V_h^{16}	11.70, 10.44, 6.57	4
Tetracarbonic acid methane, Tetramethyl ester	tetr.	C_{4h}^2	9.12, ..., 7.02	2
Tetrachlorodibromoethane (sym.)	rhomb.	V_h^{16}	11.73, 10.37, 6.50	4
Tetrachlorodibromoethane (unsym.)	rhomb.	V_h^{16}	11.61, 10.35, 6.51	4
Tetraethyl ammonium iodide	tetr.	S_4^2	8.87, ..., 6.95	
Tetramethyl ammonium bromide	tetr.	D_{4h}^7	7.76, ..., 5.53	
" " perchlorate	tetr.	....	8 290, ..., 6.006	
" " chloride	tetr.	D_{4h}^7	7.78, ..., 5.53	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Tetramethyl ammonium chloroplatinate	cub.	....	12.65	
" " chlorostannate	cub.	O_h^5	12.87	4
" " iodide	tetr.	D_{4h}^7	7.96, ..., 5.75	
" " *per*manganate	tetr.	D_{4h}^7	8.439, ..., 6.019	2
" methane..........	cub.	O_h^7	12.48	8
Tetranitromethane............	cub.	T^4 or T_d^1	9.2	4
Tetraphenyl methane..........	tetr.	V_d^4	10.86	2
Thallic dimethyl bromide.......	tetr., b.c.	D_{4h}^{17}	4.47, ..., 13.78	2
" " chloride.......	tetr., b.c.	D_{4h}^{17}	4.29, ..., 14.01	2
" " iodide........	tetr., b.c.	D_{4h}^{17}	4.78, ..., 13.43	2
Thiophene (−170°)............	tetr.	....	7.22, ..., 9.53	4
Thiourea....................	rhomb.	V_h^{16}	5.50, 7.68, 8.57	4
Tolane......................	pseud. rhomb.	....	12.80, 5.68, 28.4	
Toluidine (*o*)................	rhomb.	V^4	6.50, 7.48, 23.62	4
Toluolsulfamide (*o*)...........	tetr.	C_{4h}^6	18.8, ..., 9.15	16
Tribromobenzonitrile (2,4,6)....	monocl.	C_{2h}^2	12.50, 10.30,4.87, β = 135° 36′	2
Trichlorotribromoethane........	rhomb.	V_h^{16}	11.77, 10.44, 6.54	4
Triethyl ammonium bromide...	hex.	....	8.56, ..., 7.49	
" " chloride...	hex.	....	8.38, ..., 7.08	
" " iodide.....	hex.	....	8.78, ..., 7.74	
" methyl ammonium chlorostannate	cub.	....	13.51	4
Trimethyl ammonium chlorostannate	cub.	T_h^6	12.19	4
Trimethyl ethyl ammonium chlorostannate	cub.	T_h^6	13.17	4
Trimethyl sulfonium chlorostannate	cub.	....	12.41	
Trimethylene trinitroamine.....	rhomb.	V_h^1	11.63, 13.25, 10.78	8
Triphenyl....................	monocl.	C_{2h}^5	8.14, 5.64, 14.1, β = 105°	2
Triphenylbenzene (*sym.*).......	rhomb.	V_h^{16}	11.12, 19.8, 7.6	4
Triphenyl bromomethane......	hex.	D_{3d}^5	10.8, α = 81° 30′	3
Triphenylcarbinol.............	hex.	....	16.5, ..., 8.8	6
Triphenylmethane.............	rhomb.	....	15.16, 26.25, 7.66	8
Triphenyl methanol...........	hex.	D_{3d}^5	11.1, α = 107° 42′	3
Tyrosine hydrochloride (*d*).....	monocl.	C_2^2	5.03, 8.97, 22.50, β = 101° 28′	4
Urea........................	tetr.	V_d^3	5.670, ..., 4.726	2
Veronal.....................	rhomb.	V_h^{17}	....	4
Xylose......................	....	V^4	9.21, 12.48, 5.56	4

LIGHT

PHOTOMETRIC QUANTITIES, UNITS AND STANDARDS

Photometric quantities and units are also given in the section Quantities and Units under the sub-division Light.

Candle (or International Candle). The candle is the unit of luminous intensity. It is a specified fraction of the average horizontal candlepower of a group of 45 carbon-filament lamps preserved at the Bureau of Standards.

Lumen. The lumen is the unit of luminous flux. It is equal to the flux through a unit solid angle (steradian) from a uniform point source of one candle, or to the flux on a unit surface all points of which are at unit distance from a uniform point source of one candle.

Illumination. Illumination is the density of the luminous flux on a surface. It is the quotient of the flux by the area of the surface when the latter is uniformly illuminated.

Least Mechanical Equivalent of Light. One lumen at the wavelength of maximum visibility (0.556μ) equals 0.00161 watts ($=0.000385$ gram calories per sec.); one watt at the same wavelength equals 621 lumens.

Relative Visibility. The relative visibility factor for a particular wavelength is the ratio of the visibility factor for that wavelength to the maximum visibility factor.

Values of the relative visibility are given as a part of the specification of the standard observer under Colorimetry.

Efficiency of a Source of Light. The efficiency of a source is the ratio of the total luminous flux to the total power consumed. In the case of an electric lamp it is expressed in lumens per watt.

Spherical Candlepower. The spherical candlepower of a lamp is the average candlepower of the lamp in all directions in space. It is equal to the total luminous flux of the lamp in lumens divided by 4π.

FLAME STANDARDS

Value of Various Former Standards in International Candles

Standard Pentane Lamp, burning pentane......	10.0 candles
Standard Hefner Lamp, burning amyl acetate...	0.9 "
Standard Carcel Lamp, burning colza oil.......	9.6 "

The *Carcel unit* is the horizontal intensity of the carcel lamp, burning 42 grams of colza oil per hour. For a consumption between 38 and 46 grams per hour the intensity may be considered proportional to the consumption.

The *Hefner unit* is the horizontal intensity of the Hefner lamp burning amyl acetate, with a flame 4 cm. high. If the flame is l mm. high, the intensity $I = 1 + 0.027(l - 40)$.

EFFICIENCIES OF ILLUMINANTS

The rating listed is the commercial rating of the lamp. The absolute efficiency is the equivalent power in light flux (at 0.556μ) per watt input. Efficiency is given in lumens per watt input.

Lamp	Rating, or Specifications	Eff.	Ab. Eff.
Acetylene..............	1.0 liters per hour	.67	0.0011
Arc, Electric			
Carbon, Enclosed, d.c..	6.6 amp., opal globe and reflector	5.9	0.0095
Carbon, Open, d.c.....	9.6 amp., clear globe	11.8	0.0190
High Intensity........	150. amp., bare arc	18.5	0.0298
Magnetite, d.c........	6.6	21.6	0.0348

EFFICIENCIES OF ILLUMINANTS (Continued)

Lamp	Rating, or Specifications	Eff.	Ab. Eff.
Gas burner, Open flame..	Bray high pressure	0.22	0.00035
Gas mantle, Incandescent			
(high pressure)........	.578 lumens per B.t.u. per hr.	2.0	0.0031
(low pressure).........	.350 lumens per B.t.u. per hr.	1.2	0.0019
Incandescent electric	...		
Carbon filament.......	4. watts per candle	2.6	0.0042
Treated Carbon.......	1.25 watts per candle	8.0	0.0129
Tungsten, Mazda C....	40. watts, 115 volts	10.9	0.0176
Tungsten, Mazda C....	75. watts, 115 volts	13.9	0.0224
Tungsten, Mazda C....	100. watts, 115 volts	15.3	0.0247
Tungsten, Mazda C....	1,000. watts, 115 volts	19.3	0.0311
Tungsten, Mazda C....	5,000. watts, 115 volts	29.0	0.0467
Tungsten, vacuum.....	10. watts, 115 volts	7.9	0.0127
Tungsten, vacuum.....	40. watts, 115 volts	11.3	0.0182
Mercury in Glass			
Low pressure, d.c......	6.6 amp., 50 in. tube	13.	0.0210
Optimum pressure, a.c.	400. watts	35.	0.0565
Mercury in Quartz.......	110. volts, d.c. (Arc only)	22.	0.0354
Moore nitrogen vacuum tube................	220-v. 60-cycle, 113 ft.	5.21	0.0083
Nernst lamp...........	....	4.8	0.0076
Sodium Arc............	11,000. lumens	60.	0.0966

INTRINSIC BRILLIANCY OF LIGHT SOURCES

Brightness of source is given in candles per square centimeter.

Source	$\frac{\text{cd}}{\text{cm}^2}$
Carbon Filament at 2200° K............	107
Clear sky, average....................	.4
Crater, Carbon arc....................	13,500
Crater, High Intensity Arc 150 amp....	83,000
Flames, candle........................	0.4–0.6
gas, argand burner....................	1.14
Kerosene, flat wick...................	1.2
Mercury, High Pressure................	27.0
Mercury, Low Pressure.................	2.1
Moon (Full)...........................	0.25
Sodium Arc............................	4.7
Star (Algol)..........................	840,000
Sun (Max).............................	160,000
Tungsten at 15 lumens per watt........	380
Tungsten at 30 lumens per watt........	1,550
Tungsten lamp, 40-watt vacuum, filament....	206
Tungsten lamp, 40-watt vacuum, frosted-bulb....	2.5
Tungsten lamp, projection 1000 watt, color temperature 3175° K....	2,065

VELOCITY OF LIGHT (IN VACUO)

$(2.99796 \pm .00004) \times 10^{10}$ cm/sec.
299,796. km/sec.
186,284. miles/sec.

WAVE LENGTHS OF VARIOUS RADIATIONS

	Ångströms
Cosmic Rays	0.0005
Gamma Rays	0.010–1.40
X-Rays	10–150
Ultra Violet, below	4000
Limit of suns U.V. at earth's surface	2920
Visible Spectrum	4000–7000
Violet, representative, 4100, limits	4000–4240
Blue, representative, 4700, limits	4240–4912
Green, representative, 5200, limits	4912–5750
Maximum visibility	5560
Yellow, representative 5800, limits	5750–5850
Orange, representative, 6000, limits	5850–6470
Red, representative, 6500, limits	6470–7000
Infra Red, greater than	7000
Hertzian Waves, beyond	2.20×10^6

BRIGHTNESS OF TUNGSTEN

Characteristics of Straight Tungsten Wire in a Vacuum
(Forsythe and Worthing, 1924).

Temperature °K			Brightness Candles/cm²	$\frac{B}{dB}\ \frac{dt}{T}$
Absolute	Brightness	Color		
1000	966	1006	0.00012	22.0
1200	1149	1210	0.006	20.0
1400	1330	1414	0.11	17.2
1600	1509	1619	0.92	15.2
1800	1684	1825	5.05	13.7
2000	1857	2033	20.0	12.3
2200	2026	2242	61.3	11.2
2400	2192	2452	157.0	10.3
2600	2356	2663	347.0	9.6
2800	2516	2878	694.0	8.9
3000	2673	3094	1257.0	8.3
3200	2827	3311	2110.0	7.8
3400	2978	3533	3370.0	7.6
3655*	3165	3817	5740.0	7.3

* Melting-point of tungsten.

COEFFICIENT OF REFLECTION OF MAGNESIUM CARBONATE

(Benford.)

Wavelength	4000 A	K = 0.930
Wavelength	4400 A	K = 0.960
Wavelength	5000 A	K = 0.975
Wavelength	6000 A	K = 0.975
Wavelength	7000 A	K = 0.975

WAVE LENGTHS OF THE FRAUNHOFER LINES

SUN'S SPECTRUM

At 15° C and 76 cm pressure. Wave length in Ångström units (Fabry and Buisson system).

Line	Due to	Wave length	Line	Due to	Wave length
U	Fe	2947.9	*h*	H	4101.750
t	Fe	2994.4	*g*	Ca	4226.742
T	Fe	3021.067	*G*	Fe	4307.914
s	Fe	3047.623		Ca	4307.749
S_1, S_2	Fe	3100.683	*G'*	H	4340.477
	Fe	3100.326	*F*	H	4861.344
	Fe	3099.943	b_4	Fe	5167.510
R	Ca	3181.277		Mg	5167.330
	Ca	3179.343	b_2	Mg	5172.700
Q	Fe	3286.773	b_1	Mg	5183.621
P	Ti	3361.194	E_2	Fe	5269.557
O	Fe	3441.020	D_2	Na	5889.977
N	Fe	3581.210	D_1	Na	5895.944
M	Fe	3727.636	*C*	H	6562.816
L	Fe	3820.438	*B*	O	6869.955
K	Ca	3933.684	*A*	O	7621
H	Ca	3968.494		O	7594
			Z	....	8228.5
			Y	....	8990.0

WAVE LENGTHS FOR SPECTROSCOPE CALIBRATION

Source	Wave Length	Source	Wave Length
Potassium flame	0.7699μ	*E*, solar	0.5270μ
Potassium flame	0.7665	b_1, solar or magnesium flame	0.5184
Mercury arc	0.6907	b_2, solar or magnesium flame	0.5173
B, solar	0.6869	Mercury arc	0.4960
Lithium flame	0.6708	Mercury arc	0.4916
C, solar or hydrogen tube	0.6563	*F*, solar or hydrogen tube	0.4867
Mercury arc	0.6234	Strontium flame	0.4608
D_1, solar or sodium flame	0.5896	Mercury arc	0.4358
D_2, solar or sodium flame	0.5890	*G'*, solar or hydrogen tube	0.4340
Mercury arc	0.5791	Mercury arc	0.4047
Mercury arc	0.5770	H_1, solar	0.3969
Mercury arc	0.5461	*K*, solar	0.3934
Thallium flame	0.5351		

FLAME SPECTRA

Listed below are the prominent distinct lines of the elements which are visible in the flame spectra. Other lines and bands not listed are ordinarily visible due to the compounds. Wave lengths are in Ångstrom units. Less prominent lines in parentheses.

Barium........	5535.53	Magnesium,. (burning metal)	4571.12	Rubidium	4201.8
Cadmium.....	4678.15		(5167.33)		4215.6
($CdCl_2$, $CdBr_2$)	4799.91		(5172.68)		6298.6
	5085.82		(5183.60)		7800.3
Calcium.......	4226.73	Potassium ..	4044.16	Sodium...	5889.97
Cesium.......	4555.5		(5782.6)		5895.93
	4593.18		(5801.9)	Strontium.	4607.34
	6010.4		(5832.0)	Thallium .	5350.47
	(6103.6)		7664.94		
	6707.86		7699.01		

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS

The following table gives the wave lengths of the principal lines of the emission spectra of elementary substances, produced by the arc, spark or Geissler tube.

Wave Lengths are stated in ångstroms and refer to air at a pressure of 1 atmosphere except in the Schumann region. 1 ångstrom (Å) = 10^{-8} cm. = 10^{-4} microns (μ) = 10^{-1} millimicrons ($m\mu$) = $100\mu\mu$.

Intensities of lines are indicated by the numbers 1 to 10, the latter, the higher intensity. For more complete tables the reader is referred to Kayser: *Handbuch der Spektroscopie.*

Characteristics of the lines are indicated by symbols following the intensity numbers, as shown below.

The **number of components** of an unresolved line is indicated by the subscripts: $_2$, $_3$, $_4$ attached to the intensity number.

Classes of spectra are indicated by the symbols I, II, III etc. referring to lines emitted by the neutral, ionized or doubly ionized atom. These symbols preceed the wave length.

Persistent lines are indicated by p. The most sensitive of the persistent lines by P. These symbols follow the wave length.

r, easily reversed
n, broad or nebulous
N, very broad and diffuse
<, broadened toward greater wave lengths
>, broadened toward shorter wave lengths
$_2$, $_3$, $_4$, etc. unresolved line of 2, 3 or 4 components
I, II, III etc. classes of spectra emitted by neutral, ionized or doubly ionized atom respectively
p, persistent lines
P, the most sensitive of the persistent lines.

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS

Aluminum

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
III 695.82	..	3	I 2 210.05	2r	....	III 3 702.09	..	2n
III 696.23	..	2	I 2 258.0	2	....	III 3 713.10	..	3n
III 854.98	..	3	I 2 263.45	4r	2r	II 3 900.68	..	2
III 856.80	..	3	I 2 263.73	2	....	I 3 944.03 p	10r	8r
II 1 190.07	..	2	I 2 269.09	4r	2r	I 3 961.54 P	10r	8r
II 1 191.83	..	2	I 2 269.21	2r	....	II 4 226.81	..	6
II 1 211.93	..	1	I 2 312.4	..	1	III 4 479.97	..	5n
1 310.?	..	6	II 2 321.56	2	6	III 4 512.53	..	5n
1 319.?	..	6	I 2 367.06	8r	4r	III 4 529.18	..	6
III 1 384.	..	5	II 2 369.30	1	4	II 4 585.82	..	6
III 1 606.	..	8	I 2 372.06	3	3	II 4 663.05	..	10
III 1 612.	..	8	I 2 373.13	8r	4r	III 4 701.65	..	6
II 1 671. p	..	10	I 2 373.36	2r	2r	I 5 105.	?(2)	....
II 1 719.	..	9	I 2 378.43	3	1	III 5 150.86	..	5
II 1 721.	..	9	II 2 545.60	..	6	III 5 163.90	..	7
II 1 725.	..	10	II 2 568.00	10r	6r	I 5 557.05	2	....
II 1 750.	..	2	I 2 575.11	10r	6r	I 5 557.95	2	....
1 752.	..	3	I 2 575.44	3r	2	II 5 593.23	..	10
II 1 760.1	..	7	II 2 631.73	..	7n	III 5 696.45	..	5
II 1 761.9	..	7	I 2 652.48	10r	4r	III 5 722.65	..	6
II 1 763.9	..	10(2)	I 2 660.39	10r	5r	II 5 861.53	..	7
II 1 765.7	..	7	II 2 669.17	..	10	6 151.7	1n	....
II 1 767.6	..	9	III 2 762.81	..	9	6 176.	1n	....
— 1 777.	..	4	II 2 816.3	..	10n	II 6 231.76	..	7
1 792.	..	3	III 2 907.5	..	10	II 6 243.35	..	10
1 818 3	..	2	II 3 050.08	4	8	I 6 696.07	3	....
III 1 854.67 p	..	10	3 054.70	4	2	I 6 698.73	3	....
II 1 858.15 p	..	7	II 3 057.15	4	10	7 362.5	2<	....
II 1 862.48 p	..	10	3 059.93	2	1	7 466.	..	....
III 1 862.90 p	..	10	3 064.31	4	2	I 7 836.9	6<	....
II 1 930.3	..	2	3 066.16	4	2	I 8 774.5	5<	....
III 1 935.2	..	7	I 3 082.16 p	10r	8r	I 11 255.	..	....
II 1 989.8	..	8	I 3 092.72 p	10r	8r	I 13 125.	..	....
II 2 016.1	..	1	I 3 092.85 p	6r	4r	I 13 151.	..	....
II 2 094.8	..	5	II 3 443.65	..	6	I 16 720.	..	....
I 2 168.00	1r	1	II 3 587.06	..	10n(3)	I 16 752.	..	....
I 2 174.02	1r	1	III 3 601.62	..	7n	I 21 098.	..	....
I 2 199.57	1	....	III 3 612.35	..	7n	I 21 166.	..	....
I 2 204.63	2r	....	II 3 655.00	..	8(2)	I 39 103.	..	....

Antimony

456.	..	1	1 211.	..	10	1 926.6	..	5
691.	..	2	1 225.	..	10	2 023.9	..	4
723.	..	3	1 307.	..	10	2 039.7	..	5
805.	..	5	1 438.	..	10	2 054.0	..	6
861.	..	6	1 514.	..	10	2 068.4 p	4r	1
976.	..	10	1 566.3	..	8	I 2 175.9 p	5r	3r
981.	..	10	1 585.	..	8	2 179.25	4r	3r
1 012.	..	10	1 712.	..	6	2 306.5	5r	4
1 042.	..	10	1 725.	..	6	I 2 311.5 p	6r	10r
1 048.	..	10	1 731.	..	5	2 373.7	4r	3
1 162.	..	10	1 762.	..	10	2 383.64	3r	4
1 168.	..	10	1 783.	..	10	2 426.36	3r	3
1 171.	..	10	1 810.	..	5	I 2 445.55	3r	6
1 193.	..	10	1 867.	..	8	2 478.34	2	6
1 205.	..	10	1 870.6	..	10	I 2 528.54 p	6r	10r

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

ANTIMONY (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 590.29	..	10	3 473.9	..	10	6 806.3	6	1
I 2 598.08 p	10r	10r	3 498.5	..	10	7 844.4	4	....
2 612.32	3r	8	I 3 504.5	3	10	7 924.6	6	....
2 652.60	3r	8	I 3 637.8	9	6	9 520.	2	....
I 2 670.67	5r	5	I 3 722.8	8	5	9 951.	2	....
2 682.77	4r	5	I 4 033.5	6	4	10 080.	4	....
2 692.27	3r	3	4 195.1	..	8	10 263.	4	....
2 718.90	3r	10	4 265.0	..	10	10 587.	5	....
2 727.22	5r	8	4 352.2	..	10	10 678.	10	....
I 2 769.95	10r	10r	4 591.8	..	5	10 743.	5	....
2 790.4	..	10	4 693.0	..	10	10 840.	5	....
2 851.1	4	4	5 568.0	3	3	10 880.	3	....
I 2 877.92	10r	10r	5 632.0	4	....	11 013.	2	....
2 913.3	..	5	5 639.7	2	5	11 082.	2	....
I 3 029.8	8r	10	5 730.4	4	....	11 109.	2	....
3 040.7	..	10	6 005.0	6	3	11 190.	1	....
I 3 232.5 p	8r	10	6 079.6	6	1	11 268.	4	....
3 241.2	..	10	6 129.9	6	3	11 864.	4	....
I 3 267.5 p	8r	10	6 611.4	3	2	12 118.	2	....
I 3 383.2	5	2	6 778.4	6	....			

ARGON, BLUE SPECTRUM

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
1 333.7	5	2 313.9	4	2 796.7	2
1 334.5	7	2 316.4	4	2 806.2	6
1 335.8	7	2 331.6	4	2 842.6	2
1 460.1	5	2 337.7	5	2 855.2	3
1 589.5	4	2 344.3	5	2 865.9	4
1 600.7	5	2 350.5	4	2 878.8	3
1 669.7	7	2 364.1	4	2 884.1	4
1 673.5	7	2 395.6	4	2 891.7	4
1 675.6	7	2 404.3	4	2 896.8	2
1 788.1	5	2 415.6	6	2 924.7	3
1 820.0	7	2 438.7	6	2 931.5	2
1 830.6	10	2 452.9	1	2 943.0	7
1 831.4	9	2 479.1	6	2 955.4	5
1 836.3	9	2 480.8	5	2 979.1	6
1 843.1	9	2 490.9	6	3 029.0	4
1 855.7	9	2 499.4	4	3 033.6	3
1 865.9	8	2 500.3	4	3 093.40	6
1 868.7	8	2 512.2	3	3 139.06	5
1 873.2	10	2 515.5	8	3 161.44	5
1 877.7	8	2 516.7	8	3 169.71	5
1 879.7	8	2 544.7	6	3 181.09	4
1 886.1	7	2 562.2	6	3 204.35	3
2 050.4	1	2 647.5	8	3 212.62	2
2 219.8	4	2 708.3	8	3 243.72	3
2 234.6	4	2 732.6	6	3 249.83	3
2 243.6	4	2 744.8	8	3 263.58	3
2 252.3	4	2 753.8	8	3 281.71	5
2 281.5	5	2 762.0	3	3 285.77	7
2 309.3	4	2 769.6	6	3 293.65	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Argon, Blue Spectrum (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
3 301.81	6	3 753.5	3	4 203.4	2
3 307.23	4	3 763.59	4	4 218.66	3
3 311.19	5	3 765.32	6	4 222.64	4
3 336.15	4	3 766.14	3	4 226.98	3
3 344.73	4	3 770.61	3	4 228.2	7
3 350.97	4	3 780.89	7	4 237.21	4
3 358.51	4	3 786.42	4	4 266.29	6
3 366.61	2	3 795.38	5	4 266.4	6
3 370.93	2	3 799.47	3	4 277.5	8
3 376.47	4	3 803.23	3	4 282.88	4
3 388.54	5	3 808.58	2	4 300.66	2
3 391.77	5	3 809.46	4	4 309.15	2
3 421.67	3	3 826.80	4	4 331.17	7
3 429.69	2	3 830.43	3	4 332.04	3
3 430.48	2	3 845.37	3	4 348.0	10
3 454.15	3	3 850.56	9	4 352.21	4
3 464.20	4	3 868.55	7	4 362.04	3
3 466.3	3	3 872.14	4	4 370.75	5
3 476.79	7	3 875.25	5	4 371.31	5
3 478.26	4	3 880.29	3	4 379.64	6
3 480.51	5	3 891.39	4	4 400.09	4
3 491.29	5	3 891.99	6	4 401.00	5
3 491.57	8	3 907.70	3	4 425.99	8
3 499.68	3	3 911.56	3	4 430.18	4
3 503.59	2	3 914.78	5	4 431.00	4
3 509.36	2	3 925.76	4	4 433.90	2
3 509.80	4	3 928.61	8	4 481.83	5
3 511.16	5	3 931.20	3	4 488.2	2
3 514.40	6	3 932.56	5	4 491.0	2
3 520.02	4	3 944.30	5	4 498.5	2
3 521.29	3	3 946.10	4	4 502.95	3
3 521.97	2	3 958.40	3	4 545.06	6
3 535.37	5	3 960.45	3	4 547.7	2
3 545.64	7	3 968.37	4	4 579.35	6
3 545.86	7	3 974.52	4	4 589.89	6
3 548.53	3	3 979.40	5	4 609.56	6
I 3 559.54	7	3 992.03	4	4 637.17	3
3 561.06	6	4 013.84	7	4 657.88	4
I 3 564.41	2	4 033.85	3	4 726.83	4
3 565.06	3	4 035.45	3	4 735.87	5
3 576.65	8	4 038.83	4	4 764.85	4
3 581.66	5	4 042.89	6	4 805.99	8
3 582.39	6	4 052.96	4	4 847.77	6
3 588.49	9	4 072.02	7	4 865.9	4
3 622.18	4	4 072.43	4	4 867.5	4
3 637.08	3	4 076.70	6	4 879.9	6
3 637.86	4	4 077.03	2	4 882.3	2
3 639.86	4	4 079.61	4	4 888.7	2
3 650.9	3	4 080.61	2	4 904.8	2
3 655.35	4	4 082.41	4	4 933.2	4
3 656.12	2	4 099.45	2	4 942.9	2
3 660.52	3	4 103.95	9	4 955.1	2
3 717.21	3	4 112.82	3	4 965.1	4
3 718.25	5	4 128.6	3	4 972.2	3
3 720.46	3	4 131.78	6	5 009.3	6
3 724.53	3	4 156.14	4	5 017.2	5
3 729.33	9	4 178.38	3	5 024.3	1
3 737.92	5	4 179.30	3	5 062.1	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Argon, Blue Spectrum (Continued)

Wave length	Geissler tube	Wave length	Geissler tube	Wave length	Geissler tube
5 142.0	4	5 217.0	2	6 172.2	4
5 145.40	4	5 287.0	3	6 243.4	2
5 165.8	4	5 305.8	6	6 640.2	0
5 176.4	3	6 114.8	3		

Argon, Red Spectrum

Wave length	Geissler tube	Wave length	Geissler tube	Wave length	Geissler tube
2 516.2	4	I 4 158.59	9	5 506.4	2
2 614.5	4	I 4 164.18	7	5 525.1	2
2 802.1	3	I 4 181.88	7	5 558.8	5
2 833.5	3	I 4 190.71	5	5 559.7	2
2 873.4	3	I 4 191.03	8	5 572.6	4
2 967.2	5	I 4 198.32	8	5 581.6	2
2 968.3	2	I 4 200.68	9	5 597.7	2
3 021.8	3	4 201.9	2	5 607.0	6
3 034.6	3	I 4 251.18	5	5 618.1	2
3 295.3	2	4 259.36	9	5 648.8	2
I 3 319.3	2	4 266.29	8	5 650.8	5
3 325.49	2	I 4 272.17	8	5 659.2	3
3 373.5	2	I 4 300.10	8	5 682.4	2
3 392.8	2	I 4 333.56	7	5 691.7	1
I 3 393.8	3	I 4 335.29	6	5 739.7	3
I 3 461.06	3	I 4 345.17	7	5 772.3	2
I 3 554.31	4	I 4 363.78	3	5 802.2	1
3 555.31	2	4 501.5	1	5 832.1	1
3 556.00	2	I 4 510.73	8	5 860.4	3
I 3 563.2	3	I 4 522.33	4	5 882 7	3
I 3 564 3	2	4 596.10	5	5 888.7	4
I 3 567 68	4	I 4 528.45	5	5 900.5	1
I 3 572.27	2	4 702.32	4	5 912.1	5
I 3 599.3	1	4 768.4	1	5 916.6	2
I 3 606.53	5	4 888.1	1	5 927.1	2
I 3 632.65	4	4 894.8	1	5 928.5	4
I 3 634.46	4	5 049.	2	5 940.9	2
I 3 643.1	2	5 054.3	1	5 943.0	3
I 3 649.9	3	5 060.2	3	5 949 3	3
3 659.5	2	5 063.0	1	5 964.5	2
3 670.7	3	5 152.5	3	5 968.4	2
3 678.31	5	5 162.4	4	5 971.7	3
3 680 1	4	5 177.6	1	5 987.3	3
I 3 690.9	1	5 187.3	3	5 999.2	2
I 3 696.5	1	6 188.3	3	6 005.8	2
3 770.4	3	5 221.6	3	6 013.6	3
I 3 775 4	1	5 252.9	3	6 025.4	3
I 3 781 33	3	5 254.4	2	6 032.13	6
I 3 834 65	5	5 373.6	2	6 043 2	6
I 3 866 14	1	5 410.6	2	6 052.6	4
I 3 894 64	3	5 421.6	4	6 059 4	5
I 3 899 90	2	5 440.1	2	6 064.7	3
I 3 947 55	4	5 442.1	1	6 067.7	1
I 3 948 98	7	5 443.3	2	6 090.8	3
I 4 032 96	2	5 451.7	5	6 098.7	4
I 4 044 42	8	5 457.8	2	6 101.1	2
4 045 88	4	5 467.2	2	6 104 5	2
I 4 054 50	3	5 473.6	2	6 105.8	4
4 152 7	3	5 495.9	6	6 113.4	2

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Argon, Red Spectrum (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
6 119.5	2	6 660.7	3	I 7 503.87 p	4
6 121.7	2	6 664.1	3	I 7 514.65	4
6 127.4	3	I 6 677.28	5	I 7 635.11	6
6 145.4	4	6 684.4	1	I 7 723.76	5
6 155.1	3	6 698.9	3	I 7 948.18	5
6 165.1	3	6 719.2	2	I 8 006.16	8
6 170.1	3	6 752.83	5	I 8 014.79	3
6 172.9	4	6 756.4	1	I 8 103.69	3
6 212.4	4	6 786.3	1	I 8 115.31 p	10
6 215.9	4	6 871.29	4	I 8 264.52	5
6 248.5	3	6 888.8	1	8 405.	6
6 278.6	2	6 937.67	2	I 8 408.21	6
6 296.8	3	I 6 965.43 p	6	I 8 424.65	10
6 307.6	3	7 030.25	2	I 8 521.44	5
6 364.8	3	I 7 067.22 p	5	I 9 123.7	10
6 369.6	3	I 7 147.04	1	I 9 225.9	5
6 384.5	4	7 206.99	1	I 9 658.9	7
6 416.31	6	I 7 272.94	3	I 10 640.	12
6 431.6	3	7 311.6	1	I 11 590.	8
6 466.5	3	7 315.9	1	12 500.	30
6 481.0	2	7 353.32	1	13 505.	4
6 493.9	2	7 372.12	1	13 719.	4
6 513.7	1	I 7 383.98	5	....	....
6 604.9	3	7 435.5	1	....	....

Arsenic

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
529.	...	1	......	2 074.	...	12	......
827.	...	5	......	2 113.	2	3	......
873.	...	8	......	2 134.	2	2	......
878.	...	8	......	2 144.2	4	1	......
926.	...	8	......	2 165.5	4	2	......
952.	...	8	......	2 183.0	1	1	......
956.	...	8	......	2 192.1	...	2	......
963.	...	10	......	2 205.2	2	.....	......
984.	...	10	......	2 206.0	2	.....	......
1 001.	...	10	......	2 228.7	2	1	......
1 009.	...	10	......	2 271.39	4	1	......
1 081.	...	50	......	I 2 288.14 p	10r	3	......
1 093.	...	20	......	I 2 349.84 p	10r	6	4
1 106.	...	10	......	2 369.67	4r	5	4
1 171.	...	15	......	2 370.77	4r	5	4
1 208.	...	30	......	I 2 381.20	4r	5	5
1 267.	...	40	......	2 437.22	1	5	3
1 287.	...	10	......	2 456.52	4r	7	5
1 700.2	...	10	......	2 492.91	2	5	4
1 733.0	...	15	......	2 602.9	...	2	6
1 742.9	...	20	......	I 2 745.00	6r	5	7
1 890. p	...	4r	......	I 2 780.23 p	8r	10	8
1 936. p	...	5	......	2 830.4	...	4	8
1 972. p	...	4r	......	I 2 860.46	4r	8	7
2 031.	...	10	......	I 2 898.73	4r	6	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Arsenic (Continued)

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
2 926.2	...	1	6	4 458.6	...	2	7
2 959.6	...	7	6	4 461.1	...	.....	8
I 2 990.99	2	4	5	4 466.4	...	1	7
3 003.8	...	2	6	4 474.4	...	4	8
I 3 032.84	4	8	6	4 494.4	...	3	7
I 3 075.32	2	5	5	4 515.9	...	.....	7
3 116.5	...	3	7	4 528.4	...	.....	7
I 3 119.6	4	7	5	4 539.8	...	3	8
3 126.9	...	.....	6	4 543.6	...	.....	7
3 180.6	...	.....	6	4 549.0	...	2	9
3 255.	...	2	6	4 552.2	...	2	7
3 513.0	...	.....	6	4 590.8	...	.....	7
3 551.6	...	.....	5	4 602.5	...	.....	7
3 671.7	...	.....	6	4 607.3	...	2	5
3 787.2	...	3	6	4 619.4	...	.....	7
3 842.9	...	4	7	4 629.9	...	.....	7
3 922.5	...	10	7	4 672.5	..	.....	7
3 931.1	...	2	7	4 707.6	...	.....	7
3 948.6	...	3	6	4 730.7	...	.....	8
4 006.2	...	3	6	4 787.1	...	1	6
4 037.0	...	6	6	4 799.5	...	1	6
4 062.6	...	.....	7	4 802.1	...	1	6
4 065.4	...	2	7	4 811.8	...	1	6
4 082.4	...	.....	7	4 888.6	...	2	8
4 157.5	...	.....	7	4 915.3	...	.....	7
4 190.2	...	2	7	4 985.4	...	5	9
4 197.5	...	3	7	5 105.5	...	8	8
4 207.8	...	2	7	5 107.6	...	8	8
4 221.0	...	.....	7	5 161.1	..	7	7
4 228.2	...	2	7	5 182.2	..	.....	7
4 243.1	...	.....	7	5 205.3	..	1	6
4 299.4	...	3	6	5 331.3	...	8	7
4 302.1	...	.....	8	5 496.9	...	5	6
4 315.7	...	1	7	5 497.8	...	10	7
4 324.0	...	.....	7	5 558.1	..	10	8
4 336.7	...	5	7	5 620.6	...	1	10
4 352.1	...	5	7	5 651.3	...	10	10
4 352.9	...	.....	8	5 657.0	...	1	8
4 371.	...	5	7	5 684.8	...	1	7
4 412.0	...	.....	7	5 731.8	...	1	6
4 413.5	...	.....	7	5 837.9	...	.....	6
4 420.9	...	.....	7	6 023.	...	6	......
4 427.2	...	.....	7	6 110.	...	6	......
4 431.6	...	4	8	6 170.	...	6	......

Barium

Wave length.	Arc.	Spark.	Wave length.	Arc	Spark.	Wave length.	Arc.	Spark.
1 331.	. .	2	II 1 869.	. .	5	II 2 634.80	5	8<
1 415.	. .	3	II 2 304.22	6r	8r	II 2 647.29	4	4
1 504.	. .	4	II 2 335.25	6r	10r	I 2 702.65	6<	2
1 554.	. .	3	II 2 347.58	5	7	II 2 771.4	2	3<
1 674.	. .	4	II 2 528.51	. .	6<	I 2 785.26	6<	. . .
II 1 694.	. .	6	I 2 596.68	6<	. . . .	I 3 071.60	8r	6r

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Barium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 3 262.4	3r	....	5 680.17	5	1	9 370.1	3	....
I 3 356.9	6<	....	I 5 7'7.7 p	10r	5	9 527.	10	....
I 3 377.0	8	....	5 800.34	7	2	9 611.	10	....
I 3 377.4			5 805.71	5r	2	9 713.	2	....
I 3 420.3			I 5 826.30	7r	4	I 9 832	7	....
I 3 421.0	10	....	II 5 853.7	8r	5	10 002	3	....
I 3 421.5			I 5 907.6	6	2	II 10 034.	6	....
I 3 501.12	8r	2	I 5 971.71	10	3	I 10 189.	1	....
I 3 525.0	6<	....	I 5 997.10	7r	3	10 234.	6	....
I 3 544.7	6<	....	I 6 019.49	7r	3	I 10 273.	5	....
I 3 547.7	4n	....	I 6 063.16	8r	4	I 10 326.	..	....
I 3 579.7	6<	2	I 6 110.80	8r	5	10 474.	6	....
3 630.65	8<	2	II 6 141.74	10r	10r	II 10 651.	8	....
3 889.32	5	2	I 6 341.70	7r	3	10 692.	2	....
II 3 891.78	8<	8r	I 6 450.85	7	3	11 016.	4	....
3 892.65	5		6 482.93	7r	3	11 116.	2	....
I 3 909.92	6<	6<	II 6 496.91	10r	10r	I 11 304.	2	....
I 3 935.72	7<	6<	I 6 498.77	8r	4	11 608.	2	....
I 3 937.88	5	3	I 6 527.32	8r	3	11 886.	5	....
I 3 993.40	8r	6	I 6 595.35	7r	3	11 978.	2	....
II 4 130.68	8r	10r	I 6 675.29	6r	2	II 12 084.	5	....
4 132.44	5	3	I 6 693.86	6r	2	12 554.	3	....
II 4 166.04	5<	10<	6 865.69	5	....	12 815.	1	....
I 4 283.12	8	8	I 7 059.96	8r	....	13 057.	1	....
I 4 323.00	4>	1	II 7 120.30	6	....	I 13 207.	4	....
I 4 332.91	4>	1	I 7 195.26	6	....	13 811.	4	....
4 350.38	8	5	7 228.82	5	....	13 957.	2	....
4 402.55	8	6	7 280.31	8r	....	14 078.	4	....
I 4 431.91	7	6	I 7 392.44	6	....	14 160.	3	....
I 4 488.97	7>	2	7 417.55	4	....	14 211.	3	....
I 4 493.64	5>	2	7 459.7	5	....	14 325.	3	....
4 505.94	8	5	7 488.10	5	....	I 15 000.	4	....
4 523.25	8<	3	7 642.9	5	....	17 065.	1	....
II 4 524.95	8	10<	7 672.10	7	....	17 182.	1	....
II 4 554.04 P	10r	10r	7 780.50	8	....	18 204.	2	....
4 573.88	6r	4	7 839.58	5	....	19 075.	2	....
4 579.66	8r	8	I 7 905.77	7	....	19 988.	3	....
4 599.75	6r	2	I 7 911.35	6	..	I 20 712.	4	....
I 4 619.98	5<	1	8 120.5	3	....	I 21 477.	2	....
I 4 628.83	5>	1	8 147.8	2	....	22 221.	2	....
I 4 673.61	7>	2	8 210.32	10	....	22 313.	2	....
4 691.63	7r	4	8 559.91	10	....	23 255.	3	....
I 4 700.45	6<	1	8 567.6	3	....	I 25 516.	5	....
I 4 726.46	8<	5	8 582.1	4	....	26 221.	2	....
II 4 899.96	8	10	8 654.03	4	....	27 751.	3	....
I 4 902.88	4<	....	I 8 799.7	2n	....	I 29 224.	5	....
II 4 934.10 p	10r	10r	8 860.96	4	....	29 791.	4	....
I 5 424.63 p	7<	3	8 915.00	4	....	30 469.	2	....
I 5 519.11 p	8r	5	9 189.4	2	....	I 30 687.	2	....
I 5 535.53 P	10r	6	9 219.7	2	....	I 30 934.	3	....

Beryllium

II 1 036.32	..	3	II 1 776.34	..	8	I 2 351.50	6	....
II 1 512.30	..	8	I 2 056.71	4	....	I 2 494.53	7	3
II 1 512.45	..	10	I 2 175.72	10	....	I 2 494.58	7	3
II 1 776.12	..	6	2 348.62 P	8r	3	I 2 494.72	7	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Beryllium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
I 2 651.	10	10(6)	II 4 674.55	..	8	15 393.	6	....
II 3 047.86	..	4	II 5 274.28	..	4	15 400.		
II 3 131.32	9	10	10 283.	5	....	15 951.	..	....
3 131.97	9	5	10 674.	4	....	16 794.	2	....
II 3 198.01	..	4	12 141.	7	....	17 571.	2	....
II 3 275.57	..	5	12 329.	4	....	21 560.	3	....
I 3 321.97	8	2	12 355.	6	....	21 897.	2(2)	....
I 3 322.04	8	2	13 227.	6	....	22 239.	2	....
I 3 322.30	8	2	14 904.	3	....	23 097.	6	....
II 4 362.21	..	7	15 006.	3	....	23 110.		
4 572.69	8	1	15 013.					

Bismuth

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
670.	..	1	2 627.93	8r	4	5 742.55	6	....
791.	..	2	2 696.76	6r(2)	4r	5 861.14	..	4
967.	..	3	2 730.50	4r(2)	2r	6 128.1	..	4
1 045.	..	10	2 780.52 p	7r	4	6 134.85	5	1
1 051.	..	10	2 809.63 p	8r	2	6 475.5	3	....
1 306.	..	10	2 897.98 p	10r	5r	6 476.2	3	....
1 317.	..	15	2 938.31 p	10r	8r	6 497.5	..	4
1 346.	..	10	2 989.04 p	9r	5r	6 600.1	..	7
1 533.7	5	3	2 993.34	9r	4	6 809.1	..	7
1 776.7	3	4	3 024.64	8r	4r	6 991.1	4	....
1 787.1	3	4	3 067.73 P	9r	6r	7 036.2	2	....
1 791.7	4	4	3 076.67	3	2	7 335.0	1	....
1 823.5	3	5	3 397.21	5r	2	7 441.3	1	....
1 902.5	..	1	3 405.23	2r	1	7 502.3	2	....
1 959.6	..	3	3 510.85	6r	5	7 838.7	3	....
1 973.2	..	3	3 596.11	3r	4	7 840.3	2	....
2 061.7 p	8r	3	3 695.53	..	8	8 210.8	10	....
2 110.3	8r	2	3 792.9	..	8	8 501.8	1	....
2 113.8	3	....	3 887.94	2	1	8 544.5	2	....
2 133.5	7r	....	3 888.22	2	1	8 579.7	1	....
2 134.4	8r	1	4 079.22	..	10	8 627.9	1	....
2 143.6	..	2	4 121.52	6	4	I 8 754.9	2	....
2 144.4	..	2	4 121.85	6	4	8 761.5	3	....
2 152.9	7r	....	4 259.64	..	10	8 907.8	2	....
2 153.5	4r	....	4 302.13	..	10	9 058.6	2	....
2 156.9	4r	....	4 308.20	4	2	9 342.6	4	....
2 164.1	4r	....	4 308.56	4	2	9 657.2	10	....
2 177.3	6r	1	4 328.6	..	3	9 829.	2	....
2 189.59	6r	....	4 340.6	..	4	10 106.	2	....
2 203.1	4n	1	4 561.15	..	8	10 302.	2	....
2 214.1	3	1	4 722.2	10	5	10 540.	1	....
2 228.25	6r	2r	4 722.5	10	8	11 073.	1	....
2 230.62	8r	4r	4 722.7	8	8	11 556.	1	....
2 276.57 p	5r	2	4 729.9	..	3	11 711.	10	....
2 309.3	4N	....	4 733.8	2<	....	11 995.	1	....
2 328.2	2n	....	4 797.5	..	3	12 167.	4	....
2 400.89	8r	7	5 124.4	..	4	12 691.	3	....
2 430.5	2n	....	5 144.50	..	6	14 332.	3	....
2 489.4	5N	1	5 209.28	..	10	25 554.	1	....
2 515.68	6r	1	5 552.24	8	3			
2 524.52	7r	2	5 599.41	3	....			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Boron

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
III 677.01	..	5	I 1 825.87	..	1	I 2 089.6	..	2
III 677.16			I 1 826.41			2 266.3	..	2
III 758.47	..	3	III 2 066.4	..	2	2 266.9	..	2
III 758.68			III 2 067.9			I 2 496.78 p	9r	9r
II 1 624.4	..	8(5)	I 2 088.8	..	1	I 2 497.73 P	10r	10r
						II 3 451.2 p	..	10

Bromine

Wave length.	Spark.	Geissler tube.	Wave length	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
1 251.8	....	4	3 929.57	....	6	4 742.70	3	8
1 384.6	....	8	3 935.16	....	6	4 766.07	2	5
1 488.6	....	8	3 939.70	2	5	4 767.1	2	8
1 531.9	....	7	3 950.60	1	7	4 776.43	2	7
1 540.8 p	....	6	3 955.35	....	8	4 780.33	....	6
1 575.0	....	9	3 968.65	....	5	4 785.48 p	10	10
1 576.5	....	6	3 980.01	....	5	4 816.72 p	8	8
1 582.4	....	8	3 980.43	....	10	4 848.80	1	6
1 633.6 p	....	10	3 986.53	1	8	4 928.7	1	5
2 386.8	3	......	4 007.30	....	5	4 930.6	1	5
2 389.8	3	......	4 008.78	....	6	4 979.77	....	4
2 522.	4	......	4 024.04	....	5	5 054.7	....	4
2 541.	4	......	4 135.64	....	5	5 164.4	....	5
2 557.	4	......	4 140.22	1	6	5 182.4	3	7
2 594.	3	......	4 175.76	....	5	5 183.9	....	4
2 660.	3	......	4 179.62	1	8	5 238.3	2	8
2 872.	3	......	4 193.45	1	6	5 272.7	....	4
2 892.	3	......	4 223.85	....	6	5 304.1	....	7
2 926.	5	......	4 236.85	....	6	5 332.0	....	10
2 968.	4	......	4 291.38	2	6	5 396.5	....	5
3 020.8	4	......	4 365.58	4	8	5 422.8	....	7
3 074.	4	......	4 425.13	....	5	5 425.0	....	5
3 168.	3	......	4 441.74	....	8	5 435.1	....	5
3 282.1	3	......	4 472.64	....	8	5 466.2	....	5
3 333.0	5	......	4 477.78	....	10	5 488.8	....	6
3 396.9	4	......	4 490.48	....	5	5 490.4	....	7
3 417.	5	......	4 513.47	1	5	5 536.3	....	4
3 506.5	5	......	4 525.6	....	8	5 589.9	....	8
3 517.4	5	......	4 529.80	....	5	5 600.7	....	4
3 540.1	8	......	4 538.75	1	5	5 657.6	....	4
3 562.4	10	......	4 542.93	2	8	5 711.0	....	4
3 693.5	3	......	4 575.77	....	6	5 719.0	....	4
3 794.0	3	4	4 601.4	....	5	5 830.8	....	7
3 834.71	....	6	4 614.6	....	6	5 852.2	....	5
3 857.21	....	6	4 622.7	3	8	5 940.6	....	4
3 871.23	....	6	4 652.00	1	6	6 118.7	....	4
3 891.64	1	8	4 672.58	1	6	6 123.3	....	3
3 914.26	1	10	4 678.70	8	8	6 149.7	....	10
3 919.6	....	6	4 693.30	5	3	6 350.8	....	10
3 920.68	....	6	4 704.83 p	10	10	6 560.0	....	4
3 923.36	....	6	4 719.76	3	8	6 631.8	....	5
3 924.09	2	8	4 735.47	....	5	6 682.	....	2

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Cadmium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
396.	..	1	I 2 836.92	8r	6N	I 5 085.82	10r	10
847.	..	10	I 2 868.3	6<	3<	I 5 297.7	3	....
1 369.	..	20	I 2 880.78	8r	6	II 5 337.49	3	25
1 397.	..	20	I 2 881.24	4r	3N	5 338.5	..	10
1 462.	..	20	I 2 980.62	8r	6	I 5 339.	2	....
1 466.	..	8	I 3 080.83	8<	3<	5 378.	3	....
1 472.	..	8	3 095.5	..	5<	II 5 378.12	..	10
1 514.	..	20	3 129.23	..	5n	II 5 381.82	..	10
1 628.7	..	6	I 3 133.17	2<	5<	5 497.	..	10n
1 707.5	..	8	3 185.53	..	5	I 5 598.8	3	....
1 747.9	..	6	II 3 250.29	..	25	I 5 604.7	2	....
1 768.8	..	6	I 3 252.53	8<	6n	5 637.3	5	....
1 773.1	..	6	I 3 261.05	10r	7	I 6 031.4	3	....
1 844.5	..	10	3 298.97	4	4r	I 6 099.1	5	....
1 853.0	..	15	I 3 403.65 p	10r	10	I 6 111.5	3	....
1 873.6	..	15	II 3 417.40	..	10	I 6 116.12	3	1
1 900.7	..	6	I 3 466.20 p	10r	8r	I 6 325.1	5	1
1 921.8	..	2	I 3 467.66	8r	10	I 6 329.94	5	....
1 939.	..	2	II 3 495.36	..	15	II 6 359.93	..	10
I 1 942.	..	2	II 3 535.67	..	20	I 6 438.47	10	10r
1 995.	..	3	I 3 610.51 p	10r	10r	II 6 464.98	..	10
2 004.2	..	5	I 3 612.88	8r	9	II 6 725.83	..	15
2 055.3	..	3	I 3 614.4	7	7	I 6 777.7	2n	....
2 062.0	..	5	I 3 729.06	4r	....	I 7 346.0	1n	....
II 2 144.39 P	4r	6r	3 852.1	..	3	I 7 382.3	2n	....
II 2 194.62	1	4r	3 940.3	..	5	I 7 399.	5	....
2 239.86	6r	3	3 976.6	..	5	I 8 200.1	1n	....
II 2 265.03 p	4r	10r	3 977.3	..	5	I 10 394.6	10	....
2 267.47	4r	2	3 988.2	..	4	I 11 268.	4	....
I 2 288.03 P	10r	10r	II 4 029.08	..	10	I 11 630.	2	....
2 306.63	4r	3	4 057.5	..	5	I 13 979.	10	....
II 2 312.88	4	10r	4 094.8	..	4	I 14 327.	10	....
II 2 321.15	1	7	4 127.0	..	4	I 14 354.	8	....
2 329.27	8r	6	II 4 134.78	..	15	I 14 473.	8	....
2 469.76	..	4	4 191.6	..	4	I 14 849.	2	....
I 2 553.6	4<	....	4 216.9	..	6	I 15 154.	10	....
II 2 573.04	4	10	4 245.6	..	4	15 258.	7	....
I 2 639.50	6r	1n	II 4 412.31		10	I 15 711.	7	....
I 2 677.6	$8_{(2)}$	3n	4 415.68	1	6	I 16 402.	2	....
I 2 712.6	6<	1n	I 4 678.15	10	10	I 16 432.	6	....
II 2 748.58	..	10	I 4 799.91	10r	10	I 16 482.	6	....
I 2 763.9	6r	3N	II 4 881.73	..	10	I 39 086.	..	....

Calcium

404.	..	6	1 562.	..	4	II 2 208.7	3	3
410.	..	6	1 667.	..	5	I 2 275.5	1	4r
537.	..	5	II 1 807.8	..	7	I 2 398.58	8r	1r
655.	..	6	II 1 815.0	..	8	2 493.00	7	....
669.	..	6	II 1 838.	..	$9_{(2)}$	2 899.78	9	....
688.	..	5	II 1 840.2	..	10	2 924.33	8	....
718.	..	6	II 1 843.7	..	6	I 2 994.95	3	2
832.	..	10	II 1 851.3	..	7	I 2 997.31	3	2
840.	..	6	2 035.	4	....	I 3 000.87	4	2
902.	..	10	2 040.	4	....	I 3 006.85	4	4
II 1 434.	..	6	II 2 103.2	2	3	I 3 009.21	2	2
II 1 553.	..	7	II 2 112.7	2	3	3 119.66	..	8
II 1 555.	..	$8_{(2)}$	II 2 197.8	3	3	II 3 158.87	8	10r

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Calcium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
II 3 179.34	6	10r	I 4 455.88 p	8r	8	6 449.82	5	3
II 3 181.3	4	10	I 4 456.62 p	4	5	6 455.57	3	2
I 3 215.1	3>	....	4 499.90	..	10	I 6 462.57	6r	6
I 3 225.8	4<	....	I 4 526.98	6	5	I 6 471.68	5	5
I 3 286.1	5	....	I 4 578.57	8	5	I 6 493.76	8	5
I 3 344.49	5>	....	I 4 581.45	8	6	I 6 499.64	5	4
I 3 350.19	6>	1	I 4 585.84	6	....	I 6 572.75	2	1
I 3 361.91	6>	1	I 4 585.91	2	8	I 6 717.7	8	2
I 3 468.48	4<	....	I 4 685.2	4>	1	7 148.18	10	....
I 3 474.78	4<	....	I 4 878.17	10<	8<	7 202.18	8	....
I 3 487.61	6<	1	I 5 141.65	8<	3	I 7 326.12	8	....
I 3 624.10	6	1	I 5 188.84	6	5	7 610.	6<	....
I 3 630.73	6	1	I 5 260.39	4	3	II 8 498.0	8	....
I 3 630.96	5	1	5 261.70	6	5	II 8 542.1	10	....
I 3 644.39	10	4	5 262.23	6	5	II 8 662.1	9	....
I 3 644.76	5	....	I 5 264.23	6	5	9 251.	3	....
II 3 706.03	6	8<	5 265.55	8	8	9 547.	7	....
II 3 736.91	6	10r	I 5 270.27	10	10	9 695.	7	....
I 3 875.7	3	....	5 349.46	10	5	I 10 345.	10	....
II 3 933.67 P	10r	10r	I 5 512.93	8	2	I 12 822.	5(2)	....
I 3 948.91	4<	1	5 581.96	8	4	13 038.	3	....
I 3 957.07	6<	2	5 588.74	10	10	I 16 145.	2	....
II 3 968.47 P	10r	10r	5 590.10	10	6	I 16 162.	2	....
I 3 973.7	6<	3<	I 5 594.47	8	6	I 16 200.	3	....
I 4 098.6	4<	2<	5 598.46	10	8	16 433.	1	....
I 4 226.73	10r	10r	I 5 601.26	8	4	I 19 311.	4	....
I 4 240.44	4	2	5 602.84	8	5	I 19 453.	5	....
I 4 283.00	8r	8r	5 857.49	10	10	I 19 507.	3	....
I 4 289.36	8r	8r	5 867.62	4<	....	I 19 777.	6	....
I 4 298.99	6	8r	I 6 102.73	8r	8r	19 817.	1	....
I 4 302.53	10r	10r	I 6 122.24	10r	10r	I 19 857.	4	....
I 4 307.74	8r	8r	I 6 161.32	5	2	I 19 865.	4	....
I 4 318.65	8r	8r	I 6 162.20	10r	8r	I 19 918.	1	....
I 4 355.2	6n	2	I 6 163.80	4	2	I 19 936.	3	....
I 4 425.44	10r	10	I 6 166.49	4	2	I 19 947.	1	....
I 4 434.96	10r	10r	I 6 169.08	4	3	I 22 610.	1	....
I 4 435.68	8r	8	I 6 169.60	7	3	I 22 625.	3	....
I 4 454.78 p	10r	10r	I 6 439.06	10r	8	I 22 656.	4	....

Caesium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
1 884.0	..	6	2 544.	..	10	2 977.	..	6
1 889.2	..	6	2 573.	..	8	3 067.	..	10
1 935.2	..	8	2 597.	..	10	3 149.6	..	8
2 035.7	..	8	2 600.	..	8	3 152.7	..	6
2 080.6	..	8	2 631.	..	10	3 211.	..	6
2 089.2	..	8	2 700.	..	8	3 268.3	..	10
2 102.4	..	10	2 707.	..	10	3 300.	..	3
2 132.4	..	10	2 776.	..	10	3 316.	..	8
2 142.2	..	10	2 811.	..	6	3 341.	..	8
2 147.5	..	10	2 838.	..	8	3 350.	..	8
2 180.2	..	9	2 845.	..	10	3 411.3	..	9
2 206.3	..	10	2 859.	..	10	3 559.8	..	5
2 221.3	..	10	2 887.	..	10	3 597.4	..	6
2 268.3	..	10	2 894.	..	8	3 608.3	..	5
2 274.5	..	10	2 931.1	..	10	3 661.4	..	6
2 495.	..	8	2 938.	..	8	3 699.5	..	5
2 526.	..	10	2 963.	..	8	II 3 785.4	..	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Caesium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
II 3 805.1	..	6	II 4 646.5	..	5	I 7 280.0	5<	1
3 876.2	1	....	4 763.6	..	5	I 7 609.0	8	...
3 888.4	2	2	II 4 830.2	..	6	I 7 944.0	8	....
II 3 897.0	..	7	4 870.0	..	6	I 8 016.2 }	5<	....
II 3 925.6	..	6	II 4 952.8	..	6	8 016.9 }		
II 3 965.2	..	6	II 4 972.6	..	5	I 8 079.1 }	10<	....
3 974.2	..	6	II 5 043.8	..	6	I 8 079.8 }		
4 006.5	..	6	II 5 096.6	..	4	I 8 521.2 P	10r	....
4 039.8	..	9	II 5 227.0	..	8	I 8 761.3	4	....
4 068.0	..	6	II 5 249.4	..	6	I 8 944. P	6r	....
4 068.8	..	6	5 274.0	..	4	I 9 172.2	4	....
4 158.6	..	4	II 5 371.0	..	6	I 9 209.	6	....
4 213.3	..	6	5 402.8	..	4	I 10 026.	10	....
4 232.19	..	6	II 5 419.7	..	5	I 10 124.	10	....
4 264.68	..	10	II 5 563.0	..	4	I 13 589.	8	....
II 4 277.1	..	9	II 5 831.2	..	5	I 13 605.	..	....
II 4 288.4	..	7	5 925.7	..	5	I 14 695.	10	....
4 300.6	..	6	6 010.4	4	2	I 29 317.	8	....
II 4 373.0	..	6	II 6 128.6	..	4	I 30 103.	6	....
II 4 384.4	..	5	6 213.0	8	2	I 30 963.	4	....
4 405.3	..	7	6 217.5	3	1	I 34 893.	7	....
II 4 435.7	..	4	6 354.5	4	1	I 36 128.	2	....
4 501.5	..	7	6 562.8	..	5	I 39 180.	1	....
II 4 526.7	..	7	I 6 586.5	10	1	I 42 202.	4	....
II 4 538.9	..	6	I 6 587.1	5<	....	I 68 070.	2	....
I 4 555.5 p	10r	4	I 6 723.3	10r	3	69 310.	2	....
I 4 593.18 p	10r	3	II 6 955.5	..	4	71 110.	1	....
II 4 603.8	10	10	I 6 973.3	10r	3	I 71 930.	1	....
4 616.1	..	4	I 6 983.4	6	1	74 250.	1	....
4 623.1	..	4	I 7 228.6	5<	1			

Carbon

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
313.	..	1	......	IV 1 550.9	..	3	......
372.	..	1	......	I 1 561.3	5	5	5
III 459.7	..	6	......	1 657.	6	$6_{(4)}$	......
II 533.9	.	1	......	III 1 930.98	5	$7_{(2)}$	......
III 538.4	..	7	......	III 2 297.59	2	10	......
II 543.4	..	2	......	I 2 478.3 P	10	10	10
II 560.5	..	2	......	II 2 746.50	..	....	4n
574.4	..	6	......	II 2 747.31	..	....	6n
II 594.9	4	5	......	II 2 836.71	..	....	10
II 636.2	..	2	......	II 2 837.60	..	....	8
651.	2	$6_{(2)}$	......	II 2 992.63	..	....	4
II 687.1	8	7	8	II 3 919.06	..	....	6
II 858.2	8	8	8	II 3 920.77	..	....	8
II? 904.	4	$10_{(4)}$	......	II 4 267.02 p	..	....	8n
III 977.02	..	12	......	II 4 267.27 p	..	....	10n
I 1 010.1	9	10	......	III 4 648.70	..	3	......
II 1 036.2	..	} 10	5	III 4 651.46	..	2	......
II 1 036.8	..		5	III 4 652.68	..	7	......
1 176.	10	$15_{(5)}$	......	II 6 578.03	.	....	10
1 323.7	7	7	......	II 6 582.85	..	....	8
1 329.1	8	} 4	......	II 7 231.12	..	....	6n
1 329.6	8			II 7 236.19	..	....	8n
1 334.5 p	10	} 10	......				
1 335.7 p	10						

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

CERIUM

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
399.	..	1	4 083.24	10	5	5 655.14	5	1
741.	..	5	4 106.89	5r	3	5 669.96	5	1
830.	..	20	4 133.82	10	10	5 677.74	4	1
1 332.	..	20	4 137.64	9	10	5 696.99	5	1
1 373.	..	20	4 149.94	10r	10	5 699.22	5	1
2 651.02	4	1	4 152.01	8	10	5 719.04	5	....
2 696.06	4	....	4 165.61 p	9	10	5 725.84	4	....
2 791.42	4	....	4 186.60 p	10	10	5 743.54	5	....
2 833.30	4	....	4 222.62	10	5<	5 768.94	4	1
2 896.75	4	....	4 248.67	8	6	5 773.12	4	....
2 976.90	4	1	4 255.79	8	3	5 788.15	4	....
3 017.18	4	1	4 289.94	9	6	5 804.42	4	....
3 051.98	5	1	4 296.68	9	8	5 812.9	5	....
3 063.00	6	2	4 306.73	8	4	5 838.12	4	1
3 103.38	6	1	4 320.73	8	3	5 862.49	4	....
3 146.40	6	1	4 337.76	9	4	5 871.58	3	....
3 171.63	6r	1	4 349.79	8	4	5 910.00	5r	....
3 194.83	7	1	4 375.18	8	3	5 928.34	4	....
3 201.72	7	1	4 382.17	8	5	5 934.40	4	....
3 221.17	7	1	4 391.66	8	8	5 940.86	4	1
3 234.17	7	1	4 396.58	3r	2	5 975.87	4	....
3 272.25	7	2	4 418.78	7	5	6 013.41	5	....
3 285.23	6	1	4 449.33	9	4	6 024.18	5	....
3 304.84	7	1	4 460.21	10	10	6 043.39	5	2
3 344.76	7	2	4 471.24	10	5	6 057.99	3	....
3 366.56	7	1	4 509.18	4r	3	6 069.48	3	....
3 377.13	7	2	4 527.35	10	5	6 098.35	4	1
3 426.20	8	1	4 528.47	10	5	6 123.66	4	....
3 442.38	7	1	4 539.74	10	5	6 186.16	3	....
3 476.84	6	2	4 562.35	10	10	6 209.00	3	....
3 485.06	8	2	4 572.28	10	10	6 228.98	4	1
3 488.55	7	1	4 593.93	10	10	6 232.47	3	1
3 517.38	7	2	4 606.41	4	5	6 272.05	4	2
3 539.08	7	2	4 628.15	10	10	6 295.58	3	....
3 560.82	8	4<	4 654.28	4	2	6 300.22	3	....
3 577.45	8	4<	4 684.61	4	3	6 310.03	3	....
3 613.70	10r	2	4 714.01	4	3	6 343.98	4	1
3 623.84	7	3	4 725.09	4	2	6 371.13	4	....
3 655.85	10	3	4 737.24	4	3	6 393.06	3	1
3 667.97	9	3	4 773.93	4	3	6 458.06	3	....
3 679.42	6	2	4 882.44	4	3	6 466.89	3	....
3 709.29	8	3<	4 893.93	3	2	6 467.40	3	....
3 716.36	9	3	4 971.50	4	2	6 473.69	3	....
3 764.12	8	3<	5 022.85	4	1	6 513.63	3	....
3 786.63	8	3	5 044.02	4	1	6 555.65	3	....
3 801.53	10	8	5 079.68	5	2	6 606.87	3	....
3 853.16	8	2	5 117.14	4	1	6 628.90	3	....
3 875.04	6r	2	5 187.44	6	2	6 652.75	3	....
3 878.37	9	2	5 191.63	5	1	6 665.65	3	....
3 890.00	8	3<	5 211.91	4	....	6 700.67	3	....
3 942.75	10	5	5 274.23	5	3	6 704.40	3	....
3 952.58	9r	8<	5 330.53	5	2	6 774.27	2	....
3 956.29	9	3	5 393.39	7	3	6 898.49	2	....
3 992.39	9	3	5 409.23	6	2	6 899.07	2	....
3 993.83	9	4	5 472.27	5	3	6 924.80	3	....
3 999.25	10	6	5 512.06	8	3	6 986.00	2	....
4 012.40 p	10	10	5 556.27	4	1	6 999.87	2	....
4 040.76 p	9	8	5 601.28	5	1	7 030.98	2	....
4 073.49	9	4	5 614.73	3	....	7 061.69	3	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Cerium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
7 086.31	3	....	7 860.54	2	....	8 355.32	2	....
7 150.21	2	....	8 002.66	2	....	8 363.82	2	....
7 238.38	2	....	8 025.59	2	....	8 371.90	2	....
7 252.72	3	....	8 171.32	2	....	8 396.20	2	....
7 329.92	2	....	8 234.12	3n	....	8 495.64	3	....
7 397.78	2	....	8 245.10	2	....	8 560.60	2	....
7 689.13	2	....	8 261.03	2	....	8 612.62	2	....
7 797.73	2	....	8 300.58	2	....	8 647.59	2	....
7 835.81	2	....	8 310.22	2	....	8 772.08	3	....
7 859.05	2	....						

Chlorine

Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
IV 538.08	....	3	2 532.5	....	7	3 805.2	2	6
556.4	....	4	2 577.1	....	6	3 820.3	1	5
561.5	....	4	2 580.7	....	8	3 827.7	2	5
574.3	....	4	2 601.2	....	5	3 833.4	2	8
586.9	....	4	2 603.5	....	6	3 843.	2	5
V 629.33	....	6	2 609.50	....	7	3 845.4	....	8
V 633.18	....	6	2 611.4	....	5	3 845.7	2	8
V 635.31	....	6	2 616.99	....	8	3 851.0	....	10
V 639.24	....	5	2 620.07	....	6	3 851.5	3	8
653.7	....	4	2 624.72	....	6	3 861.	5	10
663.2	....	4	2 658.7	....	4	3 868.7	1	6
712.6	....	4	2 661.5	....	4	3 914.	2	5
VI 730.31	....	4	2 665.5	....	6	4 032.2	....	5
787.8	....	4	2 684.75	....	5	4 104.8	....	4
VII 800.70	....	3	2 685.40	....	5	4 132.5	10	3
VII 813.00	....	2	2 688.03	....	6	4 158.0	2	4
840.9	....	6	2 691.49	....	6	4 209.7	....	5
888.0	....	4	2 710.37	....	6	4 226.4	....	7
960.4	....	6	2 782.4	....	6	4 234.0	....	5
984.8	....	4	2 996.5	....	5	4 241.3	....	8
1 008.6	....	4	3 063.0	....	6	4 253.4	2	9
1 014.9	....	4	3 071.3	1	6	4 291.8	2	5
1 070.9	....	4	3 076.6	....	7	4 304.1	1	4
1 145.0	....	2	3 139.2	....	6	4 307.6	3	6
1 547.2	....	3	3 191.4	3	7	4 323.4	....	6
1 577.7	....	2	3 259.2	2	4	4 336.3	2	5
1 821.9	....	2	3 289.7	1	6	4 343.7	5	10
2 087.1	....	5	3 315.3	1	6	4 363.3	....	8
2 093.4	....	4	3 320.5	2	8	4 369.5	....	6
2 251.0	....	5	3 329.0	....	8	4 371.6	....	5
2 251.5	....	5	3 340.3	3	8	4 373.0	2	6
2 283.9	....	4	3 353.3	3	7	4 379.9	....	8
2 359.6	....	4	3 392.8	....	8	4 387.6	....	5
2 370.4	....	4	3 522.0	....	6	4 389.8	....	8
2 403.2	....	5	3 602.1	4	2	4 403.4	....	5
2 434.5	....	5	3 650.1	1	4	4 438.6	....	4
2 448.6	....	4	3 750.0	....	5	4 469.4	....	5
2 471.1	....	4	3 781.2	....	5	4 475.3	....	4
2 519.5	....	6	3 798.8	2	5	4 490.0	1	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Chlorine (Continued)

Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube
4 526.3	....	5	4 819.4 p	10	9	5 392.1	2	4
4 572.6	1	5	4 896.7	2	5	5 423.2	2	6
4 601.0	....	4	4 904.7	2	4	5 443.4	1	5
4 768.6	2	4	5 078.2	2	4	5 444.2	....	3
4 781.3	3	5	5 317.8	1	3	5 457.1	....	3
4 794.5 p	10	10	5 321.3	1	4	5 634.9	....	1
4 810.0 p	10	9						

Chromium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
202.6	..	1	2 812.01	2	10	3 346.73	4r	1
438.3	..	4	2 822.38	2	10	3 358.50	3	10
456.8	..	4	2 830.48	2	10	3 360.32	3	10
464.0	..	4	II 2 835.64 P	5r	10	3 368.05	4	10
469.8	..	4	II 2 843.25 p	4	10r	3 382.68	2	10
575.3	..	5	II 2 849.83 p	4	10	3 403.32	2	10
619.9	..	6	II 2 855.68 p	4	10	3 408.76	3	10
629.9	..	6	II 2 862.58	3	10	3 421.21	3	9
637.8	..	6	2 879.28	3r	1	3 422.74	3	10
648.7	..	5	2 893.26	3r	1	3 433.60	5r	2
667.1	..	5	2 910.91	4r	1	3 550.64	4	2
681.3	..	5	2 967.64	4r	1	I 3 578.69	10r	10r
840.	..	3	2 971.90	2	10	I 3 593.48	10r	10r
885.2	..	10	2 979.74	2	10	I 3 605.33	10r	10
925.5	..	2	2 985.32	2	10	3 636.59	5r	3
1 004.4	..	3	2 986.47	6r	2	3 639.81	6r	5
1 018.7	..	3	2 989.19	2	10	3 743.56	4r	3
1 816.4	..	10	2 995.11	4r	1	3 743.88	4r	3
2 034.4	2	....	2 996.58	4r	1	3 749.00	4r	3
2 039.3	3	....	2 998.80	4r	1	3 804.80	5	3
2 133.5	3	1	3 005.07	5r	1	I 3 885.22	5r	3
2 150.7	3	1	3 014.77	5r	1	I 3 894.05	4r	3
2 226.5	2	2	3 014.92	6r	1	I 3 908.76	6r	3
2 324.9	..	4	3 017.58	6r	2	I 3 919.17	7r	5
2 408.67	2	1	3 018.50	5r	1	I 3 921.03	5r	3
2 538.3	..	5	3 021.57	6r	2	I 3 928.65	6r	3
2 591.86	4r	1	3 034.20	5r	1	I 3 941.50	5r	3
2 677.17	5r	10	3 037.05	5r	1	3 963.70	7r	8
2 678.79	4	10	3 040.85	5r	10	3 969.75	7r	8
2 691.05	4	10	3 050.14	2	10	3 976.68	7r	8
2 731.90	5r	1	3 053.88	6r	2	3 983.92	7r	5
II 2 743.63	3	8	II 3 118.65	3	10	3 991.13	6r	4
II 2 750.73	3	10	II 3 120.37	4	10	4 001.45	4	2
II 2 751.87	3	10	II 3 124.97	4	10	4 026.17	4	2
2 752.87	3r	1	II 3 132.05	4	10	4 058.79	4	3
2 757.11	4r	2	3 180.73	3	10	4 109.58	4	1
II 2 762.60	3	10	3 197.08	3	10	4 163.63	4	4
II 2 766.54	4r	10	3 209.18	2	10	4 179.26	4	3
2 769.91	6r	1	3 217.40	3	8	I 4 254.34 P	10r	10
2 780.71	7r	....	3 307.05	1	8	I 4 274.80 p	10r	10
2 792.16	1	10	II 3 339.80	3	10	I 4 289.73 p	10r	10
2 800.77	1	10	II 3 342.58	3	10	I 4 337.57	6r	9

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Chromium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 4 339.45	6r	5	I 5 345.80	10	6	I 9 009.97	10	....
I 4 339.72	5r	4	I 5 348.31	10	5	I 9 017.08	5	....
I 4 344.51	7r	8	I 5 409.80	10	8	I 9 021.8	4	....
I 4 351.05	5r	4	5 664.03	4	2	9 035.9	3	....
I 4 351.77	7r	9	5 694.73	5	2	9 140.4	1	....
I 4 359.63	6r	8	5 698.33	5	2	9 141.1	1	....
I 4 371.28	6r	9	5 712.77	4	2	9 142.6	1	....
I 4 384.98	6r	7	5 781.81	7	1	9 290.4	10	....
4 458.53	4	3	5 783.13	8	3	9 294.1	8	....
4 465.35	4	4	5 783.93	9	3	9 447.0	10	....
I 4 496.86	6r	10	5 785.02	8	3	9 574.2	10	....
4 511.92	4	6	5 787.98	9	6	9 670.5	5	....
4 540.71	4	6	5 791.02	10	8	9 734.5	10	....
I 4 545.96	5r	6	5 884.44	3	2	9 948.	2	....
I 4 580.06	7	3	6 102.71	3	1	10 082.	2	....
I 4 591.41	6	2	6 261.27	3	1	10 486.	4	....
I 4 600.75	6r	4	I 6 330.11	6	3	10 673.	3	....
I 4 616.13	6r	6	I 6 362.87	5	3	10 820.	4	....
I 4 626.19	6r	5	6 501.23	3	....	10 906.	6	....
I 4 646.17	7r	10	6 537.95	3	....	11 016.	8	....
I 4 652.17	6r	5	6 661.12	5	2	11 158.	9	....
4 708.04	7	3	6 669.26	4	....	11 312.	2	....
4 718.45	7	6	6 715.42	3	....	11 337.	4	....
4 737.34	5	3	I 6 881.65	9	....	11 392.	5	....
4 756.13	6	8	I 6 882.41	9	....	11 483.	4	....
4 789.35	5	3	6 883.04	9	....	11 611.	10	....
4 801.04	5	2	I 6 924.15	10	....	13 462.	2	....
4 829.36	5	4	I 6 925.23	9	....	15 680.	3	....
4 870.80	3	3	6 978.50	10	....	15 861.	3	....
4 887.01	3	3	I 6 979.81	7	....	18 479.	3	....
4 922.26	4	3	I 7 355.97	10	....	18 584.	3	....
4 954.80	4	2	I 7 400.3	10	....	18 654.	3	....
5 013.31	3	2	I 7 462.4	10	....	18 717.	2	....
5 166.24	3	4	7 722.9	2	....	25 460.	2	....
I 5 204.54 p	9r	10	7 908.3	2	....	25 490.	1	....
I 5 206.04 p	10r	10	7 942.0	2	....	25 560.	1	....
I 5 208 43	10r	10	8 163 2	3	....	25 584.	2	....
I 5 247.56	5r	3	8 235.9	2	....	25 665.	1	....
I 5 264.15	6r	5	8 348.3	2	....	25 709.	1	....
I 5 265.73	5r	3	8 450.3	2	....	25 785.	1	....
I 5 275.16	4	5	8 455.2	2	....	25 816.	1	....
I 5 296.69	5	6	8 548.8	2	....	25 850.	2	....
I 5 298.28	6	10	8 947.2	2	....	25 902.	1	....
I 5 328.35	10	8	8 976.8	3	....	26 232.	2	....

Cobalt

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
342.	..	1	1 882.2	..	4	2 165.6	3	2
937.	..	5	1 928.	..	6	2 196.6	5	....
1 128.	..	3	1 940.3	..	6	2 213.9	3	1
1 502.	..	3	1 950.	..	4	2 276.6	3	1
1 574.	..	5	1 955.2	..	4	2 286.2 P	2	6r
1 580.	..	5	1 956.6	..	5	2 307.9 p	2	6r
1 631.6	..	3	1 969.4	..	5	2 363.8	2	10
1 772.7	..	5	1 974.1	..	4	2 378.6 p	2	10
1 790.4	..	4	2 011.5	..	7	2 388.9 p	2	10r
1 846.	..	4	2 105.	4	1	2 397.4	1	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Cobalt (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 2 407.3	3r	2	I 3 465.79 p	6r	5	I 4 530.97	7	10
I 2 411.6	3r	3	I 3 474.02	9r	8	4 549.66	6	5
I 2 415.3	3r	2	3 485.35	7	3	4 565.61	7	7
2 424.9	3r	....	I 3 489.40	5r	7	I 4 581.62	8	8
2 432.3	3r	5	I 3 495.68	6r	5	4 594.62	6	3
2 447.7	..	10	I 3 502.28	5r	6	4 596.90	6	3
2 464.2	2	8	I 3 506.32	6r	8	I 4 629.38	8	4
2 506.4	3	10	I 3 509.85	4r	5	I 4 663.41	8	4
2 511.1	2r	4	I 3 510.42	4r	4	I 4 682.36	7	3
2 519.8	1	10	I 3 512.64	4r	6	I 4 749.69	8	3
I 2 528.97	3r	2	I 3 513.48	4r	4	I 4 792.87	7	7
2 541.95	2	10	I 3 518.35	6r	7	I 4 813.49	8	10
2 559.40	3	10	I 3 520.09	4r	3	I 4 840.28	8	8
2 564.04	3	10	3 521.57	5r	5	I 4 867.88	8	8
2 574.36	3r	....	I 3 523.44	4r	5	I 4 971.95	6	....
2 632.4	..	10	I 3 526.85	9r	6	I 5 122.76	5	1
2 648.65	4	10	I 3 529.04	4r	3	5 133.45	5	1
2 663.53	4	10	I 3 529.81 p	8r	6	5 176.07	6	....
2 675.99	4	4	I 3 533.36	6r	4	I 5 212.70	5	1
2 731.11	4	2	I 3 550.60	5r	3	I 5 230.21	5	1
2 745.10	4	3	I 3 564.95	5r	4	5 266.49	6	1
2 766.22	4	2	I 3 569.38	7r	10	I 5 280.63	5	1
2 815.55	4	1	I 3 574.96	5r	4	5 342.68	8	2
2 886.45	5	2	I 3 575.36	6r	5	5 343.38	7	2
I 2 987.17	5r	3	I 3 587.19	8r	10	I 5 352.05	8	2
I 2 989.59	6r	3	I 3 602.08	5r	4	5 353.48	7	2
I 3 044.00	8r	4	I 3 627.81	8r	4	5 362.76	8	1
I 3 072.34	5r	3	3 639.44	10	2	I 5 369.59	7	1
I 3 082.61	5r	3	3 676.56	8	6	5 444.56	8	1
I 3 086.77	6r	3	3 683.05	8	8	5 454.55	9	1
I 3 137.32	6r	3	I 3 704.06	8	7	I 5 483.35	10	2
I 3 139.94	7r	3	3 732.40	8	7	I 5 530.77	8	1
I 3 147.06	7r	3	I 3 745.50	6r	10	I 5 590.73	8	1
I 3 149.30	6r	2	3 755.45	6r	4	5 647.22	8	1
I 3 158.76	6r	3	I 3 842.06	6r	10	5 830.06	7	....
I 3 159.66	6r	1	I 3 845.48	10r	10	5 890.48	7	2
3 243.84	8r	2	I 3 861.17	7r	10	5 915.53	8	3
3 247.17	7r	2	I 3 873.12	9r	10	5 946.51	8	1
3 254.20	10r	2	I 3 876.84	8r	5	I 5 984.19	10	2
3 260.81	7r	2	I 3 894.09	9r	10	5 991.88	10	5
3 265.35	6r	1	I 3 935.97	6r	10	6 000.71	8	1
3 283.45	10r	3	I 3 941.74	5r	4	6 006.30	8	2
3 319.48	10	2	I 3 957.94	6r	4	6 007.63	8	2
I 3 334.15	5r	4	I 3 974.73	5r	4	6 049.06	10	2
3 346.94	10	2	I 3 995.31	8r	10	6 082.46	10	5
I 3 354.38	6r	4	I 3 997.91	7r	10	6 086.66	7	2
3 377.06	8r	1	I 4 020.90	7r	5	I 6 093.14	6	2
I 3 385.228	9r	4	I 4 045.40	8r	5	6 107.93	7	1
I 3 388.18	9r	5	I 4 066.39	7r	5	6 122.68	10	2
I 3 395.38	10r	5	I 4 086.32	8	9	I 6 188.98	8	3
I 3 405.12	7r	10	I 4 092.40	8r	8	6 211.13	8	1
I 3 409.18	4r	6	I 4 110.54	9	10	I 6 231.02	7	3
I 3 412.34	4r	4	I 4 118.78	8r	10	6 257.61	10	3
I 3 433.04	6r	6	I 4 121.33	10r	10r	6 271.40	10	....
I 3 443.65	3r	6	4 160.7	1	8	I 6 282.65	10	4
I 3 449.17	6r	5	I 4 190.71	7	4	6 320.35	10	2
I 3 449.45	6r	5	4 252.30	5	2	6 347.79	10	1
I 3 453.51 P	6r	10	4 339.64	5	3	6 395.19	7	1
I 3 462.81	6r	5	I 4 469.57	8	5	6 417.80	8	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Cobalt (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
6 429.89	7	....	7 840.1	7	....	9 544.5	2	....
I 6 450.23	10	6	7 855.9	7	....	9 597.9	2	....
6 455.02	10	5	7 869.9	6	....	10 020.7	..	....
6 477.89	9	....	7 871.4	6	....	10 189.2	..	....
6 490.32	7	1	7 908.8	10	....	10 206.1	..	....
6 563.40	9	3	7 926.6	8	....	10 210.8	..	....
6 595.90	6	3	7 987.4	7	....	10 213.3	..	....
6 617.30	10(2)	1	8 007.3	10	....	10 236.4	..	....
6 632.44	6	2	8 022.2	7	....	10 272.9	..	....
I 6 678.81	6	....	8 029.3	7	....	10 284.6	..	....
I 6 771.05	10	2	8 043.3	8	....	10 366.6	..	....
I 6 814.96	10	1	8 056.0	8	....	11 275.5	..	....
6 872.38	7	2	8 066.5	7	....	11 293.5	..	....
6 937.8	7	....	8 094.0	10	....	11 340.8	..	....
I 7 016.6	10	....	8 116.4	7	....	11 453.4	..	....
7 027.82	8	....	8 152.0	6	....	11 634.	2	....
I 7 052.85	10	....	8 193.1	8	....	11 895.	1	....
7 054.04	8	....	8 208.7	8	....	14 062.	4	....
I 7 084.97	10	....	8 269.4	8	....	14 559.	2	....
7 134.33	8	....	8 299.0	5	....	14 611.	4	....
I 7 154.7	8	....	8 372.8	10	....	14 681.	2	....
7 159.16	8	....	8 378.4	7	....	14 958.	3	....
7 193.60	8	....	8 575.3	4	....	15 210.	2	....
7 285.3	7	....	8 819.2	10	....	16 133.	5	....
I 7 354.6	6	....	8 835.2	8	....	16 257.	5	....
7 388.7	7	....	8 850.7	10	....	16 388.	3	....
I 7 417.4	8	....	8 870.8	4	....	16 447.	2	....
7 457.4	8	....	8 904.7	8	....	16 574.	3	....
7 554.0	8	....	8 926.2	10	....	17 005.	5	....
7 590.6	6	....	8 958.5	6	....	17 080.	3	....
7 610.3	6	....	9 037.9	8	....	18 176.	3	....
7 712.7	9	....	9 095.4	6	....	18 274.	2	....
7 734.3	6	....	9 357.0	10	....	19 779	3	....
7 838.2	8	....						

Columbium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 584.03	2	6	I 3 580.27	10	3	4 079.73 p	10	6
II 2 697.07	3	7	3 697.84	10	3	4 100.97	10	6
II 2 927.82	8	10	3 713.05	10	3	4 123.85 p	10	4
I 2 941.57	4	8	3 726.24	10	3	4 129.97	10	3
II 2 950.91	6	10	3 739.82	10	3	4 137.13 p	10	4
II 3 094.19 P	10	10	3 740.80	10	5	4 139.74	10	4
II 3 130.78 p	8	10	3 742.41	10	3	4 152.63	10	5
II 3 163.37 p	5	10	3 759.57	10	3	4 163.64	10	10
II 3 194.95 p	5	10	3 787.08	10	3	4 164.66	10	5
II 3 225.47 p	5	10	3 790.14	10	3	4 168.13	10	5
II 3 236.44	3	10	3 791.24	10	4	4 190.91	10	4
3 341.95	10	4	3 798.11	10	4	4 192.07	10	3
3 358.38	10		3 802.98	10	4	4 205.32	10	3
3 498.62	10	2	3 810.48	10	3	4 214.74	10	3
I 3 510.30	3	8	3 818.92	1	8	4 217.95	10	3
I 3 535.30	10	3	3 914.71	10	3	4 229.15	10	3
I 3 537.50	10	2	3 937.47	10	3	4 262.10	8	3
I 3 554.62	10(2)	2	3 966.23	10	3	4 299.63	8	4
I 3 563.53	10	2	4 032.55	10	3	4 301.10	10	5
I 3 575.85	10	2	4 058.97 P	10	10	4 326.37	10	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Columbium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
4 331.42	10	3	4 713.48	5	3	5 437.29	7	2
4 351.60	10	3	4 733.88	5	3	5 551.38	6	2
4 377.90	10	4	4 810.57	6	3	5 664.72	6	2
4 410.22	10	3	4 816.33	7	1	5 665.57	6	3
4 437.23	10	8	4 924.84	3	8	5 671.1	7	1
4 447.22	10	3	4 989.0	5	2	5 729.2	6	2
4 523.40	8	3	5 039.04	6	2	5 787.53	6	2
4 546.83	10	4	5 078.95	8	3	5 819.47	6	3
4 573.09	10	5	5 095.29	10	3	5 838.66	8	5
4 581.64	10	5	5 134.73	5	2	5 866.5	6	3
4 606.76	10	10	5 160.33	6	3	5 900.62	10(2)	2
4 630.12	10	10	5 164.36	7	2	5 983.26	7	2
4 648.94	7	3	5 180.30	6	2	6 430.50	8	1
4 663.83	9	4	5 271.53	9	3	6 544.67	6	1
4 672.10	10	9	5 276.20	10	3	6 677.34	8	1
4 675.38	10	8	5 344.15	10	5	6 723.66	6	1
4 708.26	7	4	5 350.72	7	3	6 828.14	4	....

Copper

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
155.7	..	0	2 400.10	2	5	3 317.20	5	2
324.5	..	6	I 2 441.62	5	2	3 337.85	8	3
329.2	..	5	2 473.46	1	4	3 365.36	6	2
358.0	..	5	I 2 492.15	5r	2	3 381.43	3	1
452.8	..	7	2 506.4	1	6	3 402.23	4	1
777.3	..	5	2 529.43	1	5	3 450.33	7	6
788.3	..	6	I 2 618.39	10r	3	3 454.72	6	3
1 594.	..	5	2 701.1	1	5	I 3 457.85	4	1
1 642.	..	8	2 713.6	1	5	3 483.75	6	3
1 652.	..	6	I 2 766.39	10	4	I 3 512.11	6	3
1 670.	..	6	2 824.38	10	5	3 520.00	4	1
1 672.	..	6	2 882.95	6	3	3 527.49	5	1
1 679.	..	6	2 961.18	9	6	3 530.38	7	2
1 687.	..	6	2 997.37	6	4	3 533.74	7	1
1 702.	..	5	3 010.84	7	1	I 3 599.14	8	2
1 722.	..	6	3 036.10	8	2	3 602.04	8	2
I 1 741.	..	6	I 3 063.42	7	3	3 621.23	6	2
1 750.	..	6	3 073.82	5	2	3 600.54	3	1
1 769.	..	4	3 094.00	6	2	3 741.25	3	1
1 783.	..	3	3 099.92	6	3	3 771.9	3	1
1 840.	..	8	3 108.60	8	5	I 3 861.75	3	1
1 979.2	4	1	3 116.33	7	2	I 4 022.70	10	8
1 999.6	5	2	3 126.10	7	3	I 4 062.7	10	7
2 149.	1	3	3 128.67	6	2	I 4 063.4	6	1
2 199.62	4r(2)	2	3 140.33	6	2	4 177.7	6	2
I 2 214.57	4r	2	3 142.43	7	2	4 248.97	6	4
I 2 227.75	4r	2	3 146.82	6	2	4 275.13	8	8
2 230.08	4r	2	I 3 194.10	8	3	4 378.2	8	8
2 242.60	2	6	3 208.20	6	2	I 4 480.38	7	2
2 246.98	3	6r	3 231.17	4	2	4 509.39	6	3<
I 2 263.1	3r	2	3 243.15	6	4	I 4 530.84	8<	2
2 276.24	1	4	I 3 247.55	10r	10r	4 587.00	10	10
2 293.85	6r	3	I 3 273.97 p	10r	10r	4 651.17	8	7<
2 294.34	3	5	3 279.80	5	3	4 674.78	5	3
2 356.63	2	4	3 290.55	10	6	4 704.60	4	2
I 2 369.88	5	8	3 293.92	4r	2r	5 016.63	2	2
I 2 392.64	7	1	3 307.95	9	7	I 5 105.55	7	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Copper (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 5 153.26	8	8	6 268.3	6	....	I 7 933.23	10	....
I 5 218.20	10	10	6 325.4	4	....	I 8 092.77	10	....
I 5 220.06	6	5	6 474.20	5	....	I 16 008.	5	....
5 292.54	4	4	6 485.16	5	....	I 16 653.	4	....
5 535.8	1	1	6 672.23	5	....	I 18 194.	7	....
5 554.94	2	1	6 741.4	6	....	I 18 229.	5	....
I 5 700.24	5	4	6 905.9	6	....			
I 5 782.15	6	6	7 570.1	5	....			

Dysprosium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 422.75	3	....	3 724.42	5	5	4 632.43	5	1
2 560.19	3	....	3 757.37	4	3	4 890.12	5	1
2 600.17	3	....	3 786.20	6	5	4 923.14	6	1
2 634.80	3	1	3 806.25	6	10	4 957.41	10	2
2 772.59	3	....	3 836.49	6	4	5 003.86	5	....
2 816.38	3	2	3 898.54	6	10	5 032.98	6	....
2 877.90	3	1	3 944.69	10	10	5 120.01	5	....
2 906.39	3	1	3 968.42	10	10	5 139.58	8	1
2 948.30	3	1	3 978.57	6	10	5 169.64	6	....
2 985.92	3	1	3 996.72	5	4	5 197.66	8	....
3 016.98	3	1	4 000.50 p	8	10	5 260.58	5	....
3 043.46	4	1	4 046.00 p	10	4	5 301.59	5	....
3 141.09	4	2	4 077.98 p	10	10	5 380.68	6	....
3 162.79	4	3	4 103.34	8	8	5 389.58	6	....
3 216.60	5	3	4 111.35	8	4	5 423.30	5	....
3 235.87	5	3	4 146.06	6	2	5 515.40	5	1
3 269.12	5	1	4 167.99 p	10	4	5 547.27	5	....
3 282.78	5	3	4 183.68	6	3	5 600.68	5	....
3 308.87	6	3	4 186.80	8	4	5 651.99	6	....
3 319.87	6	3	4 194.85	8	4	5 685.57	4	....
3 358.57	5	2	4 211.74 p	10	5	5 702.91	4	....
3 385.03	6	3	4 215.13	6	3	5 740.23	3	....
3 393.58	6	3	4 221.12	8	3	5 805.55	3	....
3 407.77	8	3	4 225.14	6	3	5 868.18	3	....
3 418.77	6	3	4 256.33	8	3	5 915.18	3	....
3 454.36	6	10	4 295.02	6	5	5 974.52	5	....
3 484.66	6	3	4 308.66	5	4	6 010.85	5	....
3 494.47	8	5	4 358.50	5	2	6 088.27	6	....
3 524.03	5	10	4 375.33	5	2	6 168.47	6	....
3 531.70	10	10	4 409.40	8	3	6 259.12	10	....
3 536.04	5	5	4 449.72	8	4	6 348.32	5	....
3 546.83	6	4	4 503.25	5	2	6 386.89	5	....
3 550.21	8	10	4 577.81	6	3	6 421.95	6	....
3 563.12	6	4	4 589.35	10	5	6 486.62	5	....
3 576.89	6	3	4 612.27	8	4	6 579.42	6	....
3 600.34	6	10	4 698.72	4	2	6 667.93	6	....
3 645.40	8	10	4 731.84	10	3	6 747.96	3	....
3 676.56	3	10	4 745.79	6	2	6 835.51	6	....
3 694.75	6	10	4 775.81	6	1	6 899.40	4	....
3 698.17	4	10	4 825.00	5	1			

Erbium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 910.36	5	4	3 025.91	4	2	3 154.28	4	3
2 964.52	4	3	3 070.77	4	2	3 230.95	5	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Erbium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 267.11	5	4	4 522.67	6	....	5 456.58	5	1
3 312.42	6	5	4 552.12	6	4	5 485.93	5	2
3 368.07	6	4	4 563.28	6	3	5 593.40	4	1
3 372.77	10	10	4 606.62	5	3	5 601.19	4	1
3 401.84	4	4	4 630.91	6	4	5 626.52	4	1
3 464.50	5	2	4 675.61	5	10	5 665.45	4	2
3 499.12 p	10	10	4 679.07	6	5	5 710.88	4	1
3 599.84	5	8	4 724.54	6	3	5 739.17	5	1
3 638.68	6	1	4 731.61	6	3	5 757.62	5	1
3 692.65 p	..	10	4 751.55	6	2	5 762.80	5	1
3 729.56	5	5	4 762.65	6	3	5 826.78	6	1
3 766.26	10	3	4 795.50	8	3	5 902.10	5	....
3 787.88	6	3	4 820.33	6	4	6 006.80	5	....
3 797.08	6	3	4 831.14	8	3	6 076.46	5	....
3 830.54	6	6	4 848.83	6	2	6 221.01	6	1
3 892.72	6	2	4 861.60	5	1	6 299.43	5	....
3 896.26	6	6	4 872.09	5	3	6 308.79	8	....
3 906.34 p	10	10	4 900.09	5	4	6 326.13	5	....
3 938.65	8	4	4 951.73	8	3	6 388.19	6	....
3 969.46	5	2	5 007.24	5	1	6 441.33	5	....
3 987.64	5	1	5 028.90	5	1	6 583.47	5	....
4 007.96	10	4	5 042.06	5	2	6 601.11	6	....
4 048.34	5	3	5 127.41	5	2	6 616.75	4	....
4 087.66	10	1	5 133.83	5	2	6 721.93	4	....
4 123.10	6	....	5 188.91	5	2	6 759.88	4	....
4 151.11	6	4	5 218.22	5	2	6 848.11	4	....
4 194.81	10r	2	5 255.93	6	2	6 897.53	3	....
4 230.19	6	3	5 279.31	5	....	6 951.87	3	....
4 276.50	6	3	5 302.31	5	1	7 001.44	3	....
4 319.95	5	3	5 344.49	5	1	7 135.69	3	....
4 374.95	10	6	5 395.86	6	2	7 316.29	3	....
4 419.62	8	10	5 414.63	6	1	7 469.46	5	....
4 473.51	5	4	5 422.79	5	1	7 680.00	3	....
4 500.75	8	6	5 454.25	5	1			

Europium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 727.77	4	6	4 594.07	10	10	5 967.09	10	1
2 906.68	5	5	4 627.26	10	10	6 083.89	9	1
3 111.43	5	1	4 661.90	10	10	6 173.03	10	3
3 334.32	5	2	4 911.40	8	2	6 188.10	10	2
3 688.42	10	10	5 022.91	6	1	6 262.26	10	2
3 724.97	10	10	5 133.52	5	1	6 303.42	10	3
3 819.64	10r	10	5 223.48	5	1	6 350.02	10	1
3 907.10	10	10	5 357.61	9	1	6 437.63	10	5
3 930.51	10	10	5 402.77	10	2	6 501.57	7	....
3 971.95	10	10	5 451.52	9	2	6 645.20	10	10
4 129.72 p	10	10	5 452.95	9	2	6 802.78	10	....
4 202.01	10	....	5 547.44	10	1	6 864.57	10	....
4 205.01 p	10	10	5 570.31	10	1	7 077.14	8	....
4 435.54	10	10	5 577.12	9	1	7 194.80	8	....
4 522.56	10	10	5 831.98	10	3	7 217.55	8	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Fluorine

Wave length.	Geissler tube.	Spark.	Wave length.	Geissler tube.	Spark.	Wave length.	Geissler tube.	Spark
378.6	1	....	3 164.1	4	....	I 6 239.66	6	....
420.1	1	....	3 201.1	3	....	I 6 348.50	6	....
III 430.15	4	....	3 240.8	3	....	I 6 413.65	5	....
III 467.70	7	....	3 262.7	3	....	6 569.72	2	....
II 546.84	4	....	3 416.4	4	....	6 762.9	2	....
IV 572.65	4	....	3 473.5	5	....	I 6 774.00	6	....
II 605.67	8	....	3 475.2	5	....	I 6 834.29	8	....
II 606.27	7	....	3 501.9	8	....	I 6 856.05 p	10	....
II 606.81	9	....	3 503.3	9	....	I 6 870.25	7	....
II 606.95	4	....	3 505.8	10	....	I 6 902.49 p	9	....
II 607.48	7	....	3 598.9	5	....	I 6 909.88	7	....
II 608.06	8	....	3 601.	5	....	I 7 037.56	9	....
III 656.10	7	....	3 602.7	5	....	7 202.4	3	....
III 656.86	6	....	3 847.1	5	....	7 311.2	4	7
III 658.34	8	....	3 850.0	5	....	7 332.1	5	10
IV 676.06	4	....	3 851.7	5	....	I 7 398.8	6	10
IV 677.17	5	....	3 898.8	5	....	7 426.	3	6
IV 679.19	5	....	4 025.1	10	....	7 482.95	1	2
I 951.81	5	....	4 103.4	10	....	7 552.2	2	2
I 954.78	7	....	4 246.3	10	....	7 573.5	2	2
I 955.53	6	....	4 299.1	8	....	7 754.9	5	2
I 958.49	5	....	4 446.8	10	....	7 800.6	4	1
3 151.7	3	....						

Gadolinium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
2 564.51	..	6	3 494.41	5	5	3 894.72	[illegible]	4
2 628.12	..	10	3 545.78	9	10	3 916.57	9	8
2 655.59	..	6	3 549.37	7	10	3 934.81	6	3
2 679.41	..	8	3 584.96	8	10	3 957.69	5	5
2 717.30	..	8	3 592.69	5	8	3 959.51	7	6
2 904.73	..	10	3 613.42	5	4	3 994.20	5	3
2 955.50	..	10	3 646.19 p	10	10	4 037.34	9	6
2 999.06	5	4	3 654.64	7	8	4 037.89	7	5
3 010.15	5	6	3 656.15	7	8	4 049.44	6	4
3 027.60	6	6	3 664.64	7	10	4 049.90	8	6
3 032.85	7	8	3 671.24	10	8	4 063.46	10	5
3 034.06	7	6	3 687.76	5	5	4 070.36	9	5
3 082.00	10	6	3 697.74	5	5	4 073.80	8	8
3 100.51	8	8	3 712.71	6	10	4 078.46	5	4
3 145.00	5	4	3 716.38	5	4	4 078.73	5	3
3 350.48	7	10	3 719.48	9	10	4 085.59	8	8
3 358.60	7	8	3 730.87	5	5	4 098.64	8	6
3 362.25	6	10	3 743.41	7	10	4 098.91	5	4
3 416.93	5	4	3 758.29	5	4	4 130.39	10	10
3 418.72	7	4	3 768.40 p	10	10	4 132.29	5	5
3 422.46	8	10	3 770.70	4	6	4 137.10	6	8
3 439.21	6	5	3 796.43	9	10	4 184.28	9	10
3 440.06	7	6	3 813.99	9	6	4 197.68	5	5
3 450.38	5	6	3 850.69	7	4	4 212.00	7	5
3 481.33	6	8	3 851.00	7	5	4 214.97	6	5
3 481.83	5	5	3 852.50	10	8	4 217.15	5	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Gadolinium (Continued)

Wave length.	Arc.	Spark.	Wave length	Arc.	Spark.	Wave length.	Arc.	Spark.
4 225.10	5	3	4 732.58	5	4	6 857.14	5	....
4 225.87	7	3	4 743.64	6	3	6 887.65	5	....
4 238.77	5	4	4 758.67	6	2	6 916.58	7	....
4 251.75	8	10	4 767.23	6	2	6 957.71	4	....
4 262.09	9	10	4 786.80	5	1	6 985.86	7	....
4 280.54	7	5	4 801.03	5	3	6 991.89	6	....
4 316.05	5	3	4 821.69	6	2	6 996.77	10	....
4 325.66	9	5	5 015.03	6	2	7 006.13	5	....
4 327.11	8	4	5 092.24	5	2	7 037.24	5	....
4 341.25	7	5	5 103.46	5	1	7 050.97	4	....
4 342.18	10	10	5 155.84	6	1	7 054.61	4	....
4 346.45	8	2	5 342.98	5	1	7 068.07	4	....
4 347.25	5	3	5 350.36	5	1	7 118.90	4	....
4 387.63	5	3	5 353.21	5	1	7 122.58	5	....
4 401.86	5	3	5 370.69	5	....	7 147.37	5	....
4 406.67	4	10	5 393.64	8	....	7 168.3	10	....
4 419.04	5	8	5 535.16	7	....	7 172.30	6	....
4 421.27	3	8	5 617.91	5	....	7 189.64	5	....
4 422.44	6	3	5 643.24	5	....	7 201.43	4	....
4 436.18	6	10	5 696.20	8	....	7 252.72	5	....
4 438.23	5	8	5 701.35	5	....	7 262.7	5	....
4 476.13	5	3	5 733.86	6	1	7 301.24	4	....
4 506.24	6	2	5 751.85	5	....	7 313.28	4	....
4 519.62	5	3	5 754.20	5	....	7 324.91	5	....
4 540.01	4	10	5 913.56	4	1	7 394.91	4	....
4 582.50	5	3	6 114.07	6	1	7 464.37	4	....
4 596.97	4	4	6 305.16	5	1	7 563.02	6	....
4 597.90	4	5	6 634.4	5	....	7 733.50	4	....
4 601.03	5	5	6 752.67	5	....	7 846.36	3	...
4 683.34	5	2	6 828 30	6	....			
4 728.46	6	4	6 846.61	8	....			

Gallium

124.	..	0	1 192.9	..	6	1 845.0	..	8
425.	..	4	1 195.0	..	6	2 294.	1r	2
509.	..	3	1 228.0	..	7	2 338.	1r	....
511.	..	3	1 258.8	..	9	2 371.30	1	3
645.	..	2	1 264.6	..	6	2 418.70	1	4
800.4	..	5	1 267.1	..	7	I 2 450.07	1	4
828.8	..	5	1 279.2	..	7	I 2 500.18	2	7
839.9	..	5	1 285.3	..	7	I 2 659.87	2	7
860.4	..	5	1 293.5	..	6	I 2 719.66	3	8
874.4	..	6	1 295.9	..	10	2 780.2	..	9
909.3	..	5	1 299.5	..	9	I 2 874.24	10r	2
938.5	..	6	1 303.5	..	10	I 2 943.65	10r	2
989.5	..	6	1 338.1	..	7	I 2 944.20	5r	1
1 050.2	..	6	1 414.4	..	10	3 004.1	..	6
1 102.7	..	7	1 483.9	..	6	3 575.3	..	7n
1 120.6	..	5	1 495.4	..	10	3 806.8	..	5
1 133.6	..	6	1 534.5	..	10	4 033.01 p	10r	10r
1 135.9	..	5	1 586.3	..	8	4 172.05 P	10r	10r
1 136.9	..	5	1 625.3	..	7	4 864.9	..	5
1 156.1	..	7	1 799.2	..	7	I 6 396.8	10	5
1 163.5	.	6	1 802.3	..	7	I 6 413.74	8r	....
1 170.4	..	9	1 813.9	..	9			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Germanium

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
547.0	..	1	......	I 2 533.24	3	6	......
760.3	..	3	......	2 556.29	1	....	......
847.9	..	5	......	I 2 589.20	3	5	......
868.3	..	6	......	I 2 592.55	10	10r	......
892.6	..	5	......	2 644.18	2	2	......
915.0	..	8	......	I 2 651.18 p	10	10r	......
936.7	..	9	......	I 2 651.58 p	10	10r	......
938.9	..	6	......	I 2 691.35	10	10	......
989.0	..	6	......	2 709.68	10	10r	......
995 7	..	8	......	2 740.44	8	7	......
996.5	..	8	......	I 2 754.59	10	10r	......
1 004.2	..	6	......	2 793.94	3	2	......
1 011.2	..	9	......	2 829.01	3	2	.....
1 016.5	..	8	......	2 845.4	..	4	......
1 045.5	..	7	......	I 3 039.09 p	10r	10r	.....
1 058.8	..	6	......	3 067.04	7	1	......
1 072.4	..	6	......	I 3 124.83	10	5	......
1 088.3	..	8	......	I 3 269.50 p	10	10	......
1 098.6	..	5	......	4 179.0	..	10	......
1 105.0	..	6	......	I 4 226.73 p	7	10	......
1 116.8	..	6	......	4 260.81	..	10	......
1 138.0	..	8	......	4 291.56	..	3n	......
1 159.5	..	8	......	I 4 685.84	5	10	......
1 160.8	..	8	......	4 743.8	..	2	......
1 173.7	..	6	......	4 814.70	..	9	8
1 183.4	..	8	......	4 854.74	6	....	......
1 189.0	..	10	......	5 131.69	..	7	......
1 229.8	..	10	......	5 134.71	..	....	10
1 237.0	..	6	......	5 178.57	..	....	7
1 393.8	..	8	......	5 229.37	..	6	......
1 402.8	..	6	......	5 564.72	..	....	5
1 500.6	..	6	......	5 606.98	..	....	1
1 733.	..	6	......	5 621.41	..	....	6
2 198.71	..	2r	......	5 691.94	..	....	6
2 314.22	1	3	......	5 701.88	..	....	4
2 327.93	1	3	......	5 893.42	..	....	10
2 379.15	1	3	......	6 021.04	..	....	10
2 417.28	3	10	......	6 484.2	..	....	5
I 2 497.97	3	7	......				

Gold

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
458.	..	1	1 590.	..	3	1 727.	..	3
832.	..	5	1 600.	..	3	1 740.	..	4
854.	..	4	1 622.	..	4	1 767.	..	3
864.	..	5	1 629.	..	3	1 784.	..	5
975.	..	20	1 639.	..	3	1 795.	..	5
1 402.	..	2	1 659.	..	3	1 802.	..	5
1 435.	..	4	1 673.	..	6	1 822.4	..	4
1 488.	..	4(2)	1 694.	..	6	1 845.7	..	3
1 500.	..	4(2)	1 699.	..	3	1 850.1	..	2
1 534.	..	3	1 720.	..	3	1 861.1	..	3
1 562.	..	3	1 726.	..	4	1 871.1	..	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Gold (Continued)

Wave length.	Arc.	Spark.	Wave length	Arc.	Spark.	Wave length.	Arc.	Spark.
I 1 879.1	..	3	I 2 688.7	4	3	3 586.7	..	5
1 886.3	..	4	I 2 700.88	4	3	3 614.0	..	2
1 889.8	..	2	I 2 748.26	6r	4	3 633.25	..	3
1 903.9	..	2	2 780.83	..	3	3 649.1	..	3
I 1 918.9	..	4	2 802.21	..	10	3 706.8	..	4
1 921.0	..	4	2 819.98	..	8	3 804.0	..	5
I 1 951.2	..	3	2 822.7	..	3	3 825.7	..	3
1 977.3	..	8	2 825.4	..	4	3 853.6	1	2
2 000.6	..	3	2 838.0	..	3	3 874.7	..	2
2 082.0	..	3	I 2 883.45	4	3	I 3 897.89	4	8
2 110.7	..	2	I 2 891.95	4	2	I 3 909.39	2	2
2 201.3	..	3	2 905.90	6	3	4 016.1	..	4
2 229.0	..	3	2 907.1	..	4	I 4 040.95	2	2
2 242.7	..	3	2 913.5	4	10	4 052.8	..	5
2 283.3	..	3	2 932.19	5	4	I 4 065.08	6	8
2 291.51	..	3	2 954.4	..	4	I 4 084.14	1	2
2 304.80	..	4	2 963.77	2	1	I 4 241.82	1	3
2 314.67	..	3	2 970.41	2	....	I 4 315.1	1	3
2 340.22	..	3	2 973.25	2N	....	I 4 437.29	4	3
I 2 352.67	4	3	2 990.3	..	5	I 4 488.25	4	4
I 2 364.58	4	2	2 995.0	..	5	I 4 607.4	4	2
I 2 376.25	3	2	I 3 029.21	6>	5	I 4 792.62	8	6
I 2 387.77	4	3	3 033.4	2N	2N	I 4 811.61	3	2
I 2 427.98 P	10r	10r	3 117.0	4	1	I 5 064.61	2	2
2 503.3	..	5	3 122.5	..	5	5 230.30	2	3
I 2 510.51	4	2	I 3 122.79	6r	8	I 5 655.8	2	2
I 2 544.2	4	2	I 3 194.71	4	2	5 759.9	..	3
I 2 590.07	4	2	I 3 204.74	4	3	I 5 837.41	4	6
I 2 641.50	4	4	3 230.61	3	3	I 5 863.0	2	3
I 2 675.95 p	10r	10	I 3 308.31	2	2	I 5 957.0	2	3
2 687.6	..	3	I 3 320.16	3	2	I 6 278.2	4	3
2 688.2	..	3	3 553.55	2	4	I 7 510.7	5	....

Hafnium

Wave length.	Arc.	Spark.	Wave length	Arc.	Spark.	Wave length.	Arc.	Spark.
2 351.2	5	6	2 861.0	5	6	3 194.2	6	6
2 410.1	5	6	2 861.7	6	6	3 253.7	6	6
2 417.7	5	6	2 866.4	6	6	3 255.3	5	6
2 447.2	5	6	2 898.3 p	6	5	3 312.9	6	6
2 460.5	6	6	2 916.5 p	6	5	3 318.0	5	6
2 469.2	4	6	2 919.6	6	6	3 332.7	6	6
2 512.7	6	5	2 929.6	6	5	3 352.0	6	6
2 513.0 p	6	5	2 968.9	6	5	3 399.8	6	6
2 516.9 p	6	6	2 975.9	5	6	3 410.2	5	6
2 551.4	5	6	3 012.9	6	6	3 479.2	6	6
2 571.7	5	6	3 016.8	6	5	3 505.2	6	6
2 622.8	6	6	3 031.2	5	6	3 552.7	5	6
2 638.7	6	6	3 067.4	6	5	3 561.6	6	6
2 641.4 p	6	6	3 072.9 p	6	5	3 569.0	5	6
2 647.3	6	6	3 080.8	6	6	3 616.9	5	6
2 683.4	5	6	3 101.4	6	6	3 644.3	6	6
2 705.6	6	6	3 109.1	6	6	3 682.2	6	6
2 706.7	6	5	3 134.8 p	6	6	3 701.1	5	6
2 738.7	5	6	3 145.3	5	6	3 719.3	6	6
2 773.4 p	6	6	3 162.6	5	6	3 918.1	6	6
2 820.2 p	6	6	3 172.9	5	6	4 044.4	8	3
2 822.7	6	6	3 176.9	6	6	4 093.2 p	6	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Hafnium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
4 232.4	4	6	5 018.1	6	4	5 550.6	6	4
4 336.7	5	6	5 037.3	6	1	5 552.1	6	4
4 350.5	4	6	5 040.8	6	6	5 719.2	6	4
4 356.3	5	6	5 181.9	6	3	5 902.9	6	3
4 417.9	4	6	5 298.0	6	3	6 644.7	6	....
4 598.9	6	6	5 311.5	6	4	6 789.4	6	....
4 620.8	6	5	5 354.7	6	2	6 819.0	6	....
4 800.5	6	6	5 373.9	6	3	7 131.8	6	....
4 975.2	6	5	5 463.3	6	3			

Helium

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
I 585.? p	10	I 3 187.74	8	I 4 471.48	6
II 1 215.?	....	I 3 203.17	8	I 4 713.14	3
II 1 640.? p	5	I 3 447.59	2	I 4 921.93	4
I 2 252.81	2	I 3 613.64	3	I 5 875.62 p	10
I 2 306.12	2	I 3 819.60	4	I 6 678.15	6
I 2 385.39	5	I 3 888.65 P	10	I 7 065.19	5
I 2 511.22	5	I 3 964.73	4	I 7 281.35	3
I 2 733.24	7	I 4 026.19	5	I 10 829.	1
I 2 763.80	2	I 4 120.81	3	I 10 830.	5
I 2 829.06	4	I 4 143.76	2	I 20 581.	20
I 2 945.10	6	I 4 387.93	3	I 40 540.	....

Holmium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
2 433.0	..	10	3 574.80	5	10	4 356.72	8	8
2 774.70	..	10	3 598.77	10	10	4 629.1	8	5
2 936.77 p	..	10r	3 626.68	10	8	4 649.8	8	1
3 166.61	5	8	3 627.18	8	8	4 742.0	10	3
3 171.71	5	8	3 662.28 p	10	5	5 566.5	8	....
3 181.50	4	10	3 685.16	3	8	5 674.7	10	....
3 289.37	5	10	3 748.19 p	10	10	5 691.5	10	....
3 343.56	10	10	3 757.26	10	10	5 860.3	10	....
3 398.97	10	10	3 796.73	10	10	5 883.0	10	....
3 410.25	10	8	3 810.73	10	10	5 921.8	10	....
3 414.90	10	10	3 854.07	4	10	5 933.7	10	....
3 416.46	10	10	3 861.68	..	10	5 948.0	10	....
3 421.62	10	10	3 888.96	10	10	5 982.9	10	....
3 425.35	10	10	3 891.01 p	10	10	6 081.8	8	....
3 428.10	10	10	4 040.81	8	3	6 133.6	10	....
3 453.13	10	10	4 045.44	10	10	6 234.2	10	....
3 456.00	10	10	4 053.92	10	8	6 255.7	10	....
3 461.96	10	10	4 065.08	10	5	6 305.4	10	....
3 474.26	10	10	4 103.84	10	10	6 372.6	10	....
3 484.8	10	10	4 108.5	10	5	6 550.9	10	....
3 494.8	10	10	4 127.15	10	5	6 604.9	10	....
3 515.58	10	10	4 173.22	10	....	6 629.0	10	....
3 546.00	10	10	4 254.42	10	8	6 694.3	7	....
3 556.77	8	10	4 350.73	10	5			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Hydrogen, First Spectrum

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
972.54	....	3 671.34	....	3 835.40	....
992.	....	3 673.7	....	3 889.06	....
1 025.73	....	3 676.34	....	3 970.07	....
1 086.	....	3 679.35	....	4 101.74	....
1 215.68 p	....	3 682.82	....	4 340.47	....
3 656.6	....	3 686.83	....	4 861.33 p	....
3 657.6	....	3 691.55	....	6 562.73	....
3 658.0	....	3 697.15	....	6 562.85 p	....
3 660.3	....	3 703.86	....	9 500.	....
3 661.2	....	3 711.98	....	10 900.	....
3 662.2	....	3 721.95	....	12 817.	....
3 663.4	....	3 734.37	....	18 751.	....
3 664.6	....	3 750.15	....	26 300.	....
3 666.1	....	3 770.06	....	40 500.	....
3 667.7	....	3 797.91	....	74 000.	....
3 669.42	....				

Hydrogen, Second Spectrum

3 990.03	4	4 849.32	5	5 888.16	6
3 991.9	4	4 873.03	5	5 931.4	7
4 062.49	6	4 928.7	9	5 938.62	7
4 069.65	6	4 934.27	6	5 949.91	7
4 087.75	4	4 973.26	6	5 975.44	9
4 171.29	5	5 013.05	6	5 982.55	7
4 177.07	6	5 055.07	6	6 018.30	9
4 205.10	7	5 084.84	5	6 027.98	6
4 212.51	6	5 113.18	5	6 031.9	10
4 412.25	5	5 196.38	5	6 070.00	7
4 447.56	5	5 266.04	5	6 079.80	9
4 460.96	6	5 303.16	7	6 090.93	6
4 490.45	6	5 336.51	5	6 095.98	6
4 498.10	6	5 366.0	5	6 121.78	10
4 568.11	7	5 388.2	7	6 127.3	6
4 572.72	6	5 419.90	6	6 135.35	8
4 580.03	7	5 434.84	5	6 182.98	6
4 582.60	6	5 481.09	5	6 199.38	6
4 625.3	5	5 505.5	5	6 224.81	9
4 627.96	6	5 537.45	6	6 238.37	7
4 631.88	9	5 688.20	6	6 299.40	6
4 634.0	9	5 731.90	6	6 327.04	8
4 662.77	5	5 736.86	7	6 935.8	10
4 683.78	6	5 775.0	6	6 940.4	10
4 719.01	6	5 812.58	9	6 962.6	10
4 723.00	6	5 836.0	7	7 072.	10
4 797.74	5				

Indium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
161.8	..	0	684.	..	2	882.	..	4
583.	..	1	752.	..	1	954.7	..	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Indium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
973.	..	3	I 2 306.1	5	7	3 008.2	..	10
1 031.5	..	5	I 2 340.2	6r	....	I 3 039 36	10r	4r
1 054.	..	6	I 2 389.6	8r	....	I 3 256 06	10r	8r
1 082.	..	6	I 2 399.2	4r	....	I 3 258.54	6r	3
1 222.5	..	6	I 2 460.1	6r	....	I 4 101.8 p	8r	10
1 233.	..	6	I 2 468.0	4r	....	I 4 511.31 P	10r	10
1 320.	..	7	I 2 521.4	8r	1	4 638.9	..	10
1 381.	..	9	I 2 523.9	4r	....	4 656.6	..	10
1 406.	..	8	I 2 560.2	8r	3	4 681.9	..	10
1 435.	..	5	I 2 601.8	4r	1	5 248.6	..	10
III 1 488.	..	8	I 2 710.25	10r	3	5 644.87	..	10
1 521.6	..	9	I 2 713.94	6r	1	I 5 709.7	5	....
1 533.5	..	9	I 2 753.89	6r	3	5 819.9	4	10
II 1 625.6	..	10	2 836.9	8	....	6 097.0	..	7
III 1 749.2	1	12	2 890.23	..	5	6 197.8	..	6
1 966.7	2	9	I 2 932.66	6r	4	I 6 847.8	8	....
1 977.3	2	8	2 941.24	..	8	6 891.3	..	10
2 062.7	..	8	2 983.0	..	6	6 900.37	6	....
2 079.2	4	10						

Iodine

Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
1 234.2	....	3	3 686.6	3	8	5 065.5	....	6
1 336.7	....	6	3 688.3	3	8	5 119.3	....	10
1 355.5	....	6	3 724.9	3	8	5 161.2 p	10	10
1 390.9	....	5	3 741.9	3	8	5 204.1	....	10
1 425.7	....	8	3 808.2	5	10	5 216.2	1	10
1 458.2	....	6	3 897.4	5	10	5 234.6	....	10
1 459.2	....	6	3 931.1	....	10	5 245.6	4	10
1 514.8	....	9	3 940.1	....	10	5 265.2	1	$10_{(2)}$
1 518.3	....	7	4 128.7	2	10	5 269.4	1	10
1 641.1	....	7	4 221.1	3	10	5 309.0	....	8
1 642.5	....	7	4 342.1	1	8	5 338.2	3	10
1 782.9 p	....	9	4 399.0	1	8	5 345.1	3	10
1 830.4	....	10	4 410.1	1	10	5 369.7	1	10
1 844.5	....	9	4 434.3	1	10	5 405.3	1	$10_{(4)}$
1 876.4	....	7	4 453.0	2	10	5 407.3	1	10
2 062.1 p	....	10	4 512.6	1	8	5 435.7	1	10
3 038.4	4	5	4 528.1	1	8	5 437.9	....	8
3 055.2	10	3	4 574.3	1	10	5 464.7 p	5	10
3 077.9	....	6	4 632.4	2	10	5 491.5	....	$8_{(2)}$
3 081.7	8	5	4 640.8	....	10	5 493.3	....	$8_{(2)}$
3 194.0	10	8	4 666.5	....	10	5 496.9	2	$10_{(5)}$
3 275.0	5	10	4 675.6	....	10	5 598.7	....	$6_{(2)}$
3 288.3	10	10	4 708.0	....	8	5 612.9	....	6
3 303.0	3	10	4 730.5	1	8	5 625.7	1	10
3 342.5	3	8	4 763.4	1	10	5 678.1	1	$10_{(2)}$
3 350.1	2	8	4 806.5	....	8	5 690.8	1	$10_{(2)}$
3 461.0	3	8	4 850.4	....	10	5 710.4	1	10
3 481.8	1	8	4 862.3	....	10	5 738.5	....	10
3 498.0	4	8	4 896.7	....	10	5 739.5	....	10
3 561.2	3	8	4 916.9	....	10	5 774.8	1	10
3 583.3	3	8	4 987.0	....	10	5 787.1	....	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iodine (Continued)

Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.	Wave length.	Spark.	Geissler tube.
5 830.0	....	6	6 127.4	....	8	6 339.5	....	6
5 893.8	....	8	6 204.7	....	6	6 359.1	....	4
5 950.1	1	10	6 257.4	....	4	6 488.1	....	4
6 023.9	....	6	6 293.9	....	6	6 560.3	....	4
6 074.9	....	6	6 337.9	....	4	6 585.0	....	4
6 082.3	....	10						

Iridium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 024.4	..	4	3 448.99	7	4	5 123.66	8	....
2 051.1	..	5	3 513.67 p	9	8	5 177.93	8	....
2 092.7	..	3	3 515.96	6	3	5 238.92	10	....
2 221.1	..	5	3 522.05	6	4	5 273.77	6	....
2 372.78	4	2	3 573.74	6	6	5 340.74	8	....
2 475.11	4	2	3 605.83	2	10	5 364.32	10	....
2 512.57	2	5	3 609.78	6	3	5 385.62	7	....
2 543.98	5	4	3 617.23	6	4	5 390.98	7	....
2 661.99	6	3	3 628.69	7	5	5 449.50	10	1
2 664.77	5	3	3 636.22	6	3	5 454.50	10	....
2 694.22	6	3	3 653.20	1	6	5 620.05	6	....
2 712.72	4	2	3 661.72	5	3	5 625.55	10	....
2 774.98	2	5	3 675.00	4	4	5 709.32	6	....
2 823.18	5	2	3 731.35	4	8	5 736.23	5	....
2 824.44	6	4	3 734.75	2	6	5 768.89	4	....
2 833.23	4	10	3 747.21	5	6	5 778.28	4	....
2 839.18	6	2	3 800.10	6	6	5 828.54	7	....
2 849.74 p	7	4	3 895.6	..	8	5 873.49	5	....
2 924.81 p	8	4	3 915.38	4	6	5 882.29	9	....
2 934.63	6	3	3 976.33	5	10	5 887.38	5	....
2 936.71	5	3	3 992.14	6	6	5 894.09	10	....
2 943.17	7	4	4 020.05	5	8	6 026.12	5	....
2 951.23	5	3	4 033.77	4	4	6 067.85	7	....
3 039.25	5	3	4 069.93	4	8	6 110.68	8	....
3 042.63	2	6	4 115.80	4	5	6 211.33	4	....
3 100.42	8	3	4 259.12	4	2	6 288.3	7	....
3 120.77	5	3	4 268.09	4	5	6 334.45	6	....
3 133.31	6	5	4 311.50	5	4	6 496.9	4	....
3 168.88	5	3	4 399.48	6	8	6 624.74	5	....
3 198.93	5	1	4 426.29	6	4	6 686.08	7	....
3 220.79 P	8	5	4 616.37	6	2	6 830.06	4	....
3 229.28	5	3	4 778.15	4	2	6 888.72	4	....
3 241.52	5	3	4 938.07	10	....	6 893.4	4	....
3 266.45	8	3	4 970.46	8	....	6 929.9	5	....
3 277.28	4	2	4 999.72	10	....	7 037.85	4	....
3 334.19	5	3	5 002.70	10	....	7 183.74	5	....
3 368.50	8	3	5 015.00	10	....	7 834.32	5	....
3 437.05 p	8	4	5 046.06	8	....			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
294.3	..	2	2 191.8	5	....	2 383.25	4	2
365.8	..	5	2 196.0	5	....	2 388.63	6	3
381.1	..	4	2 199.5	5	....	2 389.98	4	....
392.9	..	7	2 200.7	5	....	2 395.42	4	3
417.5	..	4	2 213.6	4	....	II 2 395.63 p	8	4
552.1	..	7	2 221.3	4	....	2 399.24	6	5
602.4	..	4	2 229.1	6	....	2 404.43	4	2
609.1?	..	9	2 231.2	7	....	II 2 404.89 p	6	6
666.9	..	4	2 240.6	5	....	2 406.66	6	4
669.9	..	4	2 245.6	6	....	II 2 410.53 p	6	5
859.9	..	4	2 248.9	6	....	2 411.07	6	3
863.2	..	3	2 249.2	7	....	2 413.31 p	6	3
929.2	..	3	2 251.9	6	....	2 439.75	4	1
983.8	..	3	2 253.2	6	....	2 442.57	4	1
1 006.0	..	2	2 255.8	7	....	2 443.87	4	1
1 017.6	..	6	2 260.8	6	....	2 444.5	..	4
1 031.8	..	4	2 265.2	5	....	I 2 447.72	4	2
1 062.1	..	2	2 266.9	5	....	2 453.48	4	1
1 143.4	..	2	2 267.1	5	....	2 457.60	6	1
1 186.4	..	2	2 267.6	5	....	I 2 462.19	6	1
1 228.9	..	2	2 272.8	5	....	I 2 462.65	6	1
1 254.1	..	2	2 274.1	5	....	2 465.16	5	....
1 260.8	..	2	I 2 276.0	5	....	2 468.88	5	1
1 272.2	..	2	2 279.9	6	....	2 472.35	5	....
1 373.9	..	2	2 280.2	6	....	I 2 472.87	5	....
1 387.8	..	2	2 287.3	5	....	I 2 472.91	4	1
1 409.4	..	2	2 287.6	5	....	2 473.16	4	....
1 430.6	..	2	2 289.0	6	....	2 474.82	5	2
1 525.5	..	2	2 290.6	5	....	I 2 479.78	4	1
1 532.3	..	2	2 291.1	6	....	2 483.28	5r	1
1 538.3	..	2	2 292.5	5	....	2 483.54	4	....
1 597.7	..	2	I 2 297.8	6	....	I 2 484.19	6	....
1 630.9	..	2	I 2 298.2	7	....	2 486.38	4	3
1 702.0	..	3	I 2 299.2	5	....	2 486.69	4	1
1 718.3	..	2	2 300.1	5	....	2 487.07	4	1
1 724.0	..	2	2 310.01	5	....	2 487.37	4	1
1 787.0	..	5	2 313.1	5	....	I 2 488.15	4	2
1 788.3	..	5	2 327.39	6	....	I 2 489.76	6	....
1 843.9	..	2	2 332.80	6	....	I 2 490.66	4	....
1 869.7	..	4	2 338.01	6	....	I 2 491.16	4	....
1 895.6	..	4	2 343.50	7	....	2 493.3	..	8
1 913.3	..	4	2 344.3	4	....	2 496.54	5	1
1 914.2	..	3	2 348.12	5	....	2 507.90	4	1
1 953.6	..	2	2 348.3	5	....	I 2 510.84	6	1
2 000.3	3	....	2 351.2	4	....	2 511.8	..	5
2 020.6	3	....	2 354.9	6	....	2 512.37	4	....
2 040.6	3	....	2 359.11	6	....	2 517.66	4	1
2 063.7	3	....	II 2 360.3	5	....	I 2 518.11	6	1
2 084.2	4	....	2 362.1	8	....	I 2 522.86	4	3
2 093.7	4	....	2 364.83	8	....	2 523.66	4	1
2 106.4	4	....	2 366.59	5	....	I 2 524.29	6	1
2 139.7	5	....	II 2 368.59	7	....	2 525.4	..	4
2 144.4	5	....	2 370.5	6	....	I 2 527.44	4	2
2 151.7	5	....	2 373.62	4	....	I 2 529.14	6	1
2 159.9	5	....	II 2 373.73	6	4	I 2 529.84	6	....
2 165.8	5	....	II 2 375.19	4	....	2 533.7	..	5
2 166.8	6	....	2 379.28	4	3	I 2 535.61	6	....
2 171.3	5	....	2 380.76	4	3	2 537.18	6	....
2 178.1	5	....	II 2 382.04 P	8	10	I 2 540.98	6	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

IRON (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	2 542.11	5	1		2 696.29	5	....		2 778.85	4	1
	2 543.93	5	1		2 699.11	4	1		2 779.30	3	4
	2 544.72	4	....		2 704.00	3	4	I	2 781.80	4	1
I	2 549.62	6	....		2 706.59	5	2		2 783.69	3	5
II	2 562.54	5	5		2 708.58	4	1		2 787.94	4	....
	2 563.48	5	4		2 710.55	4	1		2 788.11	6	2
	2 566.92	4	3		2 711.66	5	....		2 789.81	3	1
	2 570.54	3	1	II	2 714.42	6	5		2 791.79	3	1
	2 570.86	3	3		2 714.88	4	....		2 797.78	4	1
	2 574.37	3	4		2 718.45	4	1		2 804.52	7	1
	2 575.76	4	1		2 719.04	7	2		2 806.99	7	2
	2 576.70	4	....		2 719.43	4	2	I	2 813.29	9	2
	2 576.87	4	3	I	2 720.91	7	2		2 823.28	7	2
	2 577.94	4	3	I	2 723.58	6	2		2 825.56	6	1
	2 582.31	4	....		2 724.89	3	3	I	2 825.69	4	1
II	2 582.59	4	4		2 724.96	4	....	I	2 827.89	4	1
	2 584.54	4	1		2 726.06	4	1		2 831.56	3	4
II	2 585.88	7	10		2 726.24	3	1		2 832.44	6	1
	2 587.96	3	....		2 727.39	3	2		2 838.12	6	1
	2 588.01	5	3		2 727.54	5	6		2 843.63	5	1
II	2 591.55	4	4		2 728.03	4	1		2 843.97	7	2
	2 592.80	4	4		2 730.74	4	3		2 845.60	4(2)	2
	2 598.38	7	8	I	2 733.58	9	2		2 848.72	4	1
II	2 599.40	6	10		2 734.01	4	1		2 851.80	8	2
	2 599.57	3	....		2 734.27	4	1	I	2 858.90	4	....
	2 606.83	5	....	I	2 735.48	8	2		2 863.43	4	1
	2 607.10	7	10	II	2 736.97	4	4	I	2 863.87	5	1
II	2 611.88	8	10	I	2 737.31	6	1		2 866.63	4	1
	2 613.84	8	8	II	2 739.55	9	10	I	2 869.31	6	1
	2 617.62	6	6	I	2 742.26	4	1		2 872.34	4	3
	2 618.03	4	1	I	2 742.41	6	1	I	2 874.18	7	1
	2 619.08	3	2	II	2 743.20	6	8		2 877.30	5	1
	2 620.42	3	2	I	2 744.07	8	1		2 887.81	4	1
	2 620.70	3	2		2 744.53	5	1		2 894.51	4	1
	2 621.67	6	4	II	2 746.49	7	10		2 895.04	4	1
	2 623.54	4	1	II	2 746.99	7	8		2 899.42	4	1
	2 625.50	4	3		2 749.18	4	....	I	2 912.16	8	2
II	2 625.68	8	4	II	2 749.32	7	10		2 918.03	5	2
	2 628.30	6	8	I	2 750.15	6	2	II	2 926.58	7	3
I	2 629.60	5	3		2 750.87	4	....	I	2 929.01	7	1
	2 630.08	3	2		2 753.29	4	5	I	2 936.90	7r	2
	2 631.05	6	4		2 753.69	4	1		2 937.81	6	....
	2 631.33	6	3	I	2 754.03	4	1	I	2 941.35	8	3
	2 632.25	4	1	II	2 755.74	8	10		2 944.40	4	4
	2 635.82	4	1	I	2 756.33	5(2)	1		2 947.66	4	4
	2 641.65	3	1		2 757.32	4	1	I	2 947.88	5	3
	2 651.72	3	1		2 759.82	4	1		2 948.44	4	1
	2 656.15	3	1	I	2 761.79	5	2		2 950.25	6	1
	2 664.67	3	4		2 761.81	4	....	I	2 953.94	4	2
	2 666.64	3	4	I	2 762.03	5	1	I	2 957.37	5	2
	2 666.82	4	....		2 763.11	4	1		2 960.00	4	2
	2 679.06	6	2		2 764.33	4	1	I	2 965.26	5	2
	2 681.59	4	....	I	2 766.91	4	1	I	2 966.90	6r	3
	2 684.76	3	4	I	2 767.52	7	5	I	2 969.48	4	2
	2 689.22	5	2		2 772.08	4	....	I	2 970.11	4	2
	2 689.84	4	1	I	2 772.11	6	1	I	2 973.14	4	2
	2 692.61	3	4		2 773.23	4	1	I	2 973.24	4	2
	2 694.54	4	....	I	2 774.73	4	2	I	2 981.45	4	2
	2 696.00	4	....	I	2 778.23	6	1	II	2 984.83	4	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

IRON (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
								1
I 2 987.30	5	1	3 171.35	4	1	3 341.91	4	1
2 990.40	4	1	3 175.45	6	1	3 347.93	4	1
I 2 994.44	6r	3	3 178.01	6	1	3 355.23	4	
2 999.52	5	2	3 180.23	8	2	3 370.79	6	2
3 000.45	4	1	I 3 180.77	4	....	3 378.68	4	1
I 3 000.95	5	2	3 181.53	4	1	3 379.02	4	1
3 007.15	4	1	I 3 184.90	4	1	3 380.12	5	1
I 3 007.29	4	1	3 188.84	5	1	3 383.70	4	1
3 008.15	5	2	3 191.66	5	1	3 383.99	5	1
I 3 009.58	5	2	3 192.81	5	2	3 392.31	4	2
3 011.49	4	1	3 196.94	4	2	3 392.66	5	2
I 3 017.63	5	2	I 3 199.53	6	1	3 394.59	4	1
I 3 018.99	5	2	3 200.48	6	1	3 399.34	6	2
I 3 020.50	5	2	3 205.40	7	1	3 402.26	4	1
I 3 020.65	6r	3	3 210.25	4	1	3 404.35	6(2)	2
I 3 021.08	6r	3	3 210.84	5	1	3 407.46	7(2)	4
I 3 024.04	5	2	3 211.70	4	1	3 413.14	7	3
3 025.64	4	2	3 212.00	4	2	3 417.85	6	2
I 3 025.85	5	2	II 3 213.32	4	2	3 418.51	5	2
I 3 026.47	6	2	3 214.05	8	2	3 422.66	4	2
3 030.16	4	2	3 215.94	5	2	3 424.29	6	2
3 031.22	4	2	3 217.39	4	1	I 3 426.39	4(2)	1
I 3 031.64	5	2	3 219.58	5	....	3 426.64	6	1
I 3 037.39	5	3	3 219.82	4	....	3 427.12	6	4
3 040.43	4	2	3 222.07	6	3	3 428.20	6	2
I 3 041.75	4	2	3 225.79	8	3	I 3 440.61	7r	4
I 3 042.03	4	1	II 3 227.76	4	5	I 3 440.99	6r	4
I 3 042.67	5	2	3 227.82	4	5	3 442.37	4	1
3 045.09	4	....	3 228.26	4	1	I 3 443.88	6r	3
I 3 047.61	6	3	3 233.06	5	2	3 445.15	4	2
3 053.07	4	1	3 233.98	6	....	3 447.28	6	1
3 055.27	4	....	3 234.62	5	1	3 450.33	6	1
I 3 057.45	5	3	I 3 236.23	5	1	3 451.92	6	1
I 3 059.09	5r	3	3 239.44	8	2	I 3 452.28	4	1
3 067.12	4	....	3 244.19	8	2	3 459.92	4	1
I 3 067.25	5	3	3 246.97	4	1	I 3 465.87	6r	3
3 068.18	4	1	3 248.21	6	1	3 468.85	4	1
I 3 075.73	5	3	3 251.24	5	1	I 3 475.46	6r	3
I 3 083.75	4	3	3 254.37	4	2	3 475.65	4	....
I 3 091.58	4	2	3 257.60	4	1	I 3 476.71	5	3
I 3 099.90	4	....	3 264.52	4	1	I 3 483.01	4	1
I 3 099.97	4	4	3 265.05	3	1	3 485.34	6	1
I 3 100.31	4	2	3 265.62	6	2	3 489.67	4	1
I 3 100.67	4	3	3 268.25	4	....	I 3 490.58	6r	4
I 3 116.64	5	1	3 271.01	6	2	3 497.11	4	2
3 119.50	4	1	3 280.27	5	1	I 3 497.84	5	3
3 120.44	4	1	3 282.90	4	1	3 506.50	5	1
I 3 125.66	6	2	3 284.59	4	1	I 3 513.82	5	3
3 129.34	4	....	3 286.76	8	3	I 3 521.27	5	3
I 3 134.11	5	1	3 290.99	4	1	3 524.08	4	1
3 142.45	4	1	3 292.03	5	1	3 524.24	4	1
3 142.89	4	1	3 292.60	5	1	I 3 526.02	4	2
3 143.99	6	1	3 298.14	5	1	I 3 526.17	5	2
3 151.35	6	1	3 305.98	8	3	3 526.38	3	....
3 157.04	4	1	3 306.36	8	3	3 526.47	4	1
3 157.88	4	1	3 314.75	6	1	3 526.67	5	1
3 160.66	6	1	3 323.74	4	1	3 527.80	4	1
3 161.95	5	1	3 328.87	4	1	3 530.38	4	1
3 166.44	4	1	3 337.67	4	1	3 533.01	4	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	3 533.20	5	2	I	3 687.46	6r	4		3 867.22	3	2
	3 536.56	6	3		3 689.46	6	2	I	3 872.51	6	4
	3 537.78	4	1		3 694.00	6	2		3 873.77	4	2
	3 540.13	4	1		3 701.09	6	2	I	3 878.02	6	4
	3 541.09	6	3		3 704.46	5	2	I	3 878.58	6r	5
	3 542.08	6	3	I	3 705.57	6r	4		3 878.66	4	....
	3 545.64	5	1		3 707.83	3	....	I	3 886.29	7r	5
	3 553.74	5	2		3 707.92	5	4 (?)	I	3 887.05	6	3
	3 554.93	8	4	I	3 709.25	6	4	I	3 888.52	7	4
	3 556.88	6	2		3 716.45	6	....		3 891.93	4	1
I	3 558.52	5	4	I	3 719.94 P	8r	10		3 893.40	4	2
I	3 565.38	6r	5	I	3 722.57	6r	4	I	3 895.66	5	3
	3 568.98	4	1		3 724.38	6	2		3 897.90	4	2
I	3 570.10	7r	10	I	3 727.62	6r	5	I	3 898.01	4	2
	3 570.24	7	....		3 732.40	6	1	I	3 899.71	6	4
	3 572.00	7	2	I	3 733.32	6r	3	I	3 902.95	7	5
	3 576.76	4	1	I	3 734.87	9r	10		3 903.90	3	1
	3 581.20	8r	10	I	3 737.14 p	7r	6	I	3 906.48	5	3
	3 582.20	4	2		3 738.31	4	2		3 907.94	3	1
	3 584.66	5	2		3 743.47	4	6	I	3 917.19	5	2
	3 584.96	5	2	I	3 745.56 p	7r	5		3 918.65	4	1
I	3 585.32	6	3	I	3 745.90 P	6	4	I	3 920.26	6	4
I	3 585.71	5	3	I	3 748.27 p	6r	4	I	3 922.92	6r	4
	3 586.12	5	3	I	3 749.49	8r	10	I	3 927.92	6	4
I	3 586.99	6	3	I	3 753.62	5	2	I	3 930.30	7r	4
I	3 589.11	4	1	I	3 758.24	7r	8		3 935.82	4	1
	3 589.45	3	1		3 760.05	5	2	I	3 940.88	4	1
	3 603.21	5	3	I	3 763.79	6r	6		3 942.45	3	1
	3 605.46	5	3		3 765.54	6	3		3 948.78	4	2
	3 606.68	5	4	I	3 767.20	6r	5		3 949.96	4	2
	3 608.86	6r	6		3 785.95	5	2		3 951.17	4	2
	3 612.08	4	1		3 787.88	6r	4		3 952.61	4	1
	3 617.79	6	3		3 790.10	4	2		3 956.46	4	2
I	3 618.77	6r	6	I	3 795.01	6	5		3 956.68	6	3
	3 621.46	6	3		3 797.52	5	3	I	3 966.07	5	2
	3 622.01	6	3	I	3 798.51	6	4		3 967.43	4	2
	3 623.19	5	2	I	3 799.55	6	5	I	3 969.26	7	5
	3 625.15	4	1		3 805.35	6	3		3 971.33	4	1
	3 631.10	5	1		3 806.70	6	3		3 977.75	5	2
I	3 631.47	6r	6	I	3 807.54	4	2		3 983.97	5	2
	3 632.04	6	2	I	3 812.97	6	4		3 997.40	6	3
	3 634.34	5	1	I	3 815.84	7r	10		3 998.06	5	2
	3 637.86	4	1	I	3 820.43	8r	10	I	4 005.25	7	6
	3 638.30	6	2		3 821.13	6	3		4 009.72	5	2
	3 640.39	6	3	I	3 824.45	6r	5		4 014.54	4	2
	3 645.83	4	2	I	3 825.89	8r	8		4 021.87	5	2
I	3 647.85	6r	6	I	3 827.83	6r	8	I	4 045.82	8r	10
	3 649.51	6	3		3 833.31	4	1		4 062.45	4	2
	3 651.74	6	3	I	3 834.23	7r	6	I	4 063.60	8r	10
	3 655.47	4	1		3 839.26	5	2		4 066.98	4	1
	3 659.52	5	1	I	3 840.44	6r	4		4 067.28	3	1
	3 669.52	6	2	I	3 841.05	6r	5		4 067.99	5	1
	3 676.31	4	1		3 843.26	5	2	I	4 071 74	7	8
	3 677.63	6	2	I	3 849.97	6	4		4 074.79	3	1
I	3 679.92	5	3	I	3 850.82	5	2		4 076.64	5	2
	3 682.24	6	3	I	3 856.37	6r	5		4 107.49	5	2
I	3 683.06	4	2		3 859.22	5	2		4 109.81	4	2
	3 684.11	5	2	I	3 859.91	7r	6		4 114.45	4	1
	3 686.00	5	2	I	3 865.53	6	4		4 118.55	6	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
4 127.62	4	1	I 4 531.15	5	2	II 5 169.03	2	5
I 4 132.06	7	4	4 547.85	3	2	I 5 171.60	7	2
4 134.68	5	2	I 4 592.66	4	2	I 5 191.46	7	2
4 143.42	5	3	I 4 602.95	3	2	I 5 192.35	8	2
I 4 143.87	7	5	I 4 607.66	4	1	I 5 194.95	5	1
I 4 147.68	4	1	4 611.29	4	2	I 5 198.72	4	1
4 154.82	4	2	4 619.30	4	1	I 5 202.34	5	1
4 156.80	4	2	4 630.13	3	4	I 5 216.28	5	1
4 175.64	4	2	I 4 632.92	3	1	5 227.19	8	4
4 181.76	6	4	4 638.02	4	1	I 5 232.95	8	5
4 184.90	4	2	4 647.44	4	2	5 242.50	3	1
4 187.05	6	4	I 4 654.50	4	....	I 5 266.57	8	3
4 187.81	6	4	4 667.46	4	2	I 5 269.54	10	8
4 191.44	6	3	4 678.86	5	2	5 270.36	8	4
4 198.31	6	3	4 691 42	4	2	I 5 281.80	5	2
4 199.10	6	5	I 4 707.28	5	2	I 5 283.63	7	2
I 4 202.03	7	6	4 710.29	3	1	I 5 302.31	5	2
4 210.36	6	3	I 4 733.60	3	1	I 5 324.19	6	5
4 216.19	4	1	4 736.78	5	3	I 5 328.04	7	6
4 219.37	5	3	4 741.53	3	1	5 328.54	4	2
4 222.22	5	2	4 786.81	3	1	5 341.03	5	2
4 225.46	4	1	4 789.66	3	2	I 5 371.50	7	6
4 227.44	7	4	I 4 859.75	2	2	5 383.37	5	6
4 233.61	6	3	I 4 871.33	8	4	I 5 397.13	6	6
4 235.95	8	4	I 4 872.15	6	3	I 5 405.78	6	6
4 238.82	4	2	I 4 878.22	5	2	5 415.19	4	6
4 247.44	5	2	I 4 890.77	7	4	5 424.06	4	8
4 250.13	7	4	I 4 891.50	9	5	I 5 429.70	6	6
I 4 250.79	8	6	I 4 903.32	5	2	I 5 434.53	6	5
4 260.48	10	10	I 4 919.00	8	4	I 5 446.92	6	6
I 4 271.77	8	10	I 4 920.52	10	8	I 5 455.61	6	6
4 282.41	6	3	I 4 938.83	5	1	I 5 473.91	3	1
I 4 294.13	6	4	I 4 957.31	7	3	I 5 497.52	4	2
4 299.24	7	4	I 4 957.61	10	8	I 5 501.47	4	2
I 4 307.91	8	10	4 966.10	5	1	I 5 506.78	4	2
I 4 315.09	5	3	4 983.86	4	1	5 563.61	3	1
I 4 325.77	9	10	I 4 994.14	3	1	I 5 569.63	5	2
I 4 337.05	5	2	5 001.87	5	2	I 5 572.85	5	3
4 352.74	4	2	I 5 006.13	5	2	I 5 576.10	4	1
4 369.78	3	2	I 5 012.07	4	2	I 5 586.77	6	4
4 375.93	5	2	5 041.08	3	1	5 598.30	3	1
I 4 383.55	10	10	I 5 041.76	3	1	I 5 615.66	6	4
I 4 404.75	8	10	I 5 049.83	5	2	I 5 624.55	5	1
I 4 408.42	4	1	I 5 051.64	4	1	I 5 658.83	4	1
I 4 415.13	8	10	I 5 079.23	3	1	5 701.55	3	....
4 422.57	4	2	I 5 079.74	3	1	I 5 709.39	3	1
4 427.31	5	2	I 5 083.34	4	1	5 717.85	3	....
I 4 430.62	4	1	I 5 098.71	7	1	5 731.77	3	....
I 4 442.35	5	2	I 5 107.65	4	1	5 763.01	4	1
I 4 447.72	5	2	5 110.42	4	1	5 862.35	4	....
I 4 459.13	5	3	I 5 123.73	4	1	5 883.84	4	....
4 461.66	4	2	I 5 127.36	3	1	5 914.16	6	1
4 466.56	5	3	5 133.68	5	2	5 930.17	5	....
4 469.39	4	3	I 5 139.27	6	2	5 934.68	4	1
4 476.02	7	4	I 5 139.48	8	3	5 952.74	4	1
I 4 482.26	4	4	I 5 150.84	4	1	6 024.06	4	2
4 489.75	3	1	I 5 151.92	3	1	6 027.06	3	1
I 4 494.57	4	5	5 166.29	3	1	6 065.49	4	2
I 4 528.62	7	6	5 167.49	8	4	6 136.62	4	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Iron (Continued)

Wave length.	Arc.	Spark.	Wave length	Arc.	Spark.	Wave length.	Arc.	Spark
6 137.70	4	3	7 068.42	5	....	8 999.5	4	....
6 157.73	2	1	I 7 090.41	6	....	9 079.6	4	....
I 6 173.34	3	1	I 7 130.95	10	....	9 088.2	4	....
6 191.57	5	3	I 7 164.48	9	....	9 089.4	4	....
I 6 213.44	3	1	7 187.34	10	....	9 100.5	2	....
6 230.73	5	3	I 7 207.42	10	....	9 118.9	4	....
6 246.34	4	1	I 7 239.90	4	....	9 210.0	2	....
6 252.57	4	2	I 7 288.78	4	....	9 258.5	3	....
I 6 265.14	4	1	I 7 293.08	6	....	I 9 350.5	1	....
I 6 297.80	3	....	7 386.40	4	....	9 738.7	2	....
I 6 301.52	5	1	I 7 389.43	7	....	10 063.	2	....
6 318.03	4	1	I 7 411.19	8	....	10 144.	3	....
I 6 335.34	4	1	I 7 445.78	9	....	11 641.	3	....
6 336.84	4	1	I 7 495.10	8	....	11 884.	5	....
6 393.61	5	2	7 511.05	9	....	11 975.	8	....
6 400.02	5	3	7 531.18	4	....	12 034.	3	....
6 408.04	4	....	I 7 568.93	4	....	13 564.	5	....
6 411.67	5	1	7 586.07	7	....	13 899.	5	....
6 421.36	4	1	7 664.30	4	....	14 237.	4	....
I 6 430.86	5	1	7 748.29	4	....	14 288.	4	....
6 462.74	4	....	7 780.60	5	....	14 402.	10	....
6 494.99	5	3	7 832.24	6	....	14 513.	8	....
6 546.25	5	1	I 7 937.18	9	....	14 558.	4	....
6 569.23	5	....	7 945.89	7	....	14 711.	2	....
6 592.92	5	1	I 7 998.98	6	....	14 828.	2	....
6 609.12	4	....	I 8 046.09	5	....	15 054.	2	....
6 663.45	4	....	8 085.21	5	....	15 213.	4	....
6 678.00	5	....	8 220.42	7	....	15 296.	4	..
6 750.16	4	....	I 8 327.06	8	....	15 396.	3	....
6 828.61	4	....	I 8 331.95	6	....	15 625.	3	....
6 841.36	5	....	I 8 387.79	8	....	15 771.	4	....
6 843.68	4	....	I 8 468.42	7	....	15 815.	3	....
6 855.18	6	....	I 8 661.92	6	....	15 821.	3	....
6 885.77	4	....	I 8 688.64	7	....	16 166.	2	....
6 916.71	4	....	I 8 824.25	6	....	16 317.	2	....
6 945.21	7	....	8 838.4	2	....	25 987.	3	....
6 978.86	7	....	8 866.9	3	....	26 229.	2	....

Krypton

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
2 227.9	6	2 320.8	6	2 413.9	9
2 237.0	5	2 329.2	8	2 415.0	9
2 245.3	6	2 344.5	8	2 418.2	10
2 273.1	6	2 359.9	10	2 420.2	10
2 277.4	7	2 362.9	8	2 426.4	9
2 282.8	10	2 371.5	8	2 428.3	10
2 287.7	10	2 375.6	10	2 439.2	8
2 300.3	8	2 392.8	7	2 442.6	7
2 301.6	8	2 394.0	8	2 446.5	8
2 211.9	8	2 398.3	10	2 452.3	6
2 314.1	8	2 406.3	6	2 453.3	6
2 315.4	9	2 408.5	7	2 456.1	8
2 316.2	10	2 409.1	8	2 457.7	8

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Krypton (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
2 459.6	7	3 679.5	4	4 489.9	4
2 464.8	8	3 680.4	7	4 501.0	7
2 478.9	4	3 686.1	6	4 502.2	9
2 506.6	9	3 690.6	5	4 523.1	5
2 592.5	5	3 718.0	10	4 524.6	4
2 620.4	4	3 718.6	8	4 556.6	4
2 639.8	4	3 721.3	7	4 577.2	6
2 648.2	4	3 735.8	5	4 582.7	4
2 681.2	4	3 741.69	10	4 615.3	5
2 712.4	8	3 744.8	9	4 619.12	6
2 795.8	5	3 754.2	5	4 624.28	10
2 816.5	6	3 778.11	10	4 633.88	5
2 833.0	6	3 783.2	10	4 658.9	5
2 892.2	5	3 796.9	4	4 671.23	10
2 967.3	5	3 860.4	5	4 680.5	4
3 046.9	5	3 863.8	5	4 694.9	4
3 063.1	5	3 875.4	7	4 734.1	4
3 124.4	6	3 894.7	5	4 738.96	7
3 141.3	6	3 906.2	8	4 762.45	5
3 189.1	7	3 912.3	5	4 765.7	6
3 191.2	6	3 917.6	6	4 807.0	4
3 200.4	6	3 920.4	8	4 829.7	3
3 207.8	8	3 954.7	5	5 498.0	3
3 239.5	6	3 994.8	6	5 519.4	4
3 240.4	6	3 997.9	5	5 562.2	6
3 245.7	10	4 044.6	5	5 570.29 p	10
3 264.8	8	4 050.5	5	5 633.0	6
3 268.5	7	4 057.01	8	5 660.1	3
3 311.5	6	4 065.05	8	5 681.9	5
3 320.3	10	4 088.36	8	5 870.92 p	10
3 325.7	9	4 098.7	7	6 056.1	2
3 330.7	7	4 109.2	6	6 456.3	5
3 351.9	6	4 145.12	6	6 904.6	5
3 405.1	7	4 273.97	10	7 587.40	10
3 439.5	6	4 282.97	4	7 601.55	10
3 446.5	7	4 292.94	6	7 685.22	7
3 460.1	6	4 300.5	5	7 694.53	8
3 470.0	7	4 318.0	5	7 854.81	7
3 474.6	7	4 318.55	8	8 059.47	4
3 488.6	8	4 319.58	10	8 104.33	7
3 503.2	6	4 355.47	10	8 112.89	10
3 507.4	9	4 362.6	9	8 190.02	6
3 535.3	6	4 376.1	10	8 263.22	4
3 589.6	7	4 399.9	6	8 281.02	3
3 599.9	6	4 436.8	4	8 298.07	6
3 607.9	9	4 453.91	10	8 508.85	2
3 631.9	10	4 463.68	10	8 776.73	5
3 653.96	10	4 475.0	4	8 928.72	1
3 669.0	9				

Lanthanum

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
2 297.8	..	7	2 476.7	..	7	2 651.7	..	8
2 379.4	..	10	2 610.34	4	5	2 808.36	5	3

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

LANTHANUM (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 171.7	..	10	4 383.45	6	8	5 808.32	5r	1
3 245.12	6	4	4 385.18	5	4	5 821.99	6r	1
3 249.35	5	3	4 427.56	7	8	5 823.83	4r	....
3 265.65	6	4	4 429.90	10	10	5 829.73	4r	....
3 303.11	6	5	4 452.17	6	1	5 845.03	4r	....
3 337.49	8	10	4 522.38	9	10	5 848.36	4r	....
3 344.56	8	7	4 525.29	6	8	5 855.59	4r	....
3 380.91	8	10	4 526.11	8	8	5 863.70	5r	2
3 517.1	..	10	4 549.50	6	1	5 880.63	5r	2
3 645.41	6	8	4 558.45	7	5	5 894.83	4r	....
3 650.17	5	4	4 567.90	6	1	5 930.59 P	6r	3
3 713.55	5	6	4 570.02	6	1	6 038.59	4r	....
3 715.52	5	4	4 574.85	8	5	6 068.74	4r	....
3 759.07	8	10	4 580.06	6	3	6 108.49	5r	....
3 790.82	8	10	4 613.38	6	5	6 111.74	4r	....
3 794.76	8	10	4 619.83	5	6	6 126.09	4r	3
3 840.70	5	5	4 655.49	7	10	6 129.57	5r	3
3 849.00	6	10	4 662.51	6	4	6 134.42	5r	....
3 871.63	8	10	4 663.76	5	8	6 165.73	5r	....
3 886.34	7	10	4 668.90	5	8	6 249.94 p	7r	5
3 916.03	7	10	4 671.81	4	5	6 262.29	5r	6
3 921.54	7	10	4 692.49	5	5	6 266.06	4r	1
3 929.21	8	10	4 728.41	7	3	6 293.60	4r	2
3 949.10 P	10	10	4 740.27	8	5	6 296.11	5r	5
3 988.52	10	10	4 743.08	8	10	6 320.39	5r	5
3 995.75	10	5	4 748.72	6	5	6 325.93	5r	1
4 025.87	6	4	4 809.00	6	3	6 390.48	5r	7
4 031.70	7	10	4 824.06	6	4	6 394.24	6r	6
4 042.92	8	10	4 860.90	6	3	6 399.04	5	5
4 050.09	6	10	4 899.92	7	4	6 411.00	10	3
4 067.39	6	8	4 920.98	7	5	6 454.53	6	1
4 077.35 p	10	10	4 921.80	7	5	6 456.00	5r	3
4 086.71	10	10	4 986.83	6	2	6 526.98	8	4
4 099.55	7	10	4 999.46	6	3	6 543.17	8	1
4 123.23 p	10	10	5 106.22	6	1	6 578.54	5	3
4 141.75	10	10	5 114.54	6	3	6 616.60	4	....
4 151.97	8	10	5 122.96	5	3	6 650.81	4	....
4 152.78	4	5	5 183.41	8	5	6 661.41	4	1
4 192.34	7	8	5 301.96	5	1	6 671.41	4	2
4 196.55	10	10	5 455.14 p	6	1	6 709.51	4	....
4 204.04	5	4	5 464.39	5	1	6 753.07	4	....
4 217.55	6	10	5 501.35	6r	1	6 774.28	6	3
4 230.95	4	6	5 541.26	4r	....	6 925.26	3	....
4 238.39	10	10	5 588.34	4r	....	7 066.21	5	....
4 249.99	5	6	5 648.25	5	....	7 068.34	4	....
4 263.59	6	8	5 740.65	6r	1	7 161.22	4	....
4 269.49	6	10	5 744.41	5r	....	7 282.33	5	....
4 275.64	4	4	5 761.84	5r	1	7 334.17	5	....
4 286.95	8	10	5 769.07	7r	3	7 345.34	4	....
4 296.06	9	8	5 769.35	7r	1	7 483.48	4	....
4 322.53	6	5	5 769.97	5r	....	8 324.69	3	....
4 333.80	10	10	5 789.23	6r	1	8 346.55	3	....
4 334.97	6	8	5 791.33	7r	1	8 545.43	3	....
4 354.39	8	10	5 797.59	7r	2	8 674.38	3	....
4 378.09	7	4	5 805.76	5r	2	8 748.42	2	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Lead

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
884.	..	5	2 059.	7r	10	3 176.5	..	10
890.	..	3	2 060.	7r	7	3 572.74	5r	10
894.	..	5	2 088.2	5r	....	3 639.58 p	6r	10r
907.	..	7	2 115.0	5r	....	3 683.47 p	3r	10r
927.	..	7	2 159.6	3r	....	3 739.95	5r	4r
954.	..	3	2 170.0 P	6r	2r	3 854.0	..	10
1 004.	..	3	2 175.6	4r	....	4 019.64	3	10
1 029.	..	10	2 203.5 P	3	4r	4 057.83 p	5r	10r
1 166.	..	7	2 237.42	3r	2r	4 062.15	3	10
1 203.	..	7	2 246.90	6r	4r	4 168.04	3	10
1 213.	..	3	2 332.47	4r	2	4 242.5	..	10
1 232.	..	7	2 393.81	5r	3r	4 245.2	..	10
1 250.	..	10	2 401.94	4r	3	4 386.	..	10
1 267.	..	7	2 411.75	4r	2	5 005.45	3	2
1 316.	..	10	2 443.86	4r	4	5 608.8	4	10
1 349.	..	3	2 446.20	4r	4	5 895.7	5	....
1 434.	..	10	2 476.39	4r	2r	6 002.	5	....
1 534.	..	7	2 577.28	6r	3r	7 228.98	6	....
1 554.	..	10	2 613.68	3r	3r	10 291.	10	....
1 660.	..	2	2 614.20	6r	5r	10 500.	10	....
1 671.	..	2	2 663.17	10r	10r	10 651.	6	....
1 682.5 p	6	2	2 802.01	5r	10r	10 888.	1	....
1 726.	6	2	2 823.20	4r	10r	10 971.	3	....
1 781.	..	2	2 833.07 p	6r	10r	12 564.	4	....
1 796.5	6	3	2 873.32	6r	10r	13 102.	4	....
1 822.	8	3	3 043.87	1	10	14 744.	3	....
1 869.	..	5	3 137.8	..	10	15 315.	3	....

Lithium

I 2 394.4	1r	....	I 4 148.	..	....	13 566.	2	....
2 425.6	3r	....	I 4 273.3	5	2	I 17 552.	2	....
I 2 475.	4r	....	I 4 602.0	9r	10	18 697.	5	....
I 2 562.5	5r	....	I 4 603.0	9r	10	I 19 290.	1	....
I 2 741.3	6r	2r	I 4 636.	3	....	23 991.	2	....
I 3 232.7 p	8r	3r	I 4 971.9	7	4	I 24 467.	8	....
I 3 719.	3	....	I 6 103.6	10r	10	I 26 875.	2	....
I 3 794.	5	....	I 6 240.6	1	....	26 891.	1	....
I 3 915.	2r	1	I 6 707.86 P	10r	10r	I 40 475.	1	....
I 3 985.7	3	....	I 8 126.4	10	....	I 74.360.	1	....
I 4 132.3	5	1	I 12 232.	1	....			

Lutecium

2 578.79	4	5	2 963.33	7	10	3 281.75	10	5
2 603.32	..	10	2 969.81	6	10	3 312.12	10	5
2 615.42	10	10	3 020.56	4	10	3 359.59	10	5
[illegible] 657.83	4	10	3 056.74	10	10	3 376.54	10	5
2 754.19	4	10	3 057.96	..	10	3 397.02 p	10	10
2 772.60	..	10	3 077.62	10	10	3 472.49 p	10	10
2 796.64	4	10	3 081.48	9	3	3 507.40	10	10
2 847.50	5	10	3 118.42	7	3	3 508.41	10	3
2 894.86 p	10	10	3 191.78	2	10	3 544.93	5	....
2 900.32	10	10	3 198.13	10	10	3 554.43 p	10	10
2 911.40 p	10	10	3 254.31	10	10	3 567.84	10	5
2 951.68	3	8	3 278.96	10	4	3 623.97	10	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Lutecium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
3 636.26	10	3	4 839.52	4	1	6 160.00	6	1
3 647.77	5	2	4 904.87	5	1	6 199.73	5	....
3 684.34	4	....	4 994.13	10	3	6 221.88	10	4
3 841.15	7	2	5 001.14	6	1	6 235.39	5	1
3 876.65	10	10	5 135.11	10	1	6 242.42	7	1
4 054.46	5	2	5 402.57	10	1	6 345.44	7	....
4 124.73	10	5	5 476.70	10	10	6 463.16	10	3
4 184.24	10	10	5 736.54	10	1	6 523.16	10	....
4 281.03	5	1	5 775.39	6	....	6 793.80	5	....
4 296.02	5	1	5 983.65	10	1	6 917.28	7	....
4 518.54 p	10	5	5 984.11	10	1	7 031.18	4	....
4 658.00	10	3	6 004.54	10	1	7 125.85	7	....
4 785.45	5	3	6 055.05	6	....			

Magnesium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
1 231.6	..	2	II 2 802.71 p	10r	10r	I 4 571.12	5	2
1 320.9	..	5	I 2 846.78	4	1	I 4 703.07	10	5
1 323.2	..	4	I 2 848.42	5	1	II 4 739.6	..	5
II 1 735.	1	6	I 2 852.13 P	10r	10r	II 4 851.1	..	5
II 1 737.	2	7	2 915.5	3	8	I 5 167.33	8r	10
1 741.	5	....	II 2 928.7	3	10	I 5 172.68	10r	10
1 744.	5	....	II 2 936.6	4	10r	I 5 183.60	10r	10
II 1 750.9	..	5	I 2 936.8	4	....	I 5 528.48	10	5
II 1 753.6	..	6	I 2 938.5	5	....	I 5 711.13	5	1
I 1 828.	3	....	I 2 942.06	6	2	I 6 318.5	2	....
1 856.	5	....	I 3 091.09	8r	1	II 6 347.1	4	....
1 864.	4	....	I 3 093.05	8r	2	I 7 658.	2	....
1 886.	5	....	I 3 096.92	10r	2	II 7 877.1	..	4
1 931.	6	....	II 3 104.7	..	10	II 7 896.3	..	5
I 2 026.	6	6	II 3 104.8	..	10	I 8 806.8	5	....
II 2 660.76	..	5	I 3 329.94	8	3	I 8 929.	2	....
II 2 660.82	..	5	I 3 332.17	10	5	9 224.	1	....
I 2 668.2	3	....	I 3 336.69	10	8	I 9 258.	3	....
I 2 669.7	6	....	II 3 535.0	..	5	I 10 813.	3	....
I 2 672.6	8	....	II 3 538.8	..	6	I 10 963.	1	....
I 2 693.8	2	....	I 3 829.36 p	8r	10r	I 10 970.	3	....
I 2 695.3	4	....	I 3 832.17 p	10r	10r	11 054.?	2	....
I 2 698.2	5	....	I 3 838.29	10r	10r	I 11 828.	10	....
I 2 733.55	4	1	II 3 848.2	..	7	I 12 083.	5	....
I 2 736.6	4	1	II 3 850.4	..	6	I 14 877.	10	....
I 2 776.71	6r	6r	I 4 167.6	4	1	I 15 028.	6	....
I 2 778.29	6r	6r	I 4 351.9	8	2	I 15 759.	1	....
I 2 779.85	8r	8r	II 4 384.6	..	8	I 15 768.	4	....
I 2 781.43	6r	6r	II 4 390.6	..	10	I 17 108.	6	....
2 782.99	6r	6r	II 4 428.0	..	7	I 23 963.	1	....
II 2 790.83	4	10r	II 4 434.0	..	8	I 23 977.	1	....
II 2 795.54 P	10r	10r	II 4 481.	..	10	I 25 991.	1	....
II 2 798.0	..	10						

Manganese

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
311.	..	1	1 118.	..	5	1 892.0	..	4
648.	..	2	1 438.	..	5	1 904.	..	5
893.	..	10	1 573.?	..	5	1 952.1	..	3
1 113.	..	5	1 789.	..	10	1 993.	..	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

MANGANESE (Continued)

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
II	2 452.52	2r	10	I	3 570.10	4r	3	I	4 709.70	7	2
	2 575.51	5	1	I	3 577.88	8r	5	I	4 727.46	7	2
II	2 576.12 P	5r	10r	I	3 586.55	5	5	I	4 739.00	5	2
	2 592.95	5	1	I	3 607.52	8	3	I	4 754.05	10	8
II	2 593.73 p	4r	10r	I	3 608.48	6	3	I	4 761.53	5	2
II	2 605.69 p	5r	10r	I	3 610.30	6	3	I	4 762.38	9	4
	2 618.15	4	8	I	3 806.86	6	8	I	4 765.86	5	2
	2 625.6	..	8	I	3 809.60	6	6	I	4 766.42	6	3
	2 632.35	1	8	I	3 823.51	4r	6	I	4 783.43	10	4
	2 638.17	1	5	I	3 823.90	4	4	I	4 823.52	10	4
	2 655.8	..	5	I	3 833.87	6	4		4 965.86	5	1
	2 672.58	1	5	I	3 834.36	6r	8		5 196.60	5	1
	2 695.36	1	5	I	3 839.77	4	5		5 255.33	5	2
	2 701.70	3	5	I	3 841.09	4	6	I	5 341.07	10	8
	2 705.74	2	8	I	3 843.99	6	4		5 377.63	8	3
	2 711.6	..	5		3 985.24	4	3		5 394.68	7	2
I	2 794.82	6r	5r	I	4 018.11	8	8		5 399.51	8	3
I	2 798.27	6r	5r	I	4 030.76 P	6r	10r	I	5 407.43	7	2
I	2 801.08	6r	5r	I	4 033.07 p	8r	10r		5 413.70	7	2
	2 879.49	1	5		4 033.63	3r	3	I	5 420.37	7	3
	2 886.68	2	6	I	4 034.49 p	8r	10r		5 432.56	6	1
	2 889.52	3	10	I	4 035.73	5r	8	I	5 470.64	8	2
I	2 914.61	8(2)	1	I	4 041.37	8r	10	I	5 481.40	6	1
I	2 925.59	6(2)	1		4 045.20	4	5		5 505.88	6	1
II	2 933.06	6	10	I	4 048.76	4	8	I	5 516.77	8	2
II	2 939.31	6	10	I	4 055.55	8	8	I	5 537.75	7	2
I	2 940.39	6	1	I	4 079.25	6	5		5 551.99	5	1
II	2 949.21	6	10	I	4 079.43	6	5		5 567.77	4	1
I	3 044.57	4	2	I	4 082.95	6	6		5 738.28	4	....
I	3 054.38	4	2	I	4 083.64	6	6		5 780.17	5	....
I	3 062.13	4	1		4 131.12	4	4		5 848.97	3	....
I	3 079.63	5	1		4 176.60	4	4	I	6 013.50	10	1
	3 110.69	5	1		4 189.99	4	4	I	6 016.64	10	1
I	3 148.19	4	1	I	4 235.14	8	....	I	6 021.79	10	1
I	3 178.53	8	1	I	4 235.29	8	10		6 078.40	3	....
I	3 212.89	6	2	I	4 239.73	5	5		6 382.19	3	....
	3 228.10	5	3	I	4 257.67	5	4		6 440.97	5	....
I	3 236.79	6	3	I	4 265.92	5	5		6 491.71	7	....
I	3 243.79	4	2	I	4 281.10	5	5		6 605.57	4	....
I	3 248.52	4	3		4 374.94	4	2		6 942.55	5	....
I	3 256.14	4	2	I	4 414.87	8	6		6 989.94	4	....
I	3 258.42	4	2	I	4 436.36	7	5		7 069.86	4	....
	3 317.30	6n	1	I	4 451.59	9	3		7 151.33	8	....
	3 320.70	4	1	I	4 453.01	5	3		7 184.29	5	....
	3 330.67	4	3	I	4 455.02	6	3		7 247.83	5	....
I	3 442.00	5	10	I	4 455.32	6	3		7 283.30	6	....
I	3 460.33	3	10	I	4 455.82	5	3		7 302.92	6	....
I	3 474.14	4	10	I	4 457.04	5	2		7 326.55	7	....
I	3 482.92	4	10	I	4 457.55	6	4		7 646.34	3	....
I	3 488.69	4	10	I	4 458.27	6	5		7 680.20	5	....
I	3 495.84	5	6	I	4 461.09	6	4		7 710.2	5	....
I	3 531.84	4r	2	I	4 462.03	9	8		7 712.4	5	....
I	3 532.00	5r	3	I	4 464.68	7	5		7 764.8	5	....
I	3 532.11	5r	3	I	4 470.14	7	4		7 821.3	2	....
I	3 547.79	5r	4	I	4 472.80	7	3		7 942.9	2	....
I	3 548.02	4r	3	I	4 490.09	5	3		8 212.4	2	....
I	3 548.19	4r	3	I	4 498.90	7	4		8 654.6	2	....
I	3 569.50	6r	5	I	4 502.22	7	4	I	8 670.8	2	....
I	3 569.80	8r	4		4 626.54	5	2	I	8 672.1	2	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Manganese (Continued)

Wave length.	Arc	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
I 8 703.7	3	....	I 13 294.	5	....	I 13 997.	10	....
I 8 740.9	3	....	I 13 318.	3	....	14 970.	3	....
11 378.	2	....	13 416.	8	....	15 218.	8	....
11 614.	4	....	13 500.	10	....	15 263.	10	....
11 782.	6	....	I 13 626.	10	....	15 965.	10	....
12 307.?	..	....	13 685.	8	....	17 336.	8	....
I 12 900.	8	....	I 13 864.	10	....	17 608.	2	....
12 976.	4	....						

Mercury

Wave length.	Arc	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
I 1 269.7	..	5	I 3 021.50	5	4	I 6 072.63	5	....
1 527.	..	5	I 3 125.6	8	8r	6 123.47	6	....
1 592.	..	8	I 3 131.56	7	5r	I 6 234.35	8	....
1 599.	..	7	I 3 131.84	7	4r	I 6 907.5	10	....
II 1 650. p	..	10	I 3 341.48	6	5	I 7 082.0	4	....
1 677.9	..	10	I 3 650.15	10	9r	7 729.2	6	....
1 738.3	..	8	I 3 654.83 p	7	5	I 10 140.	10	....
1 798.7	..	9	I 3 662.87	4	4	I 11 287.	9	....
I 1 849. P	10	10	I 3 663.27	6	5	I 11 888.	1	....
II 1 942. p	10	5	I 3 906.4	6	....	I 13 570.	6	....
II 2 224.7	4	4	3 983.99	6	8	I 13 673.	8	....
I 2 378.3	3	....	I 4 046.56	10	10r	I 13 950.	4	....
I 2 399.4	3	....	I 4 077.8	7	5r	15 295.	5	....
I 2 482.7	3	....	I 4 339.23	6	1	I 16 921.	2 (2)	....
I 2 534.8	4	2	I 4 347.50	6	1	I 17 073.	2	....
I 2 536. P	10r	10r	I 4 358.34	10	10r	I 17 110.	2	....
I 2 652.0	5	2	I 4 916.0	5	1	18 333.	1	....
2 698.9	3	....	4 960.3	5	....	19 701.	1 (2)	....
I 2 752.8	4	4	I 5 460.73	10r	10r	I 23 253.	1	....
I 2 803.5	4	....	I 5 675.8	5	....	36 492.	2	....
II 2 847.7	..	8	I 5 769.60	10	5	I 39 425.	10	....
I 2 893.6	5	5	I 5 790.66	10	5	40 159.	8	....
I 2 967.28	5	8r						

Molybdenum

Wave length.	Arc	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
1 377.	..	1	II 2 911.91	5	10	3 504.41	6	2
1 548.	..	4	II 2 923.40	4	10	3 524.62	2	7
1 692.	..	2	3 087.61	2	10	3 614.25	8	3
1 697.	..	4	3 116.08	1	8	3 635.15	2	10
1 809.8	..	7	3 121.99	2	10	3 651.14	1	8
2 538.46	2	10	I 3 132.60	10r	2	II 3 688.33	1	10
II 2 638.75	3	10	3 158.16	9r	2	II 3 692.66	2	9
II 2 644.33	2	10	I 3 170.35	10r	2	II 3 702.56	2	8
II 2 660.58	2	10	I 3 193.98	10r	2	I 3 798.26 P	10r	10r
2 672.84	2	10	3 208.85	10	2	3 833.76	7	3
II 2 684.13	3	10	3 292.32	1	10	I 3 864.12 p	10r	10
II 2 701.42	2	10	3 325.67	10	1	I 3 902.96 p	10r	10
2 775.40	3	10	I 3 327.30	10	1	II 3 941.50	1	10
2 780.04	3	10	3 344.75	8	2	3 961.49	3	10
II 2 816.15 P	5	10	3 347.02	6	1	4 069.91	9	8
II 2 848.21 p	5	10	I 3 358.12	9	2	4 084.39	8	3
2 853.19	1	10	I 3 384.62	8	2	I 4 102.16	7	3
II 2 871.50 p	4	10	3 402.81	1	8	4 143.56	9	5
2 903.07	2	10	3 447.13	10	3	4 185.82	8	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Molybdenum (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
4 188.32	10	5	4 731.45	10	7	6 357.21	5	3
4 232.61	10	5	4 760.20	9	9	6 424.37	8	8
4 250.69	1	10	4 819.26	10	4	6 519.84	4	3
4 251.86	10r	2	4 830.52	10	4	I 6 619.15	9	8
4 276.92	10	5	4 868.03	5	2	6 650.38	7	1
I 4 277.26	10	6	4 979.12	5	2	I 6 733.99	7	1
II 4 279.03	2	10	I 5 172.94	9	1	6 746 28	5	1
I 4 292.21	9	4	I 5 174.15	9	2	6 838.95	4	....
I 4 293.24	10	4	I 5 238.20	7	3	6 886.37	4	....
I 4 293.89	9	3	I 5 240.94	6	3	6 914.05	5	....
4 326.14	9	4	I 5 360.59	10	8	6 989.01	4	....
II 4 363.65	1	10	5 473.35	6	6	I 7 060.23	4	....
II 4 377.76	1	10	I 5 506.50	10	10	I 7 109.87	8	....
4 381.65	10	8	I 5 533.03	10	10	I 7 134.09	4	....
4 411.71	10	8	I 5 570.46	10	10	I 7 242.54	7	....
II 4 433.51	1	8	I 5 632.47	9	8	7 245.87	4	....
4 434.96	10	4	I 5 650.13	8	6	I 7 391.36	5	....
4 468.27	10	2	I 5 689.15	9	10	I 7 485.73	7	....
4 491.29	6	2	I 5 722.77	8	7	I 7 656.74	5	....
I 4 524.34	7	2	I 5 751.42	10	10	7 720.74	4	....
I 4 576.49	8	2	I 5 791.84	10	10	I 8 245.06	3	....
I 4 595.15	7	2	I 5 858.28	8	10	I 8 328.43	5	....
4 621.35	7	2	I 5 888.32	10	10	I 8 389.28	6	....
I 4 626.45	10	4	I 5 928.82	9	10	8 695.53	2	....
4 707.25	10	5	I 6 030.66	9	10	9 348.01	2	....

Neodymium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 092.91	4	2	4 061.09	10	10	4 811.33	5	5
3 133.56	4	2	4 069.26	5	4	4 825.47	8	8
3 217.10	4	1	4 075.24	7	2	4 859.01	5	5
3 275.20	4	2	4 109.09	8	6	4 920.66	9	3
3 300.14	4	2	4 109.47	9	8	5 192.62	6	3
3 328.26	5	2	4 135.33	9	7	5 249.54	7	4
3 388.01	5	1	4 156.16	10	10	5 293.17	9	5
3 410.21	4	1	4 177.34 p	9	10	5 319.80	9	4
3 543.33	5	2	4 178.68	6	3	5 361.47	5	4
3 592.58	5	2	4 232.40	8	5	5 431.53	4	3
3 609.78	5	1	4 247.37	10	8	5 485.68	7	4
3 653.10	6	2	4 282.51	10	8	5 594.40	8	5
3 735.59	7	5	4 303.61 p	10	10	5 620.58	8	5
3 780.40	5	3	4 314.50	7	8	5 688.49	6	3
3 851.73	8	5	4 325.77	10	5	5 708.25	5	2
3 863.37	10	8	4 327.93	7	5	5 729.28	4	....
3 875.85	6	2	4 351.23	9	8	5 804.00	5	2
3 889.95	6	3	4 358.20	9	8	6 007.63	4	....
3 890.59	6	4	4 375.00	10	6	6 066.05	4	....
3 890.96	7	4	4 385.68	10	8	6 071.70	4	....
3 892.06	6	4	4 400.84	10	5	6 073.97	4	....
3 894.65	6	3	4 411.03	8	5	6 178.55	4	1
3 900.25	6	6	4 446.37	10	10	6 310.48	7	1
3 905.90	7	4	4 451.55	10	10	6 341.48	7	2
3 941.53	7	8	4 462.96	10	10	6 385.18	8	3
3 951.15 p	9	8	4 501.82	7	5	6 485.69	4	1
3 963.12	7	6	4 541.25	5	5	6 630.16	4	....
3 990.13	9	6	4 563.21	6	5	6 650.56	4	1
3 994.70	8	5	4 579.30	5	4	6 655.67	4	....
4 012.28	9	10	4 634.21	5	3	6 740.10	4	....
4 021.76	7	3	4 706.54	7	4	6 790.42	4	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

NEODYMIUM (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
6 803.98	4	....	7 511.15	4	....	7 965.69	4	....
6 846.74	5	....	7 513.77	4	....	7 982.34	4	....
7 037.34	4	....	7 529.03	4	....	8 000.75	4	....
7 066.90	4	....	7 538.27	4	....	8 043.33	4	....
7 129.36	4	....	7 696.60	4	....	8 141.72	4	....
7 189.41	4	....	7 808.53	4	....	8 143.29	4	....
7 418.18	4	....	7 862.84	4	....	8 375.23	3	....
7 448.73	4	....	7 958.93	4	....	8 456.80	3	....

NEON

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
2 595.21	6	3 600.16	6	4 790.22	8
2 645.51	6	3 609.17	5	4 810.07	5
2 645.70	5	3 633.66	6	4 817.64	6
2 647.42	8	3 664.3	7	4 818.79	5
2 651.01	6	3 682.23	7	4 821.93	6
2 675.24	6	3 685.73	7	4 827.34	8
2 675.64	6	3 694.4	9	4 827.59	6
2 795.10	5	3 701.22	7	4 837.31	7
2 872.66	5	3 713.3	9	4 884.91	8
2 913.17	6	3 727.3	6	4 892.08	7
2 932.72	5	4 422.52	6	4 955.38	5
2 947.30	6	4 424.81	6	4 957.03	8
2 974.71	7	4 425.42	5	4 957.12	5
2 982.66	7	4 483.19	5	4 994.92	5
2 992.42	6	4 488.09	6	5 005.15	8
2 992.44	6	4 536.31	5	5 031.34	7
3 057.39	7	4 537.68	6	5 037.74	8
3 063.69	6	4 537.76	10	5 080.38	6
3 076.97	6	4 538.31	6	5 113.66	5
3 078.87	5	4 540.38	8	5 116.49	6
3 079.18	5	4 575.06	6	5 122.25	6
3 126.19	[illegible]	4 575.86	10	5 122.34	6
3 148.60	5	4 582.05	5	5 144.93	8
3 335.1	7	4 582.45	5	5 145.01	8
3 355.2	6	4 609.91	7	5 151.96	5
3 369.81	8	4 628.30	7	5 188.61	6
3 369.91	10	4 645.41	6	5 193.12	6
3 417.90	8	4 656.38	6	5 193.23	6
3 447.70	7	4 661.09	5	5 203.90	6
3 454.20	6	4 678.21	6	5 208.87	5
3 460.52	5	4 679.13	5	5 298.20	6
3 464.34	5	4 702.53	5	5 301.77	5
3 466.58	6	4 704.39	10	5 326.41	5
3 472.57	8	4 708.86	10	5 330.78	10
3 498.06	5	4 710.06	8	5 341.10	10
3 501.21	6	4 712.06	8	5 343.29	9
3 515.19	6	4 715.34	10	5 349.21	6
3 520.47	10	4 749.56	6	5 355.18	6
3 568.7	8	4 752.73	8	5 355.40	6
3 574.9	6	4 758.72	5	5 358.02	10
3 593.52	8	4 780.34	6	5 360.02	6
3 593.63	7	4 788.93	10	5 372.31	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Neon (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube	Wave length.	Geissler tube.
5 400.56 p	10	5 974.64	9	6 678.28	8
5 412.66	7	5 975.53	8	6 717.04	5
5 418.56	6	5 987.93	7	6 929.47	9
5 433.65	7	5 991.68	6	7 024.05	6
5 448.51	6	6 000.95	5	7 032.41	6
5 533.68	5	6 030 00	7	7 051.30	4
5 562.44	6	6 074.34	9	7 059.12	4
5 562.76	8	6 096.16	8	7 173.94	10
5 563.05	5	6 128.45	6	7 245.17	10
5 652.57	5	6 142.51	5	7 438.89	8
5 656.03	5	6 143.06	10	7 472.46	6
5 656.66	8	6 150.27	5	7 488.89	5
5 662.55	6	6 163.60	8	7 535.78	8
5 689.81	7	6 182.15	5	7 544.05	8
5 718.90	7	6 205.76	5	7 943.19	8
5 719.22	9	6 213.88	6	8 082.46	8
5 719.53	6	6 217.28	9	8 136.41	4
5 748.29	9	6 246.71	5	8 236.42	7
5 748.65	6	6 258.78	5	8 259.36	4
5 764.42	9	6 266.50	10	8 266.02	5
5 804.10	6	6 293.7	5	8 300.35	7
5 804.45	9	6 304.79	5	8 377.62	7
5 811.42	7	6 313.65	6	8 418.41	7
5 820.17	9	6 328.15	7	8 495.37	7
5 828.91	6	330.89	6	8 591.25	6
5 852.49	10	6 334.43	9	8 634.63	5
5 868.4	5	6 351.8	5	8 654.38	6
5 872.17	5	6 364.96	5	8 679.52	3
5 872.84	9	6 382.99	10	8 681.86	3
5 881.90	10	6 401.08	5	8 780.63	4
5 902.48	5	6 402.25 p	10	8 783.75	4
5 906.44	5	6 409.71	6	8 853.97	3
5 913.63	7	6 421.68	5	8 865.72	3
5 918.92	7	6 444.70	6	9 148.72	2
5 939.32	5	6 506.53	10	9 201.88	2
5 944.83	9	6 532.88	5	9 220.28	2
5 961.63	5	6 598.95	8	9 300.70	2
5 965.44	10				

Nickel

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
1 398.	..	2	2 029.1	..	6	I 2 798.66	4	1
1 499.	..	2	I 2 310.99	3r	2	I 2 821.30	4	2
1 527.	..	2	I 2 312.36	3r	1	I 2 943.92	6	2
1 653.	..	6	I 2 320.08	5r	1	I 2 981.65	7	3
1 693.	..	7	I 2 325.81	3r	2	I 2 992.60	6	2
1 709.	..	6	I 2 345.53	2r	8r	I 2 994.46	7r	3
1 767.	..	6	2 375.43	1	8	I 3 002.49	10r	5
1 855.	..	5	2 394.56	2	10	I 3 003.63	9r	4
1 929.7	..	5	2 416.14	1	10	I 3 012.01	9r	5
1 979.3	..	6	2 437.90	1	10	I 3 037.94	9r	4
2 019.0	..	6	2 510.89	4	10	I 3 050.83	10r	6
2 021.0	..	6	2 545.92	1	6	I 3 054.32	8r	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Nickel (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 3 057.65	10r	4	I 4 592.54	9	4	I 6 339.17	10	....
I 3 064.63	6	2	I 4 600.37	8	1	I 6 378.22	7	....
I 3 080.76	6	2	I 4 604.99	9	3	I 6 384.69	7	....
I 3 097.12	5	2	I 4 648.66	10	3	6 421.47	7	....
I 3 101.56	9r	4	I 4 686.21	5	3	I 6 482.84	7	1
I 3 101.88	9r	3	I 4 714.42	10	8	I 6 586.33	6	....
I 3 134.10	10r	4	I 4 715.76	8	3	I 6 598.54	6	....
I 3 197.12	5	2	I 4 756.53	7	3	6 635.14	6	....
I 3 221.66	4r	2	I 4 786.54	10	3	I 6 643.66	10	1
I 3 225.03	5r	2	I 4 829.03	8	3	I 6 767.79	10	....
I 3 232.94	8r	3	I 4 831.19	5	3	I 6 772.36	9	....
I 3 234.66	5r	2	I 4 855.42	8	3	I 6 842.08	6	....
I 3 243.06	8r	3	I 4 866.28	7	2	I 6 914.58	7	....
I 3 315.67	7r	3	4 904.42	9	3	I 7 024.76	8	....
I 3 320.26	5r	3	4 980.17	9	2	I 7 122.29	10	....
I 3 361.56	5r	3	I 4 984.12	9	2	I 7 182.06	9	....
I 3 365.77	4r	3	I 5 017.59	7	2	I 7 197.07	4	....
I 3 366.17	5r	3	I 5 035.36	10	3	I 7 261.94	8	....
I 3 369.57	10r	4	5 080.53	8	3	I 7 291.30	8	....
I 3 371.99	5r	3	5 081.12	9	3	7 385.23	7	....
I 3 374.22	4r	2	5 084.07	6	1	7 386.24	7	....
I 3 380.58	10r	6	I 5 099.97	7	1	I 7 393.67	10	....
I 3 380.88	4r	2	I 5 115.42	9	2	I 7 409.35	9	....
I 3 391.05	7r	4	I 5 125.20	7	....	I 7 414.51	6	....
I 3 392.99	10r	8	I 5 129.38	8	1	I 7 422.34	9	....
I 3 413.48	5r	3	I 5 137.09	8	1	I 7 481.49	5	....
I 3 413.94	3r	2	I 5 142.76	10	2	I 7 522.87	8	....
I 3 414.77 P	10r	10	I 5 146.48	10	2	I 7 525.18	8	....
I 3 423.71	8r	5	I 5 155.76	9	1	I 7 555.67	9	....
I 3 433.57	9r	6	I 5 168.66	8	1	I 7 574.10	7	....
I 3 437.28	6r	5	5 176.55	6	1	I 7 617.02	10	....
I 3 446.26	10r	10	5 411.20	6	1	I 7 619.24	9	....
I 3 452.89	6r	5	I 5 435.87	7	1	I 7 714.27	8	....
I 3 458.47	10r	10	I 5 476.91	10	10	I 7 715.64	7	....
I 3 461.66	10r	10	I 5 592.24	7	2	I 7 727.68	10	....
I 3 472.55	7r	5	I 5 593.74	6	1	7 748.94	10	....
I 3 483.78	6r	4	I 5 614.79	6	1	I 7 788.95	6	....
I 3 492.96 p	10r	10	5 625.28	7	1	I 7 797.66	8	....
3 500.85	6	4	5 682.20	7	1	I 7 863.70	5	....
I 3 510.34	7r	10	5 694.97	7	1	I 7 917.47	7	....
I 3 515.06 p	9r	10	I 5 709.55	8	2	I 8 862.60	4	....
I 3 524.54 p	10r	10	I 5 715.09	8	1	9 106.33	3	....
I 3 566.38	10r	10	I 5 754.67	6	1	I 9 519.99	2	....
I 3 571.87	7r	3	I 5 760.84	6	1	10 195.	5	....
I 3 597.70	8r	6	I 5 805.20	10	....	10 301.	3	....
I 3 610.47	9	4	5 831.60	8	....	10 330.	3	....
I 3 619.39	10	10	I 5 857.76	10	1	10 378.	4	....
I 3 674.13	6	3	I 5 892.88	9	1	10 980.	5	....
I 3 722.48	6	1	I 6 086.34	10	1	11 198.	4	....
I 3 736.81	6	3	I 6 108.14	7	1	11 591.	3	....
I 3 775.57	8	5	I 6 116.16	9	1	13 553.	2	....
I 3 783.53	8	5	6 163.36	8	1	13 722.	5	....
I 3 807.14	8	8	I 6 175.44	10	1	13 829.	3	....
I 3 831.69	6	2	6 176.80	10	2	13 969.	2	....
I 3 858.33	10	8	I 6 186.77	7	....	14 102.	2	....
I 4 401.55	10	8	I 6 191.23	7	1	14 874.	3	....
I 4 459.04	9	8	I 6 223.97	6	....	16 313.	2	....
I 4 462.46	8	3	I 6 256.39	7	1	16 363.	10	....
I 4 470.48	9	3	I 6 314.66	10	....	16 409.?	5	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Nickel (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
16 495.	2	....	16 999.	6	....	18 040.	2	....
16 868.	2	....	17 986.	2	....			

Nitrogen

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
III 685.5	5(4)	4 176.1	5	II 5 010.6	3
II 916.82	2(4)	4 179.7	3	II 5 015.4	3
IV 922.02	....	III 4 195.7	3	II 5 025.6	3
IV 922.57	....	4 200.0	5	II 5 045.0	6
IV 923.18	....	4 206.5	4	5 179.5	4
IV 923.68	....	I 4 223.09	5	I 5 328.67	5
IV 924.31	....	II 4 227.7	4	5 462.7	3
III 989.90 p	2	II 4 236.9	8	II 5 495.9	6
III 991.66 p	3	4 241.8	8	5 530.2	4
1 085.	10(4)	I 4 305.46	6	5 535.2	6
1 184.1	10	I 4 358.29	7	5 543.4	3
1 200.4 p	10	III 4 379.0	8	II 5 666.5 p	10
V 1 242.2	4	4 432.6	5	II 5 675.9 p	5
II 1 276.0	10(3)	4 447.0	10	II 5 679.5 p	10
1 335.3	10	I 4 492.45	5	II 5 686.2	5
I 1 492.83	3	I 4 494.68	5	II 5 931.9	4
I 1 494.78	3	III 4 510.8	4	II 5 941.9	7
1 561.1	7	III 4 514.8	4	I 5 999.46	5
1 657.2	7	4 530.0	6	I 6 008.49	9
I 1 742.81	5	4 552.4	4	I 6 441.70	5
I 1 745.31	5	II 4 601.5	7	I 6 482.74	9
II 3 006.8	7	II 4 607.1	7	I 6 483.77	4
II 3 329.2	3	II 4 613.9	6	I 6 484.88	8
II 3 437.1	7	II 4 621.4	7	6 610.	4
I 3 650.1	5	II 4 630.5	8	I 6 644.97	7
I 3 822.0	5	III 4 634.1	6	I 6 722.60	5
II 3 830.0	6	III 4 640.6	6	I 7 423.88	3
3 839.0	4	II 4 643.0	9	I 7 442.56	4
II 3 842.8	3	II 4 654.5	3	I 7 468.74	5
II 3 856.1	3	4 667.2	3	8 185.05	3
3 870.0	4	II 4 774.2	3	8 188.16	3
3 919.0	6	II 4 779.8	3	8 200.59	1
3 940.0	3	II 4 788.2	4	8 210.94	2
II 3 955.8	7	II 4 793.8	3	8 216.46	5
II 3 995.0	10	II 4 803.3	5	8 223.28	3
4 026.0	4	II 4 810.3	3	8 242.47	3
II 4 035.0	5	III 4 858.82	3	8 568.04	1
4 041.3	7	III 4 867.14	4	8 594.34	1
II 4 043.5	3	4 895.3	3	8 629.61	2
III 4 097.3 p	10	I 4 914.92	4	8 680.35	2
III 4 103.4 p	7	I 4 935.03	9	8 683.61	2
I 4 109.94 P	10	4 987.3	4	8 686.38	1
4 133.6	3	4 994.4	4	8 703.42	1
4 145.8	4	II 5 001.34	7	8 711.87	1
I 4 151.44	9	5 005.1	6	8 718.99	1
4 171.6	4	5 007.4	3	8 729.07	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Osmium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 909.08	7	5	3 857.09	10	....	5 149.73	7	....
3 058.66	7	4	3 876.80	7	3	5 416.33	10	....
3 156.25	7	3	3 963.63	10	3	5 523.56	10	....
3 232.05	6	3	3 977.24	10	3	5 584.43	10	....
3 267.94 p	8	3	4 066.71	10	3	5 721.94	10	....
3 301.56 p	9	2	4 091.83	9	2	5 780.81	10	....
3 370.60	7	2	4 112.03	10	4	5 857.57	10	....
3 528.60	9	3	4 135.80	10	5	5 995.99	10	...
3 559.82	9	3	4 172.55	6	1	6 227.74	10	....
3 560.88	9	4	4 173.24	9	2	6 403.18	8	....
3 598.11	9	2	4 175.62	7	2	6 576.81	6	....
3 656.90	7	1	4 260.85	10	5	6 729.54	9	....
3 670.90	7	2	4 293.95	8	3	6 806.61	7	....
3 719.50	10	2	4 311.39	10	3	6 955.96	8	....
3 720.13	10	2	4 394.87	8	3	7 060.62	6	....
3 752.7 p	10	7	4 420.46	10	10	7 145.50	8	....
3 782.20 p	10	4	4 550.40	6	3	7 148.89	6	....
3 790.12	9	3	4 616.78	10	2	7 253.52	5	....
3 793.90	10	3	4 631.83	10	2	7 407.97	4	....
3 836.03	10	2	4 794.00	10	3	7 602.96	6	....
3 840.29	10	1	4 865.61	10	....	7 852.18	3	....
3 849.96	10	....						

Oxygen

	Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.		Wave length.	Arc.	Spark.
	136.6	..	0	III	832.93	..	7		1 085.2	..	10
	305.7	..	3	II	833.33	..	9		1 128.4	..	5
	374.3	..	4	III	833.74	..	8		1 132.3	..	10
III	507.38	..	4	II	834.46	..	10		1 134.8	..	10(2)
III	507.68	..	5	III	835.09	..	3		1 152.6	..	6
III	508.18	..	6	III	835.29	..	9		1 175.6	..	10
III	525.79	..	6		889.7	..	8		1 200.	..	10(2)
IV	553.33	..	5		904.7	..	10		1 217.62	..	10
IV	554.07	..	5		916.4	..	15		1 247.7	..	10(3)
IV	554.52	..	5		917.8	..	15		1 277.	..	5
IV	555.23	..	5	I	948.7	4	....	I	1 302.3 p	10	....
	580.41	..	3	I	950.2	4	....	I	1 305.0 p	10	....
	580.98	..	4	I	950.9	4	....	I	1 306.1 p	10	....
II	616.31	..	5	I	952.4	4	....	I	1 355.7	8	....
II	617.06	..	5	I	953.0	2	....	I	1 358.7	5	....
II	644.16	..	6	I	971.76	8	8		1 743.1	..	5
II	672.91	..	5	I	973.26	5	5		1 760.9	..	8
II	673.75	..	5	I	973.92	4	4		1 781.4	..	7
III	702.33	..	6	I	976.50	5	5		1 787.0	..	7
III	702.82	..	6	I	978.00	5	5	II	1 961.60	..	3(3)
III	702.90	..	6	I	978.62	4	4	II	2 182.72	..	4
III	703.85	..	7		990.	..	10(2)		2 435.2	..	6
II	718.50	..	7		991.5	..	10(2)		2 478.5	..	6
II	718.57	..	7		1 010.5	..	10		2 506.8	..	5
V	758.69	..	4	I	1 026.0	9	5		2 514.3	..	4
V	759.45	..	4	I	1 027.5	8	....		2 516.1	..	7
V	760.23	..	3	I	1 028.2	7	....		2 524.1	..	4
V	760.46	..	5		1 036.9	..	7		2 528.6	..	5
V	761.13	..	4	I	1 039.26	8	8		2 631.3	..	4
V	762.00	..	4	I	1 041.0	8	8		2 881.5	..	8
II	796.61	..	6	I	1 041.71	5	7	I	2 883.84	6	....
II	832.76	..	8		1 066.3	..	5	I	3 692.44	7	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Oxygen (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 712.7	..	4	4 349.44	..	7	I 5 328.97	6	....
3 727.36	..	5	4 351.28	..	7	I 5 329.58	7	....
3 754.72	..	4	4 366.91	..	6	I 5 330.65	10	....
3 759.86	..	5	I 4 368.30	10	....	I 5 435.16	5	....
I 3 823.56	7	....	4 414.89	..	10	I 5 435.76	6	....
I 3 825.07	6	....	4 416.97	..	9	I 5 436.83	8	....
3 882.2	..	5	4 448.3	..	4	I 5 950.60	5	....
3 911.95	..	5	4 590.98	..	8	I 5 958.53	6	....
3 945.03	..	5	4 596.19	..	7	I 6 046.34	7	....
I 3 947.29	10	....	4 638.87	..	5	6 105.	..	5
I 3 947.48	7	....	4 641.83	..	8	6 115.	..	5
I 3 947.58	4	....	4 649.15	..	9	I 6 155.99	7	....
3 954.37	..	7	4 650.85	..	5	I 6 156.78	8	....
3 973.27	..	7	I 4 655.36	4	....	I 6 158.21	10	....
3 982.73	..	6	4 661.65	..	5	6 265.	..	5
4 069.90	..	9	4 676.25	..	5	I 6 453.69	6	....
4 072.16	..	10	4 699.0	..	5	I 6 454.55	7	....
4 075.87	..	10	4 705.2	..	6	I 6 456.08	9	....
4 085.2	..	5	4 751.5	..	4	6 549.	..	5
4 089.3	..	5	I 4 772.54	3	....	6 641.3	..	4
4 092.9	..	4	I 4 772.89	4	....	6 654.7	..	4
4 097.	..	4	I 4 773.36	5	....	I 7 002.22	4	....
4 105.00	..	6	I 4 803.00	4	....	7 157.3	..	10
4 119.22	..	8	4 857.0	..	4	I 7 771.97 p	10	....
4 120.27	..	6	II 4 906.88	..	5	I 7 774.20 p	8	....
4 132.99	..	5	II 4 924.60	..	6	I 7 775.42 p	6	....
4 153.31	..	6	4 941.0	..	4	I? 7 947.7	..	6
4 185.45	..	8	4 943.2	..	6	I? 7 950.8	..	5
4 189.79	..	8	I 4 967.40	4	....	I? 7 952.3	..	5
I 4 217.09	4	....	I 4 967.86	5	....	I 8 446.37	..	....
I 4 222.78	5	....	I 4 968.76	6	....	I 8 446.77	..	....
I 4 233.32	7	....	I 5 018.78	3	....	I 9 263.9	7	....
4 254.1	..	4	I 5 019.34	4	....	I 11 287.	4	....
4 317.16	..	6	I 5 020.13	5	....	I 11 294.	2	....
4 319.65	..	6	I 5 146.06	5	....	I 11 300.	2	....
4 345.57	..	6	I 5 299.00	5	....	I 13 163.	1	....
4 347.43	..	5						

Palladium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
II 1 596.8	..	5	II 2 505.72 p	2	10	I 3 302.14	6r	10
II 1 625.8	..	5	2 551.78	1	10	I 3 373.00	6r	10
II 1 667.6	..	7	II 2 565.51	1	10	I 3 404.59 P	10r	10
II 1 693.4	..	6	II 2 628.24	1	10	I 3 421.23 p	8r	10
II 1 704.3	..	8	2 635.92	2	10	I 3 433.44	5r	10
II 1 741.0	..	6	2 658.74 p	2	10	I 3 441.41	6r	10
II 1 781.8	..	6	I 2 763.09	8r	6	3 451.36	..	10
II 2 367.96	1	10	2 776.87	..	10	I 3 460.75	7r	10
2 372.16	2	10	2 787.94	..	10	I 3 481.16	7r	10
2 418.73	1	10	2 854.60 p	2	10	I 3 489.78	4r	10
I 2 426.87	1	10	I 2 922.51	7r	3	I 3 516.95 p	8r	10
II 2 433.11	2	10	2 980.66	1	10	I 3 553.09	7r	10
2 446.18	1	10	I 3 027.92	4r	6	I 3 571.17	5r	10
I 2 447.92	10r	8	I 3 065.31	4r	4	I 3 609.55 p	9r	10
I 2 476.43	10r	2	I 3 114.05	5r	8	I 3 634.68 p	10r	10
2 486.53	1	10	I 3 242.71	10r	10	I 3 690.37	6r	10
2 488.92 p	4	10	I 3 251.64	5r	6	I 3 718.91	4r	10
2 498.79 p	3	10	I 3 258.78	6r	8	I 3 799.20	5r	8

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Palladium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 3 832.32	10	10	I 5 395.26	10	....	I 6 833.42	8	....
I 3 894.21	6r	10	I 5 542.79	10	1	I 6 916.56	9	....
I 3 958.65	5r	10	I 5 670.04	10	1	7 194.11	6	....
I 4 212.98	6r	10	I 5 695.08	9	1	I 7 368.14	10	....
I 4 473.61	7	4	I 5 739.66	4	....	I 7 486.93	7	....
I 4 788.20	8	2	I 6 130.60	8	....	I 7 763.99	10	...
I 4 817.52	9	2	I 6 508.4	6	....	I 7 915 89	7	....
I 5 163.80	10	1	I 6 774.6	6	....	I 8 132.85	6	....
5 295.60	10	2	I 6 784.6	10	1			

Phosphorus

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
IV 823.21	..	5	......	I 2 553.31	3	5	......
IV 824.76	..	6	......	I 2 554.95	3	4	1
IV 827.95	..	6	......	2 644.2	..	1	5
III 859.69	..	6	......	IV 2 725.67	..	4	4
V 865.48	..	4	......	IV 2 739.3	..	2	5
V 871.42	..	5	......	III 2 884.75	..	5	......
III 913.99	..	4	......	III 2 896.17	..	5	5
III 917.14	..	5	......	V 3 176.06	..	5	5
III 918.69	..	5	......	III 3 220.23	..	6	......
III 921.86	..	5	......	III 3 234.54	..	6	6
III 998.03	..	5	......	IV 3 347.7	..	6	6
III 1 003.64	..	5	......	IV 3 364.4	..	6	6
IV 1 035.54	..	4	......	IV 3 371.1	..	5	5
V 1 118.02	..	10	......	I 3 424.91	1	3	6
V 1 128.04	..	10	......	3 556.5	..	2	6
1 671.5	..	....	3	3 706.1	..	6	7
1 685.8	..	....	5	3 827.4	..	3	7
1 693.8	..	....	4	3 978.3	..	6	8
1 774.8 p	..	....	7	III 4 060.41	..	6	6
1 782.7 p	..	....	7	III 4 081.18	..	7	7
1 787.5 p	..	....	6	4 178.4	..	5	8
1 834.5	..	....	4	III 4 223.34	..	7	7
I 1 846.8	..	....	7	III 4 247.87	..	7	7
I 1 851.11	6	....	6	4 385.3	..	2	6
I 1 859.36	6	....	6	4 479.7	..	2	5
I 2 023.98	7	....	7	4 587.9	..	5	8
I 2 024.98	6	....	6	4 602.0	..	5	8
I 2 032.98	6	....	6	4 727.5	..	....	6
I 2 034.02	7	....	7	4 943.4	..	2	7
I 2 136.10	6	....	6	5 253.5	..	5	8
I 2 136.79 p	8	....	8	5 296.1	..	4	8
I 2 149.81 p	8	....	8	5 425.9	..	7	7
I 2 153.63	6	....	6	5 499.7	..	3	7
I 2 154.77	7	....	7	5 676.9	..	....	5
I 2 533.98	2	4	......	III 6 024.14	..	....	8
I 2 535.62	4	5	......	III 6 043.05	..	....	9

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Platinum

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
390.	..	1	2 467.44	6r	2	3 628.11	10	4
696.	..	3	2 487.18	4r	2	3 672.00	8	3
702.	..	3	2 628.05	7r	5	3 922.98	8	10
714.	..	3	2 646.89	6r	4	4 118.69	10	10
805.	..	3	2 650.86	4r	4	4 327.07	6	3
930.	..	3	2 659.44 p	10r	10	4 442.55	10	5
935.	..	3	2 702.40	6r	6	4 498.75	10	10
1 056.	..	3	2 705.89	5r	5	4 520.90	10	4
1 118.	..	3	2 719.02	5r	4	4 552.41	10	10
1 199.	..	3	2 733.94	8r	6	4 657.95	6	3
1 213.	..	3	2 771.67	4r	2	4 684.09	5	1
1 226.	..	5	2 794.21	5r	6	5 059.48	10	3
1 287.	..	5	2 830.29 p	8r	5	5 227.64	10	2
1 461.	..	4	2 893.87	6	3	5 301.02	10	5
1 473.	..	4	2 929.79 p	8r	4	5 368.99	10	1
1 597.	..	3	2 997.96 p	7r	10	5 475.78	10	2
1 680.	..	5	3 042.62	4r	4	5 478.50	10	2
1 723.	..	4	3 064.71 P	6r	10	5 840.13	4	1
1 889.	..	5	3 139.37	8	3	6 326.6	10	1
1 928.5	..	5	3 156.56	8	3	6 523.5	4	....
2 288.19	6	3	3 200.72	7	3	6 710.39	10	....
2 310.97	3	5	3 204.05	9	4	6 842.60	8	....
2 357.10	4r	2	3 301.87	10	5	7 113.75	10	....
2 424.90	1	10	3 408.14	8	8	7 217.58	6	....
2 428.05	8r	2	3 485.27	8	3	8 224.79	6	....

Potassium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
382.5	..	2	I 3 446.37	8r	3	I 5 112.5	3r	1
470.4	..	4	I 3 447.38	6r	2	I 5 323.4	4r	1
612.5	..	3	3 530.71	..	8	I 5 339.9	4r	2
765.7	..	3	3 608.88	..	5	I 5 343.2	4r	1
1 669.	..	4(2)	3 618.43	..	5	I 5 359.7	5r	2
1 703.	..	9	3 681.5	..	4	I 5 782.6	5r	3
1 771.	..	6	3 897.9	..	8	I 5 801.9	6r	4
1 787.	..	4	4 001.2	..	5	I 5 812.4	6r	3
1 944.	..	5	I 4 044.16 p	10r	10r	I 5 832.0	7r	4
2 078.	..	10	I 4 047.22 p	10r	10r	I 6 911.3	10	4
2 190.	..	6	4 134.7	..	5	I 6 939.0	10	6
2 241.	..	5	4 149.2	..	5	I 7 664.94 P	10r	5r
2 358.	..	3	4 186.1	..	10	I 7 699.01 p	10r	5r
2 550.	..	5	4 223.0	..	5	7 931.	..	....
I 2 942.7	1r	....	4 225.6	..	4	I 8 500.	1	....
I 2 963.2	1r	....	4 263.3	..	8	I 8 908.	1	....
I 2 992.2	1r(2)	3	4 309.0	..	5	I 9 590.	1	....
I 3 034.8	4r(2)	....	4 388.13	..	5	I 11 028.0	10	....
3 062.4	..	5	4 466.66	..	4	I 11 689.76	10	....
I 3 102.0	4r	1	4 505.34	..	5	I 11 771.73	10	....
I 3 102.2	2r	....	4 608.43	..	6	I 12 434.3	10	....
I 3 217.2	6r	1	I 4 942.9	1r	1	I 12 523.0	9	....
I 3 217.6	4r	1	I 4 952.0	1r	....	I 15 165.8	10	....
3 345.7	..	5	I 4 956.6	1r	....	27 065.6	2	....
3 363.3	..	8	I 4 965.3	1r	....	I 27 215.0	1	....
3 364.7	..	6	5 005.58	..	5	I 31 395.	8	....
3 381.1	..	4	I 5 084.3	2r	1	I 31 596.8	4	....
3 385.3	..	4	I 5 097.6	2r	....	I 36 372.7	1	....
3 440.4	..	3	I 5 099.3	3r	1	I 36 626.4	3	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Potassium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 37 075.6	3	....	I 62 030.	2	....	I 74 260.	1	....
I 37 354.3	4	....	I 62 360.	2	....	I 84 520.	1	....
I 37 370.7	1	....	I 64 310.	1	....	I 85 100.	1	....
I 40 115.5	6	....	I 64 610.	1	....			

Praseodymium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 488.75	..	5	4 189.52	10	10	5 381.27	4	2
2 980.51	..	8	4 206.72	10	10	5 469.88	5	....
2 985.77	..	8	4 223.00	10	10	5 509.16	4	2
3 355.66	3	1	4 225.34 p	10	10	5 605.63	5	2
3 645.66	3	1	4 241.03	10	10	5 668.46	6	...
3 687.05	4	3	4 272.27	9	5	5 707.60	6	...
3 739.19	4	3	4 280.09	8	4	5 815.24	8	1
3 762.35	4	1	4 297.75	8	5	5 823.70	6	1
3 800.31	5	4	4 305.80	10	10	5 879.18	6	1
3 816.10	9	8	4 333.98	10	8	5 939.94	5	2
3 877.22	10	10	4 368.33	9	8	6 017.82	5	2
3 908.05	7	4	4 405.84	8	5	6 055.13	6	....
3 908.43	10	8	4 408.83	10	10	6 161.20	5	2
3 918.85	7	5	4 429.23	10	10	6 281.34	5	....
3 947.63	9	4	4 449.84	8	4	6 359.07	5	....
3 964.82	9	4	4 468.67	9	8	6 429.7	5	1
3 972.15	8	3	4 496.43	10	10	6 431.9	5	....
3 982.06	9	6	4 510.15	10	10	6 478.1	5	....
3 989.70	10	5	4 517.58	6	2	6 566.8	5	....
3 994.81	10	5	4 534.15	6	4	6 656.9	6	....
4 008.73	10	8	4 563.13	5	3	6 673.68	10	....
4 054.87	9	6	4 628.74	4	3	6 747.17	6	....
4 056.54	9	8	4 736.72	4	2	6 798.69	8	....
4 062.83 p	10	8	4 783.39	4	1	6 827.70	6	....
4 100.75	10	10	5 110.40	6	2	7 021.55	6	....
4 118.49	10	10	5 110.79	6	3	7 114.58	4	....
4 141.26	10	6	5 173.92	6	4	7 451.72	4	....
4 143.14	10	10	5 220.11	5	3	7 645.68	3	....
4 164.19	10	10	5 322.77	5	3	7 721.82	3	....
4 179.43 p	10	10						

Radium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 708.94	8	8	II 4 682.20 p	10	10	5 616.6	1	8
2 813.73	10	10	I 4 825.94 P	10	10	5 660.6	5	10
II 3 649.60	10	10	4 856.1	5	8	II 5 813.7	3	10
II 3 814.44 P	10	10	4 971.7	2	8	5 958.2	1	10
4 305.	3	7	5 400.1	2	8	6 167.2	1	8
II 4 340.67	10	10	5 406.6	2	8	6 200.4	5	10
II 4 436.22	5	10	5 501.8	1	8	6 337.0	1	6
II 4 533.17	10	10	5 601.5	..	8	6 446.1	5	8

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Radon

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
3 612.	4	4 371.7	5	4 768.8	7?
3 665.	5	4 435.	5	4 797.	2
3 867.6	3	4 460.	7	4 817.5	7
3 957.3	5	4 508.	6	4 979.0	10
3 971.8	7	4 578.	8	5 084.5	10
3 981.8	9	4 604.6	9	5 393.	3
4 017.9	7	4 609.7	7	5 582.4	8
4 114.7	6	4 625.7	10	5 716.	6
4 166.5	10	4 644.4	10	5 945.	2
4 188.	4	4 681.0	10	5 977.	3
4 203.3	10	4 702.	5	6 309.	5
4 308.	10	4 721.7	5	7 057.	3
4 349.9	10				

Rhodium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 490.76	3	10	3 748.22	9	10	5 424.04	10	2
2 520.53	2	10	3 765.08	10r	10	5 535.02	10	1
2 625.40	2	8	3 793.22	10r	10	5 544.60	10	1
2 705.62	3	10	3 799.31	10r	10	5 599.43	10	3
2 715.30	2	10	3 822.35	10r	10	5 686.36	10	1
2 968.67	5	1	3 828.47	10r	10	5 806.86	10	1
3 263.14	9	2	3 833.87	10r	10	5 831.57	10	1
3 280.54	10r	5	3 856.50	10r	10	5 983.58	8	2
3 283.56	10r	5	3 934.23	10r	6	6 102.72	8	1
3 323.10 p	10r	10	3 958.86	10r	10	6 414.7	8	1
3 396.82 p	10r	10	4 082.80	10	5	6 519.72	10	....
3 434.90 P	10r	10	4 097.54	8	4	6 630.16	10	....
3 462.04	10r	8	4 128.90	10r	10	6 752.40	10	1
3 470.76	10r	8	4 135.29	10r	10	6 879.94	10	....
3 474.78	10r	7	4 211.14	10r	10	6 965.65	10	....
3 478.91	10r	10	4 288.72	10r	8	7 101.68	10	....
3 502.53	10r	10	4 374.82	10r	10	7 270.82	10	....
3 528.03	10r	10	4 379.93	8	3	7 475.74	10	....
3 583.10	10r	8	4 528.73	10	5	7 495.22	10	....
3 596.19	10r	10	4 675.02	10	5	7 791.61	9	....
3 597.15	10r	10	4 851.62	10	3	7 824.91	10	....
3 626.60	10r	10	5 193.12	10	3	7 830.05	6	....
3 657.99 p	10r	10	5 354.38	10	5	8 045.40	7	....
3 690.72	10r	10	5 379.08	10	3	8 136.20	4	....
3 692.35 p	10r	10	5 390.43	10	3	8 425.51	2	....
3 700.92	10r	10						

Rubidium

2 561.9	..	5	3 111.4	..	6	3 340.6	..	8
2 631.8	..	6	3 198.8	..	8	I 3 348.7	4r	4r
2 807.6	..	6	I 3 228.0	2r	2r	I 3 350.9	5r	5r
2 956.1	..	10	I 3 229.1	2r	2r	3 393.1	..	7
3 023.7	..	5	3 271.0	..	7	3 434.2	..	8
3 086.9	..	5	3 321.5	..	8	3 461.6	..	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Rubidium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 492.7	..	10	4 377.1	..	10	I 7 280.2	10	....
3 531.6	..	10	4 380.7	..	10	I 7 408.4	10	....
I 3 587.1	4r	4r	4 401.4	..	10	I 7 800.30 P	10r	....
I 3 591.6	4r	4r	4 426.1	..	10	I 7 947.63 p	8r	....
3 600.7	..	10	4 430.7	..	10	I 10 082.	10	....
3 662.7	..	10	4 530.3	..	6	I 13 237.	10	....
3 699.6	..	10	4 571.8	..	10	I 13 444.	10	....
3 801.9	..	10	4 622.4	..	10	I 13 667.	10	....
3 940.6	..	10	4 648.6	..	10	I 14 754.	10	....
3 978.1	..	10	4 776.0	..	9	I 15 290.	10	....
4 083.9	..	10	4 782.9	..	7	I 38 511.	3	....
4 104.3	..	10	4 885.6	..	5	I 39 827.	3	....
4 136.2	..	10	5 152.1	..	6	I 39 898.	6	....
4 193.0	..	10	5 522.8	..	6	I 46 190.	1	....
I 4 201.8 p	10r	9r	5 636.0	..	6	I 46 960.	8	....
I 4 215.6 p	10r	9r	5 699.2	..	6	I 52 313.	2	....
4 244.4	..	10	I 5 724.5	4	2	I 64.360.	2	....
4 273.1	..	10	I 6 206.5	8	2	I 65 670.	2	....
4 293.9	..	10	I 6 298.6	10	3	72 690.	2	....
4 348.3	..	10	6 775.1	..	9	I 74.280.	3	....
4 371.8	..	10						

Ruthenium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 402.72	3	10	I 3 730.43	9r	8	5 401.00	10	1
2 678.73 p	4	10	I 3 742.28	10r	3	5 427.61	10	1
2 692.1 p	5	10	I 3 786.04	10r	10	5 454.82	10	1
2 712.40 p	4	10	I 3 790.50	10r	10	I 5 484.33	10	1
2 734.34	4	10	I 3 798.89	10r	10	5 510.72	10	1
2 875.00	7	2	I 3 799.34	10r	10	I 5 636.24	8	3
2 916.26	8	3	3 923.48	8	5	I 5 814.99	10	1
2 945.67 p	3	10	I 4 080.62	10r	10	I 5 921.45	10	1
2 965.55 p	3	10	I 4 112.76	9	5	I 6 444.81	9	....
2 976.58 p	4	10	I 4 199.91	10r	10	6 690.0	10	....
3 064.83	7	2	I 4 212.08	10	8	6 824.06	10	....
3 177.03	3	8	I 4 297.72	10	10	6 923.22	10	....
I 3 294.13	8	8	I 4 372.21	10	10	6 981.99	10	....
3 339.55	8	2	I 4 460.04	8	8	I 7 027.93	10	....
3 417.35	10r	3	I 4 554.52	10r	10	7 238.95	9	....
3 428.32	10r	3	I 4 584.45	10	8	7 393.92	8	....
I 3 436.74 p	10r	5	I 4 709.48	10	5	7 499.78	10	....
I 3 498.95 P	10r	8	I 4 757.85	10	3	7 621.52	6	....
I 3 593.03	10r	6	I 4 815.50	10	3	7 791.87	8	....
I 3 596.17 p	10r	6	I 4 869.16	10	3	7 809.18	9	....
3 634.94	10r	3	I 5 136.55	10	1	7 881.48	10	....
I 3 661.35	8r	10	I 5 171.03	10	2	7 924.46	5	....
I 3 726.93	10r	8	I 5 309.26	10	2	8 264.95	4	....
I 3 728.02	10r	8	5 361.75	10	1	8 710.76	2	....

Samarium

3 365.86	3	3	3 724.91	6	....	4 118.57	6	5
3 408.66	3	3	3 739.16	6	5	4 203.03	6	6
3 592.62	5	5	3 745.60	5	3	4 229.70	6	4
3 634.27	4	4	3 986.66	4	2	4 256.40	5	5
3 661.36	4	4	4 092.29	5	4	4 280.80	5	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Samarium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
4 318.95	5	8	5 493.72	6	....	6 601.84	5	....
4 390.86 p	5	10	5 498.22	6	....	6 679.25	5	....
4 424.35 P	6	10	5 519.64	5	....	6 731.86	6	....
4 434.34 p	6	8	5 550.38	6r	....	6 794.20	5	....
4 467.33	5	10	5 626.01	5	....	6 861.14	6	....
4 519.64	8	5	5 644.11	6	....	6 955.33	5	....
4 543.95	5	5	5 696.74	4	....	7 020.47	5	....
4 595.31	5	5	5 773.77	5	....	7 039.24	6	....
4 615.71	5	4	5 787.04	5	....	7 082.40	5	....
4 676.92	5	4	5 814.88	5	....	8 068.47	4	....
4 704.42	5	3	5 874.22	4	....	8 161.88	3	....
4 760.28	5	2	5 938.91	4	....	8 230.34	3	....
4 844.20	4	3	5 965.70	4	....	8 305.79	4	....
4 883.78	4	1	6 159.49	4	....	8 510.92	4	....
4 910.41	4	1	6 256.69	5	....	8 632.83	3	....
5 044.27	4	1	6 426.63	4	1	8 717.89	3	....
5 071.20	4	1	6 487.65	4	1	8 859.76	2	....
5 271.38	4	1	6 569.34	6	2	8 913.66	2	....
5 341.26	5	....						

Scandium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
791.	..	5	II 3 572.55	10	10	5 031.03	10	4
1 214.	..	6	II 3 576.36	10	10	I 5 081.57	10	2
1 603.	..	5	II 3 580.96	10	10	5 239.82	10	2
1 880.	..	5	II 3 589.65	10	10	5 349.29	10	1
1 993.	..	5	II 3 590.50	10	10	5 481.98	10	1
2 062.	..	4	II 3 613.83 P	10	10	5 520.50	10	1
2 272.9	4	....	II 3 630.76 p	10	10	5 526.82	10	3
2 438.62	5	....	II 3 642.80 p	10	10	II 5 657.90	10	2
II 2 552.39	10	10	II 3 645.32	10	10	I 5 671.81	10	1
II 2 560.26	5	6	II 3 651.81	10	10	I 5 686.86	10	1
2 699.12	6	10	I 3 907.50 p	10	6	I 5 700.15	10	1
2 734.10	4	8	I 3 911.81 P	10	6	I 5 711.75	10	1
2 988.95	10	3	I 3 996.61	10	2	I 6 210.67	10	1
I 3 019.33	10	1	I 4 020.41	10	8	I 6 258.98	10	1
3 039.94	10	2	I 4 023.70	10	8	I 6 305.70	10	1
3 045.73	10	3	I 4 047.82	7	2	6 413.37	10	....
3 052.92	10	4	I 4 054.55	8	3	6 604.62	4	1
3 065.1	10	5	I 4 082.42	10	3	6 737.90	10	....
I 3 269.92	5	2	4 165.21	6	....	6 817.10	10	....
I 3 273.64	5	2	II 4 246.84	10	10	6 819.51	10	....
3 353.74	10	10	II 4 314.10	10	10	6 829.52	10	....
II 3 359.69	10	8	II 4 320.73	10	10	6 835.03	10	....
II 3 361.29	10	8	II 4 325.00	10	10	7 136.13	6	....
II 3 361.95	10	8	II 4 374.50	10	10	7 697.76	10	....
II 3 368.95	10	10	II 4 400.40	10	10	7 741.20	10	....
II 3 372.15	10	10	II 4 415.56	10	10	7 800.44	10	....
3 535.73	10	10	4 670.41	9	10	8 194.87	4	....
II 3 558.55	10	10	I 4 743.82	10	4	8 241.18	4	....
II 3 567.71	10	10						

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Selenium

Wave length.	Geissler tube.	Spark.	Arc.
1 854.	......	7	..
1 960. p	......	10r	10
1 993.	......	....	5
2 038.	......	8	2
2 063. p	......	8	8
2 073.	......	3	8
2 354.3	5	3	..
2 459.5	7	3	..
2 591.4	10	5	..
2 630.9	8	5	..
2 685.9	8	4	..
2 767.4	10	3	..
2 777.7	9	3	..
2 837.2	8	4	..
2 880.4	8	3	..
2 914.9	9	3	..
2 951.7	10	3	..
3 038.7	8	2	..
3 060.8	10	....	..
3 069.9	8	2	..
3 094.3	8	3	..
3 185.5	9	3	..
3 225.9	8	3	..
3 323.1	8	3	..
3 379.8	8	3	..
3 387.2	10	6	..
3 514.	10	8	..
3 544.	10	10	..
3 637.5	10	10	..
3 711.6	10	6	..
3 738.7	10	10	..
3 800.9	10	8	..
3 849.6	8	2	..
3 877.3	8	4	..
3 901.6	8	....	..
4 008.1	8	2	..
4 046.7	10	3	..
4 083.2	8	3	..
4 108.8	8	3	..
4 169.0	10	3	..
4 176.	9	10	..
4 182.	9	10	..
4 280.3	8	2	..
4 320.4	9	3	..
4 382.8	10	6	..
4 401.0	9	3	..
4 446.0	8	....	..

Wave length.	Geissler tube.	Spark.	Arc.
4 449.2	8	2	..
4 467.6	9	3	..
4 516.2	8	2	..
4 563.9	9	4	..
4 604.3	9	5	..
4 618.7	8	3	..
4 648.4	8	5	..
I 4 730.9 P	10	....	..
I 4 739.1 p	9	....	..
I 4 742.4 p	8	....	..
4 763.6	8	2	..
4 840.5	8	1	..
4 844.8	10	1	..
4 975.7	8	....	..
4 992.9	8	1	..
5 031.3	8	....	..
5 068.6	8	1	..
5 096.5	8	1	..
5 142.1	8	1	..
5 176.0	9	2	..
5 227.5	9	2	..
5 253.7	7	....	..
5 271.1	8	....	..
5 305.3	9	....	..
I 5 365.4	8	....	..
I 5 369.9	10	....	..
I 5 374.1	10	....	..
5 455.8	7	....	..
5 522.6	8	....	..
5 567.0	9	....	..
5 591.2	8	....	..
I 5 617.8	5	....	..
5 623.1	9	....	..
5 697.9	8	....	..
I 5 718.1	7	....	..
5 747.6	7	....	..
I 5 753.3	7	....	..
5 842.6	6	....	..
5 866.2	6	....	..
I 5 961.9	5	....	..
I 6 325.6	6	....	..
I 6 679.5	5	....	..
I 6 699.6	6	....	..
I 6 746.4	6	....	..
I 6 831.0	5	....	..
I 7 061.9	5	....	..

Silicon

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
IV 361.6	..	....	1	IV 749.7	..	....	3
IV 457.7	..	....	3	IV 815.0	..	....	7

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Silicon (Continued)

Wave length.	Arc.	Spark.	Geissler tube.	Wave length.	Arc.	Spark.	Geissler tube.
IV 818.0	..	....	7	III 2 541.83	..	10	......
IV 1 066.3	..	....	8	I 2 631.28	5	6	......
III 1 110.47	..	....	5	I 2 881.59 P	10r	10	......
II 1 194.89	..	....	5	I 2 987.65	5	4	......
III 1 206.9	..	....	10	III 3 086.23	..	....	7
II 1 260.66	..	....	8	III 3 093.42	..	....	6
II 1 265.04	..	....	10	IV 3 149.56	..	....	6
IV 1 393.9	..	....	10	IV 3 165.72	..	....	8
IV 1 402.9	..	....	8	III 3 590.46	..	2	8
III 1 500.39	..	....	5	III 3 791.41	..	6	3
II 1 526.38 p	..	....	8	III 3 796.11	..	7	4
II 1 533.55 P	..	....	10	III 3 806.56	..	3	5
II 1 711.0	..	....	6	II 3 853.66	..	3	3
II 1 808.14	..	....	8	II 3 856.02	..	5	8
II 1 817.06	..	....	10	II 3 862.59	..	4	6
1 885.	..	10	......	I 3 905.52 p	10	5	10
I 1 988.97	..	5	......	IV 4 088.86	..	6	10
I 2 058.20	..	....	5r	II 4 128.05	..	5	8
II 2 071.94	..	....	8	II 4 130.88	..	6	10
II 2 072.61	..	....	10	III 4 552.65	..	3	9
I 2 124.12	..	6r	......	III 4 567.87	..	2	7
I 2 216.69	3	3	......	III 4 574.78	..	1	4
IV 2 287.08	..	10	......	II 5 041.06	..	1	8
I 2 435.16	5r	5	......	II 5 056.02	..	2	10
I 2 506.90 p	10r	6	......	I 5 708.40	..	....	5
I 2 514.32	8r	5	......	III 5 739.76	..	....	8
I 2 516.12 p	10r	10	......	II 5 957.61	..	....	5
I 2 519.21	8r	5	......	II 5 978.97	..	....	7
I 2 524.12	10r	8	......	II 6 347.09	..	5	10
I 2 528.52 p	10r	8	......	II 6 371.36	..	2	8

Silver

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
1 445.	..	5	1 916.3	..	4	2 205.9	1	2
1 486.	..	4	1 932.3	..	2	2 208.4	1	1
1 496.	..	4	1 956.9	..	3	2 211.18	..	2
1 539.	..	4	1 999.5	..	2	2 219.70	..	2
1 566.	..	6	2 000.6	..	3	2 226.12	..	2
1 656.8	..	5	2 033.8	..	4	2 229.51	2	4
1 674.	..	2	2 061.	..	1	2 238.36	..	2
1 693.	..	6	2 065.9	..	4	2 240.42	..	2
1 722.	..	3	2 070.0	..	1	2 246.38 p	3	3
1 751.	..	6	2 113.8	2	3	2 248.73	3	3
1 769.	..	4	2 120.4	1	2	2 253.46	..	2
1 772	..	4	2 125.4	..	1	2 275.24	..	2
1 794	..	4	2 145.6	1	3	2 277.38	..	2
1 802.	..	4	2 162.0	..	2	2 279.97	1	5
1 816.	..	3	2 166.5	2	2	2 309.54	6r	4
1 839.	..	3	2 170.9	..	1	2 312.4	4N	2
1 860.	..	4	2 171.7	..	1	2 317.03	2	5
1 873.	..	4	2 186.76	2	3	2 320.24	2	6
1 880.	..	4	2 192.	1	1	2 321.52	..	3
1 889.	..	4	2 202.1	2	2	2 324.63	2	6

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

SILVER (Continued)

Wave length.	Arc.	Spark.
2 325.1	..	4
2 331.35	4	6
2 357.92	..	6
2 358.85	..	5
2 362.19	..	3
2 363.99	..	4
2 375.0	4N	3
2 383.20	..	2
2 386.32	..	3
2 386.8	..	2
2 390.57	..	3
2 392.97	..	2
2 395.66	..	2
2 402.57	..	3
2 411.38	..	7
2 413.22	4	8
2 420.12	..	5
2 429.65	..	7
2 437.77 p	3	8
2 444.20	..	4
2 447.91	2	7
2 453.37	..	6
2 460.32	..	5
2 462.27	..	4
2 472.94	..	2
2 473.88	..	7
2 477.30	..	6
2 480.42	..	4
2 485.78	..	2
2 486.7	..	2
2 504.07	..	4
2 506.65	2	5
2 535.3	..	5
2 553.41	..	2
2 564.42	..	3
2 567.15	..	2
2 575.5	4N	1n
2 580.7	..	6
2 595.6	..	3
2 606.14	..	6
2 614.5	..	6
2 628.6	..	2
2 656.8	..	6
2 660.4	3	5
2 681.4	..	4
2 688.4	..	3
2 712.1	..	4
2 721.79	3	2
2 743.9	..	3
2 756.4	..	6
2 767.5	..	8
2 786.5	..	3
2 799.64	..	6
2 815.6	..	4
2 824.40	6	1
2 873.59	2	4
2 896.46	..	4
I 2 902.08	..	4
2 920.0	..	3
2 929.3	..	5
2 934.2	..	6
2 938.5	4	4
2 983.52	..	1
3 012.9	..	1
3 099.11	2	1
3 115.	..	1
3 117.8	..	1
3 130.0	3	1
3 153.1	..	2
3 170.6	2	1
3 172.3	..	1
3 173.6	..	1
3 180.7	..	2
3 185.1	..	1
3 187.8	..	1
3 191.8	..	1
3 200.0	..	1
3 207.3	..	1
3 215.6	2	1
3 216.7	..	1
3 223.	..	2
3 233.	3n	1
3 241.3	..	1
3 244.97	..	3
3 249.8	..	1
3 252.8	..	1
3 267.33	..	1
3 280.67 P	10r	9r
3 289.2	..	2
3 299.4	..	2
3 301.5	..	2
3 305.7	2	....
3 312.6	..	1
3 331.8	..	2
3 349.	1	....
3 352.	..	1
3 364.	..	1
I 3 382.88 p	10r	9r
3 409.	1	....
3 413.	1	....
3 456.	1	....
3 469.2	1	1
3 475.8	..	2
3 501.8	3	1
3 505.1	..	1
3 507.	1	....
3 520.	1	....
3 542.5	3	2
3 616.	..	1
3 624.2	1n	....
I 3 682.3	2n	1
3 710.	1	....
3 810.7	2n	1
I 3 840.79	2	1
3 949.4	1	2
I 3 981.63	4<	1
3 985.	..	2
I 4 055.25	8r	3
4 085.9	..	3
I 4 212.01	8r	4r
4 311.05	2<	2
4 379.24	2n	....
4 385.	..	1
4 396.	2n	1
4 447.0	..	1
I 4 476.06	6	4
4 556.	3N	1
4 615.9	3N	1
I 4 668.54	8<	3
4 677.9	2n	1
4 848.1	2N	....
4 874.16	2<	1
4 888.3	2n	....
I 5 209.04	10r	8
5 276.4	1<	....
5 329.7	4<	....
5 333.3	2<	....
5 401.	..	1N
5 403.	..	1N
I 5 465.43	10	6
I 5 471.51	6	5
5 489.	..	3N
5 494.	..	1N
5 523.7	3	....
5 529.9	2	....
5 545.65	4<	....
5 558.	..	1N
5 570.	..	1N
5 590.	..	1n
5 666.4	4n	2n
5 970.	..	1
6 037.	..	2
I 7 687.85	10	....
I 8 273.58	10	....
I 12 551.	1	....
I 16 819.	3	....
I 17 415.	1	....
I 18 307.	1	....
I 18 382.	1	....
39 889.	5	....
39 951.	8	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Sodium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
1 372.3	..	2	2 847.	..	4	I 4 748.1	3n	2
1 376.6?	..	1	I 2 852.8	4r	5	I 4 752.0	4n	2<
1 659 7	..	4	I 2 853.0	5r		I 4 979.0	5<	4
1 668.7	..	4	2 951.4	..	5	I 4 983.2	6<	4<
1 669.3	..	4	2 980.	..	4	I 5 675.8	..	8
1 698.9?	..	10	2 984.3	..	4	I 5 682.8	8	8<
1 703.5	..	9	3 056.3	..	3	I 5 688.3	10	8<
1 749.3	..	8	3 078.5	..	4	I 5 889.97 P	10r	10
1 770.8	..	6	3 093.	..	6	I 5 895.93 p	8r	10
1 773.5	..	6	3 129.	..	6	I 6 154.4	4	3
1 787.4	..	4	3 189.	..	4	I 6 160.8	5	4
2 490.7	1r	....	3 285.	..	5	I 8 183.33	8	....
2 493.3	..	2	I 3 302.34 p	9r	9r	I 8 194.93	10	....
I 2 512.1	1r	1	I 3 302.94 p	8r	8r	I 11 382.4	10	....
I 2 512.2	1r		3 533.1	..	8	I 11 404.2	10	....
I 2 543.8	2r	1	3 631.	..	5	I 18 459.5	10	....
I 2 543.9	1r		3 711.	..	3	I 40 449.	8r	....
I 2 593.8	3r	3	I 4 393.	3	1	I 74 430.	1r	....
I 2 593.9	2r		I 4 665.	3<	3n	I 90 480.	..	3
I 2 680.3	4r	4	I 4 669.	4<	3n	I 90 850.	..	4
I 2 680.4	3r							

Strontium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark
II 1 613.	4	....	I 4 876.07	6	1	I 6 791.07	6	1
II 1 620.	5	....	I 4 876.31	6	1	I 6 878.37	10	....
II 1 769.	8	....	I 4 892.01	6	2	I 7 070.15	10r	1
II 1 778.	9	....	I 4 962.25 p	6r	2	I 7 167.30	6	....
II 2 166.	1r	1	I 4 967.92	4	1	I 7 232.24	5	....
I 2 354.3	1r	....	I 5 156.08	5	1	I 7 309.45	7	....
I 2 428.11	3r	....	5 222.21	5	1	I 7 621.53	5	....
I 2 569.50	3r	....	5 225.12	5	1	7 673.10	6	....
I 3 301.74	5	2	5 229.28	5	1	II 10 038.	10	....
I 3 307.54	4	1	5 238.56	6	1	II 10 328.	10	....
I 3 322.23	5	1	5 256.91	6	3	II 10 915.	10	....
3 330.01	4	2	I 5 480.87	7	4	I 11 242.	10	....
I 3 351.26	6r	2	I 5 486.13	5	2	17 137.	..	....
II 3 366.33	5	2	I 5 504.19	5	3	17 170.	..	....
II 3 380.72	5	6	I 5 521.76	6	3	17 446.	..	....
I 3 464.47	6	7	I 5 534.80	5	2	I 20 262.	10	....
I 3 940.80	5	2	I 5 540.04	5	2	20 705.	..	....
II 4 030.38	5	4	I 5 543.32	5	2	20 767.	..	....
II 4 077.71 P	10r	10r	5 598.4	6	1	I 26 024.	6	....
II 4 161.81	4	3	I 6 363.95	4	1	26 714.	..	....
II 4 215.52 p	9r	9r	I 6 369.98	4	1	26 806.	..	....
I 4 305.47	4	4	I 6 380.74	5	1	I 26 915.	6	....
I 4 361.71	4	2	I 6 386.53	7	1	26 947.	..	....
I 4 438.04	6	3	I 6 388.27	6	1	I 27 356.	6	....
I 4 607.34 P	10r	6r	6 408.48	9	4	28 516.	..	....
I 4 722.27	6	3	6 504.01	8	4	28 964.	..	....
I 4 741.91	5	1	6 546.80	5	2	I 29 225.	6	....
I 4 811.86	6r	4	6 550.27	6	3	I 30 110.	5	....
I 4 832.07 p	6	3	6 617.27	6	3	30 482.	..	....
I 4 855.07	4	1	6 643.55	5	2	I 30 665.	..	....
I 4 872.48 p	6	2						

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

SULFUR

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
IV 661.42	6	....	4 332.7	1	5	5 614.3	..	5
IV 753.75	6	....	4 362.5	..	6	5 640.0	..	8
IV 750.23	5	....	4 525.0	..	6	5 647.1	..	8
IV 748.40	5	....	4 694.2 p	..	10	5 660.1	..	6
IV 744.92	5	...	4 695.5 p	..	8	I 5 696.8	..	6
V 786.51	6	....	4 696.3 p	..	6	I 5 700.4	..	7
IV 815.97	5	....	4 925.3	..	6	I 5 706.2	..	8
V 854.81	5	....	5 009.6	..	6	I 6 042.0	..	5
VI 933.42	5	....	5 014.0	..	8	I 6 046.0	..	6
IV 3 098.36	5	....	5 032.5	..	8	I 6 052.8	..	7
3 497.3	8	....	5 201.0	..	6	I 6 403.5	..	2
3 717.7	5	6	5 212.6	1	8	I 6 408.1	..	3
3 837.37	4	7	5 278.1	..	3	I 6 415.5	..	4
3 838.29	8	8	5 278.6	..	5	6 538.1	..	6
3 928.5	..	8	5 279.0	..	6	I 6 743.7	..	5
3 983.7	..	5	5 320.7	..	8	I 6 748.8	..	6
3 993.5	..	5	5 345.7	..	8	I 6 757.2	..	7
4 028.8	..	6	5 428.7	..	9	7 244.8	..	6
4 142.5	2	8	5 432.8	..	10	7 679.6	..	4
4 145.1	2	10	5 453.8	..	10	7 686.1	..	6
4 153.2	..	8	5 473.6	..	8	7 696.7	..	8
4 163.	3	10	I 5 507.0	..	5	8 585.6	..	6
4 174.31	1	7	5 509.6	..	10	8 694.3	..	4
4 189.9	..	5	5 564.9	..	8	I 9 212.80 p	..	2
4 253.60	..	10	5 579.1	..	6	I 9 228.17 p	..	2
4 284.97	5	8	5 606.1	..	8	I 9 237.71 p	..	3
4 294.42	..	8n						

TANTALUM

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 647.46	3	2	3 566.72	4	1	5 461.29	4	2
2 714.67	3	2	3 607.40	7	2	5 518.89	3	2
2 758.31	3	1	3 626.61	9	3	5 664.88	6	3
2 802.07	3	1	3 642.05	10	2	5 776.71	7	2
2 891.85	4	1	3 918.51	3	2	5 811.09	8	....
2 933.56	5	2	4 026.95	4	2	5 882.29	5	....
2 965.15	4	4	4 067.91	6	2	5 997.24	7	....
3 012.53	5	3	4 129.42	5	2	6 045.4	5	....
3 049.54	5	1	4 175.22	4	3	6 256.62	8	2
3 103.25	5	1	4 205.88	6	2	6 268.66	8	2
3 124.96	4	1	4 279.06	3	2	6 309.56	8	3
3 170.28	4	1	4 415.73	3	3	6 389.42	8	3
3 223.83	4	2	4 510.98	8	3	6 430.76	9	5
3 242.05	4	....	4 530.82	5	3	6 450.36	10	5
3 311.14 P	9	3	4 574.32	5	3	6 485.36	10	10
3 317.91	7	1	4 681.87	5	5	6 514.36	9	3
3 361.63	5	1	4 691.89	3	2	6 516.11	10	3
3 406.94 p	5	2	4 740.14	4	2	6 673.70	4	1
3 436.00	5	1	4 812.74	4	2	6 675.51	5	2
3 497.85	5	....	4 936.40	3	1	6 866.20	3	1
3 511.03	8	2	5 136.47	3	3	6 966.16	2	....

TELLURIUM

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
509.	..	1	813.	..	5	931.	..	4
634.	..	1	928.	..	4	1 004.	..	5

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Tellurium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
1 007.	..	5	1 297.	..	5	2 383.27 p	10r	10r
1 064.	..	5	1 345.	..	7	2 385.78 p	10r	10r
1 107.	..	5	1 461.	..	7	2 530.73 p	7	5
1 117.	..	5	1 826.	..	5	2 769.65 p	9	4
1 123.	..	7	2 081.8	8	....	3 175.13	9	2
1 150.	..	5	2 143.0 p	9r	1	4 866.5	..	4
1 167.	..	10	2 147.33	8	1	5 045.2	..	4
1 174.	..	7	2 160.12	6	1	5 449.7	..	5
1 216.	..	7	2 208.88	6	2	5 649.3	..	10
1 219.	..	7	2 255.50	5r	3	5 708.1	..	10
1 223.	..	7	2 259.02	8r	3	5 755.8	..	8
1 291.	..	5	2 265.52	5r	3	6 438.0	..	10

Terbium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 539.91	..	8	3 981.90	10	10	4 752.50	10	8
2 658.91	..	10	4 005.57	8	10	4 813.77	6	....
2 891.29	..	10	4 012.85	7	5	4 837.58	6	1
2 909.24	..	10	4 033.07	8	8	4 875.58	6	1
2 913.28	..	10	4 061.59	6	2	4 881.14	6	2
3 078.87	4	8	4 066.22	5	3	4 915.91	6	....
3 139.65	4	3	4 094.44	5	4	4 931.79	6	....
3 218.95	5	5	4 144.46	5	10	4 970.99	5	....
3 274.24	6	....	4 187.16	5	....	4 993.85	6	....
3 293.08	5	8	4 278.54	10	10	5 065.79	5	....
3 324.40	8	5	4 313.25	6	1	5 089.11	5	1
3 413.77	5	4	4 318.85	6	3	5 228.11	5	....
3 454.06	7	4	4 342.53	6	2	5 319.23	5	....
3 509.18 p	10	10	4 353.20	6	3	5 354.87	5	....
3 561.75 p	10	10	4 356.84	6	2	5 369.71	5	....
3 568.52	7	5	4 367.31	5	3	5 375.98	5	....
3 628.20	8	3	4 423.11	5	1	5 424.10	5	....
3 638.45	7	5	4 436.13	5	....	5 470.34	5	....
3 650.42	7	8	4 493.08	5	2	5 524.11	5	....
3 658.87	8	8	4 511.52	6	....	5 685.72	5	....
3 676.35	8	10	4 563.69	6	1	5 747.58	6	....
3 702.85	6	10	4 578.68	8	3	5 785.18	5	....
3 703.93	8	8	4 641.98	8	3	5 803.11	5	....
3 711.75	10	4	4 645.29	9	2	5 851.07	5	....
3 765.14	6	8	4 662.79	6	1	5 967.35	5	....
3 776.50	8	8	4 681.86	8	....	6 038.97	4	....
3 848.76 p	10	10	4 702.40	8	2	6 331.68	4	....
3 874.19 p	10	10	4 716.08	6	....	6 677.94	6	....
3 899.19	8	8	4 734.19	6	1	6 785.12	4	....
3 925.45	10	10	4 739.92	6	1	6 794.58	5	....
3 939.54	10	10	4 747.79	6	....	6 896.37	5	....
3 976.86	10	10						

Thallium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
395.	..	1	1 082.	..	4	1 561.	..	8
662.	..	3	III 1 266.	..	8	1 660.	..	10
697.	..	4	1 337.	..	4	1 793.	..	9
817.	..	3	1 478.	..	4	1 815.	..	10
908.	..	2	1 492.	..	4	1 828.	..	6
1 029.	..	4	III 1 559.	..	10	1 893.	..	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Thallium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 2 207.1	4r	2	4 738.1	..	10	I 14 515.	10	....
I 2 237.8	6r	3r	5 153.3	..	10	I 14 593.	1	....
I 2 316.0	6r	4	I 5 350.47 P	10r	10	I 14 598.	3	....
I 2 379.60	8r	10r	5 948.9	8	8	I 16 123.	10	....
I 2 517.44	4r	....	I 6 550.	8	3	I 16 340.	10	....
I 2 552.5	6r	....	6 714.	5	2	20 486.	1	....
I 2 552.9	2r	....	I 8 376.	1	....	21 397.	1	....
I 2 580.16	8r	6r	I 9 136.	2	....	I 21 803.	3	....
I 2 585.6	4r	1	I 9 171.	2	....	27 024.	1	....
I 2 608.98	6r	2	I 9 513.	3	....	I 27 889.	4	....
I 2 609.75	4r	....	I 10 292.	6	....	I 33 393.	1	....
I 2 709.24	8r	6r	I 10 492.	5	....	I 35 680.	1	....
I 2 710.7	4r	4	I 10 496.	8	....	I 35 950.	2	....
I 2 767.89	10r	10	I 11 482.	5	....	I 38 131.	5	....
I 2 826.2	8r	....	I 11 513.	10	....	I 39 215.	2	....
I 2 918.34	10r	1	I 11 594.	8	....	I 39 246.	2	....
I 2 921.53	6r	1	11 691.	1	....	39 286.	6	....
I 3 229.76	10r	1	I 12 492.	2	....	I 51 058.	2	....
I 3 519.22	10r	10r	12 728.	2	....	I 55 590.	1	....
I 3 529.41	8r	10	I 12 736.	10	....	I 70 230.	1	....
I 3 775.73 p	10r	10r	I 13 014.	10	....	I 71 170.	1	....

Thorium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 413.50	..	6	4 069.23	3	7	5 539.89	5	2
2 427.98	..	8	4 085.05	3	7	5 604.48	4	1
2 431.74	..	7	4 116.75	2	6	5 639.71	5	1
2 441.30	..	9	4 178.04	3	5	5 707.07	4	1
2 463.72	..	7	4 208.85	4	8	5 749.32	4	1
2 512.72	..	8	4 381.89	5	10	5 815.38	4	....
2 686.17	..	6	4 391.12	5	10	5 870.51	4	1
2 898.92	..	6	4 510.54	4	5	5 914.38	4	1
2 978.68	..	8	4 602.88	5	1	5 989.02	7	2
3 097.92	..	6	4 619.50	7	3	6 015.41	4	1
3 108.26	4	5	4 740.47	6	4	6 087.28	5	1
3 188.22	5	5	4 752.41	6	4	6 099.08	4	1
3 216.58	..	8	4 761.10	5	3	6 104.79	4	1
3 221.27	2	10	4 774.27	5	2	6 112.84	4	1
3 232.08	1	7	4 818.62	4	4	6 120.56	4	1
3 290.59 p	..	10	4 832.78	5	2	6 261.06	4	1
3 300.54	1	10	4 863.17	9	8	6 274.14	4	1
3 313.69	1	10	4 919.80	9	6	6 342.86	4	....
3 392.05	4	5	4 964.15	5	1	6 358.64	4	....
3 469.94	4	5	4 987.16	5	3	6 376.94	4	....
3 507.57	..	10	5 017.24	8	3	6 396.4	4	....
3 511.64	5	6	5 028.59	5	2	6 411.91	4	....
3 538.75 p	1	10	5 049.77	7	3	6 416.10	4	....
3 601.05 p	3	7	5 067.97	5	....	6 457.26	4	....
3 617.07	4	5	5 148.17	4	2	6 462.64	5	1
3 627.40	..	2r	5 247.65	5	2	6 531.3	4	....
3 659.51	3	6	5 277.45	5	2	6 584.0	4	....
3 741.21	5	6	5 325.10	4	2	6 989.7	4	....
3 752.58	4	6	5 435.86	4	1	6 993.1	4	....
4 019.14 p	5	10	5 462.58	4	1	7 054.8	4	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Tin

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
392.	..	1	2 113.9	4r	1r	3 283.5	..	10
410.	..	2	2 121.2	3r	....	3 330.60	6r	6
502.	..	2	2 140.6	3r	1	3 352.3	..	10
508.	..	2	2 148.6	3r	1	3 801.03	9r	8r
752.	..	3	2 151.4	3r	2	4 524.74 p	6	10
784.	..	3	2 171.3	3r	....	4 585.6	..	10
892.	..	3	2 194.5	3r	2r	5 333.	..	10
902.	..	15	2 199.3	3r	2r	5 562.7	..	10
907.	..	3	2 209.63	3r	2r	5 589.4	..	10
910.	..	3	2 231.73	4r	2	5 731.70	7	3
956.	..	10	2 246.05	3r	3r	5 799.4	..	10
1 019.	..	15	2 268.92	3r	3r	5 970.3	5	....
1 044.	..	15	2 286.68	4r	3r	6 037.7	5	....
1 058.	..	3	2 317.22	5r	4r	6 054.9	5	....
1 062.	..	3	2 334.80	4r	4r	6 069.0	7	....
1 086.	..	5	2 354.84	5r	6r	6 149.6	6	....
1 089.	..	5	2 408.18	4r	3	6 154.6	5	....
1 132.	..	12	2 421.70	6r	8r	6 171.5	4	....
1 158.	..	20	2 429.51	7r	8r	6 310.8	4	....
1 224.	..	10	2 483.40	5r	4r	6 453.5	3	6
1 251.	..	20	2 495.72	5r	4r	6 579.2	..	4
1 314.7	..	10	2 546.56	5r	5r	6 844.2	2	2
1 327.	..	7	2 571.60	5r	5r	8 114.1	7	....
1 347.	..	4	2 594.43	4r	3r	8 552.6	7	....
1 370.	..	4	2 658.61	..	10	9 852.	1	....
1 387.	..	5	2 661.25	5r	4r	10 458.	1	....
1 410.8	..	5	2 706.50	7r	7r	10 808.	1	....
1 437.7	..	10	2 779.81	4r	5	10 896.	4	....
1 475.	..	6	2 785.02	3r	4	11 194.	7	....
1 570.	..	4	2 813.58	5r	4r	11 279.	10	....
1 757.	..	10	2 839.99 p	8r	10r	11 457.	6	....
1 811.	..	10	2 850.61	6r	7r	11 618.	6	....
1 899.	3	10	2 863.32 p	8r	8r	11 672.	2	....
1 951.4	3r	....	2 913.54	6r	4	11 740.	9	....
1 983.4	3r	....	3 009.14 p	9r	8r	11 827.	4	....
2 040.	4r	....	3 032.78	3r	3	11 853.	4	....
2 072.9	5r	....	3 034.12 p	9r	8r	11 934.	10	....
2 091.6	3r	1	3 175.05 p	10r	9r	12 983.	5	....
2 096.3	4r	....	3 262.33 p	10r	5r	13 022.	2	....
2 100.8	4r	....						

Titanium

324.	..	1	III 2 375.0	..	6	I 2 646.64	9	2
781.6	..	10	I 2 384.53	3	1	I 2 661.97	5	....
834.0?	..	2	2 414.0	..	10	I 2 669.60	6	2
1 113.4	..	5	I 2 418.36	3	1	I,II 2 742.33	7	4
1 120.5	..	5	III 2 516.0	..	10	II 2 751.7	..	8
1 264.6	..	5	II 2 525.62	4	10	I 2 758.07	6	1
III 1 294.3	..	2	III 2 527.8	..	10	II 2 805.0	..	10
III 1 298.8	..	2	III 2 540.0	..	10	II 2 810.30	4	10
1 437.3	..	5	III 2 563.4	..	10	II 2 817.84	..	10
1 658.7	..	10	I 2 599.91	6	2	II 2 828.07	3	8
1 671.2	..	10	I 2 611.28	7r	1	II 2 841.94	8	4
IV 2 068.3	..	2	I 2 619.94	5	1	II 2 384.10	7	8
2 074.6	..	2	I 2 641.09	9	2	I 2 912.09	8	2
III 2 346.8	..	6	I 2 644.26	9	3	I,II 2 941.99	9	4

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Titanium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 2 948.25	9	2	I 3 729.81	8r	4	I 4 623.11	9	3
I 2 956.13	10	2	I 3 741.07	10	2	I 4 656.46	8	3
I 2 967.22	8	2	I 3 741.65	3	10	I 4 667.59	10	5
III 2 984.8	..	10	I 3 752.87	10	5	I 4 681.91	9	6
II 3 072.11	8	3	II 3 759.30	9	10	I 4 691.34	8	4
II 3 072.97	8	3	II 3 761.33	8	10	I 4 698.77	8	3
II 3 075.23	9	4	I 3 882.88	9	3	I 4 731.17	5r	3
II 3 078.65	9	6	II 3 900.54	5	10	I 4 758.13	8	5
II 3 088.03	10	10r	II 3 913.47	5	10	I 4 759.28	8	6
II 3 162.57	9	6	I 3 947.77	8	3	I 4 820.42	7	3
II 3 168.52	9	10	I 3 948.70	10	4	I 4 840.88	9	4
I 3 186.46	9r	3	I 3 956.34	10	4	I 4 870.14	7	3
II 3 190.88	7	10	I 3 958.21	10	5	I 4 885.09	8	5
I 3 192.00	9r	1	I 3 962.86	7	3	I 4 981.73 p	9	10
I 3 199.92	9r	3	I 3 964.27	7	3	I 4 991.07 p	9	10
II 3 202.54	6	10	I 3 989.76	10	6	I 4 999.51 p	10	10
II 3 217.06	8	8	I 3 998.64	10	6	I 5 007.21 p	9	10
II 3 222.84	7	8	I 4 009.66	7	4	I 5 014.25	10	9
II 3 224.24	5	8	I 4 024.58	7	3	I 5 020.03	8	5
II 3 234.52	8r	10r	I 4 078.48	6	4	I 5 022.87	9	5
II 3 236.58	7r	6r	II 4 163.66	4	10	I 5 024.85	9	3
II 3 239.04	7r	6r	II 4 171.92	3	10	I 5 025.58	8	3
II 3 241.99	7	10	I 4 274.59	10	4	I 5 035.91	7	9
II 3 248.60	4	10	I 4 282.71	6	3	I 5 036.47	9	8
II 3 261.60	4	10	I 4 287.42	9	4	I 5 038.41	9	8
II 3 322.94	8r	10	I 4 289.08	10	4	I 5 039.96	9	3
II 3 329.46	6r	10	II 4 290.23	4	10	I 5 064.66	10	5
II 3 332.11	5	8	I 4 290.94	8	2	I 5 173.74	7r	7
II 3 335.19	7	10	II 4 294.11	6	10	II 5 188.69	4	10
I 3 341.87	6r	10r	I 4 298.68	10	4	I 5 192.97	8r	10
II 3 349.04 P	6r	8r	II 4 300.06	6	8	I 5 210.39	8r	9
II 3 349.41	9r	10r	I 4 300.56	10	2	II 5 226.55	3	10
I 3 354.64	8	3	I 4 301.08	10	3	I 5 283.45	7	3
II 3 361.22 p	8r	10r	I 4 305.92	10	8	I 5 297.25	7	3
I 3 370.44	9r	2	II 4 307.89	..	8	II 5 336.80	3	10
I 3 371.46	9r	2	I 4 314.81	7	3	I 5 477.73	9	4
II 3 372.80 p	10	10r	II 4 337.92	5	10	I 5 488.23	6	3
II 3 380.29	7	10	II 4 395.04	7	10	I 5 512.53	8	10
II 3 383.77 p	8r	10	I 4 427.11	8	4	I 5 514.35	7	8
I 3 385.95	8r	....	I 4 443.81	6	10	I 5 514.54	8	8
II 3 387.84	8	10	II 4 455.33	10	4	I 5 565.47	7	8
II 3 394.58	2	10	I 4 457.44	9	5	I 5 644.14	7	10
II 3 444.32	4	10	I 4 468.50	6	10	I 5 662.16	7	8
II 3 452.48	1	8	II 4 501.28	5	10	I 5 662.92	7	3
II 3 456.39	2	9	I 4 512.74	10	4	I 5 675.43	7	4
II 3 461.50	9	10	I 4 518.03	9	4	I 5 689.48	8	3
II 3 477.19	9	10	I 4 522.81	9	4	I 5 702.68	6	2
II 3 504.89	7	10	I 4 527.32	10	4	I 5 708.23	5	1
II 3 510.85	8	10	I 4 533.25	10r	5	I 5 715.12	8	2
II 3 520.26	3	8	I 4 534.78	9r	4	I 5 762.28	7	2
II 3 535.41	4	10	I 4 535.58	8r	3	I 5 766.33	7	3
I 3 635.47 p	9r	3	I 4 535.92	6r	....	I 5 866.44	9	10
II 3 641.34	4	10	I 4 536.05	6r	4	I 5 899.29	9	10
I 3 642.68 p	10r	3	I 4 544.70	9	3	I 5 918.54	6	3
I 3 653.50 P	10r	4	I 4 548.77	9	3	I 5 922.10	7	4
II 3 659.77	4	10	II 4 549.63	5	10	I 5 941.75	7	4
II 3 662.24	4	10	I 4 555.49	9	3	I 5 953.16	8	10
II 3 685.19	10r	10	II 4 563.77	4	10	I 5 965.82	8	10
II 3 706.22	2	8	II 4 571.98	6	10			

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Titanium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
I 5 978.54	8	8	I 6 258.72	9	9	I 7 209.45	8	....
I 5 999.67	6	2	I 6 261.10	9	9	I 7 244.86	5	....
I 6 085.24	7	4	I 6 303.77	6	3	I 7 251.7	6	....
I 6 091.18	7	5	I 6 556.09	6	5	I 8 426.5	4	....
I 6 126.22	9	5	I 6 743.15	5	3	I 8 435.6	5	....
I 6 215.26	7	10	I 6 861.17	5	1	I 8 518.2	4	....
I 6 258.11	9	9						

Tungsten

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
1 550.2	..	3	2 946.98	8r	3	5 071.74	5	10
1 679.2	..	3	3 017.44	6r	2	5 224.68	10	10
1 785.5	..	5	3 041.86	5r	1	5 492.34	10	10
1 787.0	..	5	3 046.44	5r	1	5 514.72	10	10
1 788.3	..	5	3 049.68	6r	1	5 648.39	7	10
1 895.5	..	6	3 077.50	1	10	5 735.10	8	8
2 397.11 p	2	10	3 376.14	1	10	5 804.86	7	5
2 446.4	1	8	3 401.90	1	8	5 947.58	4	2
2 488.8	2	6	3 508.74	6	5	6 012.80	4	3
2 571.46	2	6	3 545.23	6	3	6 292.05	4	2
2 572.3	..	6	3 572.47	3	10	6 404.22	4	2
2 579.3	1	5	3 592.42	3	10	6 445.15	4	2
2 579.6	..	7	3 613.79 p	3	10	6 538.15	4	....
2 589.14 p	2	8	3 617.52	8r	2	6 693.12	5	....
2 658.02	2	8	3 641.41	4	10	6 820.7	4	....
2 702.1	1	10	3 736.24	1	10	6 934.28	4	....
2 762.34	4r	2	3 867.98	5	5	6 984.29	4	....
2 764.28	4r	8	4 008.76 P	10	10	7 140.51	3	....
2 768.99	4r	1	4 074.37	7	6	7 296.57	3	....
2 769.76	4r	1	4 215.38	3	8	7 385.08	3	....
2 770.90	4r	1	4 294.62 p	6r	9	7 483.34	3	....
2 774.01	5r	2	4 302.12 p	8	5	7 569.87	3	....
2 774.48	5r	3	4 484.20	8	4	7 614.07	3	....
2 818.07	5r	2	4 570.66	7	3	7 688.93	3	....
2 879.11	5r	2	4 588.74	7	3	7 784.11	3	....
2 879.40	5r	2	4 680.52	8	5	7 940.92	3	....
2 896.01	4r	2	4 843.83	9	5	8 123.78	3	....
2 896.44	6r	3	5 006.17	8	10	8 585.07	3	....
2 934.99	5r	3	5 015.34	8	8	8 594.38	3	....
2 944.41	7r	3	5 053.30	10	2	8 613.22	3	....

Uranium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
397.	..	1	4 090.13	6	4	4 731.60	5	3
764.	..	5	4 156.65	5	2	4 756.79	5	2
1 587.	..	5	4 163.70	5	2	4 772.70	4	3
1 833.	..	5	4 171.61	5	3	4 819.48	4	2
1 981.	..	5	4 241.68 p	5	4	4 899.27	4	2
1 985.	..	5	4 287.87	4	3	5 027.38	5	4
2 008.	..	5	4 341.67	5	4	5 280.38	4	1
3 566.61	4	2	4 393.60	5	2	5 475.71	5	3
3 670.07	4	3	4 472.34	5	6	5 481.20	5	3
3 831.45	4	3	4 543.64	5	8	5 492.94	8	4
3 859.57	5	3	4 627.08	5	5	5 527.84	10	4
3 932.04	5	3	4 646.60	4	4	5 564.16	5	1
3 985.80	5	2	4 689.07	5	4	5 610.88	5	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Uranium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
5 621.50	4	1	6 372.46	5	....	7 881.91	4	....
5 669.45	4	....	6 395.46	6	....	7 970.44	3	....
5 723.63	5	1	6 449.19	10	1	8 223.08	4	....
5 758.18	6	....	6 465.00	4	....	8 262.09	4	....
5 780.56	4	....	6 826.90	4	....	8 318.4	3	....
5 798.54	4	1	7 074.78	4	....	8 381.93	3	....
5 837.7	4	1	7 101.61	3	....	8 445.38	4	....
5 915.39	8	1	7 128.88	4	....	8 450.04	4	....
5 976.32	5	....	7 425.49	3	....	8 496.10	3	....
5 997.32	4	....	7 533.91	5	....	8 504.66	4	....
6 051.74	4	1	7 619.34	3	....	8 540.17	3	....
6 077.28	4	....	7 631.72	3	....	8 607.92	5	....
6 171.88	4	....	7 784.11	5	....	8 691.26	3	....

Vanadium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
483.0	..	5	II 2 952.08	8	8r	3 457.13	2	10
684.5?	..	5	2 955.80	8	....	3 496.94	3	8
723.	..	3	II 2 957.52	8	6	3 504.44	4	10
1 112.	..	2	2 968.38	8	10r	3 517.30	5	10
1 437.3	..	2	2 974.24	8	1	3 524.73	3	8
1 454.	..	2	2 976.21	8	2	3 530.77	6	10
2 074.5	..	15	2 976.53	8	3	3 545.20	6	10
2 677.83	7	4	2 977.55	8	1	3 556.80	4	10
2 678.60	7	3	2 989.59	1	3r	3 566.17	3	8
2 679.35	8	4	3 001.20	3	8r	3 589.75	5	10
2 687.99	10	5r	3 044.93	4r	1	3 592.02	5	10
2 700.96	8	5r	3 050.88	3r	3	3 593.33	5	10
2 706.19	8	3r	3 056.35	3r	2	3 618.95	1	8
2 715.69	10	5	3 060.45	3r	....	3 667.72	8	3
2 762.6	..	2r	3 066.37	4r	1r	3 669.42	1	8
2 810.24	2	8	II 3 093.14 P	4	10r	I 3 688.07	8	3
2 882.51	6	8	II 3 102.30 p	10	10r	I 3 690.29	8	4
2 882.51	6	8	II 3 110.71 p	8	10r	I 3 692.22	8	4
2 884.79	6	10	II 3 118.38 p	10r	10r	3 695.87	8	3
2 891.65	10	6r	II 3 125.29 p	8	2	3 700.34	1	8
2 892.46	10	....	II 3 126.21	6	4r	I 3 703.57	8	3
2 892.67	10	5r	II 3 130.27	5	10r	3 715.47	6	10
2 893.32	10	5r	3 134.93	2	8	3 727.46	..	10
2 904.13	8	1	3 136.51	2	8	3 732.75	5	10
2 906.13	8	4r	3 139.73	1	8	3 745.80	3	10
II 2 907.47	8	3r	I 3 183.42 p	10r	2r	3 770.97	3	10
2 908.81	8r	8r	I 3 183.99 P	10r	2r	3 787.15	2	8
2 910.02	8	4r	I 3 185.41 p	10r	2r	3 794.96	8	3
2 910.39	8	4r	3 187.70	5	8r	I 3 813.50	8	3
II 2 911.06	6	3r	3 188.51	5	8r	3 815.51	3	10
2 914.93	10	2	3 190.67	7	10r	I 3 818.24	8	3
2 919.99	8	2	3 198.10	5r	2	3 847.32	4	10
II 2 420.38	8	3	I 3 202.38	5r	2	I 3 855.85	9r	3
2 923.63	8r	....	3 217.11	6	10	I 3 864.86	8	3
II 2 924.02	8	8r	3 237.87	6	10	I 3 875.08	8r	2
II 2 924.65	8	8r	3 254.75	2	8	3 878.73	1	10
II 2 930.81	8	5r	3 267.71	10	10r	3 902.26	8r	2
II 2 941.43	3	10r	3 271.11	10	10r	I 3 909.88	6r	....
2 942.35	10r	2	3 276.12	10	10r	3 914.31	2	8
2 943.20	8	1	3 279.84	3	10	3 916.40	2	8
II 2 944.6	2	8r	3 337.9	..	8	3 951.96	3	10

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

VANADIUM (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
3 973.64	3	10	I 4 408.52	6r	10r	5 670.87	9	8
3 990.57	10	6	4 416.61	..	10	I 5 698.53	10r	10
3 997.13	3	8	I 4 421.59	8	5	I 5 703.61	10r	10
3 998.73	8	4	I 4 437.84	8	6	I 5 707.02	8r	9
4 005.71	3	10	I 4 441.69	7	8	I 5 727.04	10r	10
4 023.38	2	10	I 4 444.22	8	8	5 731.28	8	5
4 035.62	2	10	4 452.03	8	10	I 5 737.07	7	7
I 4 090.59	10	10	I 4 460.31	10r	10r	I 6 039.74	10	10
I 4 092.69	10	3	4 462.37	9	9	I 6 081.47	10	6
I 4 099.80	10	2	4 469.71	8	8	I 6 090.24	10r	10
I 4 105.17	10	4	4 488.90	8	10	I 6 111.67	10	9
I 4 115.18	10	2	4 545.40	9	8	I 6 119.54	10r	8
I 4 116.48	8	7	4 549.65	6	8	6 199.20	8	8
I 4 116.70	10r	7	4 560.72	7	9	I 6 216.35	8	10
I 4 128.07	10	10	4 571.79	6	10	I 6 230.78	10	9
I 4 132.00	10r	10	I 4 577.17	8	8	I 6 242.85	4	10
I 4 134.47	9	10	I 4 580.40	8	9	I 6 243.10	9	4
4 183.4	2	10	I 4 586.37	8	9	I 6 251.83	9	8
4 202.44	1	8	I 4 594.10	10r	10	I 6 268.85	5	5
4 205.08	2	10	I 4 619.68	8	9	I 6 274.67	5	8
I 4 209.85	6	8	4 776.48	6	9	I 6 285.18	9	7
4 268.64	8	8	I 4 786.52	6	8	I 6 292.83	9	7
4 271.56	6	8	I 4 796.94	7	8	I 6 296.53	10	6
4 276.96	6	8	I 4 807.56	10	8	6 326.87	5	4
4 284.06	7	10	I 4 851.50	9	8	I 6 452.38	4	....
I 4 330.03	6	10	I 4 864.75	10r	9	I 6 504.18	4	4
I 4 332.83	8	10	I 4 875.48	10r	10	I 6 531.43	10	6
I 4 341.01	9	10	I 4 881.57	10r	10	6 753.03	4	....
I 4 352.88	10	6	5 128.54	8	9	7 338.90	4	....
I 4 379.24	10r	10r	5 138.44	6	10	I 8 116.76	5	....
I 4 384.73	10r	10r	5 194.85	4	8	I 8 161.03	4	....
I 4 389.99	10r	10r	5 401.95	7	8	8 203.0	4	....
I 4 395.24	10	10	5 415.28	10	8	8 241.6	4	....
I 4 400.59	9	10	5 487.9	5	8	8 253.5	4	....
I 4 406.65	8r	5r	5 507.75	5	8	8 255.8	4	....
I 4 407.65	8r	4r	I 5 627.66	8	9	8 919.8	3	....
I 4 408.21	6r	1						

XENON, FIRST SPECTRUM

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
3 650.2	4	4 624.28? p	9	6 469.70	3
3 951.0	10	4 671.23? p	10	6 727.90	3
3 967.6	4	4 697.02	6	6 882.07	3
4 078.8	10	4 734.15	8	7 285.36	3
4 109.7	5	4 807.02	7	7 393.80	3
4 116.1	7	4 829.71	4	7 642.04	4
4 193.5	8	4 844.33	10	8 231.62	10
4 500.98 p	8	4 923.25	5	8 280.08	10
4 524.68?	6	6 182.44	2	8 409.17	4
4 582.75?	4	6 318.06	3	8 819.38	6
4 603.03	10				

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Xenon, Second Spectrum (Continued)

Wave length.	Geissler tube.	Wave length.	Geissler tube.	Wave length.	Geissler tube.
2 475.9	10	3 596.6	5	4 585.5	10
2 605.6	10	3 624.1	8	4 592.0	6
2 677.2	8	3 676.6	7	4 603.0	10
2 717.4	7	3 776.3	7	4 652.0	6
2 794.9	5	3 781.0	10	4 698.0	5
2 814.5	6	3 841.5	7	4 823.3	6
2 816.0	5	3 877.8	8	4 844.3	10
2 871.2	5	3 880.5	6	4 862.5	8
2 937.9	6	3 895.0	6	4 876.5	7
2 957.7	5	3 907.9	7	4 883.5	6
2 979.4	6	3 922.5	10	4 890.1	5
2 993.0	5	3 950.6	8	4 921.5	6
3 065.2	6	3 992.7	5	5 080.7	7
3 083.6	6	4 050.0	6	5 292.2	10
3 091.1	5	4 057.4	5	5 314.0	8
3 138.3	6	4 109.0	6	5 339.4	9
3 150.7	6	4 180.0	10	5 372.4	8
3 151.0	6	4 193.1	8	5 419.2	10
3 196.2	5	4 208.5	6	5 439.0	8
3 239.3	6	4 238.2	10	5 460.4	6
3 242.8	7	4 245.4	10	5 472.7	7
3 285.8	8	4 330.5	10	5 531.1	7
3 322.2	6	4 393.2	10	5 616.8	6
3 330.8	6	4 395.7	10	5 659.5	5
3 454.3	7	4 414.8	7	5 667.6	6
3 458.8	5	4 434.2	6	5 719.6	6
3 467.2	5	4 448.1	10	5 751.1	5
3 468.2	5	4 462.2	10	5 976.5	7
3 542.4	6	4 480.8	7	6 036.2	6
3 552.1	6	4 540.9	8	6 051.2	7
3 579.7	6	4 545.2	8	6 097.6	7
3 583.6	6	4 577.2	6	6 557.	10

Ytterbium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 464.53	10r	....	3 126.1	..	10	3 619.83	5	8
2 642.53	1	8	3 140.91	4	10	3 694.20 p	10	10
2 672.64	3	4	3 153.86	3	10	3 770.09	7	3
2 750.49	5	10	3 169.05	3	8	3 79[illegible].76	3	5
2 851.17	4	10	3 192.87	3	8	3 988.01 p	10	10
2 859.81	3	6	3 289.37 p	10	10	4 135.13	4	8
2 914.23	2	10	3 337.17	8	2	4 180.84	10	5
2 919.36	4	10	3 342.96	10	5	4 316.96	2	5
2 970.56	6	5	3 362.60	10	4	4 439.22	8	2
2 994.80	3	8	3 431.12	6	3	4 576.22	10	3
3 005.76	5	10	3 441.50	10	3	4 726.07	8	10
3 009.39	3	8	3 454.07	5	10	4 781.90	8	....
3 017.57	3	10	3 464.33	10	5	4 786.60	10	10
3 029.6	..	10	3 476.30	8	4	4 935.51	10	....
3 031.12	10	5	3 478.84	8	10	5 277.07	6	....
3 065.03	4	10	3 520.24	4	10	5 335.14	6	1
3 107.87	10	10r	3 560.33	8	3	5 352.94	5	1
3 117.78	4	10	3 560.69	8	5	5 481.95	8	....

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Ytterbium (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
5 539.05	10	....	5 837.13	8	....	6 799.66	10	....
5 556.47	10	1	6 489.14	10	1	7 527.58	5	....
5 652.00	9	....	6 667.85	10	....	7 699.49	10	....
5 720 02	10	....						

Yttrium

2 367.2	..	10	I 4 174.14	7	4	5 527.55	6r	3
2 414.7	..	10	II 4 177.52	10	10	II 5 544.60	5	2
2 422.20	4	8	4 220.62	7	1	5 556.45	4r	1
2 817.0	1	10	II 4 235.71	8	5	5 577.42	4r	1
2 946.0	..	10	4 251.18	7	2	5 581.88	5r	2
II 3 095.88	6	2	4 302.30	10	3	5 630.13	6r	2
3 129.93	3	8	II 4 309.62	10	10	5 644.69	4r	1
3 173.05	4	10	4 348.79	9	3	5 648.46	4r	1
II 3 195.61	8	.10	II 4 358.72	7	10	5 662.95	7r	10
II 3 200.26	7	10	II 4 374.95	10	10	5 706.73	4r	2
II 3 203.32	7	10	II 4 398.03	8	10	II 5 728.90	4	2
II 3 216.67	10	10	II 4 422.60	10	10	II 5 781.68	4	2
II 3 242.28	10	10	4 505.96	8	3	5 945.72	4	1
II 3 327.88	10	10	4 527.26	8	5	6 009.20	5	3
3 361.99	5	10	4 527.79	7	3	I 6 023.42	4	2
3 496.09	9	10	I 4 643.69 p	8	5	I 6 138.45	4	2
3 548.99	10	10	4 658.31	6	3	I 6 191.72	7	4
3 584.51	4	10	I 4 674.84 P	8	5	I 6 222.58	6	2
I 3 592.91	8	4	II 4 682.31	5	10	I 6 435.03	8	8
II 3 600.73	10	10	II 4 823.31	4	10	6 538.58	4	2
II 3 601.92	10	10	4 839.86	9	10	II 6 613.75	5	3
II 3 611.05	10	10	4 845.68	6	5	6 664.37	4	....
I 3 620.94	10	8	4 852.69	6	4	I 6 687.57	5	1
3 668.48	3	10	II 4 854.88	10	10	6 700.71	4	1
II 3 710.30 P	10	10	4 859.83	6	3	6 735.99	4	....
II 3 747.55	6	10	II 4 883.69	10	10	I 6 793.71	4	1
II 3 774.33 p	10	10	II 4 900.12	10	10	II 6 795.41	4	1
II 3 788.69 p	9	10	II 5 087.42	10	10	6 845.23	4	....
II 3 950.35	10	10	II 5 123.21	6	4	6 887.22	4	....
II 3 982.61	10	10	II 5 200.41	10	10	6 950.32	4	....
I 4 047.65	7	4	II 5 205.71	10	10	II 6 951.67	4	....
I 4 077.38	6r	5	II 5 402.78	5	8	6 979.87	4	....
I 4 083.71	7	3	5 466.46	10	3	7 191.65	3	....
I 4 102.38	9r	8	II 5 497.41	5	8	II 7 264.16	4	....
I 4 128 32	8r	8	5 503.45	8	2	7 346.3	4	....
I 4 142.87	8r	8	II 5 509.91	9	4	II 7 450.2	4	....
I 4 167.52	8	4	II 5 521.62	6r	3	II 7 881.7	2	....

Zinc

677.9	..	5	1 651.9	..	7	1 839.3	..	6
I 1 457.	..	8	1 673.2	..	7	1 864.	..	5
I 1 589.	..	10	1 707.	..	7	II 2 025.5 P	4	2r
I 1 601.2	..	6	1 743.	..	10	II 2 061.9 p	4	4r
1 620.0	..	6	1 746.	..	8	II 2 100.0	..	5
1 622.9	..	7	1 750.	..	7	I 2 138.5 P	3r	2r
1 629.4	..	9	1 767.8	..	7	2 246.8	4	....
1 639.5	..	9	1 811.	..	7	2 393.80	4	1
1 645.0	..	8	1 834.	..	7	I 2 491.5	6	1

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS (Continued)

Zinc (Continued)

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
II 2 502.0	3	10	II 3 806.39	..	10	II 6 482.98	..	15
II 2 557.95	8	10	II 3 840.34	..	15	I 6 928.4	8	....
I 2 569.92	6r	1	4 057.87	6	1	I 6 938.5	6	....
II 2 570.72	..	2r	I 4 629.81	8	....	I 6 943.4	4	....
I 2 582.5	8r	2	I 4 680.14	10r	10	7 026.1	4	....
I 2 608.6	8r	3	I 4 722.16	10r	10	7 264.2	4	....
I 2 670.57	4	1	I 4 810.53	10r	10	7 338.9	4	....
I 2 684.19	6	3	II 4 911.6	10	25	II 7 478.73	4	20
I 2 712.50	6	3	II 4 924.0	10	30	II 7 588.61	..	15
I 2 756.47	6r	5	I 5 181.95	5	1	II 7 732.63	..	10
I 2 770.9	8r	8	I 5 308.57	8	....	I 7 799.1	4	....
I 2 771.0	6r	....	I 5 310.18	6	....	I 10 970.	4	....
I 2 800.0	8r	....	I 5 310.90	4	....	I 10 979.	4	....
I 2 800.8	7r	10	I 5 772.2	8	....	I 11 054.2	10	....
I 2 802.0	3r	....	I 5 775.6	6	....	I 13 053.2	10	....
I 3 018.38	6	3	I 5 777.1	5	....	I 13 150.4	10	....
I 3 035.80	10r	6	II 5 894.39	8	20	I 13 197.5	10	....
I 3 072.10	10r	10	II 6 021.26	1	15	I 13 781.4	2	....
I 3 075.88	8r	6	II 6 102.54	2	20	I 13 786.1	4	....
I 3 282.30 p	8r	10	II 6 111.56	..	10	I 14 038.5	10	....
I 3 302.6 p	8r	10	II 6 214.65	..	12	I 15 679.7	4	....
I 3 302.9	8r	10	I 6 237.9	6	....	I 16 485.7	4	....
I 3 345.0 p	10r	10	I 6 239.20	5	....	I 16 503.9	4	....
I 3 345.6	8r	10	I 6 362.35	10	10	16 504.0	4	....
I 3 345.9	8	2	I 6 479.0	7	....			

Zirconium

Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.	Wave length.	Arc.	Spark.
2 449.84	4	3	II 3 572.47 p	10	10	I 4 710.07 p	10	5
2 568.87	5	6	II 3 576.86	7	10	I 4 739.48 p	9	5
2 571.41	6	8	3 611.89	4	8	I 4 772.32 p	8	4
2 678.64	5	5	II 3 614.77	6	10	I 4 815.63 p	6	3
2 734.84	5	5	II 3 674.71	6	10	4 909.57	6	....
2 752.21	4	3	3 698.16	6	10	4 959.41	5	....
2 844.58	4	4	3 709.27	6	10	5 046.58	5	1
2 875.98	4	....	3 751.59	6	10	5 064.90	5	1
2 968.95	6	3	3 796.49	3	8	5 155.44	4	1
2 985.39	4	1	I 3 835.97	7	2	5 191.58	4	....
3 011.74	5	1	II 3 836.75	5	10	5 311.39	5	1
3 029.52	6	1	I 3 890.32	7	4	5 385.12	7	1
3 106.57	6	4	3 915.93	5	10	5 502.13	6	1
I 3 182.87	7	5	II 3 958.22	8	10	5 528.39	5	1
II 3 273.05	8	9	3 991.13	9	10	5 620.13	6	1
II 3 279.27	8	4	II 3 998.97	9	10	I 5 680.88	6	1
3 284.71	8	4	4 048.67	7	9	5 879.77	8	1
3 356.09	8	4	I 4 081.21	9	5	I 6 127.44	7	1
II 3 357.26	8	4	4 149.20	10	10	I 6 143.19	7	1
II 3 391.98 P	10	10	4 156.23	8	9	6 299.63	7	1
II 3 430.53	7	9	4 161.21	7	8	6 313.01	7	1
II 3 438.23 p	10	10	I 4 227.75	8	4	6 470.21	6	1
3 463.01	4	10	I 4 282.20	6	6	6 489.64	6	1
3 479.39	7	9	4 347.89	7	3	6 769.12	6	....
3 481.15	8	10	4 379.77	8	10	6 846.95	4	....
II 3 496.21 p	10	10	4 442.99	6	9	6 953.83	5	....
3 505.48	4	8	I 4 535.75	8	3	6 990.82	5	....
II 3 505.66	5	8	4 575.51	7	3	I 7 097.7	4	....
I 3 519.60 P	8	3	4 633.98	7	2	I 7 169.1	6	....
3 542.62	5	10	I 4 687.80 p	10	5	7 280.3	4	....
II 3 556.60	9	10	4 688.45	7	4	7 318.2	3	....

SPARK SPECTRUM OF AIR

International Ångstroms

Wave length	Intensity	Element	Wave length	Intensity	Element	Wave length	Intensity	Element
2 287.9	1	N	3 727.34	4	O	4 145.90	3	N
2 318.5	1	O	3 729.3	1	N	4 153.5	3	O
2 382.1	2	....	3 749.51	5	O	4 169.36	1	O
2 395.62	1	....	3 754.5	1	O	4 176.2	2	N
2 399.	1	....	3 759.8	1	O	4 185.5	4	O
2 404.9	2	....	3 770.9	1	N	4 189.8	6	O
2 406.9	1	....	3 804.0	1	O	4 199.3	0	N
2 433.6	1	O	3 830.7	1	N	4 206.7	2	N
2 445.5	1	O	3 839.1	2	N	4 211.1	1	N
2 507.2	2	....	3 842.8	1	N	4 223.3	1	N
2 514.5	1	....	3 845.1	0	N	4 228.	2	N
2 599.5	2	....	3 848.04	1	O	4 236.8	3	N
2 739.8	1	....	3 850.6	1	N	4 241.75	2	N
2 746.7	1	....	3 851.2	1	O	4 253.7	2	O
2 749.	1	....	3 856.7	1	N	4 266.4	2	N
2 755.9	2	....	3 864.6	1	O	4 275.9	1	N
2 795.5	1	....	3 882.3	2	O	4 303.7	1	O
2 858.3	1	....	3 893.3	1	N	4 317.11	3	O
2 927.5	1	....	3 907.6	1	O	4 319.62	3	O
3 007.	1	O	3 909.1	1	N	4 325.7	1	O
3 047.0	1	....	3 912.1	3	O	4 327.5	1	O
3 059.15	2	....	3 919.10	6	N	4 328.5	1	O
3 130.1	1	....	3 933.6	9	?	4 331.04	1	N
3 135.3	1	O	3 940.2	1	N	4 331.9	1	O
3 139.3	2	O	3 945.1	1	O	4 336.8	2	O
3 158.7	1	....	3 947.45	1	O	4 345.54	3	O
3 265.2	1	O	3 954.4	1	O	4 347.44	2	O
3 288.9	1	....	3 955.9	4	N	4 348.0	2	N
3 301.9	1	....	3 968.4	1	A(?)	4 349.40	4	O
3 312.5	1	O	3 973.30	4	O	4 351.3	2	O
3 318.8	1	....	3 982.76	2	O	4 361.6	0	N
3 320.7	2	O	3 995.1	10	N	4 366.87	3	O
3 325.	1	O	4 014.0	1	O	4 369.2	1	O
3 329.5	2	N	4 025.7	1	N	4 371.4	1	N
3 331.8	2	N	4 034.9	2	N	4 379.6	1	N
3 344.8	1	....	4 041.3	3	N	4 392.4	0	N(?)
3 354.08	1	O	4 057.8	1	N	4 396.0	1	O
3 365.8	1	N	4 063.2	1	N	4 401.2	1	N
3 367.3	1	N	4 069.90	8	O	4 414.9	6	O
3 370.9	1	N	4 072.25	8	O	4 417.0	5	O
3 374.0	2	N	4 075.93	8	O	4 425.9	1	N
3 377.2	2	O	4 078.9	2	O	4 430.1	1	N
3 390.3	2	O	4 085.20	2	O	4 432.4	2	N
3 408.3	2	O	4 089.1	1	O	4 434.0	0	N
3 437.32	3	N	4 093.00	2	O	4 443.3	1	O
3 450.9	1	....	4 097.2	3	N	4 447.04	6	N
3 471.2	2	....	4 103.3	2	N	4 452.4	2	O
3 491.9	2	....	4 105.00	3	O	4 460.1	1	N
3 514.8	1	....	4 110.84	2	O	4 465.4	2	O
3 560.6	1	....	4 112.09	1	O	4 467.8	2	O
3 570.3	1	....	4 114.0	0	O	4 469.4	1	O
3 577.2	1	....	4 119.3	4	O	4 477.7	1	N
3 589.0	1	....	4 120.5	2	O	4 507.62	2	N
3 594.6	1	....	4 121.5	2	O	4 514.8	2	N
3 609.8	1	....	4 124.1	2	O	4 529.9	2	N
3 639.6	3	....	4 129.5	1	O	4 544.8	1	N
3 702.9	1	....	4 132.88	2	O	4 552.5	2	N
3 707.3	1	O	4 133.70	2	N	4 590.93	3	O
3 709.2	1	O	4 142.2	1	O	4 596.12	3	O
3 712.7	2	O	4 143.7	1	O	4 601.48	4	N

SPARK SPECTRUM OF AIR (Continued)

INTERNATIONAL ÅNGSTROMS

Wave length	Intensity	Element	Wave length	Intensity	Element	Wave length	Intensity	Element
4 607.14	4	N	5 016.4	2	N	5 952.4	4	N
4 609.4	1	N	5 022.9	1	N	6 158.1	0	O
4 613.84	3	N	5 025.7	2	N	6 171.0	2	O
4 621.39	4	N	5 032.	0	....	6 284.3	1	N
4 630.53	10	N	5 045.1	2	N	6 341.5	0	N
4 634.0	1	N	5 061.8	0	N	6 358.1	0	N
4 638.8	2	O	5 073.5	0	N	6 370.7	0	....
4 640.5	1	N	5 136.	0	....	6 379.3	2	N
4 641.8	3	O	5 143.6	0	O	6 456.	0	O
4 643.1	4	N	5 150.	0	....	6 482.0	5	N
4 649.1	4	O	5 160.1	0	O	6 563.2	3	H
4 650.8	2	O	5 172.	1	N	6 610.4	6	N
4 654.5	1	N	5 173.4	1	N	6 640.7	0	....
4 661.6	5	O	5 175.9	2	N	6 654.8	2	....
4 674.9	1	N	5 179.4	1	N	6 721.3	1	....
4 676.2	3	O	5 183.2	0	O	6 811.9	0	....
4 697.6	0	N(?)	5 185.1	0	N	6 864.	0	....
4 699.2	3	O	5 190.6	1	N	6 887.6	1	....
4 703.1	0	O	5 206.5	1	O	6 950.	0N	....
4 705.1	1	N	5 250.6	1	N(?)	6 965.9	1	A
4 705.4	3	O	5 263.	0	....	7 067.6	0	A
4 709.9	2	O	5 281.7	0	N	7 157.4	9	O(?)
4 718.4	2	N	5 320.5	1	N	6 384.5	1	A
4 735.7	1	N	5 325.1	0	O	7 424.0	8	N
4 751.2	1	O	5 328.6	0	N	7 432.9	0	....
4 764.6	1	N	5 338.7	1	N	7 442.7	10	N
4 774.2	1	N	5 341.2	1	N	7 458.7	0	....
4 779.8	2	N	5 351.2	0	N	7 468.7	10	N
4 781.2	0	N(?)	5 356.4	0	N	7 479.	0	O
4 788.2	4	N	5 411.5	1	N	7 505.8	0	A
4 793.7	2	N	5 432.1	0	N(?)	7 515.2	0	A
4 803.3	5	N	5 452.1	1	N	7 635.7	1	A
4 805.9	1	N	5 454.1	1	N	7 772.1	10	O
4 810.3	2	N	5 462.8	1	N	7 774.3	7	O
4 847.7	1	N(?)	5 478.1	0	N	7 775.6	6	O
4 856.8	1	O	5 480.1	1	N	7 947.8	4	O
4 860.3	1	N	5 495.7	2	N	7 951.1	3	O
4 871.6	0	O	5 526.2	2	N	7 952.3	2	O
4 879.7	1	N	5 530.2	3	N	8 185.3	4	N
4 890.9	0	O	5 535.2	5	N	8 188.4	4	N
4 895.3	1	N	5 543.4	3	N	8 200.7	1	N
4 906.8	1	O	5 552.0	2	N	8 211.1	2	N
4 924.6	2	O	5 566.	0	N	8 216.7	7	N
4 934.8	1	N	5 592.3	0	O	8 223.5	4	N
4 941.0	1	N	5 645.6	1	N	8 230.2	0	O
4 942.5	1	N	5 666.6	5	N	8 242.8	4	N
4 943.0	1	O	5 675.9	3	N	8 446.8	5	O
4 955.	1	O	5 679.5	10	N	8 594.	0	....
4 964.7	0	N	5 686.2	3	N	8 630.0	0	....
4 987.4	1	N	5 710.7	2	N	8 680.6	2	N
4 991.3	1	N	5 730.6	2	N	8 683.7	1	N
4 994.4	3	N	5 747.5	1	N	8 686.4	0	N
5 001.4	6	N	5 767.4	2	N	8 692.	0	....
5 005.2	6	N	5 927.8	4	N	8 703.8	0	N
5 007.4	3	N	5 931.8	7	N	8 712.0	0	N
5 010.6	2	N	5 940.5	1	N	8 719.2	0	N
5 013.9	0	....	5 941.6	10	N			

STANDARD WAVE LENGTHS

Primary Standard

Wave length of the red cadmium line in air, 760 mm. pressure 15°C., measures of Benoit, Fabry and Perot 1907,
6438.4696 Ångström units

SECONDARY STANDARDS. Lines of the Iron Arc

Selected lines from list by Ch. Fabry: *International Critical Tables*, 1929. Wave lengths in international Ångströms, atmospheric pressure, 15°C.

Wave-length	Wave-length	Wave-length	Wave-length	Wave-length
3370.789	3935.816	4592.655	5232.948	6065.489
3399.337	3977.744	4602.945	5266.564	6137.697
3485.343	4021.870	4647.437	5371.493	6191.563
3513.821	4076.638	4691.414	5405.779	6230.729
3556.882	4118.549	4707.282	5434.527	6265.141
3606.682	4134.680	4736.782	5455.613	6318.023
3640.392	4147.673	4789.654	5497.520	6335.338
3676.314	4191.436	4878.219	5506.783	6393.606
3677.630	4233.609	4903.318	5569.626	6430.852
3724.381	4282.406	4919.001	5586.763	6494.985
3753.615	4315.087	5001.872	5615.652	6546.245
3805.346	4375.933	5012.072	5658.825	6592.920
3843.261	4427.313	5049.825	5709.396	6677.994
3850.820	4466.556	5083.343	5763.013	6750.157
3865.527	4494.568	5110.414	5857.759 Ni	
3906.482	4531.152	5167.491	5892.882 Ni	
3907.937	4547.851	5192.353	6027.058	

SECONDARY STANDARDS

Spectra of helium, neon, argon, krypton and xenon. Comparison with the primary standard made by interferometer methods. Wave lengths in Ångström units.

Helium

Merrill, Bulletin 14, Bulletin of Standards 1917.

2945.104	3888.646	4387.928	5047.736
3187.743	3964.727	4471.479	5875.620
3613.641	4026.189	4713.143	6678.149
3705.003	4120.812	4921.928	7065.188
3819.606	4143.759	5015.675	7281.349

STANDARD WAVE LENGTHS (Continued)

Neon

Burns, Meggers, Merrill, Bulletin 14, Bureau of Standards, 1918
Meissner, Annalen der Physik, 1919

Bureau of Standards	Meissner	Bureau of Standards	Meissner
3369.904	.....	6402.245	.2460
3417.906	.....	6506.528	.527
3447.705	.....	6532.883	.881
3454.197	.....	6598.953	.953
3460.526	.....	6678.276	.275
3464.340	.....	6717.043	.042
3466.581	.....	6929.468	.455
3472.578	.....	7024.049	....
3498.067	.....	7032.413	.410
3501.218	.....	....	....
3515.192	.....	7051.292	7051.314
3520.474	.....	7059.109	7059.119
3593.526	.....	7173.938	7173.938
3593.634	.....	7245.166	7245.165
3600.170	.....	7438.899	7438.885
3633.664	.....	7488.872	....
5330.779	.....	7535.784	7535.786
5341.096	.....	7544.050	7544.061
5400.562	.564	....	7937.010
5764.419	.....	7943.182	7943.193
5820.155	.....	....	8082.460
5852.488	.4875	....	8118.554
5881.895	.896	8136.408	8136.423
5944.834	.834	....	8259.392
5975.534	.534	....	8266.092
6029.997	.999	8300.369	8300.338
6074.338	.337	8377.606	8377.630
6096.163	.163	....	8418.447
6143.062	.061	8495.358	8495.359
6163.594	.594	....	8591.266
6217.280	.279	....	8634.668
6266.495	.495	....	8654.380
6304.789	.788	....	....
6334.428	.428	....	....
6382.991	.991	....	....

STANDARD WAVE LENGTHS (Continued)

Argon

Meggers, Journal Optical Society of America, 1921

Bureau of Standards	Meissner	Bureau of Standards	Meissner
3948.980	4300.101	6871.290	7514.651
4044.419	4333.561	6937.666	7635.106
4158.591	4345.168	6965.429	7723.758
4164.180	4510.733	7030.250	7724.210
4181.884	4522.325	7067.217	7948.175
4190.714	4596.096	7147.042	8006.156
4191.027	4628.445	7206.986	8014.784
4198.316	4702.317	7272.935	8103.693
4200.676	6032.127	7353.316	8115.307
4251.184	6416.307	7372.119	8264.522
4259.362	6677.282	7383.979	8408.210
4266.286	6752.831	7503.867	8424.646
4272.169	....	....	8521.443

Krypton

Meggers, Journal Optical Society of America, 1921

Bureau of Standards	Meissner	Bureau of Standards	Meissner
4273.9696	4362.6422	4502.354	6456.290
4282.967	4376.122	4807.065	7587.414
4318.552	4399.969	5562.224	7601.544
4319.580	4453.9174	5570.2872	....
4355.478	4463.690	5870.9137	....

Xenon

Meggers, Journal Optical Society of America, 1921

4500.978	4624.275	4807.019
4524.680	4671.225	4829.705
4582.746	4697.020	4844.333
4603.028	4734.154	4923.246

PERSISTENT LINES OF THE ELEMENTS

Arranged by Elements

Spectra of the first, second and third class are indicated by I, II and III respectively.

Element	Wave length ångstrom units	Element	Wave length ångstrom units	Element	Wave length ångstrom units
A I	1048.26	Br II(?)	4704.83		2860.94
	1066.70		4785.48	Cs I	*8521.15
	6965.430		4816.72		8943.6
	7067.217	C I	*2478.6		4555.3
	7503.868	C II	1334.54		4593.2
	8115.308		1335.72	Cu I	*3247.548
Ag I	*3280.67		4267.02		3273.964
	3382.89		4267.27	Cu II	*2135.98
Ag II	2246.43	Ca I	*4226.728		2192.27
	2437.77		4454.780		2247.80
Al I	3082.162		4455.880	Dy I	4000.50
	3092.718		4456.62		4046.00
	3092.85	Ca II	*3933.670		4077.98
	3944.025		3968.475		4167.99
	*3961.537	Cb I	*4058.97		4211.74
Al II	1671.0		4079.73	Er I	3499.12
	1856.00		4100.97		3692.65
	1858.13		4123.85		3906.34
	1862.48		4137.13	Eu I	4129.72
Al III	1854.67	Cb II	*3094.19		4205.03
	1862.90		3130.78	F I	6856.01
As I	1889.9		3163.37		6902.46
	1936.9		3194.95	Fe I	*3719.938
	1972.0		3225.47		3737.135
	2288.14	Cd I	*2288.03		3745.564
	2349.84		3403.653		3748.264
	2780.23		3466.201		3745.902
	2860.46		3610.510	Fe II	*2382.04
Au I	*2427.96	Cd II	*2144.39		2395.63
	2675.95		2265.03		2404.886
B I	2496.778	Ce II	4012.40		2410.53
	*2497.733		4040.76		2413.312
B II	1362.46		4165.61	Ga I	4033.01
	3452.33		4186.60		*4172.05
Ba I	5424.63	Cl I	1379.6	Gd I	3646.19
	5519.11		1396.5		3768.40
	*5535.53		4794.5	Ge I	2651.15
	5777.7		4810.0		2651.60
Ba II	*4554.037		4819.4		3039.08
	4934.09	Co I	*3453.514		3269.49
Be I	*2348.62		3465.794		4226.61
	3321.01		3529.814	Gl see Be	
	3321.09	Co II	*2286.16	H I	1215.7
	3321.35		2307.84		6562.79
Be II	*3130.42		2378.62		4861.33
	3131.06		2388.90	He I	584.4
Bi I	2061.71	Cr I	*4254.342		*3888.64
	2276.57		4274.802		5875.63
	2780.52		4289.725	He II	303.8
	2809.63		5204.54		1640.5
	2897.98		5206.039		4685.81
	2938.31		5208.429	Hf I	2898.25
	2989.04	Cr II	*2835.64		2904.42
	*3067.73		2843.25		2916.48
Br I	1540.8		2849.83		2940.76
	1633.8		2855.66		3072.88

*The most sensitive line

PERSISTENT LINES OF THE ELEMENTS
(Continued)

ARRANGED BY ELEMENTS

Element	Wave length ångstrom units	Element	Wave length ångstrom units	Element	Wave length ångstrom units
Hf I	4093.17		4034.489	P I	1774.8
Hf II	2513.02	Mn II	*2576.12		1782.7
	2516.88		2593.733		1787.5
	2641.42		2605.69		2136.8
	2773.36	Mo I	*3798.26		2149.8
	2820.23		3864.12		2536.38
	3134.72		3902.96		2554.02
Hg I	*1849.6	Mo II	*2816.15	Pb I	*2170.0
	2536.52		2848.21		2833.07
	3650.15		2871.50		3639.584
	3654.83		2891.00		3683.472
	3662.88		2909.11		4057.830
Hg II	1649.8	N I	1199.5	Pb II	1682.4
	1942.3		1200.2		*2203.57
Ho I	3748.19		1200.7	Pd I	*3404.59
	3891.02		4099.96		3421.23
Ho II	2936.8		*4109.94		3516.95
I I	1782.9	N II	5666.6		3609.55
	2062.1		5675.9		3634.68
	5161.2		5679.5	Pd II	2488.92
	5464.6	N III	989.8		2498.79
In I	4101.76		991.6		2505.72
	*4511.31		4097.3		2658.74
Ir I	2849.74		4103.4		2854.60
	2924.81	Na I	3302.34	Pr I	4062.83
	*3220.79		3302.94		4179.43
	3437.05		*5889.965		4189.52
	3513.67		5895.932		4225.34
K I	4044.16	Nb see Cb		Pt I	2659.44
	4047.22	Nd I	3951.15		2830.29
	*7664.94		4177.34		2929.79
	7699.01		4303.61		2997.96
Kr I	5570.291	Ne I	735.95		*3064.71
	5870.917		743.73	Ra I	*4825.94
La I	5455.11		5400.56	Ra II	*3814.44
	*5930.59		5832.488		4682.20
	6249.92		6402.246	Rb I	4201.81
La II	*3949.10	Ni I	*3414.771		4215.58
	4077.35		3492.965		*7800.30
	4123.23		3515.057		7947.63
Li I	3232.67		3524.543	Rh I	3323.10
	*6707.86	Ni II	2253.9		3396.82
Lu I	4518.54		2264.45		*3434.90
Lu II	2894.86		2270.24		3657.99
	2911.40		*2287.1		3692.35
	3397.02	O I	1302.27	Ru I	3436.74
	3472.49		1304.96		*3498.95
	3554.43		1306.12		3596.17
Mg I	*2852.130		7771.97	Ru II	2678.73
	3829.36		7774.01		2692.10
	3832.31		7775.68		2712.40
	3838.29	Os I	3262.30		2945.67
Mg II	*2795.540		3267.94		2965.55
	2802.712		3301.56		2976.58
Mn I	*4030.760		3752.54	S I	1807.4
	4033.074		3782.20		1820.5

*The most sensitive line

PERSISTENT LINES OF THE ELEMENTS
(Continued)

ARRANGED BY ELEMENTS

Element	Wave length ångstrom units	Element	Wave length ångstrom units	Element	Wave length ångstrom units
S I	1826.4		4872.48		*3185.406
	4694.2		4962.25	V II	*3093.13
	4695.5	Sr II	*4077.714		3102.30
	4696.3		4215.515		3110.71
	9212.8	Ta I	*3311.14		3118.38
	9228.2		3318.85		3125.29
	9237.7		3406.65	W I	*4008.76
Sa I	4390.87	Tb I	3509.18		4294.62
	4424.35		3561.75		4302.12
	4434.34		3848.76	W II	2397.11
Sb I	2068.38		3874.19		2589.2
	2175.88	Te I	2142.75		3613.79
	2311.50		2383.27	Xe I	1295.8
	2528.53		2385.78		1469.9
	2598.08		2530.73		4500.978
	3232.52		2769.65		4624.275
	3267.48	Th I	3538.75		4671.225
Sc I	3907.49		3601.05	Yt I	4643.69
	*3911.81		4019.14		*4674.84
Sc II	*3613.83	Th II	3290.59	Yt II	*3710.30
	3630.75	Ti I	3635.467		3774.33
	3642.81		3642.680		3788.69
Se I	1960.2		*3653.497	Yb I	3289.37
	2039.7		4981.73		3694.20
	2062.6		4991.07		3988.01
	*4730.9		4999.511	Zn I	*2138.5
	4739.1		5007.214		3282.32
	4742.3		5014.25		3302.6
Si I	2506.904	Ti II	*3349.039		3344.5
	2516.119		3361.215	Zn II	*2025.5
	2528.516		3372.80		2061.9
	*2881.587		3383.765	Zr I	*3519.605
	3905.52	Tl I	3775.73		3547.691
Si II	1526.83		*5350.47		3601.19
	*1533.55	Tu I	3462.21		4687.803
Sn I	2839.987		3761.34		4710.075
	2863.322		3761.91		4739.477
	3009.135	U I	3552.20		4772.313
	3034.116		3672.59		4815.62
	3175.047		4241.68	Zr II	*3391.976
	3262.33	V I	3183.415		3438.23
	4524.74		3183.96		3496.208
Sr I	*4607.342		3184.00		3572.472
	4832.07				

*The most sensitive line

PERSISTENT LINES OF THE ELEMENTS (Continued)

ARRANGED BY WAVE LENGTHS

Wave length ångstrom units	Element	Wave length ångstrom units	Element	Wave length ångstrom units	Element
303.8	He II	36.8	P I	2605.69	Mn II
584.4	He I	*38.5	Zn I	41.42	Hf II
735.95	Ne I	42.75	Te I	51.15	Ge I
743.73	Ne I	*44.39	Cd II	51.60	Ge I
989.8	N III	49.8	P I	58.74	Pd II
991.6	N III	*70.0	Pb I	59.44	Pt I
1048.26	A I	75.88	Sb I	75.95	Au I
1066.70	A I	92.27	Cu II	78.73	Ru II
1199.5	N I	2203.57	Pb II	92.10	Ru II
1200.2	N I	46.43	Ag II	2712.40	Ru II
00.7	N I	47.80	Cu II	69.65	Te I
15.7	H I	53.9	Ni II	73.36	Hf II
95.8	Xe I	64.45	Ni II	80.23	As I
1302.27	O I	65.03	Cd II	80.52	Bi I
04.96	O I	70.24	Ni II	*95.540	Mg II
06.12	O I	76.57	Bi I	2802.712	Mg II
34.54	C II	*86.16	Co II	09.63	Bi I
35.72	C II	*87.1	Ni II	*16.15	Mo II
62.46	B II	*88.03	Cd I	20.23	Hf II
79.6	Cl I	88.14	As I	30.29	Pt I
96.5	Cl I	2307.84	Co II	33.07	Pb I
1469.9	Xe I	11.50	Sb I	*35.64	Cr II
1526.83	Si II	*48.62	Be I	39.987	Sn I
*33.55	Si II	49.84	As I	43.25	Cr II
40.8	Br I	78.62	Co II	48.21	Mo II
1633.8	Br I	*82.04	Fe II	49.74	Ir II
40.5	He II	83.27	Te I	49.83	Cr II
49.8	Hg II	85.78	Te I	*52.130	Mg I
71.0	Al II	88.90	Co II	54.60	Pd II
82.4	Pb II	95.63	Fe II	55.66	Cr II
1774.8	P I	97.11	W II	60.46	As I
82.7	P I	2404.886	Fe II	60.94	Cr II
82.9	I I	10.53	Fe II	63.322	Sn I
87.5	P I	13.312	Fe II	71.50	Mo II
1807.4	S I	*27.96	Au I	*81.587	Si I
20.5	S I	37.77	Ag II	91.00	Mo II
26.4	S I	*78.6	C I	94.86	Lu II
*49.6	Hg I	88.92	Pd II	97.98	Bi I
54.67	Al III	96.778	B I	98.25	Hf I
56.00	Al II	*97.733	B I	2904.42	Hf I
58.13	Al II	98.79	Pd II	09.11	Mo II
62.48	Al II	2505.72	Pd II	2911.40	Lu II
62.90	Al III	06.904	Si I	16.48	Hf I
89.9	As I	13.02	Hf II	24.81	Ir I
1936.9	As I	16.119	Si I	29.79	Pt I
42.3	Hg II	16.88	Hf II	36.8	Ho II
60.2	Se I	2528.516	Si I	38.31	Bi I
72.0	As I	28.53	Sb I	40.76	Hf I
*2025.5	Zn II	30.73	Te I	45.67	Ru II
39.7	Se I	36.38	P I	65.55	Ru II
61.71	Bi I	36.52	Hg I	76.58	Ru II
2061.9	Zn II	54.02	P I	89.04	Bi I
62.1	I I	*76.12	Mn II	97.96	Pt I
62.6	Se I	89.2	W II	3009.135	Sn I
68.38	Sb I	93.733	Mn II	34.116	Sn I
*2135.98	Cu II	98.08	Sb I	39.08	Ge I

*The most sensitive line

PERSISTENT LINES OF THE ELEMENTS
(Continued)

ARRANGED BY WAVE LENGTHS

Wave length ångstrom units	Element	Wave length ångstrom units	Element	Wave length ångstrom units	Element
*64.71	Pt I	97.02	Lu II	94.20	Yb I
*67.73	Bi I	3403.653	Cd I	*3710.30	Yt II
72.88	Hf I	*04.59	Pd I	*19.938	Fe I
82.162	Al I	06.65	Ta I	37.135	Fe I
92.718	Al I	*14.771	Ni I	45.564	Fe I
92.85	Al I	21.23	Pd I	45.902	Fe I
*93.13	V II	*34.90	Rh I	48.19	Ho I
*94.19	Cb II	36.74	Ru I	48.264	Fe I
3102.30	V II	37.05	Ir I	52.54	Os I
10.71	V II	38.23	Zr II	61.34	Tu I
18.38	V II	52.33	B II	61.91	Tu I
25.29	V II	*53.514	Co I	68.40	Gd I
*30.42	Be II	62.21	Tu I	74.33	Yt II
30.78	Cb II	65.794	Co I	75.73	Tl I
31.06	Be II	66.201	Cd I	82.20	Os I
34.72	Hf II	72.49	Lu II	88.69	Yt II
63.37	Cb II	92.965	Ni I	*98.26	Mo I
75.047	Sn I	96.208	Zr II	*3814.44	Ra II
83.415	V I	*98.95	Ru I	29.36	Mg I
83.96	V I	99.12	Er I	32.31	Mg I
84.00	V I	3509.18	Tb I	38.29	Mg I
*85.406	V I	13.67	Ir I	48.76	Tb I
94.95	Cb II	15.057	Ni I	64.12	Mo I
*3220.79	Ir I	16.95	Pd I	74.19	Tb I
25.47	Cb II	*19.605	Zr I	*88.64	He I
32.52	Sb I	24.543	Ni I	91.02	Ho I
32.67	Li I	29.814	Co I	3902.96	Mo I
*47.548	Cu I	38.75	Th I	05.52	Si I
62.30	Os I	47.691	Zr I	06.34	Er I
62.33	Sn I	52.20	U I	3907.49	Sc I
67.48	Sb I	54.43	Lu II	*11.81	Sc I
67.94	Os I	61.75	Tb I	*33.670	Ca II
69.49	Ge I	72.472	Zr II	44.025	Al I
73.964	Cu I	3596.17	Ru I	*49.10	La II
*80.67	Ag I	3601.05	Th I	51.15	Nd I
82.32	Zn I	01.19	Zr I	*61.537	Al I
89.37	Yb I	09.55	Pd I	68.475	Ca II
3290.59	Th II	10.510	Cd I	88.01	Yb I
3301.56	Os I	13.79	W II	4000.50	Dy I
02.34	Na I	*13.83	Sc II	*08.76	W I
02.6	Zn I	30.75	Sc II	12.40	Ce II
02.94	Na I	34.68	Pd I	19.14	Th I
*11.14	Ta I	35.467	Ti I	*30.760	Mn I
18.85	Ta I	39.584	Pb I	33.01	Ga I
21.01	Be I	42.680	Ti I	33.074	Mn I
21.09	Be I	42.81	Sc II	34.489	Mn I
21.35	Be I	46.19	Gd I	40.76	Ce II
23.10	Rh I	50.15	Hg I	44.16	K I
44.5	Zn I	*53.497	Ti I	46.00	Dy I
*49.039	Ti II	54.83	Hg I	47.22	K I
61.215	Ti II	57.99	Rh I	57.830	Pb I
72.80	Ti II	62.88	Hg I	*58.97	Cb I
82.89	Ag I	72.59	U I	62.83	Pr I
83.765	Ti II	83.472	Pb I	77.35	La II
*91.976	Zr II	92.35	Rh I	*77.714	Sr II
96.82	Rh I	92.65	Er I	77.98	Dy I

*The most sensitive line

PERSISTENT LINES OF THE ELEMENTS (Continued)

ARRANGED BY WAVE LENGTHS

Wave length ångstrom units	Element	Wave length ångstrom units	Element	Wave length ångstrom units	Element
79.73	Cb I	*11.31	In I	06.039	Cr I
93.17	Hf I	18.54	Lu I	08.429	Cr I
97.3	N III	24.74	Sn I	*5350.47	Tl I
99.96	N I	*54.037	Ba II	5400.56	Ne I
4100.97	Cb I	55.3	Cs I	24.63	Ba I
01.76	In I	93.2	Cs I	55.11	La I
03.4	N III	*4607.342	Sr I	64.6	I I
*09.94	N I	24.275	Xe I	5519.11	Ba I
23.23	La II	43.69	Yt I	*35.53	Ba I
23.85	Cb I	71.225	Xe I	70.291	Kr I
29.72	Eu II	*74.84	Yt I	5666.6	N II
37.13	Cb I	82.20	Ra II	75.9	N II
65.61	Ce II	85.81	He II	79.5	N II
67.99	Dy I	87.803	Zr I	5777.7	Ba I
*72.05	Ga I	94.2	S I	5832.488	Ne I
77.34	Nd I	95.5	S I	70.917	Kr I
79.43	Pr I	96.3	S I	75.63	He I
86.60	Ce II	4704.83	Br II	*89.965	Na I
89.52	Pr I	10.075	Zr I	95.932	Na I
4201.81	Rb I	*30.9	Se I	*5930.59	La I
05.03	Eu I	39.1	Se I	6249.92	La I
11.74	Dy I	39.477	Zr I	6402.246	Ne I
15.515	Sr II	42.3	Se I	6562.79	H I
15.58	Rb I	72.313	Zr I	*6707.86	Li I
25.34	Pr I	85.48	Br II	6856.01	F I
4226.61	Ge I	94.5	Cl I	6902.46	F I
*26.728	Ca I	4810.0	Cl I	65.430	A I
41.68	U I	15.62	Zr I	7067.217	A I
*54.342	Cr I	16.72	Br II	7503.868	A I
67.02	C II	19.4	Cl I	*7664.94	K I
67.27	C II	*25.94	Ra I	99.01	K I
74.802	Cr I	32.07	Sr I	7771.97	O I
89.725	Cr I	61.33	H I	74.01	O I
94.62	W I	72.48	Sr I	75.68	O I
4302.12	W I	4934.09	Ba II	*7800.30	Rb I
03.61	Nd I	62.25	Sr I	7947.63	Rb I
90.87	Sa I	81.73	Ti I	8115.308	A I
4424.35	Sa I	91.07	Ti I	*8521.15	Cs I
34.34	Sa I	99.511	Ti I	8943.6	Cs I
54.780	Ca I	5007.214	Ti I	9212.8	S I
55.880	Ca I	14.25	Ti I	28.2	S I
56.62	Ca I	5161.2	I I	37.7	S I
4500.978	Xe I	5204.54	Cr I		

*The most sensitive line

INDEX OF REFRACTION.

Indices of refraction for elements, inorganic, metal-organic and organic compounds will be found in the tables of physical constants for the various classes of substances in the section Properties and Physical Constants.

Values for compounds not there listed and data subsequently collected are given below.

Indices not otherwise indicated are for sodium light, $\lambda = 589.3$ mμ. Other wave lengths are indicated by the value in millimicrons or symbol in parentheses which follows the index. Wave lengths are indicated as follows: He, $\lambda = 587.6$ mμ; Li, $\lambda = 670.8$ mμ; Hg, $\lambda = 579.1$ mμ; A, $\lambda = 759.4$ mμ; C, $\lambda = 656.3$ mμ; D, $\lambda = 589.3$ mμ; F, $\lambda = 486.1$ mμ.

Temperatures are understood to be 20°C for liquids, or ordinary room temperatures in the case of solids. Other temperatures appear as superior figures with the index.

Indices for the elements and inorganic compounds will be understood to be for the solid form except as indicated by the abbreviation liq.

Elements

See also under Physical Constants of Inorganic Compounds and Index of Refraction of Gases.

Name	Formula	Index
Bromine (liq.)	Br_2	1.661^{15}
Cadmium (liq.)	Cd	0.82 (579 mμ)
(sol.)		1.13
Chlorine (liq.)	Cl_2	1.385
" (gas)		1.000768
Hydrogen (liq.)	H_2	$1.0974^{-252.83}$(579 mμ)
Iodine (sol.)	I_2	3.34
(gas)		1.001920
Lead	Pb	2.6 (579 mμ)
Mercury (liq.)	Hg	1.6–1.9
Nitrogen (liq.)	N_2	1.2053^{-190}
Oxygen (liq.)	O_2	1.221^{-181}
Phosphorus (yel.) (sol.)		2.1442^{25}
Selenium	Se_8	3.00, 4.04
" (amor.) (sol.)		2.92
Sodium (liq.)	Na	0.0045
(sol.)		4.22
Sulfur (liq.)	S_8	1.929^{110}
" (amor.) (sol.)		1.998
" (rhombic, α)		1.957, 2.0377, 2.2454
Tin (liq.)	Sn	2.1

Inorganic Compounds

See also under Physical Constants of Inorganic Compounds.

Aluminum carbide	Al_4C_3	2.7, 2.75 (700 mμ)
chloride	$AlCl_3.6H_2O$	1.560, 1.507
oxide	Al_2O_3	1.665–1.680, 1.63–1.65
Alums. See under appropriate element.		
Ammonium antimonyl tartrate	$2(NH_4.SbO.C_4H_4O_6).H_2O$	β1.6229 (C)
orthoarsenate, di-H	$NH_4H_2AsO_4$	1.5766, 1.5217
bromide	NH_4Br	1.7108
perchlorate	NH_4ClO_4	1.4818, 1.4833, 1.4881
chloroplatinate	$(NH_4)_2PtCl_6$	1.8
fluoride	NH_4F	ω<1.328
" acid	NH_4HF_2	1.385, 1.390, 1.394
hydrogen malate (d)	$NH_4C_4H_5O_5$	β1.503
nitrate	NH_4NO_3	1.413, 1.611(He), 1.637

INDEX OF REFRACTION (Continued)

Inorganic Compounds (Continued)

Name	Formula	Index
Ammonium sulfate, acid	NH_4HSO_4	1.463, 1.473, 1.510
tartrate (*dl*)	$(NH_4)_2C_4H_4O_6.2H_2O$	β1.564
thiocyanate	NH_4CNS	1.546, 1.685, 1.692
uranyl acetate	$NH_4C_2H_3O_2.UO_2(C_2H_3O_2)_2$	1.4808, 1.4933
Antimony bromide	$SbBr_3$	>1.74+
iodide, tri-	SbI_3	2.78 (Li), 2.36
Barium cadmium bromide	$BaCdBr_4.4H_2O$	β1.702
cadmium chloride	$BaCdCl_4.4H_2O$	β1.651
calcium propionate	$BaCa_2(C_3H_5O_2)_6$	1.4442
fluochloride	$BaCl_2.BaF_2$	1.640, 1.633
fluoride	BaF_2	1.475 also 1.4741
Barium oxide	BaO	1.980
*ortho*phosphate, di-	$BaHPO_4$	1.617, 1.63±, 1.635
propionate	$Ba(C_2H_5CO_2)_2.H_2O$	β1.5175
sulfide, mono-	BaS	2.155
Cadmium ammonium chloride	$CdCl_2.4NH_4Cl$	1.6038, 1.6042
cesium sulfate	$CdSO_4.Cs_2SO_4.6H_2O$	1.498, 1.500, 1.506
fluoride	CdF_2	1.56
magnesium chloride	$(CdCl_2)_2.MgCl_2.12H_2O$	1.49, 1.5331, 1.5769
oxide	CdO	2.49 (Li)
potassium chloride	$CdCl_2.4KCl$	1.5906, 1.5907
" cyanide	$Cd(CN)_2.2KCN$	1.4213
rubidium sulfate	$CdSO_4.Rb_2SO_4.6H_2O$	1.4798, 1.4848, 1.4948
Calcium aluminate	$Ca_3Al_2O_6$	1.710
borate	$CaO.B_2O_3$	1.540, 1.656, 1.682
carbide	CaC_2	>1.75
copper acetate	$CaCu(C_2H_3O_2)_4.6H_2O$	1.436, 1.478
cyanamide	$CaCN_2$	1.60, >1.95
dithionate	$CaS_2O_6.4H_2O$	1.5516, 1.5414
*pyro*phosphate	$Ca_2P_2O_7$	1.585, 1.60±, 1.605
platinocyanide	$CaPt(CN)_4.5H_2O$	1.623, 1.644, 1.767
strontium propionate	$Ca_2Sr(C_3H_5O_2)_6$	1.4871, 1.4956
sulfide (oldhamite)	CaS	2.137
sulfite	$CaSO_3.2H_2O$	1.590, 1.595, 1.628
thiosulfate	$CaS_2O_3.6H_2O$	1.545, 1.560, 1.605
Carbon dioxide (liq.)	CO_2	1.195^{15}
Cerium dithionate	$Ce_2(S_2O_6)_3.15H_2O$	β1.507
Cesium *per*chlorate	$CsClO_4$	1.4752, 1.4788, 1.4804
nitrate	$CsNO_3$	1.55, 1.56
selenate	Cs_2SeO_4	1.5989, 1.5999, 1.6003
thallium chloride	$Cs_3Tl_2Cl_9$	1.784, 1.774
Chromium cesium sulfate	$CrCs(SO_4)_2.12H_2O$	1.4810
oxide (ic)	Cr_2O_3	2.5
potassium cyanide (ic)	$CrK_3(CN)_6$	1.5221, 1.5244, 1.5373
sulfate (ic)	$Cr_2(SO_4)_3.18H_2O$	1.564
thallium sulfate	$CrTl(SO_4)_2.12H_2O$	1.5228
Cobalt acetate	$Co(C_2H_3O_2)_2.4H_2O$	β1.542
aluminate (Thenard's Blue)	$Co(AlO_2)_2$	>1.78 (red), 1.74 (blue)
ammonium selenate	$CoSeO_4.(NH_4)_2SeO_4.6H_2O$	1.5246, 1.5311, 1.5396
cesium sulfate	$CoCs_2(SO_4)_2.6H_2O$	1.5057, 1.5085, 1.5132
chloride (ous)	$CoCl_2.2H_2O$	<1.625, <1.671, >1.67
potassium selenate	$CoSeO_4.K_2SeO_4.6H_2O$	1.5135, 1.5195, 1.5358
rubidium sulfate	$CoSO_4.Rb_2SO_4.6H_2O$	1.4859, 1.4916, 1.5014
selenate	$CoSeO_4.6H_2O$	β1.5225, γ1.5227
Copper ammonium selenate	$CuSeO_4.(NH_4)_2SeO_4.6H_2O$	1.5213, 1.5355, 1.5395
ammonium sulfate	$CuSO_4.(NH_4)_2SO_4.6H_2O$	1.4910, 1.5007, 1.5054
cesium sulfate	$CuSO_4.Cs_2SO_4.6H_2O$	1.5048, 1.5061, 1.5153
chloride (ic)	$CuCl_2.2H_2O$	1.644, 1.684, 1.742
formate	$Cu(CHO_2)_2.4H_2O$	1.4133, 1.5423, 1.5571

INDEX OF REFRACTION (Continued)

Inorganic Compounds (Continued)

Name	Formula	Index
Copper oxide (ous) (cuprite)	Cu_2O	2.705
potassium chloride	$CuCl_2.2KCl.2H_2O$	1.6365, 1.6148
" cyanide (ous)	$CuK_3(CN)_4$	1.5215
" selenate	$CuSeO_4.K_2SeO_4.6H_2O$	1.5096, 1.5235, 1.5387
" sulfate	$CuSO_4.K_2SO_4.6H_2O$	1.4836, 1.4864, 1.5020
strontium formate	$Cu(HCO_2)_2.2[Sr(HCO_2)_2]$ $8H_2O$	1.4995, 1.5199, 1.5801
sulfate (ic)	$CuSO_4$	1.724, 1.733, 1.739
Cyanogen	C_2N_2	1.327^{15} (liq.)
Germanium bromide, tetra-	$GeBr_4$	1.6269
Gold sodium chloride	$AuNaCl_4.2H_2O$	$\alpha 1.545$, $\gamma 1.75+$
Hafnium oxychloride	$HfOCl_2.8H_2O$	1.557, 1.543
Ice	H_2O	1.3049, 1.3062 (A), 1.3091, 1.3104 (D), 1.3133, 1.3147 (F)
Iron ammonium chloride	$Fe(NH_4)_2Cl_4$	1.6439
ammonium selenate	$FeSeO_4.(NH_4)_2SeO_4.6H_2O$	1.5201, 1.5260, 1.5356
cesium sulfate (ic)	$FeCs(SO_4)_2.12H_2O$	1.4839
" " (ous)	$FeSO_4.Cs_2SO_4.6H_2O$	1.5003, 1.5035, 1.5094
rubidium sulfate	$FeRb(SO_4)_2.12H_2O$	1.48234
sulfate (ic)	$Fe_2(SO_4)_3$	1.802, 1.814, 1.818
thallium sulfate	$FeTl(SO_4)_2.12H_2O$	1.52365
Lanthanum sulfate	$La_2(SO_4)_3.9H_2O$	1.564, 1.569
Lead *ortho*arsenate, di-	$PbHAsO_4$	1.8903, 1.9097, 1.9765
nitrate	$Pb(NO_3)_2$	1.782
Lithium ammonium sulfate	$LiNH_4SO_4$	$\beta 1.437$ (Li)
ammonium tartrate (*d*)	$LiNH_4(C_4H_4O_6).H_2O$	$\beta 1.567$, $\gamma 1.5673$
" " (*dl*)	$LiNH_4(C_4H_4O_6).H_2O$	$\beta 1.5287$
bromide	$LiBr$	1.784
chloride	$LiCl$	1.662
dithionate	$Li_2S_2O_6.2H_2O$	1.5487, 1.5602, 1.5788
oxide	Li_2O	1.644
potassium sulfate	$LiKSO_4$	1.4723, 1.4717
" tartrate	$LiK(C_4H_4O_6).H_2O$	$\beta 1.5226$ (red)
rubidium tartrate (*d*)	$LiRb(C_4H_4O_6).H_2O$	$\beta 1.552$
sodium tartrate (*dl*)	$LiNa(C_4H_4O_6).2H_2O$	$\beta 1.4904$
Magnesium ammonium selenate	$MgSeO_4.(NH_4)_2SeO_4.6H_2O$	1.5070, 1.5093, 1.5169
ammonium sulfate	$Mg(NH_4)_2.(SO_4)_2.6H_2O$	1.4716, 1.4730, 1.4786
*ortho*borate	$3MgO.B_2O_3$	1.6527, 1.6537, 1.6748
cesium sulfate	$MgCs_2(SO_4)_2.6H_2O$	1.4857, 1.4858, 1.4916
chlorostannate	$MgSnCl_6.6H_2O$	1.5885, 1.5970
fluosilicate	$MgSiF_6.6H_2O$	1.3439, 1.3602
platinocyanide	$MgPt(CN)_4.7H_2O$	1.5608, 1.91
Magnesium potassium selenate	$MgK_2(SeO_4)_2.6H_2O$	1.4969, 1.4991, 1.5139
potassium sulfate	$MgK_2(SO_4)_2.6H_2O$	1.4607, 1.4629, 1.4755
rubidium sulfate	$MgRb_2(SO_4)_2.6H_2O$	1.4672, 1.4689, 1.4779
silicate	$MgSiO_3$	1.651, 1.654 (calc.), 1.660
sulfide	MgS	2.271 also 2.268
Manganese borate	$Mn_3B_4O_9$	1.617, 1.738, 1.776
cesium sulfate	$MnCs_2(SO_4)_2.6H_2O$	1.4946, 1.4966, 1.5025
chloride	$MnCl_2.4H_2O$	1.555, 1.575, 1.607
rubidium sulfate	$MnRb_2(SO_4)_2.6H_2O$	1.4767, 1.4807, 1.4907
sulfate (ous)	$MnSO_4.4H_2O$	1.508, 1.518, 1.522
" "	$MnSO_4.5H_2O$	1.495, 1.508, 1.514
Mercury chloride (ic)	$HgCl_2$	1.725, 1.859, 1.965
cyanide (ic)	$Hg(CN)_2$	1.645, 1.492
iodide (ic) (red)	HgI_2	2.748, 2.455
Nickel ammonium selenate	$Ni(NH_4)_2.(SeO_4)_2.6H_2O$	1.5291, 1.5372, 1.5466
cesium sulfate	$NiCs_2(SO_4)_2.6H_2O$	1.5087, 1.5129, 1.5162

INDEX OF REFRACTION (Continued)

Inorganic Compounds (Continued)

Name	Formula	Index
Nickel chloride	$NiCl_2.6H_2O$	α1.535, γ1.61
fluoride, acid	$NiF_2.5HF.6H_2O$	1.392, 1.408
potassium selenate	$NiK_2(SeO_4)_2.6H_2O$	1.5199, 1.5248, 1.5339
rubidium sulfate	$NiRb_2(SO_4)_2.6H_2O$	1.4895, 1.4961, 1.5052
selenate	$NiSeO_4.6H_2O$	1.5393, 1.5125
Platinum potassium dibromonitrite	$PtK_2(NO_2)_2Br_2.H_2O$	1.626, 1.6684, 1.757
Potassium carbonate	K_2CO_3	1.426, 1.531, 1.541
carbonate, acid	$KHCO_3$	1.380, 1.482, 1.578
*per*chlorate	$KClO_4$	1.4731, 1.4737, 1.4769
chloroplatinate	K_2PtCl_6	1.827 (577 mμ)
chloroplatinite	K_2PtCl_4	1.64, 1.67
*di*chromate	$K_2Cr_2O_7$	1.7202, 1.7380, 1.8197
cyanide	KCN	1.410
fluoborate	KBF_4	1.3239, 1.3245, 1.3247
fluoride	KF	1.352 (1.361)
"	$KF.2H_2O$	1.345, 1.352, 1.363
fluosilicate	K_2SiF_6	1.3391
*per*iodate	KIO_4	1.6205, 1.6479
lithium ferrocyanide	$K_2Li_2Fe(CN)_6.3H_2O$	1.5883, 1.6007, 1.6316
*hypo*phosphate	$K_2H_2P_2O_6.2H_2O$	1.4893, 1.5314, 1.5363
"	$K_2H_2P_2O_6.3H_2O$	1.4768, 1.4843, 1.4870
ruthenium cyanide	$K_4Ru(CN)_6.3H_2O$	β1.5837
silicate	K_2SiO_3	1.520, 1.521, 1.528
thiocyanate	$KCNS$	1.532, 1.660, 1.730
thionate, tetra-	$K_2S_4O_6$	1.5896, 1.6057, 1.6435
" penta-	$2K_2S_5O_6.3H_2O$	1.565, 1.63, 1.655
Rhodium cesium sulfate	$RhCs(SO_4)_2.12H_2O$	1.5077
Rubidium *per*chlorate	$RbClO_4$	1.4692, 1.4701, 1.4731
chromate	Rb_2CrO_4	β1.71, γ1.72
dithionate	$Rb_2S_2O_6$	1.4574, 1.5078
fluoride	RbF	1.396
selenate	Rb_2SeO_4	1.5515, 1.5537, 1.5582
Ruthenium sodium nitrate	$RuNa_2(NO_2)_5.2H_2O$	1.5889, 1.5943, 1.7163
Selenium oxide	SeO_2	>1.76
Silver cyanide	$AgCN$	1.685, 1.94
nitrate	$AgNO_3$	1.729, 1.744, 1.788
phosphate	Ag_2HPO_4	1.8036, 1.7983
potassium cyanide	$AgK(CN)_2$	1.625, 1.63
Sodium ammonium tartrate (*d*)	$NaNH_4(C_4H_4O_6).4H_2O$	1.495, 1.498, 1.499
ammonium tartrate (*dl*)	$NaNH_4(C_4H_4O_6).H_2O$	β1.473 (red)
*ortho*arsenate	$NaH_2AsO_4.H_2O$	1.5382, 1.5535, 1.5607
"	$NaH_2AsO_4.2H_2O$	1.4794, 1.5021, 1.5265
bromide	$NaBr$	1.6412
carbonate	Na_2CO_3	1.415, 1.535, 1.546
Sodium carbonate, acid	$NaHCO_3$	1.376, 1.500, 1.582
cyanide	$NaCN$	1.452
iodide	NaI	1.7745
molybdate	$3Na_2O.7MoO_3.22H_2O$	β1.627
nitrate	$NaNO_3$	1.5874, 1.3361
phosphate	$NaH_2PO_4.2H_2O$	1.4401, 1.4629, 1.4815
"	$Na_2HPO_4.7H_2O$	1.4412, 1.4424, 1.4526
*hypo*phosphate	$Na_3HP_2O_6.9H_2O$	1.4653, 1.4738, 1.4804
silicate	Na_2SiO_3	1.513, 1.520, 1.528
sulfate, acid	$NaHSO_4.H_2O$	1.43, 1.46, 1.47
sulfite	Na_2SO_3	1.565, 1.515
" acid	$NaHSO_3$	1.474, 1.526, 1.685
tartrate, acid (*d*)	$NaH(C_4H_4O_6).H_2O$	β1.533
thiocyanate	$NaCNS$	1.545, 1.625, 1.695

INDEX OF REFRACTION (Continued)

Inorganic Compounds (Continued)

Name	Formula	Index
Sodium tungstate	$Na_2WO_4.2H_2O$	1.5526, 1.5533, 1.5695
vanadate	$Na_3VO_4.10H_2O$	1.5305; ω1.5398, ϵ1.5475
"	$Na_3VO_4.12H_2O$	1.5095, 1.5232
Strontium dichromate	$SrCr_2O_7.3H_2O$	1.7146, 1.7174, 1.812
fluoride	SrF_2	1.442 (1.438)
oxide	SrO	1.870
*ortho*phosphate, acid	$SrHPO_4$	1.608, 1.62±, 1.625
sulfide, mono-	SrS	2.107
Sulfur nitride	S_4N_4	α1.908, β2.046
Thallium chloride, mono-	$TlCl$	2.247
iodide, mono-	TlI	2.78
Tin iodide (ic)	SnI_4	2.106
Uranyl potassium sulfate	$UO_2.SO_4.K_2SO_4.2H_2O$	1.5144, 1.5266, 1.5705 (580 mμ)
Vanadium ammonium sulfate	$VNH_4(SO_4)_2.12H_2O$	1.475
Zinc ammonium selenate	$Zn(SeO_4).(NH_4)_2SeO_4.6H_2O$	1.5240, 1.5300, 1.5385
bromate	$Zn(BrO_3)_2.6H_2O$	1.5452
cesium sulfate	$ZnCs_2(SO_4)_2.6H_2O$	1.5022, 1.5048, 1.5093
chloride	$ZnCl_2$	1.687, 1.713
fluosilicate	$ZnSiF_6.6H_2O$	1.3824, 1.3956
potassium cyanide	$ZnK_2(CN)_4$	1.4115
" selenate	$ZnK_2(SeO_4)_2.6H_2O$	1.5121, 1.5181, 1.5335
" sulfate	$ZnK_2(SO_4)_2.6H_2O$	1.4775, 1.4833, 1.4969
rubidium sulfate	$ZnRb_2(SO_4)_2.6H_2O$	1.4833, 1.4884, 1.4975
silicate	$ZnSiO_3$	1.616, 1.62±, 1.623
Zirconium ammonium fluoride	$Zr(NH_4)_3F_7$	1.433

Organic Compounds

See also under Physical Constants of Organic Compounds.

Name	Index
Allontoin, solid	α1.579, γ1.660
Dimethyl thiophene (α, α'), liq	$1.51693^{13.4}$ (He)
" " (β, β'), liq	1.52217^{15} (He)
Ethyl carbylamine, liq	1.3659^{24}
Ethylidene cyanhydrin, liq	$1.40582^{18.4}$
Hexyl acetylene (n), liq	$1.4208^{12.5}$

Miscellaneous

Albite glass	1.4890	Magdala red	1.90
Amber	1.546	Obsidian	1.482–1.496
Anorthite glass	1.5755	Paraffin	$1.43295^{38.3}$ (C)
Asphalt	1.635	Quartz, fused	1.45640 (656 mμ)
Bell metal	1.0052		1.45843 (589 mμ)
Borax, amorphous, fused	1.4630		1.46190 (509 mμ)
Canada balsam	1.530		1.47503 (361 mμ)
Ebonite	1.66 (red)		1.49634 (275 mμ)
Fuchsin	2.70		1.53386 (214 mμ)
Gelatin, Nelson's No. 1	1.530		1.57464 (185 mμ)
Gelatin, various	1.516–1.534	Resin, aloes	1.619 (red)
Gum Arabic	1.480 (1.514) (red)	colophony	1.548 (red)
		copal	1.528 (red)
Hoffman's violet	2.20	mastic	1.535 (red)
Ivory	1.539, 1.541	Peru balsam	1.593

MOLECULAR REFRACTION

The molecular refraction of a substance may be computed by the following relation,—

$$N = \frac{M(n^2 - 1)}{d(n^2 + 2)}$$

where N is the molecular refraction for a specified wave length and temperature, M, the molecular weight, d, the density and n the refractive index for the specified conditions.

LIQUIDS FOR INDEX BY IMMERSION METHOD

Liquid	N_D 24° C
Trimethylene chloride	1.446
Cineole	1.456
Hexahydrophenol	1.466
Decahydronaphthalene	1.477
Isoamylphthalate	1.486
Tetrachloroethane	1.492
Pentachloroethane	1.501
Trimethylene bromide	1.513
Chlorobenzene	1.523
Ethylene bromide + Chlorobenzene	1.533
o-Nitrotoluene	1.544
Xylidine	1.557
o-Toluidine	1.570
Aniline	1.584
Bromoform	1.595
Iodobenzene + Bromobenzene	1.603
Iodobenzene + Bromobenzene	1.613
Quinoline	1.622
α-Chloronaphthalene	1.633
α-Bromonaphthalene + α-Chloronaphthalene	1.640, 1.650
α-Bromonaphthalene + α-Iodonaphthalene	1.660–1.690
Methylene iodide + Iodobenzene	1.700–1.730
Methylene iodide	1.738

INDEX OF REFRACTION OF WATER

Alcohol and Carbon Bisulfide

For sodium light, λ = .5893

Temp. °C	Water, pure relative to air	Ethyl Alcohol 99.8 relative to air	Carbon Bisulfide relative to air
14	1.33348	....	....
15	1.33341	....	1.62935
16	1.33333	1.36210	1.62858
18	1.33317	1.36129	1.62704
20	1.33299	1.36048	1.62546
22	1.33281	1.35967	1.62387
24	1.33262	1.35885	1.62226
26	1.33241	1.35803	1.62064
28	1.33219	1.35721	1.61902
30	1.33192	1.35639	1.61740
32	1.33164	1.35557	1.61577
34	1.33136	1.35474	1.61413
36	1.33107	1.35390	1.61247
38	1.33079	1.35306	1.61080
40	1.33051	1.35222	1.60914
42	1.33023	1.35138	1.60748
44	1.32992	1.35054	1.60582
46	1.32959	1.34969	....
48	1.32927	1.34885	....
50	1.32894	1.34800	....
52	1.32860	1.34715	....
54	1.32827	1.34629	....
56	1.32792	1.34543	....
58	1.32755	1.34456	....
60	1.32718	1.34368	....
62	1.32678	1.34279	....
64	1.32636	1.34189	....
66	1.32596	1.34096	....
68	1.32555	1.34004	....
70	1.32511	1.33912	....
72	1.32466	1.33820	....
74	1.32421	1.33728	....
76	1.32376	1.33626	....
78	1.32332	....	....
80	1.32287	....	....
82	1.32241	....	....
84	1.32195	....	....
86	1.32148	....	....
88	1.32100	....	....
90	1.32050	....	....
92	1.32000	....	....
94	1.31949	....	....
96	1.31897	....	....
98	1.31842	....	....
100	1.31783	....	....

ABSOLUTE INDEX FOR PURE WATER FOR SODIUM LIGHT

Temperature	Index	Temperature	Index
15° C.	1.33377	60° C.	1.32754
20	1.33335	65	1.32652
25	1.33287	70	1.32547
30	1.33228	75	1.32434
35	1.33157	80	1.32323
40	1.33087	85	1.32208
45	1.33011	90	1.32086
50	1.32930	95	1.31959
55	1.32846	100	1.31819

INDEX OF REFRACTION OF GLASS

Relative to Air

Variety.	Wave length in microns.							
	.361	.434	.486	.589 (Na)	.656	.768	1.20	2.00
Zinc crown..........	1.539	1.528	1.523	1.517	1.514	1.511	1.505	1.497
Higher dispersion crown	1.546	1.533	1.527	1.520	1.517	1.514	1.507	1.497
Light flint..........	1.614	1.594	1.585	1.575	1.571	1.567	1.559	1.549
Heavy flint..........	1.705	1.675	1.664	1.650	1.644	1.638	1.628	1.617
Heaviest flint.........	...	1.945	1.919	1.890	1.879	1.867	1.848	1.832

INDEX OF REFRACTION OF ROCK SALT, SYLVINE, CALCITE, FLUORITE AND QUARTZ

(Compiled from data of Martens, Paschen, and others.)

Wave length.	Rock salt.	Silvine, KCl.	Fluorite.	Calcspar, ordinary ray.	Calcspar, extraordinary ray.	Quartz, ordinary ray.	Quartz, extraordinary ray.
0.185	1.893	1.827	......	......	......	1.676	1.690
0.198	.....	......	1.496	......	1.578	1.651	1.664
0.340	.....	......	......	1.701	1.506	1.567	1.577
0.589	1.544	1.490	1.434	1.658	1.486	1.544	1.553
0.760	.....	......	1.431	1.650	1.483	1.539	1.548
0.884	1.534	1.481	1.430				
1.179	1.530	1.478	1.428				
1.229	.....	......	......	1.639	1.479		
2.324	.....	......	......	......	1.474	1.516	
2.357	1.526	1.475	1.421				
3.536	1.523	1.473	1.414				
5.893	1.516	1.469	1.387				
8.840	1.502	1.461	1.331				

INDEX OF REFRACTION OF GLASS

Index of refraction of optical glass made at the Bureau of Standards.
Composition refers to the raw material combined, not to the finished glass.

Composition	Ordinary Crown	Borosilicate Crown	Barium flint	Light Barium flint	Light flint	Dense barium flint	Medium flint	Dense flint
	(Composition percentage)							
SiO_2	67.0	64.2	53.7	48.0	53.9	37.0	45.6	39.0
Na_2O	12.0	9.4	1.7	2.0	1.0	....	3.4	3.0
K_2O	5.0	8.3	8.3	6.1	7.6	2.7	4.1	4.0
B_2O_3	3.5	11.0	2.7	4.0	....	5.0	....	....
BaO	10.6	6.1	14.3	29.5	....	47.0	....	....
ZnO	1.5	....	2.5	10.0	....	7.7	....	....
As_2O_3	0.4	0.4	....	1.4	0.3	....	....	....
CaO	....	1.0	....	....	2.0	....	3.0	4.0
PbO	....	....	16.7	....	35.2	....	44.0	49.0
Sb_2O_3	....	....	....	....	....	....	....	1.0
Wave length, Å	(Index of Refraction)							
Hg 4046.8	1.53189	1.53817	1.58851	1.59137	1.60507	1.63675	1.65788	1.69005
Hg 4047.1	1.53147	1.53775	1.58791	1.59084	1.60430	1.63619	1.65692	1.68894
H 4340.7	1.52818	1.53468	1.58327	1.58698	1.59860	1.63189	1.64973	1.68079
Hg 4358.6	1.52798	1.53450	1.58299	1.58674	1.59826	1.63163	1.64931	1.68030
H 4861.5	1.52326	1.53008	1.57646	1.58121	1.59029	1.62548	1.63941	1.66911
Hg 4916.4	1.52283	1.52967	1.57587	1.58071	1.58958	1.62492	1.63854	1.66814
Hg 5461.0	1.51929	1.52633	1.57105	1.57657	1.58380	1.62033	1.63143	1.66016
Hg 5769.6	1.51771	1.52484	1.56894	1.57473	1.58128	1.61829	1.62834	1.65671
Hg 5790.5	1.51760	1.52475	1.56881	1.57460	1.58112	1.61817	1.62815	1.65650

INDEX OF REFRACTION OF GLASS (Continued)

Index of refraction of optical glass made at the Bureau of Standards.
Composition refers to the raw material combined, not to the finished glass

(Index of Refraction) Continued

Wave Length, Å	Ordinary Crown	Borosilicate Crown	Barium flint	Light Barium flint	Light flint	Dense barium flint	Medium flint	Dense flint
Na 5893.2	1.51714	1.52430	1.56819	1.57406	1.58038	1.61756	1.62725	1.65548
Hg 6234.6	1.51573	1.52297	1.56634	1.57242	1.57818	1.61576	1.62458	1.65250
H 6563.0	1.51458	1.52188	1.56482	1.57107	1.57638	1.61427	1.62241	1.65007
Li 6708.2	1.51412	1.52145	1.56423	1.57054	1.57567	1.61369	1.62157	1.64913
K 7682.0	1.51160	1.51908	1.56100	1.56762	1.57183	1.61047	1.61701	1.64405
Dispersion								
N_d	1.51714	1.52430	1.56819	1.57406	1.58038	1.61756	1.62725	1.65548
$n_f - n_c$	0.00868	0.00820	0.01164	0.01014	0.01391	0.01121	0.01700	0.01904
$\frac{n_d - 1}{n_f - n_c} = \gamma$	59.6	63.9	48.8	56.6	41.7	55.1	36.9	34.4
$n_d - n_f$	0.00612	0.00578	0.00827	0.00715	0.00991	0.00792	0.01216	0.01363
$n_f - n_g'$	0.00492	0.00460	0.00681	0.00577	0.00831	0.00641	0.01032	0.01168
$n_d - n_c$	0.00256	0.00242	0.00337	0.00299	0.00400	0.00329	0.00484	0.00541

OPTICAL CONSTANTS OF METALS

The following table gives the refractive index n, the absorption index k, the angle of principle incidence $\bar{\phi}$, the angle of principle azimuth $\bar{\psi}$ and the percent of light reflected R.

The reduction of amplitude of the wave of the wave length λ after traveling any distance d in the medium is given by the ratio $1 : e^{\frac{2\pi dk}{\lambda}}$. $\bar{\phi}$ is the angle of incidence for which the phase change between the two rectangular components vibrating in and normal to the plane of incidence is 90°. $\bar{\psi}$ is the azimuth at which circularly polarized light results. These quantities are connected by the following relations

$$k = \tan 2\bar{\psi}(1 - \cot^2 \bar{\phi}), \qquad n = \frac{\sin \bar{\phi} \tan \bar{\phi}}{(1+k^2)^{\frac{1}{2}}} (1 + \tfrac{1}{2} \cot^2 \bar{\phi})$$

Metal	λ	$\bar{\phi}$	$\bar{\psi}$	Computed n	k	nk	R	Authority
	μ	° ′	° ′					
Aluminum	0.589	.....	.....	1.44	.....	5.32	83.	Drude
Antimony	.589	.....	.....	3.04	.....	4.94	70.	"
Bismuth (prism)	white	.....	.....	2.26	.....	.....	....	Kundt 1889
Bronze	.527	.....	.....	1.18	.....	.....	....	Jamin
	.589	.....	.....	1.12	.....	.....	....	"
Cadmium	.589	.....	.....	1.13	.....	5.01	85.	Drude
Chromium	.579	.....	.....	2.97	.....	4.85	70.	Wartenburg, 1910
Cobalt	0.231	64 31	29 39	1.10	1.30	1.43	32.	Minor
	.275	70 22	29 59	1.41	1.52	2.14	46.	"
	.500	77 5	31 53	1.93	1.93	3.72	66.	"
	.650	79 0	31 25	2.35.	1.87	4.40	69.	Ingersoll
	1.00	81 45	29 6	3.63.	1.58	5.73	73.	"
	1.50	83 21	26 18	5.22.	1.29	6.73	75.	"
	2.25	83 48	26 5	5.65	1.27	7.18	76.	"
Columbium	.579	.....	.....	1.80	.....	2.11	41.	Wartenburg, 1910
Copper	.231	65 57	26 14	1.39	1.05	1.45	29.	Minor
	.347	65 6	28 16	1.19	1.23	1.47	32.	"
	.500	70 44	33 46	1.10	2.13	2.34	56.	"
	.650	74 16	41 30	0.44	7.4	3.26	86.	Ingersoll
	.870	78 40	42 30	0.35	11.0	3.85	91.	"
	1.75	84 4	42 30	0.83	11.4	9.46	96.	"
	2.25	85 13	42 30	1.03	11.4	11.7	97.	"
	4.00	87 20	42 30	1.87	11.4	21.3	....	Först-Fréed
	5.50	88.00	41 50	3.16	9.0	28.4	....	" "
Gold	.257	.....	.....	0.92	.....	1.14	28.	Meier, 1903
Electrolytic	.441	.....	.....	1.18	.....	1.85	42.	"
	.589	.....	.....	0.47	.....	2.83	82.	"
	1.00	81 45	44 00	0.24	28.0	6.7	....	Först-Fréed
	2.00	85 30	43 56	0.47	26.7	12.5	....	" "
	3.00	87 05	43 50	0.80	24.5	19.6	....	" "
	5.00	88 15	43 25	1.81	18.1	33.	....	" "
Iodine	.589	.....	.....	3.34	.....	0.57	30.	Meier, 1903
Iridium	.579	.....	.....	2.13	.....	4.87	75.	Wartenburg, 1916
	1.00	82 10	29 15	3.85	1.60	6.2	....	Först-Fréed
	2.00	83 10	29 40	4.30	1.66	7.1	....	" "
	3.00	81 40	30 40	3.33	1.79	6.0	....	" "
	5.00	79 00	32 20	2.27	2.03	4.6	....	" "
Iron	.257	.....	.....	1.01	0.88	.....	16.	Meier, 1903
	.441	.....	.....	1.28	1.37	.....	28.	"
	.589	.....	.....	1.51	1.63	.....	33.	"

OPTICAL CONSTANTS OF METALS

(Continued)

Metal	λ	$\bar{\Phi}$	$\bar{\Psi}$	Computed				Authority
				n	*k*	*nk*	*R*	
	μ	° ′	° ′					
Lead	.589	.....	.....	2.01	.....	3.48	62.	Drude
Magnesium	.589	.....	.....	0.37	.....	4.42	93.	"
Manganese	.579	.....	.....	2.49	.....	3.89	64.	Wartenburg, 1910
Mercury (liq.)	.326	.....	.....	0.68	.....	2.26	66.	Meier, 1903
	.441	.....	.....	1.01	.....	3.42	74.	"
	.589	.....	.....	1.62	.....	4.41	75.	"
	.668	.....	.....	1.72	.....	4.70	77.	"
Nickel	0.420	72 20	31 42	1 41	1.79	2.53	54.	Tool
	0.589	76 1	31 41	1.79	1.86	3.33	62.	Drude
	0.750	78 45	32 6	2.19	1.99	4.36	70.	Ingersoll
	1.00	80 33	32 2	2.63	2.00	5.26	74.	"
	2.25	84 21	33 30	3.95	2.33	9.20	85.	"
	.275	.....	.....	1.09	1.16	.....	24.	Meier, 1903
	.441	.....	.....	1.16	1.23	.....	25.	"
	.589	.....	.....	1.30	1.97	.....	43.	"
Platinum	1.00	75 30	37 00	1.14	3.25	3.7	....	Först-Fréed
	2.00	74 30	39 50	0.70	5.06	3.5	....	" "
	3.00	73 50	41 00	0.52	6.52	3.4	....	" "
	5.00	72 00	42 10	0.34	9.01	3.1	....	" "
Electrolytic	.257	.....	.....	1.17	1.65	.....	37.	Meier, 1903
	.441	.....	.....	1.84	.....	3.16	58.	"
	.589	.....	.....	2.63	.....	3.54	59.	"
	.668	.....	.....	2.91	.....	3.66	59.	"
Potassium	.665	65 27	43 56	.066	26.8	.....	93.8	Duncan, 1913
	.589	62 58	43 42	.068	22.1	.....	92.	"
	.472	57 9	43 0	.070	14.3	.....	86.9	"
	.546	.....	.....	1.09	1.16	.....	24.	Morgan, 1922
Rhodium	.579	.....	.....	1.54	.....	4.67	78.	Wartenburg, 1910
Selenium	.400	.....	.....	2.94	2.31	.....	44.	Wood
	.490	.....	.....	3.12	1.49	.....	35.	"
	.589	.....	.....	2.93	0.45	.....	25.	"
	.760	.....	.....	2.60	0.06	.....	20.	"
Silicon, 95% pure	.579	75 38	.....	3.87	0.116	.....	35.7	Wartenburg, 1910
	.589	.....	.....	4.18	0.09	.....	38.	Ingersoll
	1.25	.....	.....	3.67	0.08	.....	33.	"
	2.25	.....	.....	3.53	0.08	.....	31.	"
99.75% pure	0.589	76 45	.....	4.24	0.118	.....	37.8	Littleton, 1912
Silver	0.226	62 41	22 16	1.41	0.75	1.11	18.	Minor
	.293	63 14	18 56	1.57	0.62	0.97	17.	"
	.316	52 28	15 38	1.13	0.38	0.43	4.	"
	.332	52 1	37 2	0.41	1.61	0.65	32.	"
	.395	66 36	43 6	0.16	12.32	1.91	87.	"
	.500	72 31	43 29	0.17	17.1	2.94	93.	"
	.589	75 35	43 47	0.18	20.6	3.64	95.	"
	.750	79 26	44 6	0.17	30.7	5.16	97.	Ingersoll
	1.00	82 0	44 2	0.24	29.0	6.96	98.	"
	1.50	84 42	43 48	0.45	23.7	10.7	98.	"
	2.25	86 18	43 34	0.77	19.9	15.4	99.	"
	3.00	87 10	42 40	1.65	12.2	20.1	....	Först-Fréed
	4.50	88 20	41 10	4.19	7.42	33.3	....	" "
Sodium	.665	72 11	44 29	0.051	55.0	.....	97.7	Duncan, 1913
	.589	68 51	44 29	.044	55.0	.....	97.1	"
	.546	68 48	44 20	.052	42.6	.....	96.5	"

OPTICAL CONSTANTS OF METALS

(Continued)

Metal	λ	$\bar{\phi}$	$\bar{\psi}$	Computed n	Computed k	Computed nk	Computed R	Authority
	μ	° ′	° ′					
Sodium	.472	66 29	44 9	.057	33.3	.....	95.2	Duncan, 1913
	.435	66 0	44 6	.058	31.7	.....	94.8	"
(liq.)	.589	.....	.....	.004	.....	2.61	99.	Drude
(solid)	.546	.....	.....	.047	47.3	.....	96.9	Morgan, 1922
Sodium-Potassium								
17.3% K	.546	.....	.....	.081	27.2	.....	94.6	"
45. % K	.546	.....	.....	1.08	16.8	.....	90.4	"
66. % K	.546	.....	.....	.137	12.5	.....	87.0	"
74.2% K	.546	.....	.....	.124	12.8	.....	86.9	"
84.3% K	.546	.....	.....	.088	17.6	.....	90.2	"
Steel								
0.44% C	.589	77 15	.....	2.50	1.30	.....	57.4	Littleton, 1912
1.28% C	.589	77 22	.....	2.66	1.28	.....	57.5	"
3.5 % C	.589	77 35	.....	2.77	1.23	.....	57.0	"
	0.226	66 51	28 17	1.30	1.26	1.64	35.	Minor
	.257	68 35	28 45	1.38	1.35	1.86	40.	"
	.325	69 57	30 9	1.37	1.53	2.09	45.	"
	.500	75 47	29 2	2.09	1.50	3.14	57.	"
	.650	77 48	27 9	2.70	1.33	3.59	59.	Ingersoll
	1.50	81 48	28 51	3.71	1.55	5.75	73.	"
	2.25	83 22	30 36	4.14	1.79	7.41	80.	"
Tantalum	.579	.....	.....	2.05	.....	2.31	44.	Wartenburg
Tellurium								
axis horizontal	.590	.....	.....	3.07	.563	.....	34.	Van Dyke, 1922
axis vertical	.590	.....	.....	2.68	.632	.....	30.	Van Dyke, 1922
Tin	.589	.....	.....	1.48	.....	5.25	82.	Drude
Tungsten	.579	76 0	.....	2.76	0.98	.....	48.6	Wartenburg
	.589	78 31	.....	3.46	0.94	.....	54.5	Littleton, 1912
Vanadium	.579	.....	.....	3.03	.....	3.51	58.	"
Zinc	.257	.....	.....	0.55	.....	0.61	20.	Meier, 1903
	.441	.....	.....	0.93	.....	3.19	73.	"
	.589	.....	.....	1.93	.....	4.66	74.	"
	.668	.....	.....	2.62	.....	5.08	73.	"

DISPERSION

The dispersion for various types of optical glass is shown in the following table. n_D = index of refraction for the D line (of the solar spectrum) and n_F and n_C the index for the F and C lines respectively $(n_F - n_D)$ shows the dispersion for these two wave lengths.

Glass.	n_D	$(n_F - n_C)$
Light phosphate crown	1.5159	.00737
Barium-silicate crown	1.5399	.00909
High-dispersion crown	1.5262	.01026
Borate flint	1.5686	.01102
Extra light flint	1.5398	.01142
Heavy flint	1.7174	.02434
Heaviest flint	1.9626	.04882

INDEX OF REFRACTION, AQUEOUS SOLUTIONS

Substance.	Density.	Temp. °C.	Index for $\lambda = .5893$ (Na)	Observer.
Ammonium chloride	1.067	27.05	1.379	Willigen
Ammonium chloride	1.025	29.75	1.351	Willigen
Calcium chloride	1.398	25.65	1.443	Willigen
Calcium chloride	1.215	22.9	1.397	Willigen
Calcium chloride	1.143	25.8	1.374	Willigen
Hydrochloric acid	1.166	20.75	1.411	Willigen
Nitric acid	1.359	18.75	1.402	Willigen
Potash (caustic)	1.416	11.0	1.403	Frauenhofer
Potassium chloride	Normal	solution	1.343	Bender
Potassium chloride	Double	normal	1.352	Bender
Potassium chloride	Triple	normal	1.360	Bender
Soda (caustic)	1.376	21.6	1.413	Willigen
Sodium chloride	1.189	18.07	1.378	Schutt
Sodium chloride	1.109	18.07	1.360	Schutt
Sodium chloride	1.035	18.07	1.342	Schutt
Sodium nitrate	1.358	22.8	1.385	Willigen
Sulphuric acid	1.811	18.3	1.437	Willigen
Sulphuric acid	1.632	18.3	1.425	Willigen
Sulphuric acid	1.221	18.3	1.370	Willigen
Sulphuric acid	1.028	18.3	1.339	Willigen
Zinc chloride	1.359	26.6	1.402	Willigen
Zinc chloride	1.209	26.4	1.375	Willigen

INDEX OF REFRACTION OF METALS

For Sodium Light

(Drude.)

Metal.	Index of refraction.	Metal.	Index of refraction.
Aluminum	1.44	Mercury	1.73
Antimony	3.04	Nickel	1.79
Bismuth	1.90	Platinum	2.06
Cadmium	1.13	Silver	0.181
Copper	0.641	Steel	2.41
Gold	0.366	Tin, solid	1.48
Iron	2.36	Tin, fluid	2.10
Lead	2.01	Zinc	2.12
Magnesium	0.37		

INDEX OF REFRACTION, GASES

Values are relative to a vacuum and for a temp. of 0° C. and 760 mm. pressure.

(From Smithsonian Tables.)

Substance.	Kind of light.	Indices of refraction.	Observer.
Acetone	*D*	1.001079–1.001100	
Air	*D*	1.0002926	Perreau
Ammonia	white	1.000381–1.000385	
Ammonia	*D*	1.000373–1.000379	
Argon	*D*	1.000281	Rayleigh
Benzene	*D*	1.001700–1.001823	
Bromine	*D*	1.001132	Mascart
Carbon dioxide	white	1.000449–1.000450	
dioxide	*D*	1.000448–1.000454	
disulphide	white	1.001500	Dulong
disulphide	*D*	1.001478–1.001485	
monoxide	white	1.000340	Dulong
monoxide	white	1.000335	Mascart
Chlorine	white	1.000772	Dulong
Chlorine	*D*	1.000773	Mascart
Chloroform	*D*	1.001436–1.001464	
Cyanogen	white	1.000834	Dulong
Cyanogen	*D*	1.000784–1.000825	
Ethyl alcohol	*D*	1.000871–1.000885	
ether	*D*	1.001521–1.001544	
Helium	*D*	1.000036	Ramsay
Hydrochloric acid	white	1.000449	Mascart
Hydrochloric acid	*D*	1.000447	Mascart
Hydrogen	white	1.000138–1.000143	
Hydrogen	*D*	1.000132	Burton
sulphide	*D*	1.000644	Dulong
sulphide	*D*	1.000623	Mascart
Methane	white	1.000443	Dulong
Methane	*D*	1.000444	Mascart
Methyl alcohol	*D*	1.000549–1.000623	
Methyl ether	*D*	1.000891	Mascart
Nitric oxide	white	1.000303	Dulong
Nitric oxide	*D*	1.000297	Mascart
Nitrogen	white	1.000295–1.000300	
Nitrogen	*D*	1.000296–1.000298	
Nitrous oxide	white	1.000503–1.000507	
Nitrous oxide	*D*	1.000516	Mascart
Oxygen	white	1.000272–1.000280	
Oxygen	*D*	1.000271–1.000272	
Pentane	*D*	1.001711	Mascart
Sulphur dioxide	white	1.000665	Dulong
Sulphur dioxide	*D*	1.000686	Ketteler
Water	white	1.000261	Jamin
Water	*D*	1.000249–1.000259	

COEFFICIENT OF TRANSPARENCY OF UVIOL GLASS FOR THE ULTRA-VIOLET

For a thickness of 1 mm.

Wave length, microns	0.280	0.309	0.325	0.346	0.361	0.383	0.397
Uviol crown	0.56	0.95	0.990	0.996	0.999	1.000	1.000

REFLECTION OF LIGHT BY GLASS IN AIR

The table gives the percentage *R* of light reflected by one surface of glass having a refractive index of 1.55 relative to air. The angle of incidence is *i*, and the angle of refraction is *r*. The two components of the polarized light are marked $\parallel$ and $\perp$ according to the electric vector of the vibration. (Computed according to Fresnel's formula.)

i	*r*	$\parallel$	$\perp$	*R*
0	0° 0′	4.65	4.65	4.65
10	6° 26′	4.84	4.47	4.65
20	12° 45′	5.45	3.91	4.68
30	18° 49′	6.64	2.99	4.81
40	24° 30′	8.76	1.75	5.26
50	29° 37′	12.54	0.46	6.50
60	26° 2′	19.35	0.11	9.73
70	32° 41′	31.99	4.00	18.00
80	40° 33′	55.74	23.34	39.54
90	49° 49′	100.00	100.00	100.00

REFLECTION BY TRANSPARENT MEDIA IN AIR

For Normal Incidence

The table gives the per cent of the normally incident light which is reflected by transparent media of various indices of refraction. *n* = index of refraction, *R* = reflected light, *i* = angle of incidence = 0.

(Computed from Fresnel's formula.)

n	*R*	*n*	*R*	*n*	*R*
1.0	0.00	1.7	6.72	2.4	17.0
1.1	0.23	1.8	8.16	2.5	18.4
1.2	0.83	1.9	9.63	2.6	19.8
1.3	1.70	2.0	11.11	2.7	21.1
1.4	2.78	2.1	12.6	2.8	22.5
1.5	4.00	2.2	14.1	2.9	23.8
1.6	5.33	2.3	15.5	3.0	25.0

COEFFICIENT OF TRANSPARENCY OF GLASS FOR THE INFRA-RED

Normal incidence, thickness 1 cm.

Wave length, microns....	0.7	1.1	1.7	2.3	2.7	3.1
Crown, borate..........	1.00	.55	.21	.025	.04	
borosilicate...........	...	.74	.61	.33	.034	.021
Flint, light	1.00	.91	.82	.45	.083	.019
heavy..............	1.00	1.00	1.00	1.00	.45	.019

INDEX OF REFRACTION OF AQUEOUS SOLUTIONS OF SUCROSE (CANE SUGAR)

The table gives the index of refraction for $\lambda = 0.5893$ of aqueous sugar solutions at 20°C from 0 – 85% sugar. Corrections for temperatures other than 20° are given at the end of the table.

Per cent sugar		.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
00.	1.3	330	331	333	334	336	337	338	340	341	342
1.		344	345	347	348	350	351	353	355	356	357
2.		359	361	362	363	365	367	368	369	371	373
3.		374	375	377	378	380	381	382	384	385	387
4.		388	389	391	393	394	395	397	399	400	401
5.		403	405	406	407	409	411	412	413	415	417
6.		418	419	421	423	424	425	427	429	430	431
7.		433	435	436	437	439	441	442	443	445	447
8.		448	450	451	453	454	456	458	459	461	462
9.		464	465	467	469	470	471	473	475	476	477
10.		479	481	482	483	485	487	488	489	491	493
11.		494	496	497	499	500	502	504	505	507	508
12.		510	512	513	515	516	518	520	521	523	524
13.		526	527	529	531	532	533	535	537	538	539
14.		541	543	544	546	547	549	551	552	554	555
15.		557	559	560	562	563	565	567	568	570	571
16.		573	575	576	578	580	582	583	585	587	588
17.		590	592	593	595	596	598	600	601	603	604
18.		606	608	609	611	612	614	616	617	619	620
19.		622	624	625	627	629	631	632	634	636	637
20.		639	641	642	644	645	647	649	650	652	653
21.		655	657	658	660	662	663	665	667	669	670
22.		672	674	675	677	679	681	682	684	686	687
23.		689	691	692	694	696	698	699	701	703	704
24.		706	708	709	711	713	715	716	718	720	721
25.		723	725	726	728	730	731	733	735	737	738
26.		740	742	744	745	747	749	751	753	754	756
27.		758	760	761	763	765	767	768	770	772	773
28.		775	777	779	780	782	784	786	788	789	791
29.		793	795	797	798	800	802	804	806	807	809
30.		811	813	815	816	818	820	822	824	825	827
31.		829	831	833	834	836	838	840	842	843	845
32.		847	849	851	852	854	856	858	860	861	863
33.		865	867	869	870	872	874	876	878	879	881
34.		883	885	887	889	891	893	894	896	898	900
35.		902	904	906	907	909	911	913	915	916	918
36.		920	922	924	926	928	929	931	933	935	937
37.		939	941	943	945	947	949	950	952	954	956
38.		958	960	962	964	966	968	970	972	974	976
39.		978	980	982	984	986	987	989	991	993	995
40.		997	999	*001	*003	*005	*007	*008	*010	*012	*014
41.	1.4	016	018	020	022	024	026	028	030	032	034
42.		036	038	040	042	044	046	048	050	052	054
43.		056	058	060	062	064	066	068	070	072	074
44.		076	078	080	082	084	086	088	090	092	094
45.		096	098	100	102	104	107	109	111	113	115
46.		117	119	121	123	125	127	129	131	133	135
47.		137	139	141	143	145	147	150	152	154	156
48.		158	160	162	164	166	169	171	173	175	177
49.		179	181	183	185	187	189	192	194	196	198
50.		200	202	204	206	208	211	213	215	217	219
51.		221	223	225	227	229	231	234	236	238	240
52.		242	244	246	249	251	253	255	257	260	262
53.		264	266	268	270	272	275	277	279	281	283
54.		285	287	289	292	294	296	298	300	303	305
55.		307	309	311	313	316	318	320	322	325	327

INDEX OF REFRACTION OF AQUEOUS SOLUTIONS OF SUCROSE (CANE SUGAR) (Continued)

Per cent sugar		.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
55.	1.4	307	309	311	313	316	318	320	322	325	327
56.		329	331	333	336	338	340	342	344	347	349
57.		351	353	355	358	360	362	364	366	369	371
58.		373	375	378	380	382	385	387	389	391	394
59.		396	398	400	403	405	407	409	411	414	416
60.		418	420	423	425	427	429	432	434	436	439
61.		441	443	446	448	450	453	455	457	459	462
62.		464	466	468	471	473	475	477	479	482	484
63.		486	488	491	493	495	497	500	502	504	507
64.		509	511	514	516	518	521	523	525	527	530
65.		532	534	537	539	541	544	546	548	550	553
66.		558	561	563	565	567	570	572	574	577	579
67.		581	584	586	588	591	593	595	598	600	602
68.		605	607	609	612	614	616	619	621	623	625
69.		628	630	632	635	637	639	642	644	646	649
70.		651	653	656	658	661	663	666	668	671	673
71.		676	678	681	683	685	688	690	693	695	698
72.		700	703	705	708	710	713	715	717	720	722
73.		725	727	730	732	735	737	740	742	744	747
74.		749	752	754	757	759	762	764	767	769	772
75.		774	777	779	782	784	787	789	792	794	797
76.		799	802	804	807	810	812	815	817	820	822
77.		825	827	830	832	835	838	840	843	845	848
78.		850	853	855	858	860	863	865	868	871	873
79.		876	878	881	883	886	888	891	893	896	898
80.		901	904	906	909	912	914	917	919	922	925
81.		927	930	933	935	938	941	943	946	949	951
82.		954	956	959	962	964	967	970	972	975	978
83.		980	983	985	988	991	993	996	999	*001	*004
84.	1.5	007	009	012	015	017	020	022	025	028	030
85.		033									

Temperature Corrections

Below 20°C the correction should be subtracted from the per cent sugar. Above 20°C the correction is to be added to the per cent sugar.

Temp. °C	Approximate per cent sugar 5	10	15	20	30	40	50	60	70	75
15	0.25	0.27	0.31	0.31	0.34	0.35	0.36	0.37	0.36	0.36
16	0.21	0.23	0.26	0.27	0.29	0.31	0.31	0.32	0.31	0.29
17	0.16	0.18	0.20	0.20	0.22	0.23	0.23	0.23	0.20	0.17
18	0.11	0.12	0.14	0.14	0.15	0.16	0.16	0.15	0.12	0.09
19	0.06	0.07	0.08	0.08	0.08	0.09	0.09	0.08	0.07	0.05
21	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
22	0.12	0.14	0.14	0.14	0.14	0.14	0.15	0.14	0.14	0.14
23	0.18	0.20	0.20	0.21	0.21	0.21	0.23	0.21	0.22	0.22
24	0.24	0.26	0.26	0.27	0.28	0.28	0.30	0.28	0.29	0.29
25	0.30	0.32	0.32	0.34	0.36	0.36	0.38	0.36	0.36	0.37
26	0.36	0.39	0.39	0.41	0.43	0.43	0.46	0.44	0.43	0.44
27	0.43	0.46	0.46	0.48	0.50	0.51	0.55	0.52	0.50	0.51
28	0.50	0.53	0.53	0.55	0.58	0.59	0.63	0.60	0.57	0.59
29	0.57	0.60	0.61	0.62	0.66	0.67	0.71	0.68	0.65	0.67
30	0.64	0.67	0.70	0.71	0.74	0.75	0.80	0.76	0.73	0.75

REFLECTION OF LIGHT BY METALS

The table gives the per cent of normally incident light which is reflected by the polished surface of various metals.

Wave length.	Antimony.	Bronze (68 Cu, 32 Sn).	Copper, commercial.	Gold, electrolytic.	Iron.	Magnalium, Mach's.	Magnesium.	Mercury, backed glass.
.251	....	.30	25.9	38.8	....	67.0		
.288	....	....	24.3	34.0	....	70.6		
.305	....	....	25.3	31.8	....	72.2		
.326	....	....	24.9	28.6	....	75.5		
.357	....	....	27.3	27.9	....	81.2		
.385	....	.53	28.6	27.1	....	83.9		
.420	....	....	32.7	29.3	....	83.3		
.450	....	....	37.0	33.1	....	83.4	....	72.8
.500	....	.63	43.7	47.0	.55	83.3	.72	70.9
.550	....	....	47.7	74.0	....	82.7	....	71.2
.600	.53	.64	71.8	84.4	.57	83.0	.73	69.9
.650	....	....	80.0	88.9	....	82.7	....	71.5
.700	....	....	83.1	92.3	.59	83.3	....	72.8
.800	....	....	88.6	94.9	....	84.3		
1.00	.55	.70	90.1	......	.65	84.1	.74	
2.0	.60	.80	95.5	96.8	.78	86.7	.77	
3.0	.65	.86	97.1	......	.84	87.4	.80	
4.0	.68	.88	97.3	96.9	.89	88.7	.83	
9.0	.72	.93	98.4	98.0	.94	90.6	.93	

Wave length.	Nickel, electrolytic.	Platinum, electrolytic.	Silver, chemically deposited.	Silver-backed glass.	Speculum metal.	Steel.	Tungsten.
.251	37.8	33.8	34.1	......	29.9	32.9	
.288	42.7	38.8	21.2	......	37.7	35.0	
.305	44.2	39.8	9.1	......	41.7	37.2	
.326	45.2	41.4	14.6	......	......	40.3	
.357	48.8	43.4	74.5	......	51.0	45.0	
.385	49.6	45.4	81.4	......	53.1	47.8	
.420	56.6	51.8	86.6	......	56.4	51.9	
.450	59.4	54.7	90.5	85.7	60.0	54.4	
.500	60.8	58.4	91.3	86.6	63.2	54.8	.49
.550	62.6	61.1	92.7	88.2	64.0	54.9	
.600	64.9	64.2	92.6	88.1	64.3	55.4	.51
.650	66.6	66.5	94.7	89.1	65.4	56.4	
.700	68.8	69.0	95.4	89.6	66.8	57.6	.54
.800	69.6	70.3	96.8	......	......	58.0	
1.00	72.0	72.9	97.0	......	70.5	63.1	.62
2.0	83.5	80.6	97.8	......	80.4	76.7	.85
3.0	88.7	88.8	98.1	......	86.2	83.0	.90
4.0	91.1	91.5	98.5	......	88.5	87.8	.93
0	95.6	95.4	98.7	......	92.2	92.9	.95

REFLECTION OF LIGHT BY METALS

The table gives the percent of normally incident light which is reflected by the polished surface of various metals.

Coblentz, 1906, 1911.

Wave length	Aluminum	Cadmium	Cobalt	Graphite	Iridium	Molybdenum	Palladium	Rhodium	Silicon
.5	..	..	..	22	..	46	..	76	34
.6	..	..	...	24	..	48	..	77	32
.8	..	..	..	25	..	52	..	81	29
1.0	71	72	67	27	78	58	72	84	28
2.0	82	87	72	35	87	82	81	91	28
4.0	92	96	81	48	94	90	88	92	28
7.0	96	98	93	54	95	93	94	94	28
10.0	98	98	97	59	96	94	97	95	28
12.0	98	99	97	..	96	95	97	..	..

Wave length	Tantalum	Telurium	Tin	Vanadium	Zinc	Wave length	Tungsten*	Stellite*
.5	38	..	..	57	..	.15	....	.32
.6	45	49	..	58	..	.20	....	.42
.8	64	48	..	60	..	.30	....	.50
1.0	78	50	54	61	80	.50	.50	.64
2.0	90	52	61	69	92	.75	.52	.67
4.0	93	57	72	79	97	1.00	.576	.689
7.0	94	68	81	88	98	2.00	.900	.747
10.0	..	..	84	..	98	3.00	.943	.792
12.0	95	..	85	..	99	4.00	.948	.825
						5.00	.953	.848
						9.00	....	.880

* Coblentz, Emerson, 1917

RELATIVE STIMULATION OF THE THREE PRIMARY COLOR SENSATIONS BY DIFFERENT WAVE LENGTHS

Wave length...	0.36μ	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54
Red......	0.0	0.0	2.0	1.0	1.0	1.0	3.0	9.0	23.0	39.0
Green.....	0.0	0.0	0.0	0.0	0.0	2.0	7.0	23.0	61.0	87.0
Blue......	0.0	10.5	29.0	52.0	76.0	78.0	68.0	46.0	16.0	7.0

Wave length...	0.56μ	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.74
Red......	56.0	69.0	71.5	59.0	30.0	12.0	5.0	2.0	1.0	0.0
Green.....	86.0	67.0	37.0	10.0	2.5	1.0	0.0	0.0	0.0	0.0
Blue......	4.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

REFLECTION OF LIGHT BY METALS (Continued)

Coblentz, Bulletin 379, Bureau of Standards 1920

Wave-length in μ – 0.001mm.	Silver	Monel metal	Stellite	Zinc
0.45	88.0	56.5	63.5	54.0
0.50	90.0	57.8	65.8	55.0
0.55	91.5	59.0	68.3	56.0
0.60	92.7	60.2	70.1	57.5
0.65	93.5	61.8	71.0	60.0
0.70	94.1	63.7	71.8	61.0
0.75	94.7	65.6	72.4	61.5
0.80	95.1	67.2	73.0	61.5
0.90	96.0	70.0	73.5	55.5
0.95	96.3	71.1	....	51.0
1.00	96.5	72.3	74.0	49.0
1.05	96.7	73.0	....	53.5
1.10	96.9	73.6	....	62.5
1.20	97.2	74.8	74.5	74.7
1.40	97.4	77.0	75.0	85.8
1.50	97.6	78.2	75.3	88.4
1.75	97.8	81.2	76.0	92.0
2.00	97.9	83.8	76.8	94.0
2.50	98.0	87.0	78.6	95.3
3.00	98.0	88.7	80.0	95.5
3.50	98.0	89.5	81.4	95.8
4.00	98.0	91.0	82.8	96.2

TRANSMISSION FACTORS FOR "GROUND" GLASS

Luckiesch

	Side toward light	Transmission Factor	
		Narrow beam	Diffuse
Sand blasted	Rough	0.783	0.702
	Smooth	.739	.695
Etched, fine	Rough	.794	.709
	Smooth	.758	.704

DIFFUSE REFLECTING POWER

The diffuse reflecting power, or ratio of total luminous flux reflected to that received, measured for the various regions of the spectrum. The wave lengths given are those of maximum energy. — Coblentz, Bulletin, 196, Bureau of Standards 1912.

Material	Reflecting power %					
	0.54 μ	0.60	0.95	4.4	8.8	24.0
Lampblacks						
paint	....	3.2	3.4	3.2	3.8	4.4
paraffin-candle	....	....	0.97	....	....	....
rosin	....	....	1.3	1.3	....	3.0
sperm candle	....	....	1.1	.9	1.3	4.0
camphor	....	....	1.3	1.2	1.6	5.7
acetylene	....	....	0.6	.8	1.2	2.1
Platinum black						
electrolytic	....	....	1.1	1.4	2.1	4.2
Pigments						
cobalt oxide, Co_2O_3	....	3.02	3.92 4.04 2.49	13.9	14.6 11.8	5.9 ....
copper oxide, CuO	....	....	23.5	15.2	....	4.4
chromium oxide, Cr_2O_3	24.1	27.0	44.6	32.9	5.0	8.2
lead oxide, PbO	....	51.8	....	50.6	25.6	9.5
red iron oxide, Fe_2O_3	....	26.3	41.0	29.9	3.7	9.1
yttrium oxide, Y_2O_3	....	73.8	....	34.4	11.1	10.0
lead chromate, $PbCrO_4$	61.2	70.2	....	41.2	4.74	7.4
aluminum oxide, Al_2O_3	....	84.1	87.7	20.8	2.34 1.64	6.5 ....
thorium oxide, ThO_2	....	86.0	....	46.9	7.11	10.0
zinc oxide, ZnO	....	82.2	86.4	8.5	3.2 2.1	5.1
magnesium oxide, MgO	....	86.3	....	16.0	2.5	9.1
calcium oxide, CaO	....	85.4	....	22.3	3.6	6.2
zirconium oxide, ZrO_2	82.2	85.8	84.1	23.2	5.1	5.4
lead carbonate, $PbCO_3$	....	86.8 89.9	90.8 92.8 94.5	29.2	9.3 ..... 13.2	6.9 ....
magnesium carbonate, $MgCO_3$	....	85.2	89.4	10.8	4.1	8.8
Paints						
white lead No. 103	....	76.2	79.3	....	....	....
" " " 102	....	74.3	....	....	....	....
zinc lead white No. 107	....	69.6	....	....	....	....
" oxide No. 104	....	68.1	72.1	....	....	....
white lead 50% / zinc oxide 50% } No. 209	....	70.8	....	....	....	....
Miscellaneous						
asphalt (pavement)	....	14.8	....	....	....	....
black felt	....	13.9 22.5	21.2 25.6	....	....	....
black velvet	....	1.75	....	3.66	2.7	....
bluestone (sandstone) SiO_2	....	18.4	8.1	17.6	11.0	....
blue flannel	....	17.5	....	....	....	....
Brick:						
light buff	....	48.4	....	....	....	....
darker	....	40.0	....	....	....	....
red brick	...	30.1	....	....	12.4	....
darker & glazed	....	23.4	....	....	....	....
Cotton cloth:						
diamine fast red 8 B L	....	43.8	....	....	....	....
diamine fast black C B —	....	33.1	....	....	....	....
columbia fast black R	....	28.7	....	....	....	....
diamine aldehyde black	....	29.5	....	....	....	....
sulphur black A W L —	....	2.43	2.57	....	....	....

DIFFUSE REFLECTING POWER (Continued)

The diffuse reflecting power, or ratio of total luminous flux reflected to that received, measured for the various regions of the spectrum. The wave lengths given are those of maximum energy. — Coblentz, Bulletin, 196, Bureau of Standards 1912.

Material	Reflecting power %					
	0.54 μ	0.60	0.95	4.4	8.8	24.0
Woolen Cloth:						
lanacyl blue B N —	....	25.1	......	....	......	....
salacine blue black A E —	....	14.6	17.8	...	......	....
" black PB —	....	11.8	15.1	....	......	....
Linen:						
starched, dull finish	....	81.2	......	....	......	....
deep blue cloth (Navy Dept.)	....	17.0	......	....	......	....
lighter shade	....	18.2	......	....	......	....
Feldspar, $KAlSi_3O_8$	....	......	86.7	38.2	10.3	9.7
cleavage surface	....	39.4	......	....	14.6	....
Granolith (pavement)	....	16.9	......	....	......	....
Green Leaf (tulip tree)	....	21.9	38.0	5.6	......	....
Indiana limestone, $CaCO_3$	....	42.9	......	20.3	5.0	....
Quartz (powder, French Flint) SiO_2	....	81.0	41.5	7.9	9.0	....
Slate (dark clay)	....	6.7	......	13.4	20.0	....
White marble $CaCO_3$ ground, unpolished	....	53.5	......	6.4	5.1	....
cleavage, surface	....	40.8	......	....	......	....
White paper	....	71.7	74.7	18.2	5.0	....
two thicknesses	....	73.4	......	....	......	....
White paper, (Bond)	....	75.2	......	....	......	....

DIFFUSED REFLECTION

Albedo

Giving the percent of diffused reflection of "white light" for various surfaces. *Sumpner, Zöllner* and others.

Material	Reflections	Material	Reflections
Wood, pine	40	Parchment	
Cardboard		1 sheet	22
yellow	30	2 sheets	35
white	60–70	Cloth	
Painted surface,		black	1
yellow	40	tracing	35
white washed	50	white	60–70
Paper		Velvet	
tracing	22	black	0.4
ordinary white	60–70		
blotting	70–80	Loam, sandy	24
chocolate color	4		
brown	13	Earth, moist	8
blue	25		
yellow	25	Marl, argillaceous	16

REFLECTION COEFFICIENTS

Coefficients of Reflection of Miscellaneous Surfaces for Monochromatic Radiation in the Visible Spectrum
(J. L. Michaelson)

Material	Wave lengths (μ)			
	0.400	0.500	0.600	0.700
Carbon Black in Oil	0.003	0.003	0.003	0.003
Clay,				
Kaolin (treated)	0.82	0.81	0.82	0.82
Kaolin (untreated)	0.75	0.79	0.85	0.86
White Georgia	0.94	0.92	0.93	0.94
Magnesium oxide	0.97	0.98	0.98	0.98
Paint,				
Lithopone	0.95	0.98	0.98	0.98
$MgCO_3$-Vynal Acetate Lacquer	0.90	0.88	0.88	0.88
ZnO-Milk	0.74	0.84	0.85	0.86
Paper,				
Blotting	0.64	0.72	0.79	0.79
Calendered	0.64	0.69	0.73	0.76
Crepe, green	0.23	0.49	0.19	0.48
Crepe, red	0.03	0.02	0.21	0.69
Crepe, yellow	0.17	0.44	0.75	0.79
News Print Stock	0.38	0.61	0.63	0.78
Peach,				
Green	0.18	0.17	0.62	0.63
Ripe	0.10	0.10	0.41	0.42
Pear,				
Green	0.04	0.12	0.29	0.41
Ripe	0.08	0.19	0.46	0.53
Pigment,				
Chrome Yellow	0.05	0.13	0.70	0.77
French Ochre	0.06	0.14	0.50	0.56
Porcelain Enamel,				
Blue	0.44	0.10	0.05	0.23
Orange	0.09	0.09	0.59	0.69
Red	0.05	0.03	0.08	0.62
White	0.77	0.73	0.72	0.70
Yellow	0.11	0.46	0.62	0.62
Talcum, Italian	0.94	0.89	0.88	0.88
Wheat Flour	0.75	0.87	0.94	0.97

REFLECTION COEFFICIENTS OF SURFACES FOR "INCANDESCENT" LIGHT

Material	Nature of Surface	Coefficient	Authority
Aluminum, "Alzak"	Diffusing	0.77–0.81	3
"Alzak"	Specular	0.79–0.83	3
on Glass	First Surface	0.82–0.86	4
Polished	Specular	0.69	3
Black Paper	Diffusing	0.05–0.06	4
Chromium	Specular	0.62	4
Copper	Specular	0.63	4
Gold	Specular	0.75	1
Magnesium oxide	Diffusing	0.98	5
Nickel	Specular	0.62–0.64	1, 3
Platinum	Specular	0.62	1
Porcelain Enamel	Glossy	0.76–0.79	3
Porcelain Enamel	Ground	0.81	3
Porcelain Enamel	Matt.	0.72–0.76	3
Silver	Polished	0.93	1
Silvered Glass	Second Surface	0.88–0.93	3
Snow	Diffusing	0.93	2
Steel	Specular	0.55	1
Stellite	Specular	0.58–0.65	4

(1) Hagen and Rubens. (2) Nutting, Jones, and Elliot. (3) J. E. Bock. (4) Frank Benford. (5) J. L. Michaelson.

PIGMENTS AND DYES

The tables which follow give the fraction of incident light reflected by pigments or transmitted by dyes. The pigments were in dry powdered form and the dye solutions, except where indicated, in distilled water. Wave lengths are given in microns.

(*Luckiesch, 1917*)

Pigment	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
American vermilion	0.08	0.06	0.05	0.05	0.06	0.06	0.09	0.11	0.24	0.39	0.53	0.61	0.66	0.65
Venetian red	.05	.03	.05	.05	.05	.06	.07	.12	.19	.24	.28	.30	.32	.32
Tuscan red	.07	.07	.07	.08	.08	.08	.08	.12	.16	.18	.20	.22	.23	.24
Indian red	.08	.07	.07	.07	.07	.07	.07	.11	.15	.18	.20	.22	.23	.24
Burnt sienna	.04	.04	.04	.04	.05	.06	.09	.14	.18	.20	.21	.23	.24	.25
Raw sienne	.12	.13	.13	.13	.18	.26	.35	.43	.46	.46	.45	.44	.45	.43
Golden ochre	.22	.22	.23	.27	.40	.53	.63	.71	.75	.74	.73	.73	.73	.72
Chrome yellow, ochre	.08	.09	.07	.07	.10	.19	.30	.46	.60	.62	.66	.82	.81	.80
Yellow ochre	.20	.20	.21	.24	.32	.42	.53	.63	.64	.61	.60	.59	.59	.59
Chrome yellow (medium)	.05	.05	.06	.08	.18	.48	.66	.75	.78	.79	.81	.81	.81	.81
Chrome yellow (light)	.13	.13	.18	.30	.56	.82	.88	.89	.90	.89	.88	.87	.85	.84
Chrome green (light)	.10	.10	.14	.23	.26	.23	.20	.17	.14	.11	.09	.08	.07	.06
Chrome green (medium)	.07	.07	.10	.21	.21	.17	.13	.11	.09	.07	.06	.06	.06	.05
Cobalt blue	.59	.58	.49	.35	.23	.15	.11	.10	.10	.10	.11	.15	.20	.25
Ultramarine blue	.67	.54	.38	.21	.10	.06	.04	.03	.03	.04	.05	.07	.10	.17

PIGMENTS AND DYES (Continued)

Red Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	70
Carmen ruby opt.	....	....	....	....	....	....	....	....	....	0.04	0.18	0.37	0.49	0.60
Amido naphthol red	....	....	....	....	....	....	....	....	0.04	.38	.75	.92	.96	.96
Coccinine	....	....	....	....	....	....	....	0.04	.56	.96	.98	.98	.98	.98
Erythrosine	0.06	....	....	....	....	....	0.10	.53	.90	.95	.96	.96	.96	.96
Hematoxyline	.01	0.03	0.07	0.13	0.14	0.12	.13	.25	.44	.54	.63	.73	.78	.82
"	....	....	....	....	....	....	....	.01	.02	.04	.09	.15	.21	.25
Alizarine red	.01	.01	.02	.03	.04	.06	.11	.22	.39	.54	.65	.72	.77	.79
Acid rosolic (pure)	.04	.03	.01	....	....	....	.02	.38	.78	.88	.90	.91	.92	.92
Rapid filter red	....	....	....	....	....	.01	.10	.47	.86	.95	.96	.96	.96	.96
Aniline red fast extra A	....	....	....	....	....	.02	.12	.34	.55	.72	.84	.88	.90	.92
Pinatype red fast	....	....	....	....	....	....	....	....	.11	.35	.55	.65	.68	.69
Eosine (yellowish)	....	....	....	....	....	....	....	....	.06	.40	.63	.74	.82	.85
Eosine	....	....	....	....	....	....	.01	.54	.87	.93	.92	.92	.92	.92
Naphthalinrot in absolute alcohol	....	....	....	....	....	....	....	....	.06	.28	.43	.50	.57	.61
Rose bengal	.80	.70	.34	.06	.01	....	.14	.82	.96	.97	.98	.98	.98	.98
Rose bengal	.01	....	....	....	....	....	....	.09	.57	.83	.89	.92	.94	.96
Cobalt ammonium sulphate	.60	.56	.48	.37	.38	.53	.70	.82	.86	.90	.90	.90	.90	.89
Cobalt nitrate	.69	.51	.40	.31	.32	.48	.67	.82	.87	.90	.90	.90	.90	.90

PIGMENTS AND DYES (Continued)

Yellow Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Tartrazine	....	....	....	....	0.07	0.52	0.75	0.86	0.91	0.95	0.96	0.97	0.98	0.98
Chrysoidin	....	....	....	....	....	....	....	....	.02	.23	.50	.71	.79	.79
Aurantia	....	....	....	....	....	.03	.23	.53	.82	.92	.96	.96	.96	.96
Aniline yellow phosphine	....	....	....	....	.02	.20	.43	.60	.67	.75	.81	.85	.86	.87
Fluorescein	0.15	0.01	....	....	.48	.91	.97	.98	.98	.98	.98	.98	.98	.98
Aniline yellow fast, S	....	....	0.01	0.07	.43	.84	.96	.96	.96	.96	.96	.96	.96	.96
Methyl orange, indicator	....	....	....	....	....	....	.01	.31	.70	.79	.80	.81	.81	.81
Auramin	....	....	.01	.39	.77	.83	.84	.86	.87	.88	.90	.92	.93	.93
Uranine	.15	.01	....	.01	.58	.96	.97	.97	.97	.97	.97	.97	.97	.97
Uranine naphthaline	....	....	....	.04	.53	.77	.82	.83	.84	.85	.86	.86	.87	.87
Orange B Naphthol	....	....	....	....	....	.01	.43	.88	.95	.96	.97	.97	.97	.97
Safranine	....	....	....	....	....	....	....	....	.03	.27	.64	.85	.93	.93
Martius gelb	....	....	....	.01	.43	.84	.91	.94	.95	.95	.95	.95	.95	.95
Naphthol yellow	....	....	.01	.18	.74	.91	.96	.97	.98	.98	.98	.98	.98	.98
Potassium bechromate, sat. sol.	....	....	....	....	....	.10	.60	.84	.88	.89	.89	.89	.89	.88
Cobalt chromate	.17	.36	.62	.82	.88	.90	.92	.93	.95	.96	.96	.96	.96	.95

PIGMENTS AND DYES (Continued)

Green Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Naphthol green	0.02	0.04	0.07	0.21	0.30	0.36	0.29	0.16	0.07	0.02	0.01	....	....	....
Brilliant green	.04	.39	.69	.52	.23	.04	....	....	....	....	....	0.02	0.23	0.64
Filter blue green	.35	.49	.64	.70	.60	.37	.13	.02	....	....	....	....	....	....
Filter blue green	.06	.14	.23	.40	.26	.08	.01	....	....	....	....	....	....	....
Malachite green	....	.12	.20	.08	.01	....	....	....	....	....	....	....	.12	.50
Malachite green	....	.01	.04	.01	....	....	....	....	....	....	....	....	.02	.23
Malachite green	....	....	.01	....	....	....	....	....	....	....	....	....	....	.10
Saurgrun	.03	.29	.57	.57	.39	.19	.04	.01	....	....	....	....	.04	.30
Methylengrun	.28	.31	.32	.26	.17	.07	.02	.01	....	....	....	....	.03	.28
Methylengrun	.14	.16	.17	.13	.06	.01	....	....	....	....	....	....	.02	.14
Aniline green naphthol B	.02	.06	.14	.24	.34	.40	.32	.14	.04	.01	....	....	....	....
Aniline green naphthol B	....	....	.02	.06	.10	.15	.09	.02	....	....	....	....	....	....
Neptune green	....	.40	.63	.41	.13	.01	....	....	....	....	....	....	....	.05
Neptune green	....	.19	.36	.18	.02	....	....	....	....	....	....	....	....	.02
Cupric chloride	.77	.84	.89	.92	.92	.89	.80	.67	.52	.36	.19	.06	.02	....

PIGMENTS AND DYES (Continued)

Blue Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Trunbulls' blue	0.58	0.60	0.56	0.51	0.38	0.28	0.18	0.09	0.05	0.03	0.01	....	....	....
Victoria blau	.52	.23	.09	.01	....	....	....	....	....	.01	.04	0.21	0.49	0.73
Prussian blue (soluble)	.66	.71	.76	.69	.60	.46	.32	.20	.12	.07	.05	.03	.03	....
" " "	.06	.09	.09	.05	.02	.01	....	....	....	....	....	....	....	....
Wasser blau	.89	.75	.51	.26	.07	.01	....	....	.01	.02	.06	.18	.37	.60
" "	.85	.66	.42	.17	.03	.01	....	....	....	.01	.03	.10	.26	.48
Resorcine blue	.25	.18	.06	.02	.01	....	....	....	.01	.02	.14	.41	.64	.72
Toluidin blau	.66	.31	.13	.03	.01	....	....	....	....	....	.01	.04	.16	.40
Patent blue	.83	.91	.84	.76	.65	.46	.24	.08	.02	....	....	.06	.42	.78
" "	.15	.25	.17	.05	....	....	....	....	....	....	....	....	....	.12
Dianil "	.77	.69	.59	.48	.35	.24	.15	.09	.05	.05	.07	.14	.29	.53
" "	.38	.30	.18	.10	.04	.01	....	....	....	....	....	....	.02	.12
Filter "	.84	.79	.66	.44	.27	.17	.14	.19	.36	.56	.74	.81	.88	.92
" "	.35	.29	.18	.04	....	....	....	....	.02	.08	.23	.44	.62	.71
Aniline blue, methyl	.92	.88	.78	.52	.27	.09	.03	.02	.02	.04	.08	.16	.25	.45
" " "	.44	.31	.13	....	....	....	....	....	....	....	....	....	....	....

PIGMENTS AND DYES (Continued)

Purple Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Ethyl violet in gelatine (dry)	0.97	0.87	0.67	0.28	0.04	....	....	....	....	0.05	0.33	0.73	0.88	.91
Ethyl violet in gelatine (wet)	.83	.79	.45	.07	.01	....	0.01	0.03	0.05	15	.42	.76	.91	.93
Magenta	.21	.08	.02	.01	....	....	.01	.22	.73	.93	.97	.97	.97	.97
"	....	....	....	....	....	....	....	....	.07	.48	.81	.92	.95	.95
Gentian violet	.89	.83	.64	.44	.26	0.19	.15	.10	.13	.42	.75	.92	.93	.94
" "	.11	.01	....	....	....	....	....	....	....	....	.01	.15	.48	.66
Rosazeine	.50	.28	.02	....	....	....	....	.06	.55	.90	.98	.98	.98	.98
"	...	....	....	....	....	....	....	....	....	.07	.54	.90	.95	.95
Iodine (dense)	....	....	....	....	....	....	....	....	....	....	.01	.03	.11	.23
Rhodamine B	.81	.71	.45	.13	.02	....	....	.23	.83	.96	.96	.96	.95	.94
Acid violet	.84	.76	.68	.50	.33	.26	.27	.34	.49	.70	.84	.96	.96	.96
" "	.29	.08	.01	....	....	....	....	.01	.09	.32	.63	.84	.94	.94
Cyanine in alcohol	.07	.01	....	....	....	....	....	....	....	....	....	.01	.13	.23
Xylene red	.39	.23	.01	....	....	....	....	.01	.27	.79	.97	.97	.97	.96
" "	....	....	....	....	....	....	....	....	.01	.31	.79	.96	.96	.95
Methyl violet B	.25	.04	....	....	....	....	....	....	....	....	.03	.26	.63	.89

TRANSMISSION OF COLORED GLASSES

If I_o is the intensity of radiation entering a layer of some medium and I the intensity reaching the opposite surface, the ratio I/I_o is called the transmittance. In practice the ratio of intensity of radiation passing through a glass sample to that incident on its surface is often measured and plotted as transmission. The transmission is the result of two factors, the transmittance of the glass and the losses by reflection. These losses amount to about 4% for each glass-air surface; the transmission of a sample is about 92% of its transmittance. Since the reflection losses differ slightly with different samples, the correction is often determined and applied when the transmission is measured. Values which are thus corrected are marked * at the head of the column.

In order to obtain the transmittance for thicknesses other than those listed it is convenient to transform the tabular values to terms of βt in the equation $I/I_o = e^{\beta t}$ where t is the thickness (in millimeters) and β a constant for a particular sample. The base 10 is conveniently used in place of e so that βt becomes the common logarithm of the transmittance, or $\beta t = \log I/I_o$. Using the corrected value of the transmittance for a specific thickness, found in the table, the value of βt may be found, changed to the value for the new thickness and the transmittance for the second thickness computed.

For example: The tabular value of transmission for sample **CG** 396 at $\lambda = .46\mu$ is given as 0.80 for a thickness of 2 mm. It is desired to find the transmittance for 5 mm.

The corrected value of the transmittance for 2 mm is 0.80/.92 or about 0.871. Log .871 = 9.94002–10. Writing this as a wholly negative number the equation becomes $\beta t = -.05998$. For $t = 5$ $\beta t = -.05998 \times 5/2 = -.14995$ or changing to the more familiar form gives 9.85005–10 which is the logarithm of the new transmittance which is found to be .708. The transmission will be .92 × .708 or .651.

In order to identify the glasses listed, the manufacturer's number is given preceded by an abbreviation of the maker's name, as follows: **AO,** American Optical Co.; **BL,** Bausch & Lomb Optical Co.; **CE,** Chicago Eye Shield Co.; **CG,** Corning Glass Works. Data for Jena glasses are given separately in section II of the table.

This table has been compiled with the assistance of: Mr. H. P. Gage, Corning Glass Works; Mr. J. Liautaud, Chicago Eye Shield Co.; Mr. W. B. Rayton, Bausch & Lomb Optical Co.; Mr. A. J. Weinstein of the Fish-Shurman Corporation.

Abbreviations Used

abs., absorbing
bl., blue
col., colorless
didym., didymium
dk., dark
fl., fluorescent
grn., green
ht., heat
lant., lantern
lt., light
med., medium
neut., neutral
purp., purple
pyrom., pyrometer
rd red
sext., sextant
sig., signal
tr., transmitting
u.v., ultra-violet
v., very
viol., violet
yel., yellow

TRANSMISSION OF COLORED GLASSES

Section I.—Glasses of American Manufacture

Wave-length μ	**AO** Crown 1.50 neut. 1.68 mm	**BL** Crookes 1 neut. 2 mm	**BL** Crookes 2 neut. 2 mm	**BL** Crookes 3 neut. 2 mm	**BL** Smoke A neut. 2 mm	**BL** Smoke B neut. 2 mm	**BL** Smoke C neut. 2 mm	**CG** 254 black ht. tr. 1 mm	**CG** 255 sext. red 1 mm	**CG** 241 Se red pyrom. 38%
0.22	...	*	*	*	*	*	*	....	....	....
.24	...	....	...	...	...	...	...	....	....	....
.26	...	....	...	...	...	...	...	....	....	....
.28	0	....	...	...	...	...	...	....	....	....
.30	.10	.00	.00	.00	.00	.00	.00	....	....	....
.32	.56	.00	.00	.00	.00	.00	.00	....	....	....
.34	.83	.00	.00	.00	.44	.14	.00	....	....	....
.36	.89	.06	.22	.20	.83	.60	.32	....	....	....
.38	.91	.72	.70	.65	.89	.74	.61	....	0	....
.40	.92	.86	.80	.74	.90	.76	.64	....	.07	....
.42	.92	.89	.75	.54	.85	.70	.43	....	.05	....
.44	.92	.91	.77	.46	.82	.54	.28	....	.015	....
.46	.92	.93	.80	.47	.83	.53	.28	....	.005	....
.48	.92	.94	.82	.51	.84	.55	.33	....	.005	....
.50	.92	.95	.83	.55	.85	.59	.35	....	.000	....
.52	.92	.96	.85	.57	.85	.59	.34	....	.005	....
.54	.92	.97	.86	.58	.85	.59	.33	....	.005	....
.56	.92	.97	.84	.57	.85	.60	.33	....	.015	....
.58	.92	.80	.69	.49	.85	.60	.33	....	.030	....
.60	.92	.99	.85	.58	.85	.59	.32	....	.040	....
.62	.92	1.00	.89	.61	.85	.58	.32	....	.060	0
.64	.92	1.00	.90	.63	.85	.60	.33	....	.070	.067
.66	.92	1.00	.92	.66	.87	.65	.39	0	.090	.508
.68	.92	1.00	.94	.73	.90	.73	.52	.006	.120	.660
.70	...	.99	.97	.90	.95	.88	.75	.012	.150	.667
.72	...	....	...	...	...	...	...	.018	.200	.660
1.0	...	.98	.92	.85	.93	.75	.74	.724	.860	....
1.5	...	.95	.89	.87	.91	.82	.74	.845	.920	....
2.0	...	.94	.89	.83	.90	.81	.72	.812	.920	....
2.5	...	.89	.82	.80	.88	.80	.74	.818	.915	....
3.0	...	.55	.53	.53	.59	.61	.56	.672	.743	....
3.5	...	.31	.25	.33	.35	.33	.31	.549	.670	....
4.0	...	.26	.34	.32	.31	.28	.28	.325	.390	....
4.5	...	.23	.20	.21	.22	.22	.23	.030	....	....
5.0	...	.11	.09	.09	.10	.12	.10	....	....	....

TRANSMISSION OF COLORED GLASSES (Continued)

Section I.—Glasses of American Manufacture (Continued)

Wave-length μ	CG 242 Se red dark 100 %	CG 244 Se red lant. 225 %	CG 245 Se red traffic 300 %	CG 246 Se red lt. house 125 %	CG 346 amber A 2.5 mm	BL Kali-chrome A yellow 2 mm	BL Kali-chrome C yellow 2 mm	CG 348 yel. lant. Y 4	CG 351 yel. traffic Y 3	CG 338 yel. noviol C
0.22	....	....	....	....	....	*	*	....	....	....
.24	....	....	....	....	....	...	...	....	....	....
.26	....	....	....	....	....	...	...	....	....	....
.28	....	....	....	....	....	...	...	....	....	....
.30	....	....	....	....	....	.00	.00	....	....	....
.32	....	....	....	....	....	.00	.00	....	....	....
.34	....	....	....	....	....	.00	.00	....	....	....
.36	....	....	....	....	....	.00	.00	0	....	....
.38	....	....	....	....	0	.21	.00	.0008	....	....
.40	....	....	....	....	.045	.50	.00	.0010	....	....
.42	....	....	....	....	.105	.65	.00	.0020	....	....
.44	....	....	....	....	.200	.74	.00	.0039	....	....
.46	....	....	....	....	.330	.81	.00	.0075	....	.000
.48	....	....	....	....	.465	.85	.02	.0137	....	.380
.50	....	....	....	....	.585	.90	.46	.0289	0	.650
.52	....	....	....	....	.680	.93	.87	.0826	.0003	.765
.54	....	....	....	....	.750	.94	.93	.157	.289	.813
.56	0	0	....	....	.795	.94	.97	.544	.784	.820
.58	.0001	.0001	.000	.100	.835	.95	.98	.848	.844	.825
.60	.0005	.024	.148	.730	.855	.96	.98	.882	.864	.825
.62	.019	.680	.722	.828	.875	.97	.97	.890	.874	....
.64	.630	.832	.832	.844	.865	.97	.97	.893	.883	....
.66	.828	.855	.850	.850	.869	.97	.97	.894	.889	....
.68	.847	.863	....	.847	.879	.97	.97	.894	.891	....
.70	.853	.862	.850	.835	.889	.97	.97	.892	.891	....
.72	.854	.859	....	.825	.900	...	...	.888	.890	....
1.0	.605	....	....	....	....	.96	.87	....	....	....
1.5	.703	....	....	....	....	.95	.89	....	....	....
2.0	.805	....	....	....	....	.95	.90	....	....	....
2.5	.730	....	....	....	....	.89	.85	....	....	....
3.0	.330	....	....	....	....	.59	.60	....	....	....
3.5	.275	....	....	....	....	.30	34	....	....	....
4.0	.230	....	....	....	....	.22	.27	....	....	....
4.5	.023	....	....	....	....	.16	.17	....	....	....
5.0	....	....	....	....	....	.08	.10	....	....	....

TRANSMISSION OF COLORED GLASSES (Continued)

Section I.—Glasses of American Manufacture (Continued)

Wave-length μ	CG 038 lt. yel. noviol A	CG 306 lt. yel. noviol O 2 mm	CG 330 sig. yel. 210 % 2.5 mm	CG 375 U yel. fluor. 5 mm	BL Fieuzal A green 2 mm	BL Fieuzal B green 2 mm	BL Fieuzal C green 2 mm	BL Anti-glare green 2 mm	BL Green 19 green 2 mm	BL Ht. abs. green 2 mm
0.22	....	....	.....	.....	*	*	*	*	*	*
.24	....	....	.....	.....	...	...	...	...	...	...
.26	....	...	.....	.....	...	...	...	...	...	...
.28	....	....	.....	.....	...	...	...	...	...	...
.30	....	....	.....	.....	.00	.00	.00	.00	.00	.00
.32	....	....	.....	.....	.00	.00	.00	.00	.00	.00
.34	....	....	.....	0	.00	.00	.00	.00	.00	.03
.36	....	0	0	.190	.00	.00	.00	.00	.00	.22
.38	....	.120	.008	.323	.11	.00	.00	.02	.00	.43
.40	....	.473	.0075	.0622	.30	.02	.00	.14	.00	.51
.42	0	.635	.0076	.0367	.40	.05	.01	.27	.00	.55
.44	.550	.745	.0113	.184	.49	.14	.05	.29	.00	.58
.46	.702	.795	.0271	.407	.64	.29	.13	.43	.01	.61
.48	.765	.825	.0636	.518	.70	.38	.19	.50	.03	.65
.50	.787	.855	.1324	.581	.77	.48	.25	.55	.05	.66
.52	.802	.875	.241	.833	.82	.57	.33	.57	.14	.67
.54	.813	.880	.367	.858	.86	.65	.40	.58	.19	.67
.56	.820	.885	.492	.863	.86	.67	.43	.57	.17	.65
.58	.825	.885	.589	.868	.86	.46	.43	.56	.09	.62
.60	.825	.880	.654	.878	.85	.64	.41	.53	.04	.58
.62	....	.883	.693	.878	.84	.61	.39	.50	.01	.53
.64	....	....	.713	.880	.83	.59	.31	.45	.01	.48
.66	....	....	.721	.884	.82	.56	.35	.40	.01	.43
.68	....	....	.723	.893	.81	.54	.33	.36	.01	.38
.70	....	....	.720	.900	.80	.53	.31	.31	.01	.33
.72	....	....	.712	.902	...	...	...	...	...	...
1.0	....	....	.....	.910	.58	.29	.12	.11	.19	.09
1.5	....	....	.....	.880	.61	.40	.20	.15	.50	.15
2.0	....	....	.....	.862	.73	.52	.32	.27	.71	.25
2.5	....	....	.....	.705	.73	.51	.37	.34	.85	.32
3.0	....	....	.....	.090	.51	.35	.27	.27	.70	.20
3.5	....	....	.....	.010	.34	.25	.21	.17	.43	.15
4.0	....	....	.....	.....	.24	.24	.21	.15	.41	.09
4.5	....	....	.....	.....	.16	.11	.11	.11	.32	.07
5.0	....	....	.....	.....	.08	.06	.07	.05	.06	.06

TRANSMISSION OF COLORED GLASSES (Continued)

Section I.—Glasses of American Manufacture (Continued)

Wave-length μ	BL red free green 2 mm	CG 396 green 2 mm	CG 428 bl. grn. 2 mm	CG 440 sig. grn. 150 % 5.78 mm	CG 401 sext. green 1 mm	CG 502 blue 2 mm	CG 503 dk. blue 2 mm	CG 556 sig. blue 100 % 5 mm	CG 554 blue 101 % 2.8 mm	CG 590 lt. bl. 4.6 mm
0.22	*	....	....	.....	.....	....	....	.....	....	....
.24	...	....	....	.....	.....	....	....	.....	....	....
.26	...	....	....	.....	.....	....	....	.....	....	....
.28	...	....	....	.....	.....	....	....	.....	....	....
.30	.00	0	0	.....	.....	....	....	.....	....	....
.32	.00	.020	.004	.....	.....	....	....	0	....	....
.34	.00	.280	.266	.....	.....	....	....	.060	....	....
.36	.00	.530	.652	0	.....	....	....	.370	....	....
.38	.00	.670	.780	.073	.....	....	....	.650	....	.417
.40	.00	.735	.830	.237	0	.631	.766	.780	.700	.650
.42	.04	.760	.845	.366	.0494	.782	.832	.800	.730	.653
.44	.10	.785	.860	.480	.124	.825	.830	.795	.700	.550
.46	.17	.800	.865	.588	.252	.822	.791	.727	.635	.462
.48	.23	.815	.860	.638	.429	.787	.698	.458	.400	.380
.50	.25	.820	.835	.618	.592	.703	.547	.205	.175	.316
.52	.22	.820	.770	.526	.670	.578	.380	.049	.050	.258
.54	.13	.805	.660	.366	.653	.441	.236	.012	.015	.200
.56	.06	.790	.515	.205	.538	.281	.105	.022	.030	.205
.58	.02	.760	.375	.0952	.397	.171	.050	.005	.005	.170
.60	.01	.720	.255	.0375	.260	.088	.018	.0008	0	.121
.62	.00	.670	.175	.0134	.161	.038	.005	.0006	0	.099
.64	.00	.610	.105	.0051	.107	.035	.005	.0003	0	.080
.66	.00	.555	.075	.0019	.0762	.024	.003	.0003	0	.082
.68	.00	.495	.050	.....	.0632	.082	.005	.002	.015	.095
.70	.00	.430	.040	.....	.0508	.054	.015	.008	.060	.103
.72	...	.370	.030	.....	.049	.269	.173	.009	.080	....
1.0	.07	.068	....	.....	.050	....	....	.....	....	....
1.5	.10	.172	....	.....	.180	....	....	.....	....	....
2.0	.35	.279	....	.....	.525	....	....	.....	....	....
2.5	.54	.400	....	.....	.780	....	....	.....	....	....
3.0	.46	....	....	.....	.250	....	....	.....	....	....
3.5	.29	....	....	.....	.150	....	....	.....	....	....
4.0	.28	....	....	.....	.110	....	....	.....	....	....
4.5	.20	....	....	.....	0	....	....	.....	....	....
5.0	.08	....	....	.....	.....	....	....	.....	....	....

TRANSMISSION OF COLORED GLASSES (Continued)

Section I.—Glasses of American Manufacture (Continued)

Wave-length μ	**BL** Blue O blue 2 mm	**BL** Blue A blue 2 mm	**BL** Blue B blue 2 mm	**BL** Blue C blue 2 mm	**CG 511** violet 2.15 mm	**CG 557** lt. purp. 6.2 mm	**CG 555** purp. 4.8 mm	**CG 512** didym. 5 mm	**CG 507** purp. 3 mm	**CG 227** gold ruby 3 mm
0.22	*	*	*	*	.....	.....	.....	.....	.....	....
.24	.....	...	...	...	.....	.....	.....	.....	.....	....
.26	.....	...	...	...	.....	.....	.....	.....	.....	....
.28	.....	...	...	...	.....	.....	.....	.....	.....	....
.30	.020	.11	.08	.11	.....	.....	.....	.....	.....	....
.32	.450	.68	.65	.60	0	.....	.....	.....	.....	....
.34	.79	.88	.87	.87	.0018	.....	.....	.....	.212	....
.36	.88	.94	.93	.97	.082	.....	.....	.....	.552	....
.38	.94	.97	.96	.98	.326	.795	.783	.....	.728	....
.40	.98	.98	.97	.98	.502	.861	.845	.731	.726	.090
.42	1.00	.99	.98	.97	.462	.834	.786	.731	.490	.100
.44	1.00	.99	.98	.95	.326	.810	.705	.530	.225	.105
.46	.99	.99	.98	.92	.138	.781	.589	.548	.092	.100
.48	.99	.97	.93	.81	.014	.665	.318	.530	.045	.090
.50	.99	.94	.83	.66	.0003	.497	.1015	.652	.028	.055
.52	.99	.91	.73	.52	.....	.302	.0163	.601	.0299	.015
.54	.98	.89	.69	.45	.....	.185	.0028	.790	.033	.005
.56	.97	.88	.67	.43	.....	.257	.0092	.811	.050	.005
.58	.96	.87	.64	.40	.....	.160	.0017	.0082	.0727	.045
.60	.96	.86	.62	.37	.....	.095	.0002	.184	.100	.185
.62	.96	.84	.61	.35	.....	.109	.0004	.849	.128	.365
.64	.96	.85	.60	.36	.....	.0935	.0002	.851	.156	.515
.66	.96	.87	.64	.39	.....	.132	.0008	.849	.177	.615
.68	.97	.91	.75	.52	.....	.360	.035	.736	.201	.695
.70	.98	.97	.93	.81	.....	.710	.400	.804	.230	.740
.72	.....	...	...	...	.....	.852	.795	.845	.267	.740
1.0	.99	.98	.99	.99	.....	.....	.....	.....	.793	....
1.5	.96	.95	.89	.83	0	.....	.....	.....	.902	....
2.0	.97	.94	.92	.87	.100	.....	.....	.....	.863	....
2.5	.95	.87	.87	.91	.387	.....	.....	.....	.732	....
3.0	.81	.50	.55	.72	.320	.....	.....	.....	.155	....
3.5	.49	.33	.35	.41	.250	.....	.....	.....	.007	.....
4.0	.39	.31	.31	.33	.305	.....	.....	.....	.015	....
4.5	.31	.21	.19	.29	.156	.....	.....	.....	0	....
5.0	.11	.09	.12	.11	0	.....	.....	.....	.....	....

TRANSMISSION OF COLORED GLASSES (Continued)

Section I.—Glasses of American Manufacture (Continued)

Wave-length μ	CG G 984 B green	CG G 985 B blue	CG 585 bl. purp. tr. u.v. 1 mm	CG 597 rd. purp. tr. u.v. 1 mm	CG 587 rd. purp. tr. u.v. 2 mm	CG 586 violet tr. u.v. 5 mm	CG 584 red tr. u.v. 1 mm	CG 774 neut. pyrex 2 mm	CG 970 neut. corex D 2 mm	CG 980 neut. corex A 2 mm
0.22	...	0	....	....	....	.....	....	....	0	.0115
.24	0	.02	....	....	....	.....	....	....	.0027	.237
.26	.38	.18	....	....	....	.....	....	....	.039	.531
.28	.34	.46	0	0	0	.....	....	0	.305	.753
.30	.12	.68	.153	.116	.039	0	.129	.120	.700	.840
.32	.36	.78	.650	.570	.342	.0004	.555	.610	.860	.879
.34	.73	.84	.860	.850	.640	.097	.791	.830	.902	.884
.36	.79	.86	.910	.913	.795	.290	.830	.900	.....	.885
.38	.75	.86	.925	.890	.700	.080	.714	.913	.....	.....
.40	.45	.81	.900	.714	.265	0	.115	.913	.....	.887
.42	.11	.67	.840	.260	.045	.....	0	....	.....	.....
.44	.02	.41	.765	.065	.010	.....	....	.913	.....	.893
.46	.01	.16	.620	.025	.010	.....	....	....	.....	.....
.48	.03	.04	.390	.025	.005	.....	....	.917	.....	.897
.50	...	...	.199	.026	.000	.....	....	....	.....	.....
.52	...	...	.090	.026	.005	.....	....	.918	.....	.900
.54	...	...	.053	.028	.005	.....	....	....	.....	.....
.56	...	...	.104	.027	.010	.....	....	.918	.....	.900
.58	...	...	.029	.030	.005	.....	....	....	.....	.....
.60	...	...	.014	.065	.000	.....	....	.919	.....	.900
.62	...	...	.020	.034	.000	.....	....	....	.....	.....
.64	...	...	.018	.045	.000	.....	0	.919	.....	.900
.66	...	...	.033	.160	.005	.....	.010	....	.....	.....
.68	...	...	.146	.350	.035	.....	.080	.919	.....	.900
.70	...	...	.505	.505	.255	.....	.290	.919	.....	.....
.72	...	...	.760	.595	.520	.....	.405	....	.....	.900
1.0	...	...	.850	.450	....	.....	....	.915	.....	.900
1.5	...	...	.425	.610	....	.....	....	.914	.....	.898
2.0	...	...	.645	.415	....	.....	....	.904	.....	.857
2.5	...	...	.805	.450	....	.....	....	....	.....	.744
3.0	...	...	.595	.485	....	.....	....	....	.....	.018
3.5	...	...	.520	.393	....	.....	....	....	.....	.017
4.0	...	...	.580	.422	....	.....	....	....	.....	.....
4.5	...	...	.310	....	....	.....	....	....	.....	.....

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION I.—GLASSES OF AMERICAN MANUFACTURE (Continued)

Wave-length μ	**CG** 986 rd. purp. corex A 3 mm	**BL** Weld. 3 yel. grn. 1 mm	**BL** Weld. 4 yel. grn. 1 mm	**BL** Weld. 5 yel. grn. 0.5 mm	**BL** Weld. 8 yel. grn. 0.5 mm	**BL** Weld. 12 yel. grn. 0.5 mm	**CE** Cesco-weld no. 3 ht. abs.	**CE** Cesco-weld no. 4 ht. abs.	**CE** Cesco-weld no. 5 ht. abs.	**CE** Cesco-weld no. 6 ht. abs.
0.22	....	*	*	*	*	*	....	....	....	....
.24	0	...	...	...	...	...	....	....	....	....
.26	.135	...	...	...	...	...	....	....	....	....
.28	.412	...	...	...	...	...	....	....	....	....
.30	.625	.00	.00	.00	.00	.00	....	....	....	....
.32	.793	.00	.00	.00	.00	.00	....	....	....	....
.34	.814	.00	.00	.00	.00	.00	....	....	....	....
.36	.797	.03	.03	.06	.11	.00	....	....	....	....
.38	.430	.06	.09	.13	.18	.01	....	.000	.000	....
.40	.075	.09	.12	.14	.21	.03	....	.001	.001	....
.42	.023	.10	.13	.14	.16	.02	0	.002	.001	....
.44	.000	.09	.14	.15	.15	.02	.001	.004	.000	....
.46	.000	.13	.19	.21	.17	.03	.013	.009	.001	.000
.48	.000	.22	.27	.27	.20	.05	.032	.025	.005	.001
.50	.000	.31	.25	.25	.25	.07	.070	.047	.010	.003
.52	.000	.40	.42	.41	.29	.08	.160	.082	.031	.008
.54	.000	.46	.44	.45	.31	.09	.180	.094	.032	.013
.56	.000	.46	.43	.45	.32	.10	.174	.087	.030	.012
.58	.000	.43	.39	.43	.31	.09	.157	.063	.026	.010
.60	.001	.36	.31	.38	.27	.08	.120	.037	.014	.006
.62	.003	.29	.25	.31	.23	.07	.068	.020	.007	.002
.64	.010	.24	.20	.26	.20	.06	.042	.010	.004	.001
.66	.025	.19	.15	.21	.19	.05	.025	.004	.001	.000
.68	.128	.15	.12	.18	.17	.05	.016	.001	.000	.000
.70	.231	.12	.09	.16	.15	.04	.009	.001	.000	.000
.72	.240	...	...	...	...	...	.008	....	.001	.000
1.0	.095	.07	.04	.09	.04	.03	.002	.000	.000	.000
1.5	.009	.03	.02	.04	.07	.02	.000	.000	.000	.000
2.0	.026	.07	.04	.10	.12	.04	.002	.000	.000	.000
2.5	.081	.11	.10	.15	.19	.07	.010	.002	.000	.000
3.0	0	.14	.11	.20	.22	.11	.012	.001	.001	.000
3.5	....	.16	.13	.14	.28	.14	.014	.003	.002	.000
4.0	....	.20	.17	.30	.33	.21	.024	.008	.007	.001
4.5	....	.21	.17	.37	.29	.26	.022	.005	.012	.004
5.0		.06	.05	.20	.15	.30	.000	.000	.001	.000

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES*

Wave-length μ	UG 1 dk. viol. tr. u.v. 1 mm	UG 2 dk. viol. tr. u.v. 1 mm	UG 3 violet 1 mm	UG 4 dark violet 1 mm	BG 1 blue tr. u.v. 1 mm	BG 2 blue tr. u.v. 1 mm	BG 3 blue tr. u.v. 1 mm	BG 5 dk. blue abs. red 1 mm	BG 6 dk. blue 1 mm
.281	....	0.01	....	....	0.04	....	0.13	....	....
.302	0.17	.27	....	0.09	.40	0.04	.69	....	....
.312	.37	.50	0.04	.22	.64	.16	.77	....	....
.334	.69	.80	.55	.59	.93	.63	.92	....	....
.366	.85	.84	.91	.77	.97	.84	.96	0.09	0.06
.405	.08	.02	.85	.07	.97	.70	.86	.33	.34
.436	....	....	.50	.01	.86	.42	.63	.47	.48
.480	....	....	.17	.02	.44	.02	.10	.39	.33
.509	....	....	.12	.01	.14	....	.01	.19	.12
.546	....	....	.15	.02	.04	....	....	.06	.02
.578	....	....	.21	....	.05	....	....	.04	.02
.644	....	....	.35	....	.01	....	....	.01	.01
.700	.01	.12	.46	.21	.51	.32	.06	.13	.08
.775	.34	.30	.64	.52	.94	.84	.90	.13	.14
.85	.22	.19	.79	.39	.97	.83	.98	.10	.10
.95	.11	.12	.93	.39	.93	.74	.94	.12	.12
1.05	.07	.09	.97	.37	.86	.61	.81	.15	.15
1.15	.05	.07	.98	.32	.76	.50	.64	.19	.18
1.30	.04	.06	.99	.28	.58	.41	.39	.24	.23
1.45	.04	.06	.99	.27	.45	.38	.27	.29	.27
1.60	.03	.06	.99	.26	.40	.37	.19	.34	.31
1.80	.04	.06	.99	.25	.44	.38	.20	.42	.38
2.00	.04	.06	.99	.32	.50	.41	.28	.49	.46
2.40	.11	.11	.98	.51	.69	.51	.47	.68	.66
3.00	.17	.19	.86	.35	.55	.35	.49	.37	.36

* Data furnished by courtesy of the Fish-Schurman Corp., New York, Importers of Jena Glasses. All values are corrected for reflection losses.

TRANSMISSION OF COLORED GLASSES (Continued)

Section II.—Jena Glasses (Continued)

Wave-length μ	BG 7 dk. blue abs. red 1 mm	BG 9 blue-green 1 mm	BG 10 blue-green 1 mm	BG 11 lt. blue (Nd) 1 mm	BG 12 blue abs. red 1 mm	BG 13 med. blue 1 mm	BG 14 bright blue 1 mm	BG 15 blue 1 mm	BG 16 blue 1 mm
.281	....	....	....	0.02	....	....	....	....	....
.302	....	....	....	.21	....	....	....	....	....
.312	....	0.01	....	.38	0.02	....	0.13	0.03	....
.334	0.02	.21	0.12	.80	.39	....	.71	.33	0.04
.366	.26	.67	.60	.95	.75	0.35	.92	.73	.57
.405	.51	.90	.78	.97	.86	.77	.98	.86	.80
.436	.70	.94	.84	.96	.85	.87	.98	.89	.84
.480	.79	.96	.88	.93	.48	.87	.98	.90	.86
.509	.73	.96	.88	.95	.12	.85	.96	.90	.86
.546	.50	.95	.87	.99	.02	.77	.90	.90	.84
.578	.26	.93	.86	.70	.01	.64	.75	.89	.81
.644	.03	.86	.74	1.00	....	.35	.46	.80	.68
.700	....	.74	.63	0.99	.04	.21	.30	.65	.54
.775	....	.56	.42	.90	.08	.14	.24	.47	.36
.85	.01	.46	.31	.92	.08	.14	.27	.36	.25
.95	.02	.38	.25	.98	.12	.19	.35	.28	.20
1.05	.04	.34	.24	.99	.18	.24	.45	.24	.18
1.15	.08	.33	.26	.99	.18	.30	.55	.24	.17
1.30	.15	.36	.31	.98	.16	.43	.69	.30	.21
1.45	.24	.42	.39	.97	.19	.52	.78	.41	.28
1.60	.35	.49	.47	.96	.22	.61	.84	.45	.38
1.80	.48	.56	.53	.97	.27	.73	.90	.49	.44
2.00	.58	.59	.55	.97	.53	.81	.93	.54	.44
2.40	.74	.64	.58	.93	.79	.88	.94	.61	.55
3.00	.56	.50	.46	.54	.55	.59	.63	.51	.44

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	BG 17 col. abs. heat 1 mm	VG 2 yellow-green 1 mm	VG 3 green (Nd) 1 mm	GG 1 col. abs. u.v. 1 mm	GG 2 col. abs. u.v. 1 mm	GG 3 light yellow 1 mm	GG 4 light green 1 mm	GG 5 bright yellow 1 mm	GG 6 medium yellow 1 mm
.281	....	....	....	....	....	....	....	....	....
.302	0.03	....	....	0.02	....	0.03	....	0.01	0.02
.312	.11	....	....	.13	....	.05	....	.02	.05
.334	.46	....	0.01	.47	....	.09	0.03	.03	.11
.366	.89	....	.49	.86	0.64	.16	.01	.09	.14
.405	.97	....	.27	.98	.97	.21	.40	.14	.21
.436	.98	0.05	.06	.99	.99	.85	.67	.40	.36
.480	.98	.37	.02	1.00	1.00	.99	.92	.99	.73
.509	.98	.59	.38	1.00	1.00	1.00	.95	1.00	.98
.546	.98	.61	.06	1.00	1.00	1.00	.97	1.00	1.00
.578	.98	.44	.69	1.00	1.00	1.00	.96	1.00	1.00
.644	.97	.10	....	1.00	1.00	1.00	.94	1.00	1.00
.700	.93	.08	.85	1.00	1.00	1.00	.96	1.00	0.99
.775	.78	.07	.59	1.00	1.00	0.99	.99	0.99	.98
.85	.61	.06	.32	1.00	1.00	.98	.99	.99	.97
.95	.42	.09	.36	1.00	1.00	.98	.99	.98	.96
1.05	.32	.13	.22	1.00	1.00	.97	.99	.98	.95
1.15	.30	.18	.20	1.00	1.00	.97	.99	.98	.95
1.30	.33	.27	.39	1.00	1.00	.97	.99	.97	.95
1.45	.36	.37	.34	1.00	1.00	.98	.99	.97	.96
1.60	.43	.47	.22	1.00	1.00	.98	.99	.98	.96
1.80	.46	.57	.38	1.00	1.00	.98	.99	.98	.97
2.00	.42	.65	.47	1.00	0.99	.98	.99	.98	.97
2.40	.39	.75	.30	0.96	.98	.96	.98	.97	.94
3.00	.27	.54	.12	.50	.70	.62	.64	.62	.62

TRANSMISSION OF COLORED GLASSES (Continued)

Section II.—Jena Glasses (Continued)

Wave-length μ	GG 7 medium yellow 1 mm	GG 8 greenish-yellow 1 mm	GG 9 greenish-yellow 1 mm	GG 10 dk. grn.-yellow 1 mm	GG 11 deep yellow 1 mm	GG 12 yellow, grn. fl. 1 mm	OG 1 yellow-orange 1 mm	OG 2 orange 1 mm	OG 3 red-orange 1 mm
.281	....	....	....	....	....	....	....	....	....
.302	....	....	0.01	....	....	....	....	....	....
.312	0.01	....	.01	....	....	....	....	....	....
.334	.04	....	....	....	....	0.03	....	....	....
.366	.05	....	....	....	....	.74	....	....	....
.405	.12	0.05	.01	....	....	.53	....	....	....
.436	.16	.26	.14	0.09	0.01	.71	....	....	....
.480	.65	.75	.78	.59	.24	.90	....	....	....
.509	.99	.88	.88	.85	.97	.96	0.01	....	....
.546	.99	.99	.93	.97	.99	.99	.91	0.14	....
.578	1.00	.99	.92	.95	.99	1.00	.99	.94	0.48
.644	1.00	.92	.89	.83	.99	1.00	.99	.99	1.00
.700	1.00	.92	.91	.86	.99	1.00	.99	.99	1.00
.775	0.99	.98	.95	.96	.98	1.00	.99	.99	0.99
.85	.99	.98	.98	.99	.97	1.00	.99	.99	.99
.95	.98	.99	.99	.99	.96	1.00	.99	.99	.98
1.05	.98	1.00	.99	.99	.96	1.00	.99	.99	.98
1.15	.97	1.00	.99	1.00	.96	1.00	.99	.99	.98
1.30	.96	1.00	.99	1.00	.96	1.00	.99	.99	.98
1.45	.96	1.00	.99	0.99	.96	1.00	.99	.99	.98
1.60	.97	1.00	.99	.99	.96	0.99	.99	.99	.98
1.80	.98	.99	.99	.99	.97	.99	.98	.99	.98
2.00	.98	.99	.99	.99	.97	.99	.98	.99	.99
2.40	.95	.96	.97	.94	.95	.98	.97	.97	.97
3.00	.65	.68	.69	.44	.66	.67	.62	.60	.63

TRANSMISSION OF COLORED GLASSES (Continued)

Section II.—Jena Glasses (Continued)

Wave-length μ	RG 1 bright red 1 mm	RG 2 pure red 1 mm	RG 3 dark red 1 mm	RG 4 dark red 1 mm	RG 5 dark red 1 mm	RG 6 blood color 1 mm	RG 7 infra-red 1 mm	RG 8 v. dk red. 1 mm	RG 9 infra-red 1 mm
.281	....	....	....	....	....	....	....	....	....
.302	....	....	....	....	....	0.12	....	....	....
.312	....	....	....	....	....	.20	....	....	....
.334	....	....	....	....	....	.34	....	....	....
.366	....	....	....	....	....	.44	....	....	....
.405	....	....	....	....	....	.49	....	....	....
.436	....	....	....	....	....	.50	....	....	....
.480	....	....	....	....	....	.44	....	....	....
.509	....	....	....	0.02	....	.31	....	....	....
.546	....	....	....	.05	....	.18	....	....	....
.578	....	....	....	.10	....	.40	....	....	....
.644	0.96	0.92	0.54	.55	0.02	.93	....	0.01	....
.700	.98	.98	.70	.73	.96	.98	0.02	.71	0.20
.775	.98	.98	.81	.82	.98	.99	.18	.99	0.98
.85	.98	.98	.88	.87	.98	.99	.41	.99	.97
.95	.98	.98	.92	.91	.98	.99	.74	.99	.92
1.05	.98	.98	.94	.93	.98	.99	.91	.99	.80
1.15	.98	.98	.95	.94	.99	.99	.96	.99	.62
1.30	.98	.98	.97	.96	.99	.99	.97	.99	.38
1.45	.98	.98	.97	.97	.99	.99	.98	.99	.25
1.60	.98	.98	.98	.98	.99	.99	.99	.99	.19
1.80	.98	.98	.98	.98	.99	.99	.99	.99	.20
2.00	.98	.98	.98	.99	.99	.99	.99	.99	.27
2.40	.96	.95	.94	.97	.97	.96	.99	.97	.45
3.00	.65	.65	.56	.67	.58	.63	.85	.58	....

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	NG 1 v. dk. neut. 0.1 mm	NG 2 med. dk. neut. 0.1 mm	NG 3 dk. neut. 1 mm	NG 4 med. neut. 1 mm	NG 5 neut. 1 mm	NG 6 light neut. 1 mm	NG 7 blue-gray 1 mm
.281	....	0.05	....	....	....	....	....
.302	....	.30	....	....	....	....	....
.312	....	.36	....	....	....	....	....
.334	....	.46	....	....	0.02	0.07	0.01
.366	0.21	.47	0.02	0.07	.22	.53	.17
.405	.29	.45	.08	.18	.37	.89	.37
.436	.32	.46	.12	.23	.43	.92	.44
.480	.36	.50	.15	.29	.46	.89	.34
.509	.36	.52	.17	.30	.46	.89	.29
.546	.36	.56	.17	.31	.46	.89	.33
.578	.36	.58	.17	.31	.46	.89	.26
.644	.37	.62	.17	.30	.46	.87	.19
.700	.45	.77	.16	.28	.43	.86	.34
.775	.50	.80	.12	.21	.34	.85	.34
.85	.49	.80	.08	.17	.27	.86	.29
.95	.48	.81	.07	.14	.21	.87	.24
1.05	.50	.85	.07	.14	.19	.89	.21
1.15	.54	.85	.06	.16	.19	.91	.21
1.30	.59	.86	.09	.21	.22	.93	.21
1.45	.63	.88	.15	.26	.26	.95	.22
1.60	.67	.89	.20	.30	.31	.96	.26
1.80	.71	.90	.22	.34	.38	.96	.34
2.00	.73	.91	.26	.37	.43	.97	.40
2.40	.78	.93	.34	.39	.48	.96	.44
3.00	.72	.87	.20	.19	.21	.72	.25

TRANSMISSIBILITY FOR RADIATIONS

Ratio of the transmitted light to the incident light for a definite thickness of the substance, usually 1 cm.

Glass.

Glass in general is opaque to the ultra-violet and infra-red. Uviol glass is transparent to the longer radiations of the ultra-violet.

Coefficient of transparency of glass for visible and ultra-violet radiations.

	Normal incidence, thickness 1 cm.								
Wave length microns	0.309	0.330	0.347	0.357	0.361	0.375	0.384	0.388	0.396
Crown, ordinary	...	...	...	...	...	.947			
Crown, borosilicate	0.08	0.65	0.88	...	0.95	...	0.972	0.975	0.986
Flint, ordinary	...	...	...	0.72	...	...	...	0.904	
Flint, heavy	...	...	0.01	...	0.16	...	0.58		

	Normal incidence, thickness 1 cm.								
Wave length, microns	0.400	0.415	0.419	0.425	0.434	0.455	0.500	0.580	0.677
Crown, ordinary	0.964	...	0.952	...	0.960	0.981	...	0.986	0.990
Crown, borosilicate	...	0.985	...	0.993	...	...	0.993		
Flint, ordinary	...	0.959	...	...	...	...	1.00		
Flint, heavy	...	...	...	0.905					

Quartz

Quartz is very transparent to the ultra-violet and to the visible spectrum, but opaque for the infra-red beyond 7.0μ.

(Pflüger.)

Wave length, microns	0.19	0.20	0.21	0.22
Transmission for 1 mm	.67	.84	.92	.94

Fluorite

Fluorite is very transparent to the ultra-violet, nearly to 0.10μ. Coefficient of transparency at $\lambda = 186$ is found by Pflüger to be 0.80.

For the infra-red the values are given in a table below.

TRANSMISSIBILITY FOR RADIATIONS (Continued)

Rock Salt and Sylvine and Fluorite

Transparency for the Infra-red.

Thickness 1 cm.

Wave length, microns.	Rock salt.	Sylvine KCl.	Fluorite.
8.	....	....	.844
9.	0.995	1.000	.543
10.	.995	.988	.164
12.	.993	.995	.010
14.	.931	.975	.000
16.	.661	.936	
18.	.275	.862	
19.	.096	.758	
20.7	.006	.585	
23.7	.000	.155	

PHOSPHORESCENCE BY CATHODE RAYS

Substances Luminous under Excitation by Cathode Rays.

Substance (with calcium oxide).	Wave lengths of principal bands in microns (Urbain, 1909.)
Dysprosium oxide........	0.480, 0.489, 0.585, 0.675
Europium oxide..........	0.416–0.426, 0.469
Europium oxide..........	0.589–0.593, 0.613, 0.625
Neodymium oxide........	0.392, 0.419–0.429, 0.458
Praesodymium oxide......	0.488, 0.604, 0.606, 0.626, 0.634

One part.	100 parts.	Wave length.	Color.	Observer.
Antimony oxide..	calcium oxide	0.560	yellow	Bruninghaus, 1910
Antimony trisulphide.........	calcium sulphide	0.569	yellow	Bruninghaus, 1910
Bismuth oxide...	calcium oxide	0.522	blue	Bruninghaus, 1910
Bismuth sulphate.	calcium sulphate	0.640	red	Bruninghaus, 1910
Manganous carbonate........	magnesium carbonate	0.620	red	Bruninghaus, 1910
oxide.........	calcium oxide	0.589	yellow	Lecoq & Boisbaudra 1886
phosphate.....	calcium phosphate $Ca_3(PO_4)_2$	0.633	red	Bruninghaus, 1910
sulphate.......	calcium sulphate	0.540	green	Lecoq & Boisbaudran, 1886
sulphide.......	calcium sulphide	0.589	yellow	Bruninghaus, 1910

FLUORESCENCE OF ORGANIC SUBSTANCES IN SOLUTION

Excitation by White Light.

Substance.	Solvent.	Wave length microns.	Observer.
Anthracene......	alcohol	0.400 0.430 0.436	Stark & Meyer, 1907
Eosine..........	alcohol or water	0.589	Nichols & Merritt, 1907
Esculine.........	alcohol	0.460	Nichols & Merritt, 1907
Fluorescein......	water (alkaline)	0.542	Nichols & Merritt, 1907
Naphthalin, red..	alcohol	0.632	Nichols & Merritt, 1907
Quinine sulphate.	water	0.437	Nichols & Merritt, 1907
Resorcin blue....	water	0.65	Nichols & Merritt, 1907
Rhodamin.......	water	0.554	Nichols & Merritt, 1907

FLUORESCENCE

Gases and Vapors.

Gas or vapor.	Condition.	Excitation.	Color or wave length of emitted light.	Observer.
Iodine...	Vapor at ordinary temperature.	Mercury arc $\lambda = .546\mu$	Strongest bands $\lambda = .5460\mu$, $.5774\mu$ .5730, .5796	Wood, 1911
Mercury .	Vapor at ordinary temperature	Spark between aluminum electrodes	Broad band $\lambda = .5900–.3000$	Wood, 1909
Oxygen ..	....	Mercury arc in quartz tube	Strongest lines $\lambda = .1849$, .1851 (ultra-violet)	Streubing, 1910
Potassium	Vapor, 300°–400° C.	White light	Many strong lines from .6416–.6768, strongest .6544 and .6584	Wood & Carter, 1908
Rubidium	Vapor, at 270° C.	White light (elec. arc)	Strong red band $\lambda = .6900-.6620$.	Dunoyer, 1912
Sodium ..	Vapor at 350° C.	White light (elec. arc)	D, $\lambda = .5893$ (mean)	Dunoyer, 1912

COLORIMETRY

Selected from Judd, Jour. Opt. Soc. Amer. **23**, 359 (1933)

Recommendations of the International Commission on Illumination

Standard Illuminants

A. Gas-filled tungsten incandescent lamp of color temperature 2848° K.

B. Noon Sunlight. Lamp as above in combination with the Davis-Gibson filter for converting color temperature 2848° to 4800° K.

The filter is to be composed of a layer one centimeter thick of each of two separate solutions B_1 and B_2, contained in a double cell of colorless optical glass.

Solution B_1

Copper sulphate ($CuSO_4 \cdot 5H_2O$)	2.452	g
Mannite ($C_6H_8(OH)_6$)	2.452	g
Pyridine (C_5H_5N)	30.0	cc
Distilled water to make	1000	cc

Solution B_2

Cobalt ammonium sulphate ($CoSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$)	21.71	g
Copper sulphate ($CuSO_4 \cdot 5H_2O$)	16.11	g
Sulphuric acid (density 1.835)	10.0	cc
Distilled water to make	1000	cc

C. Average Daylight. Lamp as in **A** in combination with Davis-Gibson filter for converting color temperature 2848° to 6500° K.

The filter is composed of a layer one centimeter thick of each of two separate solutions C_1 and C_2, contained in a double cell made of colorless optical glass.

Solution C_1

Copper sulphate ($CuSO_4 \cdot 5H_2O$)	3.412	g
Mannite ($C_6H_8(OH)_6$)	3.412	g
Pyridine (C_5H_5N)	30.0	cc
Distilled water to make	1000	cc

Solution C_2

Cobalt ammonium sulphate ($CoSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$)	30.580	g
Copper sulphate ($CuSO_4 \cdot 5H_2O$)	22.520	g
Sulphuric acid (density 1.835)	10.0	cc
Distilled water to make	1000	cc

See R. Davis and K. S. Gibson Bur. Stds. Misc. Pub. No. 114, Jan. 1931 or Bur. Stds. Jour. Research **7**, 796 (1931).

Standard Coordinate System

The tristimulus system of color specification is based on four chosen stimuli consisting of homogeneous radiant energy of wave lengths

700.0 **546.1** **435.8**

$m\mu$ and of standard illuminant B (see above).

To establish the system of specification coordinates are assigned as follows:

Stimulus	x	y	z
700.0 $m\mu$	0.73467	0.26533	0.00000
546.1 $m\mu$	0.27376	0.71741	0.00883
435.8 $m\mu$	0.16658	0.00886	0.82456
Standard illuminant B:	0.34842	0.35161	0.29997

The Standard Observer

The "standard observer" is determined below by the specification for the equal energy spectrum both in fractions, x, y, z of the total amount for each wave length interval of 5 mμ and directly $\bar{x}$, $\bar{y}$, $\bar{z}$. The fractional values are known as the **trilinear coordinates** or **trichromatic coefficients** of the spectrum; the direct values as the **distribution functions** or coefficients.

The sum of the trichromatic coefficients is unity, that is $x + y + z = 1$ Therefore the value of z may be and often is omitted from a specification.

Relative Visibility

The value of $\bar{y}$ given in the table is the standard visibility function or relative visibility.

Wave length mμ	Trichromatic coefficients			Distribution coefficients for equal energy			Wave length mμ
	x	y	z	$\bar{x}$	$\bar{y}$ (Rel. Vis.)	$\bar{z}$	
380	0.1741	0.0050	0.8209	0.0014	0.0000	0.0065	380
385	0.1740	0.0050	0.8210	0.0022	0.0001	0.0105	385
390	0.1738	0.0049	0.8213	0.0042	0.0001	0.0201	390
395	0.1736	0.0049	0.8215	0.0076	0.0002	0.0362	395
400	0.1733	0.0048	0.8219	0.0143	0.0004	0.0679	400
405	0.1730	0.0048	0.8222	0.0232	0.0006	0.1102	405
410	0.1726	0.0048	0.8226	0.0435	0.0012	0.2074	410
415	0.1721	0.0048	0.8231	0.0776	0.0022	0.3713	415
420	0.1714	0.0051	0.8235	0.1344	0.0040	0.6456	420
425	0.1703	0.0058	0.8239	0.2148	0.0073	1.0391	425
430	0.1689	0.0069	0.8242	0.2839	0.0116	1.3856	430
435	0.1669	0.0086	0.8245	0.3285	0.0168	1.6230	435
440	0.1644	0.0109	0.8247	0.3483	0.0230	1.7471	440
445	0.1611	0.0138	0.8251	0.3481	0.0298	1.7826	445
450	0.1566	0.0177	0.8257	0.3362	0.0380	1.7721	450
455	0.1510	0.0227	0.8263	0.3187	0.0480	1.7441	455
460	0.1440	0.0297	0.8263	0.2908	0.0600	1.6692	460
465	0.1355	0.0399	0.8246	0.2511	0.0739	1.5281	465
470	0.1241	0.0578	0.8181	0.1954	0.0910	1.2876	470
475	0.1096	0.0868	0.8036	0.1421	0.1126	1.0419	475
480	0.0913	0.1327	0.7760	0.0956	0.1390	0.8130	480
485	0.0687	0.2007	0.7306	0.0580	0.1693	0.6162	485
490	0.0454	0.2950	0.6596	0.0320	0.2080	0.4652	490
495	0.0235	0.4127	0.5638	0.0147	0.2586	0.3533	495
500	0.0082	0.5384	0.4534	0.0049	0.3230	0.2720	500
505	0.0039	0.6548	0.3413	0.0024	0.4073	0.2123	505
510	0.0139	0.7502	0.2359	0.0093	0.5030	0.1582	510
515	0.0389	0.8120	0.1491	0.0291	0.6082	0.1117	515
520	0.0743	0.8338	0.0919	0.0633	0.7100	0.0782	520
525	0.1142	0.8262	0.0596	0.1096	0.7932	0.0573	525
530	0.1547	0.8059	0.0394	0.1655	0.8620	0.0422	530
535	0.1929	0.7816	0.0255	0.2257	0.9149	0.0298	535
540	0.2296	0.7543	0.0161	0.2904	0.9540	0.0203	540
545	0.2658	0.7243	0.0099	0.3597	0.9803	0.0134	545
550	0.3016	0.6923	0.0061	0.4334	0.9950	0.0087	550
555	0.3373	0.6589	0.0038	0.5121	1.0002	0.0057	555
560	0.3731	0.6245	0.0024	0.5945	0.9950	0.0039	560
565	0.4087	0.5896	0.0017	0.6784	0.9786	0.0027	565
570	0.4441	0.5547	0.0012	0.7621	0.9520	0.0021	570

The Standard Observer (Continued)

Wave length mμ	Trichromatic coefficients			Distribution coefficients for equal energy			Wave length mμ
	x	y	z	$\bar{x}$	$\bar{y}$ (Rel. Vis.)	$\bar{z}$	
575	0.4788	0.5202	0.0010	0.8425	0.9154	0.0018	575
580	0.5125	0.4866	0.0009	0.9163	0.8700	0.0017	580
585	0.5448	0.4544	0.0008	0.9786	0.8163	0.0014	585
590	0.5752	0.4242	0.0006	1.0263	0.7570	0.0011	590
595	0.6029	0.3965	0.0006	1.0567	0.6949	0.0010	595
600	0.6270	0.3725	0.0005	1.0622	0.6310	0.0008	600
605	0.6482	0.3514	0.0004	1.0456	0.5668	0.0006	605
610	0.6658	0.3340	0.0002	1.0026	0.5030	0.0003	610
615	0.6801	0.3197	0.0002	0.9384	0.4412	0.0002	615
620	0.6915	0.3083	0.0002	0.8544	0.3810	0.0002	620
625	0.7006	0.2993	0.0001	0.7514	0.3210	0.0001	625
630	0.7079	0.2920	0.0001	0.6424	0.2650	0.0000	630
635	0.7140	0.2859	0.0001	0.5419	0.2170	0.0000	635
640	0.7190	0.2809	0.0001	0.4479	0.1750	0.0000	640
645	0.7230	0.2770	0.0000	0.3608	0.1382	0.0000	645
650	0.7260	0.2740	0.0000	0.2835	0.1070	0.0000	650
655	0.7283	0.2717	0.0000	0.2187	0.0816	0.0000	655
660	0.7300	0.2700	0.0000	0.1649	0.0610	0.0000	660
665	0.7311	0.2689	0.0000	0.1212	0.0446	0.0000	665
670	0.7320	0.2680	0.0000	0.0874	0.0320	0.0000	670
675	0.7327	0.2673	0.0000	0.0636	0.0232	0.0000	675
680	0.7334	0.2666	0.0000	0.0468	0.0170	0.0000	680
685	0.7340	0.2660	0.0000	0.0329	0.0119	0.0000	685
690	0.7344	0.2656	0.0000	0.0227	0.0082	0.0000	690
695	0.7346	0.2654	0.0000	0.0158	0.0057	0.0000	695
700	0.7347	0.2653	0.0000	0.0114	0.0041	0.0000	700
705	0.7347	0.2653	0.0000	0.0081	0.0029	0.0000	705
710	0.7347	0.2653	0.0000	0.0058	0.0021	0.0000	710
715	.7347	0.2653	0.0000	0.0041	0.0015	0.0000	715
720	0.7347	0.2653	0.0000	0.0029	0.0010	0.0000	720
725	0.7347	0.2653	0.0000	0.0020	0.0007	0.0000	725
730	0.7347	0.2653	0.0000	0.0014	0.0005	0.0000	730
735	0.7347	0.2653	0.0000	0.0010	0.0004	0.0000	735
740	0.7347	0.2653	0.0000	0.0007	0.0003	0.0000	740
745	0.7347	0.2653	0.0000	0.0005	0.0002	0.0000	745
750	0.7347	0.2653	0.0000	0.0003	0.0001	0.0000	750
755	0.7347	0.2653	0.0000	0.0002	0.0001	0.0000	755
760	0.7347	0.2653	0.0000	0.0002	0.0001	0.0000	760
765	0.7347	0.2653	0.0000	0.0001	0.0000	0.0000	765
770	0.7347	0.2653	0.0000	0.0001	0.0000	0.0000	770
775	0.7347	0.2653	0.0000	0.0000	0.0000	0.0000	775
780	0.7347	0.2653	0.0000	0.0000	0.0000	0.0000	780
			Totals	21.3713	21.3714	21.3715	

SPECIFIC ROTATION

Specific rotation or rotatory power is given in degrees per decimeter for liquids and solutions and in degrees per millimeter for solids; + signifies right handed rotation, − left. Specific rotation varies with the wave length of light used, with temperature and, in the case of solutions, with the concentration. When sodium light is used, indicated by D in the wave length column, a value of $\lambda = 0.5893$ may be assumed.

Optical rotatory power for a large number of organic compounds will be found in the International Critical Tables, Vol. VII; for sugars, Vol. II.

Solids

Substance	Wave length μ	Rotation deg./mm	Substance	Wave length μ	Rotation deg./mm
Cinnabar (HgS)	D	+32.5	Quartz (continued)	0.3609	+63.628
Lead hyposulfate	D	5.5		0.3582	64.459
Potassium hyposulphate	D	8.4		0.3466	69.454
Quartz	0.7604	12.668		0.3441	70.587
	0.7184	14.304		0.3402	72.448
	0.6867	15.746		0.3360	74.571
	0.6562	17.318		0.3286	78.579
	0.5895	21.684		0.3247	80.459
	0.5889	21.727		0.3180	84.972
	0.5269	27.543		0.2747	121.052
	0.4861	32.773		0.2571	143.266
	0.4307	42.604		0.2313	190.426
	0.4101	47.481		0.2265	201.824
	0.3968	51.193		0.2194	220.731
	0.3933	52.155		0.2143	235.972
	0.3820	55.625	Sodium bromate	D	2.8
	0.3726	58.894	Sodium chlorate	D	3.13

Liquid

Liquid	Temp. °C	Wave length μ	Specific rotation deg./dm
Amyl alcohol	......	D	− 5.7
Camphor	204	D	+ 70.33
Cedar oil	15	D	− 30 to −40
Citron oil	15	D	+ 62
Ethyl malate $(C_2H_5)_2C_4H_4O_5$	11	D	− 10.3 to −12.4
Menthol	35.2	D	− 49.7
Nicotine $C_{10}H_{14}N_2$	10–30	D	−162
	20	0.6563	−126
	20	0.5351	−207.5
	20	0.4861	−253.5
Turpentine $C_{10}H_6$	20	D	− 37
	20	0.6563	− 29.5
	20	0.5351	− 45
	20	0.4861	− 54.5

SPECIFIC ROTATION (Continued)

Solutions

Corrections for values of the specific rotation for concentration are given in the last column. *c* indicates concentration in grams per 100 milliliters of solution; *d* indicates the concentration in grams per 100 grams of solution.

Substance	Solvent	Temp. °C	Wave length μ	Specific rotation deg./dm	Correction for concentration or temperature
Albumen	water	..	D	− 25 to −38	
Arabinose	water	20	D	− 105.0	
Camphor	alcohol	20	D	+ 54.4	− .135*d* for *d* = 45–91
	benzene	20	D	+ 56	− .166*d* for *d* = 47–90
	ether	..	D	+ 57	
Dextrose *d*-glucose $C_6H_{12}O_6$	water	20	D	+ 52.5	+ .025*d* for *d* = 1–18
			.5461	+ 62.03	+ .04257*c* for *c* = 6–32
Galactose	water	..	D	+ 83.9	+ .078*d* − .21*t* for *d* = 4–36 and *t* = 10–30°C
l-Glucose (β)	water	20	D	− 51.4	
Invert sugar $C_6H_{12}O_6$	water	20	D	− 19.7	− .036*c* for *c* = 9–35; $\alpha_t = \alpha_{20} + .304(t - 20) + .00165 (t - 20)^2$ for *t* = 3–30°C
		25	.5461	− 21.5	
Lactose	water	20	D	+ 52.4	+ .072 (20° − *t*) for *c* = 5
			.5461	+ 61.9	+ .085(20° − *t*) for *c* = 5
Levulose fruit sugar	water	25	D	− 88.5	− .145*d* for *d* = 2.6–18.6
		25	.5461	− 105.30	
Maltose	water	20	D	+ 138.48	− .01837*d* for *d* = 5–35
		25	.5461	+ 153.75	
Mannose	water	20	D	+ 14.1	*c* = 10.2
Nicotine	water	20	D	− 77	for *d* = 1–16
	benzene	20	D	− 164	for *d* = 8–100
Potassium tartrate	water	20	D	+ 27.14	+ .0992*c* − .00094c^2 for *c* = 8–50
Quinine sulfate	water	17	D	− 214	
Santonin	alcohol	20	D	− 161.0	*c* = 1.78
		20	D	+ 693	*c* = 4.05
	chloroform	20	D	− 202.7	+ .309*d* for *d* = 75–96.5
	alcohol	20	.6867	+ 442	*c* = 4.05
			.5269	+ 991	*c* = 4.05
			.4861	+1323	*c* = 4.05
Sodium potassium tartrate (Rochelle salt)	water	20	D	+ 29.75	− .0078*c*
Sucrose (cane sugar) $C_{12}H_{22}O_{11}$	water	20	D	+ 66.412	+ .01267*d* − .000376d^2 for *d* = 0–50; $\alpha_t = \alpha_{20}[1 - .00037 (t - 20)]$ for *t* = 14–30°C

SPECIFIC ROTATION (Continued)

Sucrose dissolved in water, 20°C.

μ	Spec. rot.	μ	Spec. rot.	μ	Spec. rot.
670.8 (Li)	+50.51	510.6 (Cu)	+90.46	435.3 (Fe)	+128.5
643.8 (Cd)	55.04	508.6 (Cd)	91.16	433.7 (Fe)	129.8
636.2 (Zn)	56.51	481.1 (Zn)	103.07	431.5 (Fe)	130.7
589.3 (Na)	66.45	480.0 (Cd)	103.62	428.2 (Fe)	133.6
578.2 (Cu)	69.10	472.2 (Zn)	107.38	427.2 (Fe)	134.2
578.0 (Hg)	69.22	468.0 (Zn)	109.49	426.1 (Fe)	134.9
570.0 (Cu)	71.24	467.8 (Cd)	109.69	419.1 (Fe)	140.0
546.1 (Hg)	78.16	438.4 (Fe)	126.5	414.4 (Fe)	144.2
521.8 (Cu)	86.21	437.6 (Fe)	127.2	388.9 (Fe)	166.7
515.3 (Cu)	88.68	435.8 (Hg)	128.49	383.3 (Fe)	171.8
				382.6 (Fe)	173.1

Substance	Solvent	°C	μ	Spec. rot.	Correct.
Tartaric acid (ord.)	water	20	D	+15.06 − .131c	
		20	.6563	7.75	for d = 41
		20	D	8.86	for d = 41
		20	.5351	9.65	for d = 41
		20	.4861	9.37	for d = 41
Turpentine	alcohol	20	D	−37 − .00482d − .00013d^2 for d = 0–90	
	benzene	20	D	−37 − .0265d for d = 0–91	
Xylose	water	20	D	+19.13	d = 2.7

OPTICAL ROTATION OF ACIDS AND BASES

Optical rotation of acids and bases commonly used in the resolution of racemic substances. Compiled by F. E. Ray.

Name	Formula	Solvent	Conc. %	α_D
Bromocamphor-sulfonic acid. K salt	$C_{10}H_{15}O_4BrS$	H_2O	....	72.1
Camphorsulfonic acid	$C_{10}H_{16}O_4S$	H_2O	....	23.9
Chlorocamphor-sulfonic acid	$C_{10}H_{15}ClO_4S$	H_2O	....	49.6
Codeinesulfonic acid	$C_{18}H_{21}NO_6S$	H_2O	3	−190.1
Hydroxybutyric acid	$C_4H_8O_3$	H_2O	3.3	− 24.8
Lactic acid	$C_3H_6O_3$	H_2O	10.5	3.8
Malic acid	$C_4H_6O_5$	H_2O	....	2.4
Mandelic acid	$C_8H_8O_3$	H_2O	2.01	155.5
Methylene-camphor	$C_{11}H_{16}O$	C_2H_5OH	....	127
Phenylsuccinic acid	$C_{10}H_{10}O_4$	C_2H_5OH	1.5	148
Tartaric acid	$C_4H_6O_6$	C_2H_5OH and H_2O	....	3 to 25*
Brucine	$C_{23}H_{26}N_2O_4$	C_2H_5OH	5.4	− 85
Cinchonidine	$C_{19}H_{22}N_2O$	C_2H_5OH	1.0	−111.0
Cinchonine	$C_{19}H_{22}N_2O$	$CHCl_3$	0.6	+209.6
Cocaine	$C_{17}H_{21}NO_4$	50 % C_2H_5OH	1.1	− 35.4
Coniine	$C_8H_{17}N$	$CHCl_3$	4	8.0
Codeine	$C_{18}H_{21}NO_3$	C_2H_5OH	5	−135.8
Hydrastine	$C_{21}H_{21}NO_6$	50 % C_2H_5OH	0.2	115
Menthol	$C_{10}H_{20}O$	C_2H_5OH	9.6	− 50.6
Menthylamine	$C_{10}H_{21}N$	C_2H_5OH	11.3	− 31.9
Narcotine	$C_{22}H_{23}NO_7$	$CHCl_3$	2.6	±200.0
Quinidine	$C_{20}H_{24}N_2O_4$	C_2H_5OH	1.0	+233.6
Quinine	$C_{20}H_{24}N_2O_2$	C_6H_6	0.6	−136
Thebaine	$C_{19}H_{21}NO_3$	$CHCl_3$	5	−229.5
Strychnine	$C_{21}H_{22}N_2O_2$	C_2H_5OH	0.9	−128

* Varies greatly with temperature, solvent, and conc.

MAGNETO-OPTIC ROTATION

Revised by Park L. Turrill

$$\text{Verdet's Constant: } \rho = \frac{\alpha}{tH \cos \theta}$$

The specific power of magnetic rotation ρ, is expressed in the above formula, where α is the total angle of rotation in minutes, t the thickness of the substance in centimeters through which the light beam passes, H the magnetic field intensity in gauss, and θ the angle between the direction of the magnetic field and the path of light. Determinations made with sodium light. $\lambda D = 5893$ Å.

Values from the Smithsonian Tables, the International Critical Tables, and the literature.

Gases

Substance	Pressure (atmospheres)	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^6$	Observer	Year
Atmospheric air	1	20	6.83	Becquerel	1880
Carbon dioxide	1.1	6.5	8.61	Siertsema	1895
Carbon disulfide	0.98	70	23.49	Bichat	1879
Ethylene	1	20	34.48	Becquerel	1880
Nitrogen	1	20	6.92	Becquerel	1880
Nitrous oxide	1	20	6.28	Becquerel	1880
Oxygen	1	20	31.39	Becquerel	1880
Sulfur dioxide	3.3	20	38.40	Bichat	1880

Liquids, Organic

Substance	Temp. °C.	$\rho \times 10^3$	Observer	Year
Acetic acid	15.1	11.09	Schwers	1912
Acetic acid	31.5	10.86	Schwers	1912
Acetone	15.2	10.35	Schwers	1912
Acetone	32.0	10.19	Schwers	1912
Amyl alcohol	15	13.1	Becquerel	1880
Benzine	20	29.7	Jahn	
Carbon disulfide	0	43.41	Becquerel	1885
	15.6	42.4	Schwers	1912
	18.0	43.0	Chaudier	1913
	20	42.26	Bichat	1880
	34	41.1	Schwers	1912
Carbon tetrachloride	15	16.03	Schwers	1912
Carvane	14.9	18.4	Herngrist	1914
Chloroform	20	16.4	Jahn	
Citranellal	16.4	15.1	Herngrist	1914
Diethyl malate	15.3	12.4	Herngrist	1914
Diethyl tartrate	15.2	12.3	Herngrist	1914
Dimethyl malate	15.3	11.8	Herngrist	1914
Dipropyl tartrate	15.4	12.6	Herngrist	1914
Ethanol	25.0	11.12	Theuvenet	1910
Isobutyl alcohol	16.1	12.66	Schwers	1912
Isobutyric acid	15.3	11.35	Schwers	1912
Isovaleric acid	15.0	12.08	Schwers	1912
Limonene	15.6	16.5	Herngrist	1914
Menthone	16.7	13.7	Herngrist	1914
Methyl chloride	18	12.9	Chaudier	1913
Pulegone	14.9	16.4	Herngrist	1914
n-Propanol	17.3	11.81	Schwers	1912
Toluene	28.4	26.9	Becquerel	1880
Xylene	15	22.1	Becquerel	1880

MAGNETO-OPTIC ROTATION (Continued)

LIQUIDS, INORGANIC

Substance	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^3$	Observer	Year
Antimony pentachloride	16	70.4	Becquerel	1885
Arsenic trichloride	16	42.53	Becquerel	1885
Nitric acid, fuming	16	8.75	Becquerel	1885
Nitrogen	−195.5	4.15	Chaudier	1913
Nitrous oxide	−92	5.54	Siertsema	1904
Oxygen	−182.5	7.82	Chaudier	1913
Phorphorous, fused	33	132.6	Becquerel	1877
Phosphorous, trichloride	16	27.7	Becquerel	1885
Silicon tetrachloride	16	18.9	Becquerel	1885
Sulfur, fused	114	80.9	Becquerel	1877
Sulfur dioxide	−10	18	Chaudier	1913
Sulfur monochloride	16	41.8	Becquerel	1885
Titanium tetrachloride	13.4	14.71	Siertsema	1915
Water (λ = 5956 Å)	0	13.11	Rodger and	....
	20	13.08	Watson	1895
	30	13.06		
	40	13.02		
	60	12.94		
	80	12.82		
	90	12.74		

SOLUTIONS, AQUEOUS

Substance	Density	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^3$	Observer	Year
Ammonium hydroxide	0.8918	....	15.3	Perkin	1884
Antimony trichloride	......	....	29.9	Becquerel	1885
Barium bromide	1.5399	20	21.5	Jahn	....
Barium chloride	1.2897	20	16.8	Jahn	....
Bismuth nitrate	......	....	19.22	Becquerel	1885
Cadmium chloride	1.3179	20	16.5	Jahn	....
Calcium chloride	1.1504	20	16.5	Humburg	1893
Ferric chloride	1.6933	15	−202.6	Becquerel	1885
Ferrous chloride	1.4331	15	2.5	Becquerel	1885
Hydriodic acid	1.2966	15	25.8	Perkin	1884
Hydrobromic acid	1.2039	15	19.4	Perkin	1884
Hydrochloric acid	1.0758	20	16.71	Schwers	1912
Lithium chloride	1.0619	20	14.5	Jahn	....
Magnesium sulfate	1.1147	16	3.6	Schönrock	1893
Manganous sulfate	1.1212	16	4.0	Schönrock	1893
Mercuric chloride	1.0381	16	13.7	Schönrock	1893
Mercuric cyanide	1.0638	16	7.1	Schönrock	1893
Nickelous chloride	1.4685	....	27.3	Becquerel	1885
Nitric acid	1.3366	15	10.5	Perkin	1884
Potassium bicarbonate	1.1906	20	14.0	Humburg	1893
Potassium bichromate	1.0786	15	12.6	Verdet	1863
Potassium bromide	1.1424	20	16.3	Humburg	1893
Potassium carbonate	1.1960	20	14.0	Jahn	....
Potassium chloride	1.6000	15	16.3	Becquerel	1885
Potassium dichromate	1.0786	15	12.6	Verdet	1863

MAGNETO-OPTIC ROTATION (Continued)

SOLUTIONS, AQUEOUS (Continued)

Substance	Density	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^3$	Observer	Year
Potassium iodide	1.6743	15	34.1	Becquerel	1885
Potassium nitrate	1.0634	20	13.0	Humburg	1893
Potassium sulfate	1.0475	20	13.3	Jahn	....
Silver nitrate	......	....	18.03	Becquerel	1885
Sodium bromide	1.1351	20	16.5	Jahn	....
Sodium carbonate	1.1006	20	14.0	Humburg	1893
Sodium chloride	1.2051	16	18.2	Becquerel	1885
Sodium sulfate	1.0061	20	13.5	Humburg	1893
Stannous chloride	1.3280	15	26.6	Verdet	1863
Sulfuric acid	1.5507	15	12.18	Schwers	1912
Zinc chloride	1.2851	16	19.6	Verdet	1863

SOLUTIONS, IN ETHYL ALCOHOL

Substance	Density	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^3$	Observer	Year
Cadmium bromide	1.0446	20	15.9	Humburg	1893
Cadmium chloride	0.8303	20	11.8	Humburg	1893
Cadmium iodide	1.0988	20	19.9	Humburg	1893
Calcium bromide	0.9966	20	15.4	Humburg	1893
Mercuric chloride	0.9988	16	10.9	Schönrock	1893
Mercuric chloride	0.8857	16	12.1	Schönrock	1893
Mercuric cyanide	0.8527	16	6.4	Schönrock	1893
Mercuric cyanide	0.8348	16	5.3	Schönrock	1893
Mercuric iodide	0.8072	16	24.4	Schönrock	1893
Strontium bromide	0.9636	20	14.0	Humburg	1893
Strontium chloride	0.8313	20	11.8	Humburg	1893

SOLIDS

Substance	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^3$	Observer	Year
Amber	19	−9.60	Quincke	1885
Calcium fluoride (fluorite)	16	8.83	Becquerel	1885
Carbon (diamond)	16	12.8	Becquerel	1877
Carbon dioxide	26	2.07	Chaudier	1913
Glass, Jena (barium crown)	18	22.0	duBois	1894
(phosphate crown)	18	16.1	duBois	1894
(light flint)	18	31.7	duBois	1894
(heavy flint)	18	60.8	duBois	1894
(very heavy flint)	18	88.8	duBois	1894
Potassium chloride (sylvite)	16	28.58	Becquerel	1885
Sodium chloride (rock salt)	16	35.85	Becquerel	1885
Sodium tetraborate (borax)	16	17.2	Becquerel	1885
Silicon (quartz)	20	16.64	Borel	1903
Stannous chloride	16	44.	Becquerel	1885
Zinc sulfide, β	16	225.	Becquerel	1885

QUANTITIES AND UNITS

MISCELLANEOUS

QUANTITIES, UNITS, LAWS AND FORMULAE OF CHEMISTRY AND PHYSICS

The following pages give definitions of quantities, their cgs units and dimensional formulae together with the more important laws and formulae.

Formulae for capacity, inductance and high frequency resistance are given in a separate collection immediately following.

The symbols used in the dimensional formulae are as follows: m, mass; l, length; t, time; θ, temperature; ϵ, dielectric constant for a vacuum; μ, magnetic permeability of a vacuum. In the case of the quantities of electricity and magnetism dimensions are given in both the electrostatic and electromagnetic system.

CHEMICAL TERMS

Acid.—Any substance which yields hydrogen ions.

Active mass of a substance is the number of gram molecular weights per liter in solution, or in gaseous form.

Adsorption.—The condensation of gases, liquids, or dissolved substances on the surfaces of solids is called adsorption.

Atom.—The smallest unit quantity of an element that is capable of entering into chemical combination.

Atomic theory.—All elementary forms of matter are composed of very small unit quantities called atoms. The atoms of a given element all have the same size and weight. The atoms of different elements have different sizes and weights. Atoms of the same or different elements unite with each other to form very small unit quantities of compound substances called molecules.

Avogadro's number.—The number of molecules in a mole or in a mass of substance equal numerically to its molecular weight.

Avogadro's theory.—Equal volumes of all gases under the same conditions of temperature and pressure contain equal numbers of molecules.

Balanced or reversible action.—One which can be caused to proceed in either direction by suitable variation in the conditions of temperature, volume, pressure or of the quantities of reacting substances.

Base.—Any substance which yields hydroxyl ions.

Catalytic agent.—A substance which by its mere presence alters the velocity of a reaction, and may be recovered unaltered in nature or amount at the end of the reaction.

Colligative property.—A property numerically the same for a group of substances, independent of their chemical nature.

Combining weight of an element or radical is its atomic weight divided by its valence.

Combining weights, law of.—If the weights of elements which combine with each other be called their "combining weights," then elements always combine either in the ratio of their combining weights or of simple multiples of these weights.

Constitutive property.—A property which depends on the constitution or structure of the molecule.

Cryohydrate.—The solid which separates when a saturated solution freezes. It contains the solvent and the solute in the same proportions as they were in the saturated solution.

Definite proportions, law of.—In every sample of each compound substance the proportions by weight of the constituent elements are always the same.

Electrochemical equivalent of an ion is the mass liberated by the passage of unit quantity (one coulomb) of electricity.

Electrolytic dissociation or ionization theory.—When an acid, base or salt is dissolved in water or any other dissociating solvent, a part or all of the molecules of the dissolved substance are broken up into parts called ions, some of which are charged with positive electricity and are called cations, and an equivalent number of which are charged with negative electricity and are called anions.

Electrolytic solution tension theory (**or the Helmholtz double layer theory**).—When a metal, or any other substance capable of existing in solution as ions is placed in water or any other dissociating solvent, a part of the metal or other substances passes into solution in the form of ions, thus leaving the remainder of the metal or substances charged with an equivalent amount of electricity of opposite sign from that carried by the ions. This establishes a difference in potential between the metal and the solvent in which it is immersed.

Electron theory of matter.—An atom is believed to consist of a nucleus bearing a positive charge, different for each sort of atom, surrounded by electrons or negative charges equal in total charge to the positive charge of the nucleus. The nucleus may consist of a certain number of **protons** or elementary positive charges and a part of the electrons. The remaining electrons revolve as satellites around the nucleus. The

electron and the proton have equal negative and positive charges, hence a neutral atom will contain as many electrons as protons.

The protons contain practically all of the mass of the atom, the number of protons determining the atomic weight. The number of satellite electrons determines the chemical properties of the atom.

Eutectic.—A term applied to the mixture of two or more substances which has the lowest melting point.

Gay-Lussac's law of combining volumes.—If gases interact and form a gaseous product, the volumes of the reacting gases and the volumes of the gaseous products are to each other in very simple proportions, which can be expressed by small whole numbers.

Gibbs' phase rule.—$F = C + 2 - P$ F, the number of degrees of freedom of a system, is the number of variable factors (temperature, pressure and concentration) of the components, which must be arbitrarily fixed in order that the condition of the system may be perfectly defined. C, the number of the components of the system, is chosen equal to the smallest number of independently variable constituents by means of which the composition of each phase participating in the state of equilibrium can be expressed in the form of a chemical equation; the components must be chosen from among the constituents which are present when the system is in a state of true equilibrium and which take part in that equilibrium; as components are chosen the smallest number of such constituents necessary to express the composition of each phase participating in the equilibrium, zero and negative quantities of components being permissible; in any system the number of components is definite, but may alter with changes in conditions of experiment; a qualitative but not quantitative freedom of selection of components is allowed, the choice being influenced by suitability and simplicity of application. P, the number of phases of the system, are the homogeneous, mechanically separable and physically distinct portions of a heterogeneous system; the number of phases capable of existence varies greatly in different systems; there can never be more than one gas or vapor phase since all gases are miscible in all proportions, a heterogeneous mixture of solid substances forms as many phases as there are substances present.

Gram atom or gram atomic weight.—The mass in grams numerically equal to the atomic weight.

Gram-mole, gram-formula weight, gram equivalent.—Mass in grams numerically equal to the molecular weight, formula weight or chemical equivalent, respectively.

Heat of combustion of a substance is the amount of heat evolved by the combustion of 1 gram molecular weight of the substance.

Henry's law.—The amount of gas which a liquid will dissolve is directly proportional to the pressure of the gas. This holds for all gases which do not unite chemically with the solvent.

Hess' law of constant heat summation.—The amount of heat generated by a chemical reaction is the same whether reaction takes place in one step or in several steps, or all chemical reactions which start with the same original substances and end with the same final substances, liberate the same amounts of heat, irrespective of the process by which the final state is reached.

Hydrogen equivalent of a substance is the number of replaceable hydrogen atoms in 1 molecule or the number of atoms of hydrogen with which 1 molecule could react.

Hydrogen ion concentration or pH value is the logarithm of the reciprocal of the gram ionic hydrogen equivalents per liter; i.e., $pH = \log \frac{1}{(H^+)}$ per liter. Water has a concentration of H^+ ion of 10^{-7} and of OH^- ion of 10^{-7} moles per liter or a pH value of 7. Due to hydrolysis the composition of a weak acid solution titrated against a strong base is basic and of a weak base against a strong acid is acid. A truly neutral titrated solution of a strong acid or base has the same concentration of H^+ and OH^- ions as water.

Ion.—A charged atom or group of atoms in solution or in a gas. Solutions always contain equivalent numbers of positive and negative ions.

Isotope.—Elements having the same chemical properties but different atomic weights are called isotopes. Atoms of such elements are supposed to have the same number of satellite electrons but different numbers of protons in the nucleus. *See* Electron theory of matter.

Mass action, law of.—At a constant temperature the product of the active masses on one side of a chemical equation when divided by the product of the active masses on the other side of the chemical equation is a constant, regardless of the amounts of each substance present at the beginning of the action.

Molar solution contains 1 gram molecular weight of dissolved substance per liter of solution.

Mole.—A mass numerically equal to the molecular weight.

Molecular volume.—Volume occupied by one mole. Numerically equal to the molecular weight divided by the density.

Molecular weight.—The sum of the atomic weights of all the atoms in a molecule.

Molecule.—The smallest unit quantity of matter which can exist by itself and retain all the properties of the original substance.

Multiple proportions, law of.—Two elements may combine in more than one proportion by weight, but if so, the weights of one element which combine with a fixed weight of the other element, are always in a simple ratio to each other.

Normal solution contains 1 gram molecular weight of dissolved substance divided by the hydrogen equivalent of the substance per liter of solution.

Oxidation is any process which increases the proportion of oxygen or acid-forming element or radical in a compound.

Periodic law.—The physical and chemical properties of the elements are functions of their atomic numbers, and most of these properties are periodic functions.

Reduction is any process which increases the proportion of hydrogen or base-forming elements or radical in a compound.

Salt.—Any substance which yields ions, other than hydrogen or hydroxyl ions. A salt is obtained by displacing the hydrogen of an acid by a metal.

Solubility product or precipitation value is the product of the concentrations of the ions of a substance in a saturated solution of the substance.

FUNDAMENTAL QUANTITIES AND UNITS, MECHANICS AND PROPERTIES OF MATTER

Absolute units.—A system of units based on the smallest possible number of independent units. Specifically, units of force, work, energy and power not derived from or dependent on gravitation.

Acceleration.—The time rate of change of velocity in either speed or direction, measured by the change in unit time. Cgs unit,—one centimeter per second per second. Dimensions,—$[l\ t^{-2}]$. *See also under* Angular acceleration.

Acceleration due to gravity.—The acceleration of a body freely falling in a vacuum. The International Committee on Weights and Measures has adopted as a standard or accepted value, 980.665 cm/sec^2 or 32.174 ft./sec^2.

Acceleration due to gravity at any latitude and elevation.—If ϕ is the latitude and H the elevation in centimeters the acceleration in cgs units is, $g = 980.616 - 2.5928 \cos 2\phi + 0.0069 \cos^2 2\phi - 3.086 \times 10^{-6} H$.
(Helmert's equation.)

Action is measured by the product of work by time. Cgs units of action are the erg-second and the joule-second. Dimensions,—$[m\ l^2\ t^{-1}]$. Planck's quantum or constant of action is 6.554×10^{-27} erg-seconds.

Altitudes with the barometer.—If b_1 and b_2 denote the corrected barometer readings at two stations, t the mean of the

temperatures, t_1 and t_2 of the air at the two stations, e_1 and e_2, the tension of water vapor at the two stations, h, the mean height above sea level, ϕ the latitude, then the difference in elevation in centimeters is $H = 1{,}843{,}000 (\log b_1 - \log b_2) (1 + 0.00367t) (1 + 0.0026 \cos 2\phi + 0.00002h + \frac{3}{8} k)$, where

$$k = \tfrac{1}{2}\left(\frac{e_1}{b_1} + \frac{e_2}{b_2}\right)$$

An approximate formula, sufficient for differences not over 1000 meters is

$$H = 1{,}600{,}000 \frac{b_1 - b_2}{b_1 + b_2} (1 + 0.004t).$$

Amplitude.—The maximum value of the displacement in an oscillatory motion.

Angle.—The ratio between the arc and the radius of the arc. Units of angle,—the radian, the angle subtended by an arc equal to the radius; the degree, 1/360 part of a circumference. Dimensions,—unity.

Angular acceleration.—The time rate of change of angular velocity either in angular speed or in direction of the axis of rotation (precession). Cgs unit,—one radian per second per second. Dimensions,—$[t^{-2}]$.

If the initial angular velocity is ω_0, and the velocity after time t is ω_t, the angular acceleration,

$$A = \frac{\omega_t - \omega_0}{t}.$$

The angular velocity after time t,

$$\omega_t = \omega_0 + At.$$

The angle swept out in time t,

$$\theta = \omega_0 t + \tfrac{1}{2} At^2.$$

The angular velocity after movement through the arc θ,

$$\omega = \sqrt{\omega_0^2 + 2A\theta}.$$

In the above equations, for angular displacement in radians, angular velocity will be in radians per second and angular acceleration in radians per second per second.

Angular harmonic motion or harmonic motion of rotation.—Periodic, oscillatory angular motion in which the restoring torque is proportional to the angular displacement. Torsional vibration.

Angular momentum or moment of momentum.—Quantity of angular motion measured by the product of the angular velocity and the moment of inertia. Cgs unit,—unnamed, its nature is expressed by g-cm²/sec. Dimensions,—$[m\, l^2\, t^{-1}]$.

The angular momentum of a mass whose moment of inertia is I, rotating with angular velocity ω, is $I\,\omega$.

Angular velocity.—Time rate of angular motion about an axis. Cgs unit,—one radian per second. Dimensions,—$[t^{-1}]$.

If the angle described in time t is θ, the angular velocity,

$$\omega = \frac{\theta}{t}.$$

θ in radians and t in seconds gives ω in radians per second.

Archimedes principle.—A body wholly or partly immersed in a fluid is buoyed up by a force equal to the weight of the fluid displaced. A body of volume V cm^3 immersed in a fluid of density d grams per cm^3 is buoyed up by a force in dynes,

$$F = dg\,V.$$

A floating body displaces its own weight of liquid.

Area, unit of.—The square centimeter. The area of a square whose sides are one centimeter in length. Other units of area are similarly derived. Dimensions,—$[l^2]$.

Bernoulli's theorem.—At any point in a tube through which a liquid is flowing the sum of the pressure energy, potential energy, and kinetic energy is a constant. If p is pressure; h, height above a reference plane; d, density of the liquid, and v, velocity of flow,

$$p + hdg + \tfrac{1}{2}\,dv^2 = \text{a constant.}$$

Bulk modulus.—The modulus of volume elasticity,

$$M_B = \frac{p_2 - p_1}{\dfrac{v_1 - v_2}{v_1}}$$

where p_1, p_2; v_1, v_2 are the initial and final pressure and volume respectively.

Capillary constant or specific cohesion,

$$a^2 = \frac{2T}{(d_1 - d_2)g} = hr$$

where T is surface tension, d_1 and d_2 the densities of the two fluids, g the acceleration due to gravity, h the height of rise in a capillary tube of radius r. *See* Surface tension.

Centripetal force.—The force required to keep a moving mass in a circular path. Centrifugal force is the name given to the outward force of a mass in rotation.

Compressibility.—Reciprocal of the bulk modulus.

Conservation of energy.—In every modification of a material system not affected by forces foreign to the system the sum of its potential and kinetic energies remains constant.

Conservation of momentum.—If two bodies of masses m_1 and m_2 have, before impact, velocities v_1 and v_2 and after impact velocities u_1 and u_2,

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2.$$

Couple.—Two equal and oppositely directed parallel but not colinear forces acting upon a body form a couple. The moment of the couple or torque is given by the product of one of the forces by the perpendicular distance between them. Dimensions,— $[m\ l^2\ t^{-2}]$.

Density.—Concentration of matter, measured by the mass per unit volume, expressed as grams per cubic centimeter. Dimensions,— $[m\ l^{-3}]$.

Diffusion.—If the concentration (mass of solid per unit volume of solution) at one surface of a layer of liquid is d_1, and at the other surface d_2, the thickness of the layer h and the area under consideration A, then the mass of the substance which diffuses through the cross-section A in time t is,

$$m = \Delta A \ \frac{(d_2 - d_1)t}{h}.$$

where Δ is the coefficient of diffusion.

Diffusivity or coefficient of diffusion is also given by Δ in the equation

$$\frac{dQ}{dt} = -\Delta \left(\frac{dc}{dx}\right) dy\ dz$$

where dQ is the amount passing through an area $dy\ dz$ in the direction of x in a time dt where dc/dx is the rate of increase of volume concentration in the direction of x. Dimensions,- $[l^2\ t^{-1}]$.

Dimensional formulae.—If mass, length, and time are considered fundamental quantities, the relation of other physical quantities and their units to these three may be expressed by a formula involving the symbols l, m and t respectively, with appropriate exponents. For example; the dimensional formula for volume would be expressed,— $[l^3]$; velocity,— $[l\ t^{-1}]$; force— $[m\ lt^{-2}]$. Other fundamental quantities used in dimensional formulae may be indicated as follows; θ, temperature; ϵ, the dielectric constant of a vacuum; μ, the magnetic permeability of a vacuum.

Diminution of pressure at the side of a moving stream.—If a fluid of density d moves with a velocity v the diminution of pressure due to the motion is (neglecting viscosity),

$$p = \tfrac{1}{2}\ dv^2.$$

Displacement or elongation at any instant. The distance of a vibrating or oscillating particle from its position of equilibrium.

Elasticity.—The property by virtue of which a body resists and recovers from deformation produced by force.

Elastic limit.—The smallest value of the stress producing permanent alteration.

Elastic moduli:

Young's modulus by stretching.—If an elongation s is pro-

duced by the weight of the mass m, in a wire of length l, and radius r, the modulus,

$$M = \frac{mgl}{\pi r^2 s}.$$

Young's modulus by bending, bar supported at both ends. If a flexure s is produced by the weight of mass m, added midway between the supports separated by a distance l, for a rectangular bar with vertical dimensions of cross-section a and horizontal dimension b, the modulus is,

$$M = \frac{mgl^3}{4sa^3b}.$$

For a cylindrical bar of radius r,

$$M = \frac{mgl^3}{12\pi r^4 s}.$$

For a bar supported at one end. In the case of a rectangular bar as described above,

$$M = \frac{4mgl^3}{sa^3b}.$$

For a round bar supported at one end,

$$M = \frac{4mgl^3}{3\pi r^4 s}.$$

Modulus of Rigidity.—If a couple C ($=mgx$) produces a twist of θ radians in a bar of length l and radius r, the modulus is

$$M = \frac{2Cl}{\pi r^4 \theta}.$$

The substitution in the above formulae for the elastic coefficients of m in grams, g in cm per sec, l, a, b, and r in cm, s in cm^2, and C in dyne-cm will give moduli in dynes per cm^2.

The dimensions of elastic moduli are the same as of stress,—$[m\, l^{-1}\, t^{-2}]$.

Coefficient of restitution.—Two bodies moving in the same straight line, with velocities v_1 and v_2 respectively, collide and after impact move with velocities v_3 and v_4. The coefficient of restitution is

$$C = \frac{v_4 - v_3}{v_2 - v_1}.$$

Energy.—The capability of doing work. **Potential energy** is energy due to position of one body with respect to another or to the relative parts of the same body. **Kinetic energy** is energy due to motion. Cgs units,—the erg, the energy expended when a force of one dyne acts through a distance of one centimeter; the joule is 1×10^7 ergs. Dimensions,—$[m\, l^2\, t^{-2}]$.

The potential energy of a mass m, raised through a distance h, where g is the acceleration due to gravity, is

$$E = mgh.$$

The kinetic energy of mass m, moving with a velocity v, is

$$E = \frac{1}{2} mv^2.$$

Energy will be given in ergs if m is in grams, g in cm per sec^2, h in cm and v in cm per sec.

Energy of rotation.—If a mass whose moment of inertia about an axis is I, rotates with angular velocity ω about this axis, the kinetic energy of rotation will be,

$$E = \frac{1}{2} I \omega^2.$$

Energy will be given in ergs if I is in g-cm^2 and ω in radians per sec.

Falling bodies.—For bodies falling from rest conditions are as for uniformly accelerated motion except that $v_o = 0$ and g is the acceleration due to gravity. The formulae become,—air resistance neglected,

$$v_t = gt, \quad s = \tfrac{1}{2}gt^2, \quad v_s = \sqrt{2gs}.$$

For bodies projected vertically upward,—if v is the velocity of projection, the time to reach greatest height, neglecting the resistance of the air,

$$t = \frac{v}{g}.$$

Greatest height,

$$h = \frac{v^2}{2g}.$$

See also under Projectiles.

Fluidity.—The reciprocal of viscosity. The cgs unit is the rhe, the reciprocal of the poise. Dimensions,—$[m^{-1} lt]$.

Force.—That which changes the state of rest or motion in matter, measured by the rate of change of momentum. Absolute unit,—the **dyne**, the force which will produce an acceleration of one centimeter per second per second in a gram mass. The gram weight or weight of a gram mass is the cgs gravitational unit. The poundal is that force which will give an acceleration of one foot per second per second to a pound mass. Dimensions,—$[m\, lt^{-2}]$.

The force F required to produce an acceleration a in a mass m is given by

$$F = ma.$$

If m is substituted in grams and a in cm per sec^2, F will be given in dynes.

Foucault's pendulum.—The rate of rotation in degrees per hour of a line on the surface of the earth relative to the plane of a Foucault's pendulum at latitude ϕ is,

$$\omega = 15 \sin\phi.$$

Frequency in uniform circular motion or in any periodic motion is the number of revolutions or cycles completed in unit time. Cgs unit,—cycles per second. Dimension,— $[t^{-1}]$.

Friction, coefficient of.—The coefficient of friction between two surfaces is the ratio of the force required to move one over the other to the total force pressing the two together.

If F is the force required to move one surface over another and W, the force pressing the surfaces together, the coefficient of friction,

$$k = \frac{F}{W}.$$

Fundamental units.—*See under* mass, length and time.

Gravitation.—The universal attraction existing between all material bodies.

The force of attraction between two masses, m and m', separated by a distance r, k being the constant of gravitation,

$$F = k\,\frac{mm'}{r^2}.$$

(If m and m' are given in grams, and r in centimeters, F will be in dynes if $k = 6.658 \times 10^{-8}$.)

Hardness.—Property of substances determined by their ability to abrade or indent one another.

An arbitrary scale of hardness is based upon ten selected minerals. For metals the diameter of the indentation made by a hardened steel sphere (Brinnell) or the height of rebound of a small drop hammer (Shore Scleroscope) serve to measure hardness.

Harmonic motion.—*See* Simple harmonic motion and Angular harmonic motion.

Hooke's law.—Within the elastic limit of any body the ratio of the stress to the strain produced is constant.

Hydrostatic pressure at a distance h from the surface of a liquid of density d,

$$P = hdg.$$

The total force on an area A due to hydrostatic pressure,

$$F = PA = Ahdg.$$

Force in dynes and pressure in dynes per cm^2 will be given if h is in cm, d in g per cm^3 and g in cm per sec^2.

Inertia.—The resistance offered by a body to a change of its state of rest or motion, a fundamental property of matter. Dimension,— $[m]$.

Kepler's laws.

I. The planets move about the sun in ellipses, at one focus of which the sun is situated.

II. The radius vector joining each planet with the sun describes equal areas in equal times.

III. The cubes of the mean distances of the planets from the sun are proportional to the squares of their times of revolution about the sun.

Length, units of.—The centimeter, one of the three fundamental units of the cgs system, is 1/100 the length of the International Prototype Meter, at Paris, at zero degrees centigrade. The meter is 1,553,164.13 times the wave length of the red cadmium line in air, 760 mm pressure, 15°C. The standard in the British system is the yard, the prototype of which is kept by the British government. The United States standard yard is defined as 3600/3937 meter.

Mass.—Quantity of matter. **Units of mass,**—the gram is 1/1000 the quantity of matter in the International Prototype Kilogram; one of the three fundamental units of the cgs system. The British standard of mass is the pound, of which a standard is preserved by the government. The United States standard mass is the avoirdupois pound defined as 1/2.20462 kilogram.

Mass by weighing on a balance with unequal arms.—If W_1 is the value for one side, W_2, the value for the other, the true mass,

$$W = \sqrt{W_1 W_2}.$$

Modulus of elasticity.—The stress required to produce unit strain, which may be a change of length (Young's modulus); a twist or shear (modulus of rigidity or modulus of torsion), or a change of volume (bulk modulus), expressed in dynes per square centimeter. Dimensions,—the same as of stress, $[m\, l^{-1}\, t^{-2}]$.

Moment of force or torque.—The effectiveness of a force to produce rotation about an axis, measured by the product of the force and the perpendicular distance from the line of action of the force to the axis. Cgs unit,—the dyne-centimeter. Dimensions,—$[m\, l^2\, t^{-2}]$.

If a force F acts to produce rotation about a center at a distance d from the line in which the force acts, the force has a torque,

$$L = Fd.$$

Moment of inertia.—A measure of the effectiveness of mass in rotation. In the rotation of a rigid body not only the body's mass, but the distribution of the mass about the axis of rotation determines the change in the angular velocity resulting from the action of a given torque for a given time. Moment of inertia in rotation is analogous to mass (inertia) in simple translation. The cgs unit is g-cm². Dimensions,—$[m\, l^2]$.

If m_1, m_2, m_3 etc. represent the masses of infinitely small

particles of a body; r_1, r_2, r_3 etc. their respective distances from an axis of rotation, the moment of inertia about this axis will be,

$$I = (m_1r_1^2 + m_2r_2^2 + m_3r_3^2 + \ldots)$$

or

$$I = \Sigma\,(mr^2).$$

Momentum.—Quantity of motion measured by the product of mass and velocity. Cgs unit,—one gram-centimeter per second. Dimensions,—$[m\ l\ t^{-1}]$.

A mass m moving with velocity v has a momentum,

$$M = mv.$$

If a mass m has its velocity changed from v_1 to v_2 by the action of a force F for a time t,

$$mv_2 - mv_1 = Ft.$$

Motion, laws of.—*See* Newton's laws of motion.

Newton's laws of motion.

I. Every body continues in its state of rest or of uniform motion in a straight line except in so far as it may be compelled to change that state by the action of some outside force.

II. Change of motion is proportional to force applied and takes place in the direction of the line of action of the force.

III. To every action there is always an equal and opposite reaction.

Pascal's law.—Pressure exerted at any point upon a confined liquid is transmitted undiminished in all directions.

Pendulum.—For a simple pendulum of length l, for a small amplitude, the complete period,

$$T = 2\pi\sqrt{\frac{l}{g}}\cdot \text{ or } g = 4\pi^2\,\frac{l}{T^2}.$$

T will be given in seconds if l is in cm and g in cm per sec^2.

For a sphere suspended by a wire of negligible mass where d is the distance from the knife edge to the center of the sphere whose radius is r, the length of the equivalent simple pendulum,

$$l = d + \frac{2r^2}{5d}.$$

If the period is P for an arc θ, the time of vibration in an infinitely small arc is approximately,

$$T = \frac{P}{1 + \frac{1}{4}\sin^2\frac{\theta}{4}}.$$

For a compound pendulum, if a body of mass m be suspended from a point about which its moment of inertia is I with its

center of gravity a distance h below the point of suspension, the period,

$$T = 2\pi\sqrt{\frac{I}{mgh}}.$$

Period in uniform circular motion is the time of one complete revolution. In any oscillatory motion it is the time of a complete oscillation. Dimension,— $[t]$.

Phase of oscillatory motion.—The fraction of a whole period which has elapsed since the moving particle last passed through its middle position in a positive direction.

Poisson's ratio is the ratio of the transverse contraction per unit dimension of a bar of uniform cross-section to its elongation per unit length, when subjected to a tensile stress.

Power.—The time rate at which work is done. Units of Power,—the watt, one joule (ten million ergs) per second; the kilowatt is equal to 1000 watts; the horse-power, 33,000 foot-pounds per minute, is equal to 746 watts. Dimensions,— $[m\ l^2\ t^{-3}]$.

If an amount of work W is done in time t the power or rate of doing work is,

$$P = \frac{W}{t}.$$

Power will be obtained in watts if W is expressed in joules (10^7 ergs) and t in sec.

Pressure.—Force applied to, or distributed, over a surface; measured as force per unit area. Cgs unit,—the barye, one dyne per square centimeter. The megabarye is equal to 10^6 dynes per square centimeter. Pressure is also measured by the height of the column of mercury or water which it supports. Dimensions,— $[m\ l^{-1}\ t^{-2}]$.

The pressure due to a force F distributed over an area A,

$$P = \frac{F}{A}.$$

Projectiles.—For bodies projected with velocity v at an angle a with the horizontal, the time to highest point of flight,

$$t = \frac{v \sin a}{g}.$$

Total time of flight,

$$T = \frac{2v \sin a}{g}.$$

Maximum height,

$$h = \frac{v^2 \sin^2 a}{2g}.$$

Horizontal range,

$$R = \frac{v^2 \sin 2a}{g}.$$

In the above equations the resistance of the air is neglected. g is the acceleration due to gravity.

Radius of gyration may be defined as the distance from the axis of rotation at which the total mass of a body might be concentrated without changing its moment of inertia. The product of total mass and the square of the radius of gyration will give moment of inertia.

Restitution, coefficient of, for two bodies on impact,—The ratio of the difference in velocity before impact to the difference after impact.

Sensitiveness of a balance.—Assuming the three knife edges of a balance to lie on a straight line,—if w is the weight of the beam, h the distance of the center of gravity below the knife edge, a the length of the balance arms and x a small mass added to one pan, the deflection θ produced is given by

$$\tan\theta = \frac{ax}{wh}.$$

Simple harmonic motion.—Periodic oscillatory motion in a straight line in which the restoring force is proportional to the displacement. If a point move uniformly in a circle, the motion of its projection on the diameter (or any straight line in the same plane) is simple harmonic motion.

If r is the radius of the reference circle, ω the angular velocity of the point in the circle, θ the angular displacement at the time t after the particle passes the mid-point of its path. the linear displacement,

$$x = r\sin\theta = r\sin\omega t.$$

The velocity at the same instant,

$$v = r\omega\cos\theta = \omega\sqrt{r^2 - x^2}.$$

The acceleration,

$$a = -\omega^2 x.$$

The force for a mass m,

$$F = -m\omega^2 x = -\frac{4\pi^2 mx}{T^2}.$$

The period,

$$T = 2\pi\sqrt{\frac{x}{a}}.$$

In the above equations the cgs system calls for x and r in cm, v in cm per sec, a in cm per sec^2, T in sec, m in grams, θ in radians, and ω in radians per sec.

Simple machine.—A contrivance for the transfer of energy and for increased convenience in the performance of work.

Mechanical advantage is the ratio of the resistance overcome to the force applied. Velocity ratio is the ratio of the distance through which force is applied to the distance through which resistance is overcome.

Efficiency is the ratio of the work done by a machine to the work done upon it.

If a force f applied to a machine through a distance S results in a force F exerted by the machine through a distance s, neglecting friction,

$$fS = Fs.$$

The theoretical mechanical advantage or velocity ratio in the above case is

$$\frac{S}{s}.$$

Actually the force obtained from the machine will have a smaller value than will satisfy the equation above. If F' be the actual force obtained, the practical mechanical advantage will be

$$\frac{F'}{f}.$$

The efficiency of the machine,

$$E = \frac{Fs'}{fS}.$$

Solid angle.—Measured by the ratio of the surface of the portion of a sphere enclosed by the conical surface forming the angle, to the square of the radius of the sphere. Unit of solid angle,—the steradian, the solid angle which encloses a surface on the sphere equivalent to the square of the radius. Dimensions,—unity.

Solubility of one liquid or solid in another is the mass of a substance contained in a solution which is in equilibrium with an excess of the substance. Under these conditions the solution is said to be saturated. Solubility of a gas is the ratio of concentration of gas in the solution to the concentration of gas above the solution.

Specific gravity.—The ratio of the mass of a body to the mass of an equal volume of water at 4°C or other specified temperature. Dimensions,—unity.

Specific volume is the reciprocal of density. Dimensions,—$[m^{-1}\ l^3]$.

Speed.—Time rate of motion measured by the distance moved over in unit time. Cgs unit,—one centimeter per second. Dimensions,—$[l\ t^{-1}]$.

Stokes' law gives the rate of fall of a small sphere in a viscous fluid. When a small sphere falls under the action of gravity through a viscous medium it ultimately acquires a constant velocity,

$$V = \frac{2ga^2(d_1 - d_2)}{9\eta}.$$

where a is the radius of the sphere, d_1 and d_2 the densities of the sphere and the medium respectively, and η the coefficient of

viscosity. V will be in cm^3 per sec if g is in cm per sec^2, a in cm, d_1 and d_2 in g per cm^3 and η in dyne-sec per cm^2 or poises.

Strain.—The deformation resulting from a stress measured by the ratio of the change to the total value of the dimension in which the change occurred. Dimensions,—unity.

Stress.—The force producing or tending to produce deformation in the body measured by the force applied per unit area. Cgs unit,—one dyne per square centimeter. Dimensions,—$[m\, l^{-1}\, t^{-2}]$.

Surface tension.—Two fluids in contact exhibit phenomena, due to molecular attractions, which appear to arise from a tension in the surface of separation. It may be expressed as dynes per cm or as ergs per square centimeter. Dimensions,—$[m\, t^{-2}]$.

The total force along a line of length l on the surface of a liquid whose surface tension is T,

$$F = l\,T.$$

Capillary tubes.—If a liquid of density d rises a height h in a tube of internal radius r the surface tension is,

$$T = \frac{rhdg}{2}.$$

The tension will be in dynes per cm if r and h are in cm, d in g per cm^3 and g in cm per sec^2.

Drops and bubbles.—Pressure in dynes per cm^2 due to surface tension on a drop of radius r cm for a liquid whose surface tension is T dynes per cm,

$$P = \frac{2T}{r}.$$

For a bubble of mean radius r cm, $P = \dfrac{4T}{r}$.

Time, unit of.—The second, 1/86400 of a mean solar day. One of the three fundamental units of the cgs system.

Torsional vibration.—*See* Angular harmonic motion.

Triangle or polygon of forces.—If three or more forces acting on the same point are in equilibrium, the vectors representing them form, when added, a closed figure.

Uniform circular motion.—If r is the radius of a circle, s the linear speed in the arc, ω the angular velocity and T the period or time of one revolution,

$$\omega = \frac{s}{r} = \frac{2\pi}{T}.$$

The acceleration toward the center is

$$a = \frac{s^2}{r} = \omega^2 r = \frac{4\pi^2 r}{T^2}.$$

The centrifugal force for a mass m,

$$F = \frac{ms^2}{r} = m\omega^2 r = \frac{4\pi^2 m r}{T^2}.$$

In the above equations ω will be in radians per second and a in cm per sec^2 if r is in cm, s in cm per sec and T in sec. F will be in dynes if mass is in grams and other units as above.

Application to the solar system.—If M is the mass of the sun, G the constant of gravitation, P the period of the planet, and r the distance of the planet from the sun, then the mass of the sun

$$M = \frac{4\pi^2 r^3}{GP^2} \quad (G = 6.657 \text{ for cgs units}).$$

If P is the period and r the distance of a satellite revolving around the planet, the above expression for M gives the mass of the planet. The formula is written on the assumption that the orbit of the planet or satellite is circular, which is only approximately true.

Uniformly accelerated rectilinear motion.—If v_0 is the initial velocity, v_t the velocity after time t, the acceleration,

$$a = \frac{v_t - v_0}{t}.$$

The velocity after time t,

$$v_t = v_0 + at.$$

Space passed over in time t,

$$s = v_0 t + \tfrac{1}{2}at^2.$$

Velocity after passing over space s,

$$v_s = \sqrt{v_0^2 + 2as}.$$

Space passed over in the nth second,

$$s = v_0 + \tfrac{1}{2}a(2n - 1).$$

In the above and following similar equations the values of the space, velocity, and acceleration must be substituted in the same system. For space in *cm*, velocity will be in *cm* per sec and acceleration in cm per sec per sec.

Unit.—A specific magnitude of a quantity, set apart by appropriate definition, which is to serve as a basis of comparison or measurement for other quantities of the same nature. *See* under the various physical quantities.

Vectors, composition of.—If the angle between two vectors is A, and their magnitude a and b, their resultant,

$$c = \sqrt{a^2 + b^2 + 2ab \cos A}.$$

Velocity.—Time rate of motion in a fixed direction. Cgs unit,—one centimeter per second. Dimensions,—$[l\ t^{-1}]$.

If s is space passed over in time t, the velocity,

$$v = \frac{s}{t}.$$

Velocity of efflux of a liquid.—If h is the distance from the opening to the free surface of the liquid, the velocity of efflux is

$$V = \sqrt{2gh}.$$

The above is the theoretical discharge velocity disregarding friction and the shape of orifice. For water issuing through a circular opening with sharp edges of area, A, the volume discharged per second is given approximately by,

$$Q = 0.62\ A\ \sqrt{2gh}.$$

Viscosity.—All fluids possess a definite resistance to change of form and many solids show a gradual yielding to forces tending to change their form. This property, a sort of internal friction, is called viscosity; it is expressed in dyne-seconds per cm^2 or poises. Dimensions,—$[m\ l^{-1}\ t^{-1}]$. If the tangential force per unit area, exerted by a layer of fluid upon one adjacent is one dyne for a space rate of variation of the tangential velocity of unity, the viscosity is one poise.

Kinematic viscosity is the ratio of viscosity to density.

Flow of liquids through a tube; where l is the length of the tube, r its radius, p the difference of pressure at the ends, η the coefficient of viscosity, the volume escaping per second,

$$v = \frac{\pi p r^4}{8 l \eta}\ \text{(Poiseuille.)}$$

The volume will be given in cm^3 per second if l and r are in cm, p in dynes per cm^2 and η in poises or dyne-seconds per cm^2.

Volume, unit of.—The cubic centimeter, the volume of a cube whose edges are one centimeter in length. Other units of volume are derived in a similar manner. Dimension,—$[l^3]$.

Weight.—The force with which a body is attracted toward the earth. Cgs unit,—the dyne. Dimensions,—$[m\ l\ t^{-2}]$.

Although the weight of a body varies with its location, the weights of various standards of mass are often used as units of force as,—pound weight, or pound force, gram weight, etc.

The weight of mass m, where g is the acceleration due to gravity,

$$W = mg.$$

The weight will be given in dynes when m is in grams and g in cm per sec^2.

Work.—When a force acts against resistance to produce motion in a body the force is said to do work. Work is measured by the product of the force acting and the distance moved through against the resistance. Cgs units of work,—the erg,

a force of one dyne acting through a distance of one centimeter. The joule is 1×10^7 ergs. Dimensions,— $[m\, l^2\, t^{-2}]$. The foot-pound is the work required to raise a mass of one pound a vertical distance of one foot where $g = 32.174$ ft./sec². The foot-poundal is the work done by a force of one poundal acting through a distance of one foot. The International joule, a unit of electrical energy, is the work expended per second by a current of one International ampere flowing through one International ohm. The kilowatt-hour is the total amount of energy developed in one hour by a power of one kilowatt.

If a force F act through a space s, the work done is

$$W = Fs.$$

Work will be given in ergs if F is in dynes and s in cm.

Work done in rotation. If a torque L dyne-cm acts through an angle θ radians, the work done in ergs is,

$$W = L\theta.$$

HEAT, RADIATION, PROPERTIES OF GASES

Absolute humidity.—Mass of water vapor present in the atmosphere measured as grams per cubic meter. It may also be expressed in terms of the actual pressure of the water vapor present.

Absolute temperature.—Temperature reckoned from the absolute zero. *See Temperature.*

Absolute zero.—The temperature at which a gas would show no pressure if the general law for gases should hold for all temperatures. It is equal to −273.18°C or −459.72°F.

Absorptive power or absorptivity for any body is measured by the fraction of the radiant energy falling upon the body which is absorbed or transformed into heat. This ratio varies with the character of the surface and the wave length of the incident energy. It is the ratio of the radiation absorbed by any substance to that absorbed under the same conditions by a black body.

Adiabatic.—A body is said to undergo an adiabatic change when its condition is altered without gain or loss of heat. The line on the pressure volume diagram representing the above change is called an adiabatic line.

Avogadro's law.—Equal volumes of different gases at the same pressure and temperature contain the same number of molecules.

Black body.—If, for all values of the wave length of the incident radiant energy, all of the energy is absorbed the body is called a black body.

Boyle's law for gases.—At a constant temperature the volume of a given quantity of any gas varies inversely as the pressure to which the gas is subjected.

For a perfect gas, changing from pressure p and volume v to pressure p' and volume v' without change of temperature,

$$pv = p'v'.$$

Charles' law for gases or Gay-Lussac's law.—At a constant pressure, the volume of a given quantity of any gas increases about 1/273 of its volume at 0°C for each rise of 1°C and at constant volume the pressure of a given quantity of any gas increases about 1/273 of the pressure at 0°C for each rise of 1°C in temperature.

Conductivity, thermal.—Time rate of transfer of heat by conduction, through unit thickness, across unit area for unit difference of temperature. It is measured as calories per second per square centimeter for a thickness of one centimeter and a difference of temperature of 1°C. Dimensions,—$[m\,l\,t^{-3}\,\theta^{-1}]$.

If the two opposite faces of a cube of a substance are maintained at temperatures t_1 and t_2, the heat conducted across the cube of section a and thickness d in a time T will be,

$$Q = K\frac{(t_2 - t_1)aT}{d}.$$

K is a constant depending on the nature of the substance, designated as the specific heat conductivity. K is usually given for Q in calories, t_1 and t_2 in °C, a in cm², T in sec, and d in cm. *See table* Heat conductivity.

Critical temperature is that temperature above which a gas cannot be liquefied by pressure alone. The pressure under which a substance may exist as a gas in equilibrium with the liquid at the critical temperature is the **critical pressure.**

Dalton's law of partial pressures.—The pressure exerted by a mixture of gases is equal to the sum of the separate pressures which each gas would exert if it alone occupied the whole volume. This fact is expressed in the following formula:

$$PV = V(p_1 + p_2 + p_3, \text{etc.})$$

Dew point.—The temperature at which condensation of water vapor in the air takes place.

Diffusivity of heat is given by Δ in the equation

$$\frac{dH}{dt} = -\Delta\, sd\, \frac{dT}{dx}\, dy\, dz$$

where dH is the quantity of heat passing through the area $dy\,dz$ in the direction of x in a time dt. The rate of variation of temperature along x is given by dT/dx, s is specific heat and d, density. Dimensions,—$[l^2\,t^{-1}]$.

Dulong and Petit's law of thermal capacity.—For simple substances the atoms all have approximately the same thermal capacity. The product of the specific heat by the atomic weight is a constant,—about 6.38.

Emissive power or emissivity is measured by the energy radiated from unit area of a surface in unit time for unit difference of temperature between the surface in question and surrounding bodies. For the cgs system the emissive power is given in ergs per second per square centimeter with the radiating surface at 1° absolute and the surroundings at absolute zero.

Entropy.—A quantity depending on the quantity of heat in a body and on its temperature, which, when multiplied by any lower temperature (minimum available), gives the unavailable energy, or unavoidable waste when mechanical work is derived from the heat energy of the body. Dimensions,— $[m\, l^2\, t^{-2}\, \theta^{-1}]$.

Expansion of gases.

Charles' law or Gay-Lussac's law.—The volume of a gas at constant pressure increases proportionately to the absolute temperature. If V_1 and V_2 are volumes of the same mass of gas at absolute temperatures, T_1 and T_2,

$$\frac{V_1}{V_2}=\frac{T_1}{T_2}.$$

For an original volume V_o at 0°C the volume at t°C (at constant pressure) is

$$V_t=V_o\ (1+0.00367t).$$

General law for gases.

$$p_t v_t = p_o v_o \left(1+\frac{t}{273}\right),$$

where p_o, v_o, p_t, v_t represent the pressure and volume at 0° and t°C.

The law may also be expressed

$$pv = RmT$$

where m is the mass of gas at absolute temperature T. R is the **gas constant** which depends on the units used. **Boltzmann's molecular gas constant** is obtained by expressing m in terms of the number of molecules.

For volume in cm^3, pressure in dynes per cm^2 and temperature in Centigrade degrees on the absolute scale $R=8.3136\times10^7$.

Reduction of a gas volume to 0°C, 760 mm pressure.—If V is the original volume of a gas at temperature t and pressure H the volume at 0°C and 760 mm pressure will be,

$$V_o=\frac{V}{(1+\alpha t)}\ \frac{H}{760}.$$

If d is the original density the density at 0°C and 760 mm pressure will be,

$$d_o = d(1 + at)\frac{760}{H}:$$

$$a = 0.00367 \text{ approximately.}$$

Gas thermometer.—Where P_o, P_s, and P_x represent the total pressures with the bulb at 0°C, at the boiling-point of water and at the unknown temperature respectively, t_s the temperature of steam and t_x the unknown temperature,

$$t_x = t_s\frac{P_x - P_o}{P_s - P_o}.$$

(approximately). The total pressure on the gas in the bulb is the sum of barometric pressure at the time and that measured by the manometer.

Heat equivalent, or latent heat, of fusion.—The quantity of heat necessary to change one gram of solid to a liquid with no temperature change. Dimensions,— $[l^2\ t^{-2}]$.

Heat quantity is measured by the change of temperature produced. The unit of heat is the **calorie**, the quantity of heat necessary to change the temperature of one gram of water from 3.5°C to 4.5°C (called a small calorie). If the temperature change involved is from 14.5 to 15.5°C, the unit is the normal calorie. The mean calorie is 1/100 the quantity of heat necessary to raise one gram of water from 0°C to 100°C. The large calorie is equal to 1000 small calories. The British thermal unit is the heat required to raise the temperature of one pound of water at its maximum density, 1°F. It is equal to 252 calories. Dimensions as of energy,— $[m\ l^2\ t^{-2}]$.

Intensity of radiation is the radiant energy emitted in a specified direction per unit time, per unit area of surface, per unit solid angle.

Isothermal.—When a gas passes through a series of pressure and volume variations without change of temperature the changes are called isothermal. A line on a pressure-volume diagram representing these changes is called an isothermal line.

Kinetic theory, expression for pressure.

$$P = \tfrac{1}{3} Nmv^2$$

where N is the number of molecules in unit volume, m the mass of each molecule and v^2 the mean square of the velocity of the molecules.

Latent heat of vaporization.—The quantity of heat necessary to change one gram of liquid to vapor without change of temperature. Both the above quantities are measured as calories per gram. Dimensions,— $[l^2\ t^{-2}]$.

Loschmidt's number.—The number of molecules per unit volume of an ideal gas at 0°C and normal atmospheric pressure. (n_o = 2.705 × 10^{19} per cm^3).

Mechanical equivalent of heat is the quantity of energy which, when transformed into heat, is equivalent to unit quantity of heat; 4.18×10^7 ergs = 1 calorie (20°C).

Monochromatic emissive power is the ratio of the energy of certain defined wave lengths radiated at definite temperatures to the energy of the same wave lengths radiated by a black body at the same temperature and under the same conditions.

Planck's constant (h) when multiplied by the frequency of radiation ν, gives the quantity of energy ($= h\nu$) contained in one quantum.

Radiance of a black body.—The hemispherical radiance of a black body of wave length λ is $I_\lambda \, d\lambda$. The hemispherical intensity,

$$I_\lambda = C_1 \lambda^{-5} \left[e^{(C_2/\lambda T)} - 1\right]^{-1}$$

where C_1 and C_2 are the first and second constants of radiation and T, the absolute temperature.

Radiation.—If I_0 is the intensity of normal radiation and I the intensity at an angle θ,

$$I = I_0 \cos \theta.$$

This is called Lambert's law. It does not apply in all cases.

Rankine scale of temperature.—The absolute Fahrenheit scale.

Relative humidity.—The ratio of the quantity of water vapor present in the atmosphere to the quantity which would saturate at the existing temperature. It is also the ratio of the pressure of water vapor present to the pressure of saturated water vapor at the same temperature.

Specific heat of a substance is the ratio of its thermal capacity to that of water at 15°C. Dimensions,—unity.

If a quantity of heat H calories is necessary to raise the temperature of m grams of a substance from t_1 to t_2°C, the specific heat, or more properly, thermal capacity of the substance,

$$s = \frac{H}{m\,(t_2 - t_1)}.$$

Specific heat by the method of mixtures.—Where a mass m_1 of the substance is heated to a temperature t_1, then placed in a mass of water m_2 at a temperature t_2 contained in a calorimeter with stirrer (of same material) of mass m_3, specific heat of the calorimeter c, t_3 the final temperature

$$m_1 \, s \, (t_1 - t_3) = (m_3 \, c + m_2)(t_3 - t_2).$$

Black's ice calorimeter.—If a body of mass m and temperature t melts a mass m' of ice, its temperature being reduced to 0°C, the specific heat of the substance is,

$$s = \frac{80.1 \, m'}{mt}.$$

Bunsen's ice calorimeter.—A body of mass m at temperature t causes a motion of the mercury column of l centimeters in a tube whose volume per unit length is v. The specific heat is

$$s = \frac{884\ lv}{mt}.$$

Stefan-Boltzman law of radiation.—The energy radiated in unit time by a black body is given by, $E = K(T^4 - T_o{}^4)$, where T is the absolute temperature of the body, T_0 the absolute temperature of the surroundings, and K a constant.

Temperature may be defined as the condition of a body which determines the transfer of heat to or from other bodies. The customary unit of temperature is the **Centigrade** degree, 1/100 the difference between the temperature of melting ice and that of water boiling under standard atmospheric pressure. The degree **Fahrenheit** is 1/180, and the degree **Reaumur** 1/80 the same difference of temperature.

The fundamental temperature scale is the absolute, thermodynamic or **Kelvin scale** in which the temperature measure is based on the average kinetic energy per molecule of a perfect gas. The zero of the Kelvin scale is -273.13°C. The temperature scale adopted by the International Bureau of Weights and Measures is that of the constant volume hydrogen gas thermometer. The magnitude of the degree in both these scales is defined as 1/100 the difference between the temperature of melting ice and that of boiling water at 760 mm pressure.

Thermal capacity of a substance is the quantity of heat necessary to produce unit change of temperature in unit mass. It is ordinarily expressed as calories per gram per degree Centigrade. Numerically equivalent to specific heat.

Thermal capacity or water equivalent.—The total quantity of heat necessary to raise any body or system unit temperature, measured as calories per degree centigrade in the cgs system. Dimension,—$[m]$.

Thermal expansion.—The coefficient of linear expansion or expansivity is the ratio of the change in length per degree to the length at 0°C. The coefficient of surface expansion is two times the linear coefficient. The coefficient of volume expansion (for solids) is three times the linear coefficient. The coefficient of volume expansion for liquids is the ratio of the change in volume per degree to the volume at 0°C. The value of the coefficient varies with temperature. The coefficient of volume expansion for a gas under constant pressure is nearly the same for all gases and temperatures and is equal to 0.00367 for 1°C. Dimension,—$[\theta^{-1}]$.

If l_0 is the length at 0°C, a the coefficient of linear expansion, the length at t_0 C is,

$$l_t = l_0\ (1 + at).$$

General formula for thermal expansion.—The rate of thermal expansion varies with the temperature. The general equation giving the magnitude m_t (length or volume) at a temperature t, where m_o is the magnitude at 0°C, is

$$m_t = m_o \ (1 + at + \beta t^2 + \gamma t^3 \ . \ . \ .)$$

where a, β, γ, etc., are empirically determined coefficients.

Volume expansion.—If V represents volume and β the coefficient of expansion,

$$V_t = V_o \ (1 + \beta t).$$

For solids,

$$\beta = 3a \text{ (approximately).}$$

Thermodynamics, laws of

I. When mechanical work is transformed into heat or heat into work the amount of work is always equivalent to the quantity of heat.

II. It is impossible by any continuous self-sustaining process for heat to be transferred from a colder to a hotter body.

Van der Waal's variation of Boyle's law.

$$(p + \frac{a}{v^2}) \ (v - b) = RT$$

where p and v are the pressure and volume at any constant temperature and a and b are constants. R is the gas constant and T the absolute temperature. For values of R, a and b see tables.

Wien's displacement law.—When the temperature of a radiating black body increases, the wave length corresponding to maximum energy decreases in such a way that the product of the absolute temperature and wave length is constant.

$$\lambda_{max} \ T = w$$

w is known as **Wien's displacement constant.**

WAVE MOTION AND SOUND

Air columns, frequency of vibration in.—*See* Organ pipes.

Beats.—Two tones of slightly different frequencies sounded together interfere to give a sound of regularly varying intensity. The number of beats per second is the difference in frequency of the two tones.

Doppler's principle.—The apparent frequency of a sound as

affected by motion of the hearer, the source and the medium is given by the following expression,

$$n = n_0 \frac{V + w - v_0}{V + w - v_s}.$$

where n_0 is the original frequency of the source, V the velocity of sound, w that of the medium, v_0 that of the observer and v_s that of the source. Only the components of motion parallel to the line connecting the source and observer are to be considered. All velocities are taken in the direction from source to observer; if the motion is in the opposite direction the sign of the velocity substituted in the formula should be changed.

Frequency of vibrating strings.—The fundamental frequency of a stretched string is given by

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}}.$$

where l is the length; T, the tension and m the mass per unit length.

For a string of circular section of length l, tension T, density d, and radius r, the frequency of the fundamental is,

$$n = \frac{1}{2rl}\sqrt{\frac{T}{\pi d}}.$$

The frequency in vibrations per second will be given if T is in dynes, r and l in cm and d in g per cm³.

Intensity of sound depends upon the energy of the wave motion. The intensity is measured by the energy in ergs transmitted per second through one square centimeter of surface.

The energy in ergs per cm³ in a sound wave is given by

$$E = 2\pi^2 dn^2a^2$$

where d is density in g per cm³, n is frequency in vib. per sec and a is amplitude in cm. The energy reaching the ear in unit time will also be proportional to the velocity of propagation.

Lissajou's figures.—The path described by a particle which is simultaneously displaced by two simple harmonic motions at right angles, when the periods of the two motions are in the ratio of two small whole numbers, shows a variety of characteristic curves called Lissajou's figures.

Organ pipes.—The frequency of vibration of a closed pipe or other air column of length l, where V is the velocity of sound in air, for the fundamental and first three overtones respectively is,

$$n_0 = \frac{V}{4l}, n_1 = \frac{3V}{4l}, n_2 = \frac{5V}{4l}, n_3 = \frac{7V}{4l}.$$

For an open pipe,

$$n_0 = \frac{V}{2l}, n_1 = \frac{2V}{2l}, n_2 = \frac{3V}{2l}, n_3 = \frac{4V}{2l}.$$

Pitch of sound is determined by the frequency or number of vibrations per second.

Quality or timbre of a sound depends on the coexistence with the fundamental of other vibrations of various frequencies and amplitudes.

Stationary or standing waves are produced in a medium by the simultaneous transmission, in opposite directions of two similar wave motions. Fixed points of minimum amplitude are called **nodes.** A **segment** extends from one node to the next. An **antinode** or **loop** is the point of maximum amplitude between two nodes.

Velocity of a compressional wave.—The velocity of a compressional wave in an elastic medium, in terms of elasticity E (bulk modulus) and density d,

$$V = \sqrt{\frac{E}{d}}.$$

For the velocity of sound in air, where p is the pressure and d the density,

$$V = \sqrt{\frac{p}{d}1.4}$$

Velocity of a transverse wave in a stretched cord. If T is the tension of the cord and m the mass per unit length.

$$V = \sqrt{\frac{T}{m}}.$$

Velocity of a wave.—The velocity of propagation in terms of wave length λ and period T or frequency n is,

$$V = \frac{\lambda}{T} = n\lambda.$$

Velocity of sound, variation with temperature.—The velocity in meters per sec at any temperature t in °C is given approximately by,

$$V = V_o \sqrt{1 + \frac{t}{273}}.$$

$$V = 331.5 + .607t.$$

The **variation with humidity** is given by the equation

$$V_d = V_h \sqrt{1 - \frac{e}{p}\left(\frac{\gamma_w}{\gamma_a} - \frac{5}{8}\right)}.$$

where V_d is the velocity in dry air, V_h that in air at barometric pressure p in which the pressure of water vapor is e. γ_w and γ_a are the specific heat ratios for water vapor and for air respectively.

Velocity of water waves.—If the depth h is small compared with the wave length, the velocity,

$$V = \sqrt{gh}.$$

In deep water for a wave length λ,

$$V = \sqrt{\frac{g\lambda}{2\pi}}.$$

If the wave length is very small, less than about 1.6 cm, the velocity increases as the wave length decreases and is expressed by the following,

$$V = \sqrt{\frac{2\pi T}{\lambda d} + \frac{g\lambda}{2\pi}}.$$

where T is the surface tension and d the density of the liquid. V will be given in cm per sec if h and λ are in cm, g in cm per sec^2, T in dynes per cm and d in g per cm^3.

Wave motion.—A progressive disturbance propagated in a medium by the periodic vibration of the particles of the medium. Transverse wave motion is that in which the vibration of the particles is perpendicular to the direction of propagation. Longitudinal wave motion is that in which the vibration of the particles is parallel to the direction of propagation.

ELECTRICITY AND MAGNETISM

Alternating current in circuits including resistance and inductance,

$$I = \frac{E}{\sqrt{R^2 + (2\pi n L)^2}}$$

where n is the frequency in cycles per second, L the inductance in henry. I will be given in virtual amperes if R is in ohms and E in virtual volts. The denominator is known as the impedance of the circuit.

For circuits also involving a capacity C in farads, the impedance becomes,

$$\sqrt{R^2 + \left(2\pi n L - \frac{1}{2\pi n C}\right)^2}$$

Capacity is measured by the charge which must be communicated to a body to raise its potential one unit. Electrostatic unit capacity is that which requires one electrostatic unit of charge to raise its potential one electrostatic unit. The farad = 9×10^{11} electrostatic units. A capacity of one farad requires one coulomb of electricity to raise its potential one volt. Dimensions,— $[\epsilon l]$; $[\mu^{-1} l^{-1} t^2]$.

A conductor charged with a quantity q to a potential V has a capacity,

$$C = \frac{q}{V}.$$

Capacity of a spherical conductor of radius r,

$$C = Kr.$$

Capacity of two concentric spheres of radii r and r',

$$C = K\frac{rr'}{r - r'},$$

Capacity of a parallel plate condenser, the area of whose plates is A and the distance between them d,

$$C = \frac{KA}{4\pi d}.$$

Capacities will be given in electrostatic units if the dimensions of condensers are substituted in cm.

Condensers in parallel and series.—If c_1, c_2, c_3, etc., represent the capacities of a series of conductors and C their combined capacity,—

when in parallel, $C = c_1 + c_2 + c_3 \ldots,$

when in series $\frac{1}{C} = \frac{1}{c_1} + \frac{1}{c_2} + \frac{1}{c_3} \ldots.$

Conductance, the reciprocal of resistance, is measured by the ratio of the current flowing through a conductor to the difference of potential between its ends. The practical unit of conductance, the mho, is the conductance of a body through which one ampere of current flows when the potential difference is one volt. The conductance of a body in mho is the reciprocal of the value of its resistance in ohms. Dimensions,— $[\epsilon\, l\, t^{-1}]$; $[\mu^{-1}\, l^{-1}\, t]$.

Conductivity is measured by the quantity of electricity transferred across unit area, per unit potential gradient per unit time. Reciprocal of resistivity. **Volume conductivity** or specific conductance, $k = 1/\rho$ where ρ is the volume resistivity. **Mass conductivity** $= k/d$ where d is density. **Equivalent conductivity** $\Lambda = k/c$ where c is the number of equivalents per unit volume of solution. **Molecular conductivity** $\mu = k/m$ where m is the number of moles per unit volume of solution. Dimensions: volume conductivity,— $[\epsilon t^{-1}]$; $[\mu^{-1}\, l^{-2}\, t]$,—mass conductivity,— $[\epsilon\, m^{-1}\, l^3\, t^{-1}]$; $[\mu^{-1}\, m^{-1}\, lt]$.

Conductors.—A class of bodies which are incapable of supporting electric strain. A charge given to a conductor spreads to all parts of the body.

Couple acting on a magnet of magnetic moment ml in a field

of strength H. If the magnet is perpendicular to the direction of the field,

$$C = Hml = HM.$$

If the angle between the magnet and the field is θ,

$$C = Hml \sin \theta.$$

The couple will be in dyne-cm for cgs units of H, m and l.

Current (electric).—The rate of transfer of electricity. The transfer at the rate of one electrostatic unit of electricity in one second is the electrostatic unit of current. The electromagnetic unit of current is a current of such strength that one centimeter of the wire in which it flows is pushed sideways with a force of one dyne when the wire is at right angles to a magnetic field of unit intensity. The practical unit of current is the **ampere,** a transfer of one coulomb per second, which is one tenth the electromagnetic unit. The **international ampere** is the unvarying electric current which when passed through a solution of silver nitrate in accordance with certain specifications, deposits silver at the rate of 0.00111800 gram per second. The international ampere is equivalent to 0.99991 absolute ampere. The **ampere-turn** is the magnetic potential produced between the two faces of a coil of one turn carrying one ampere. Dimensions,— $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-2}]$; $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$.

Current in a simple circuit.—The current in a circuit including an external resistance R and a cell of electromotive force E, and internal resistance r,

$$i = \frac{E}{R+r}.$$

If E is in volts and r and R in ohms the current will be in amperes.

For two cells in parallel,

$$i = \frac{E}{R+\frac{r}{2}}.$$

For two cells in series,

$$i = \frac{2E}{R+2r}.$$

Declination.—The angle between the vertical plane containing the direction of the earth's field at any point and a plane containing the geographic north and south meridian.

Diamagnetic bodies tend to set the longest dimension across the magnetic field. The permeability of a diamagnetic substance is less than unity.

Dielectric constant of a medium is defined by ϵ in the equation

$$f = \frac{qq'}{\epsilon r^2}.$$

where f is the force of attraction between two charges q and q' separated by a distance r in a uniform medium.

Dielectrics or insulators or non-conductors.—A class of bodies supporting an electric strain. A charge on one part of a non-conductor is not communicated to any other part.

Dip.—The angle measured in a vertical plane between the direction of the earth's magnetic field and the horizontal.

Electric field intensity is measured by the force exerted on unit charge. Unit field intensity is the field which exerts the force of one dyne on unit positive charge. Dimensions,—$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{1}{2}} t^{-1}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-2}]$.

The field intensity or force exerted on unit charge at a point distant r from a charge q in a vacuum.

$$H = \frac{q}{r^2}.$$

If the dielectric in the above cases is not a vacuum the dielectric constant ϵ must be introduced. The formulae become,

$$F = \frac{qq'}{\epsilon r^2}. \qquad H = \frac{q}{\epsilon r^2}.$$

The value of ϵ is frequently considered unity for air. If the dielectric constant of a vacuum is considered unity the value for air at 0°C and 760 mm pressure is 1.000576.

Electrolysis.—If a current i flows for a time t and deposits a metal whose electrochemical equivalent is e, the mass deposited is

$$m = eit.$$

The value of e is usually given for mass in grams, i in amperes and t in seconds.

Electromotive force is defined as that which causes a flow of current. The electromotive force of a cell is measured by the maximum difference of potential between its plates. The electromagnetic unit of potential difference is that against which one erg of work is done in the transfer of electromagnetic unit quantity. The **volt** is that potential difference against which one joule of work is done in the transfer of one coulomb. One volt is equivalent to 10^8 electromagnetic units of potential. The **international** volt is the electrical potential which when steadily applied to a conductor whose resistance is one international ohm will cause a current of one international ampere to flow. The international volt = 1.00043 absolute volts. The electromotive force of a Weston standard cell is 1.0183 at 20°C. Dimensions,—$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{3}{2}} t^{-2}]$.

Electron.—Considered to be the ultimate indivisible negative charge which with the **proton** or positive charge constitutes the basic elements in the formation of atoms. The electronic ratio is the ratio of the charge of an electron to its mass.

Energy of a charge in ergs where Q is the charge and V the potential in electrostatic units.

$$E = \tfrac{1}{2}QV.$$

Energy of the electric field.—If H is the electric field intensity in electrostatic units and K the specific inductive capacity, the energy of the field in ergs per cm³ is,

$$E = \frac{KH^2}{8\pi}.$$

Faraday's law.—The mass of substance decomposed by the passage of equal quantities of electricity through different electrolytic cells are, for the same electrolyte, equal, and for different electrolytes are proportional to the combining weights of the elements or radicals which are deposited.

Force between two charges.—If two charges q and q' are at a distance r in a vacuum, the force between them is,

$$F = \frac{qq'}{r^2}.$$

The force will be given in dynes if q and q' are in electrostatic units and r in cm.

Force between two magnetic poles.—If two poles of strength m and m' are separated by a distance r in a medium whose permeability is μ (unity for a vacuum), the force between them is,

$$F = \frac{mm'}{\mu r^2}.$$

Force will be given in dynes if r is in cm and m and m' are in cgs units of pole strength.

The strength of a magnetic field at a point distant r from an isolated pole of strength m is,

$$H = \frac{m}{\mu r^2}.$$

The field will be given in gauss if m and r are in cgs units.

Heat effect.—The heat in calories developed in a circuit by an electric current of i amperes flowing through a resistance of r ohms, with a difference of potential E volts for a time t seconds,

$$H = \frac{ri^2t}{4.18} = \frac{Eit}{4.18}.$$

Hysteresis.—The magnetization of a sample of iron or steel due to a magnetic field which is made to vary through a cycle of values, lags behind the field. This phenomenon is called hysteresis.

Steinmetz' equation for hysteresis gives the loss of energy in ergs per cycle per cm³,

$$W = \eta B^{1.6}$$

where B is the maximum induction in maxwells per cm² and η the coefficient of hysteresis.

Induced electromotive force in a circuit is proportional to the rate of change of magnetic flux through the circuit.

$$E = -\frac{d\phi}{dt}.$$

where $d\phi$ is the change of magnetic flux in a time dt. The induced current will be given by

$$I = \frac{d\phi}{Rdt}.$$

where R is the resistance of the circuit.

Inductance.—The change in magnetic field due to the variation of a current in a conducting circuit causes an induced electromotive force in the circuit itself. This phenomenon is known as self-induction. If an electromotive force is induced in a neighboring circuit the term mutual induction is used. Inductance may thus be distinguished as self- or mutual and is measured by the electromotive force produced in a conductor by unit rate of variation of the current. Units of inductance are the centimeter (absolute electromagnetic) and the henry, which is equal to 10^9 centimeters of inductance. The **henry** is that inductance in which an induced electromotive force of one volt is produced when the inducing current is changed at the rate of one ampere per second. Dimensions,— $[\epsilon^{-1} l^{-1} t^2]$; $[\mu\, l]$.

Induction.—Any change in the intensity or direction of a magnetic field causes an electromotive force in any conductor in the field. The induced electromotive force generates an induced current if the conductor forms a closed circuit.

Intensity of magnetization is given by the quotient of the magnetic moment of a magnet by its volume. Unit intensity of magnetization is the intensity of a magnet which has unit magnetic moment per cubic centimeter. Dimensions,— $[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{3}{2}}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{1}{2}} t^{-1}]$.

Kirchoff's laws.

I. The algebraic sum of the currents which meet at any point is zero.

II. In any closed circuit the algebraic sum of the products of the current and the resistance in each conductor in the circuit is equal to the electromotive force in the circuit.

Lenz' law.—When an electromotive force is induced in a conductor by any change in the relation between the conductor and the magnetic field, the direction of the electromotive force is such as to produce a current whose magnetic field will oppose the change.

Line of force.—A term employed in the description of an electric or magnetic field. A line such that its direction at

every point is the same as the direction of the force which would act on a small positive charge (or pole) placed at that point. A line of force is defined as starting from a positive charge (or pole) and ending on a negative charge (or pole).

The line (of force) is also used as a unit of magnetic flux, equivalent to the maxwell.

Magnetic field due to a current.—The intensity of the magnetic field in gauss at the center of a circular conductor of radius r in which a current i in absolute electromagnetic units is flowing,

$$H=\frac{2\pi i}{r}.$$

If the circular coil has n turns the magnetic intensity at the center is,

$$H=\frac{2\pi n i}{r}.$$

The magnetic field in a long solenoid of n turns per centimeter carrying a current i in absolute electromagnetic units,

$$H=4\pi n i.$$

If i is given in amperes the above formulae become,—

$$H=\frac{2\pi i}{10r} \quad H=\frac{2\pi n i}{10r}, \quad H=\frac{4\pi n i}{10}.$$

Magnetic field due to a magnet.—At a point on the magnetic axis prolonged, at a distance r cm from the center of the magnet of length $2l$ whose poles are $+m$ and $-m$ and magnetic moment M, the field strength in gauss is,

$$H=\frac{4mlr}{(r^2-l^2)^2}.$$

If r is large compared with l,

$$H=\frac{2M}{r^3}.$$

At a point on a line bisecting the magnet at right angles, with corresponding symbols,

$$H=\frac{2ml}{(r^2+l^2)^{\frac{3}{2}}}.$$

For large values of r,

$$H=\frac{M}{r^3}.$$

Magnetic field intensity or magnetizing force is measured by the force acting on unit pole. Unit field intensity, the **gauss,** is that field which exerts a force of one dyne on unit magnetic pole. The field intensity is also specified by the number of lines of force intersecting unit area normal to the field, equal numerically to the field strength in gauss. Magnetizing force

is measured by the space rate of variation of magnetic potential and as such its unit may be the **gilbert per centimeter.** The gamma, (γ) is equivalent to 0.00001 gauss. Dimensions,—$[\epsilon^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-2}]$; $[\mu^{-\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{1}{2}} t^{-1}]$.

Magnetic flux through any area perpendicular to a magnetic field is measured as the product of the area by the field strength. The unit of magnetic flux, the **maxwell** is the flux through a square centimeter normal to a field of one gauss. The line is also a unit of flux. It is equivalent to the maxwell. Dimensions,—$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{3}{2}} t^{-1}]$.

Magnetic induction resulting when any substance is subjected to a magnetic field is measured as the magnetic flux per unit area taken perpendicular to the direction of the flux. The unit is the maxwell per square centimeter or its equivalent, the gauss. Dimensions,—$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{3}{2}}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{1}{2}} t^{-1}]$.

If a substance of permeability μ is placed in a magnetic field H the magnetic induction in the substance,

$$B = \mu H.$$

If I is the magnetic moment for unit volume, or intensity of magnetization,

$$B = H + 4\pi I.$$

The susceptibility,

$$K = \frac{I}{H}, \quad \mu = 1 + 4\pi K.$$

Magnetic moment of a magnet is measured by the torque experienced when it is at right angles to a uniform field of unit intensity. The value of the magnetic moment is given by the product of the magnetic pole strength by the distance between the poles. Unit magnetic moment is that possessed by a magnet formed by two poles of opposite sign and of unit strength, one centimeter apart. Dimensions,—$[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{5}{2}} t^{-1}]$; $[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{3}{2}}]$.

If the poles are separated by a distance which is great compared with the dimensions of the magnet, the magnetic moment of a magnet of length l whose poles have values of $+m$ and $-m$ is,

$$M = ml.$$

Magnetic permeability is a property of materials modifying the action of magnetic poles placed therein and modifying the magnetic induction resulting when the material is subjected to a magnetic field or magnetizing force. The permeability of a substance may be defined as the ratio of the magnetic induction in the substance to the magnetizing field to which it is subjected. The permeability of a vacuum is unity. Dimensions,—$[\epsilon^{-1} l^{-2} t^{2}]$; $[\mu]$.

Magnetic pole or quantity of magnetism.—Two unit quantities of magnetism concentrated at points unit distance apart in

a vacuum repel each other with unit force. If the distance involved is one centimeter and the force one dyne, the quantity of magnetism at each point is one cgs unit of magnetism. Dimensions,— $[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-1}]$.

Magnetic potential or magnetomotive force at a point is measured by the work required to bring unit positive pole from an infinite distance (zero potential) to the point. The unit is the **gilbert**, that magnetic potential against which an erg of work is done when unit magnetic pole is transferred. Dimensions,— $[\epsilon^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-2}]$; $[\mu^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-1}]$.

Ohm's law.—Current in terms of electromotive force E and resistance R,

$$i = \frac{E}{R}.$$

The current is given in amperes when E is in volts and R in ohms.

Paramagnetic bodies are those which tend to set the longest dimension parallel to the magnetic field. The permeability of a paramagnetic substance is greater than unity.

Permeance, the reciprocal of reluctance. Unit permeance is the permeance of a cylinder one square centimeter cross-section and one centimeter length taken in a vacuum. Dimensions,— $[\epsilon^{-1}\, l^{-1}\, t^{2}]$; $[\mu\, l]$.

Period of vibration of a magnet of magnetic moment M and moment of inertia I vibrating in a field of strength H,

$$T = 2\pi \sqrt{\frac{I}{MH}}.$$

Potential (electric) at any point is measured by the work necessary to bring unit positive charge from an infinite distance. Difference of potential between two points is measured by the work necessary to carry unit positive charge from one to the other. If the work involved is one erg we have the electrostatic unit of potential. Dimensions,— $[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-1}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-2}]$.

The potential at a point due to a charge q at a distance r in a medium whose dielectric constant is ϵ is,

$$V = \frac{q}{\epsilon r}.$$

Power developed by a current.—The power in watts developed by an electric current flowing in a conductor, where E is the difference of potential at its terminals in volts, r its resistance in ohms, and i the current in amperes,

$$P = Ei = ri^2.$$

The work done in joules in a time t sec is,

$$W = Eit : ri^2t.$$

Power in watts for alternating current in a circuit,

$$P = EI \cos \phi$$

where E and I are the effective values of the electromotive force and current in volts and amperes respectively and ϕ the phase angle between the current and the impressed electromotive force.

The ratio,

$$\frac{P}{EI} = \cos \phi$$

is called the power factor.

Power ratios in telephone engineering are measured in **decibels.** The gain or loss of power expressed in decibels is ten times the logarithm of the power ratio. By reference to an arbitrarily chosen "power level" the actual power may be expressed in decibels. The numerical values thus used will not be proportional to the actual power level but roughly to the sensation on the ear produced when the electrical power is converted into sound. A difference of 1 decibel in the power supply to a telephone receiver produces approximately the smallest change in volume of sound which a normal ear can detect.

Quantity of electricity or charge.—The electrostatic unit of charge, the quantity which, when concentrated at a point and placed at unit distance from an equal and similarly concentrated quantity, is repelled with unit force. If the distance is one centimeter and the force of repulsion one dyne and the surrounding medium a vacuum, we have the electrostatic unit of quantity. The electromagnetic unit of quantity may be defined as that transferred by unit current in unit time. The quantity transferred by one ampere in one second is the **coulomb,** the practical unit. The **faraday** is the electrical charge carried by one gram equivalent. The coulomb $= 3 \times 10^9$ electrostatic units. Dimensions,— $[\epsilon^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{3}{2}}\ t^{-1}]$; $[\mu^{-\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{1}{2}}]$.

Reluctance is that property of a magnetic circuit which determines the total magnetic flux in the circuit when a given magnetomotive force is applied. Unit, the **oersted** the reluctance of one centimeter length and one square centimeter cross-section of space taken in a vacuum. Dimensions,— $[\epsilon\ l\ t^{-2}]$; $[\mu^{-1}\ l^{-1}]$.

Reluctivity or specific reluctance is the reciprocal of magnetic permeability. The reluctivity of empty space is taken as unity. Dimensions,— $[\epsilon\ l^2\ t^{-2}]$; $[\mu^{-1}]$.

Resistance is a property of conductors depending on their dimensions, material and temperature which determines the current produced by a given difference of potential. The practical unit of resistance, the **ohm** is that resistance through which a difference of potential of one volt will produce a current of one ampere. The **international ohm** is the resistance offered to an

unvarying current by a column of mercury at 0°C, 14.4521 grams in mass, of constant cross-sectional area and 106.300 centimeters in length, sometimes called the legal ohm. Dimensions,—$[\epsilon^{-1}\, l^{-1}\, t]$; $[\mu\, l\, t^{-1}]$.

Resistance of a conductor at 0°C, of length l, cross-section s and specific resistance ρ.

$$R_o = \rho \frac{l}{s}.$$

The resistivity may be expressed as ohm-cm when R is in ohms, l in cm and s in cm^2.

Resistance of a conductor at a temperature t whose resistance at 0°C is R_o and whose temperature resistance coefficient is a,

$$R_t = R_o\ (1 + at).$$

Resistance of conductors in series and parallel.—The total resistance of any number of resistances joined in series is the sum of the separate resistances. The total resistance of conductors in parallel whose separate resistances are $r_1, r_2, r_3, \ldots r_n$ is given by the formula

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} \ldots + \frac{1}{r_n}.$$

R is the total resistance.

For two terms this becomes,

$$R = \frac{r_1 r_2}{r_1 + r_2}.$$

Resistivity or specific resistance, the reciprocal of conductivity, is measured by the resistance of a body of the substance of unit cross-section and of unit length at 0°C also called volume resistivity. The unit may be indicated as the ohm-centimeter. Dimensions,—$[\epsilon^{-1}\, t]$; $[\mu\, l^2\, t^{-1}]$.

Mass resistivity is the longitudinal resistance per unit length of a uniform bar of the substance of such a sectional area that it contains one unit of mass per unit of length. Dimensions,—$[\epsilon^{-1}\, m\, l^{-3}\, t]$; $[\mu\, m\, l^{-1}\, t^{-1}]$.

Surface resistivity is the resistance of unit length and unit width of a surface.

Surface density of electricity.—Quantity of electricity per unit area. Dimensions,—$[\epsilon^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^{-1}]$; $[\mu^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{3}{2}}]$.

Surface density of magnetism.—Quantity of magnetism per unit area. Dimensions,—$[\epsilon^{-1}\, m^{\frac{1}{2}}\, l^{-\frac{3}{2}}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^{-1}]$.

Specific inductive capacity.—The ratio of the capacity of a condenser with a given substance as dielectric to the capacity of the same condenser with air or a vacuum as dielectric is called the specific inductive capacity. The ratio of the dielectric constant of a substance to that of a vacuum.

Susceptibility (**magnetic**) is measured by the ratio of the in-

tensity of magnetization produced in a substance to the magnetizing force or intensity of field to which it is subjected. The susceptibility of a substance will be unity when unit intensity of magnetization is produced by a field of one gauss. Dimensions,—$[\epsilon^{-1} l^{-2} t^2]$; $[\mu]$.

Tangent galvanometer.—A tangent galvanometer with n turns, of radius r, in the earth's field H, has a deflection θ, The current flowing is,

$$i = \frac{Hr}{2\pi n} \tan \theta.$$

If $\frac{2\pi n}{r} = G$ (the galvanometer constant),

$$i = \frac{H}{G} \tan \theta.$$

Temperature resistance coefficient.—The ratio of the change of resistance in a wire due to a change of temperature of 1°C to its resistance at 0°C. Dimension,—$[\theta^{-1}]$.

Thermoelectric power is measured by the electromotive force produced by a thermocouple for unit difference of temperature between the two junctions. It varies with the average temperature and is usually expressed in microvolts per degree C. It is customary to list the thermoelectric power of the various metals with respect to lead. Dimensions,—$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1} \theta^{-1}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} t^{-2} \theta^{-1}]$.

Thomson thermoelectric effect is the designation of the potential gradient along a conductor which accompanies a temperature gradient. The magnitude and direction of the potential varies with the substance.

The coefficient of the Thomson effect or specific heat of electricity is expressed in joules per coulomb per degree Centigrade. Dimensions,—$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1} \theta^{-1}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-2} \theta^{-1}]$.

Torque produced by the action of one magnet on another.—The turning moment experienced by a magnet of pole strength m' and length $2l'$ placed at a distance r from another magnet of length $2l$ and pole strength m, where the center of the first magnet is on the axis (extended) of the second and the axis of the first is perpendicular to the axis of the second,

$$C = 8\frac{mm'll'}{r^3} = \frac{2MM'}{r^3}.$$

If the first magnet is deflected through an angle θ, the expression becomes,

$$C = \frac{2MM'}{r^3} \cos \theta.$$

Tractive force of a magnet.—If a magnet with induction B has a pole face of area A the force is,

$$F = \frac{B^2 A}{8\pi}.$$

If B and A are in cgs units, A will be in dynes.

Wheatstone's bridge.—If the resistances r_1, r_2, r_3, and r_4 form the arms of a Wheatstone's bridge in order as the circuit (omitting cell and galvanometer connections) is traced, when the bridge is balanced,

$$\frac{r_1}{r_2} = \frac{r_4}{r_3} \text{ or } \frac{r_1}{r_4} = \frac{r_2}{r_3}.$$

LIGHT

Absorption, Lambert's law.—If I_o is the original intensity, I the intensity after passing through a thickness x of a material whose absorption coefficient is k,

$$I = I_o e^{-kx}.$$

The **index of absorption** k' is given by the relation $k = (4\pi k'n)/\lambda$ where n is the index of refraction and λ the wave length in vacuo. The **mass absorption** is given by k/d where d is the density. The **transmission factor** is given by I/I_o.

Achromatic.—A term applied to lenses signifying their more or less complete correction for chromatic aberration.

Angular aperture of an objective is the largest angular extent of wave surface which it can transmit.

Apochromat.—A term applied to photographic and microscope objectives indicating the highest degree of color correction.

Astigmatism is an error of spherical lenses peculiar to the formation of images by oblique pencils. The image of a point when astigmatism is present will consist of two focal lines at right angles to each other and separated by a measurable distance along the axis of the pencil. The error is not eliminated by reduction of aperture as is spherical aberration.

Brewster's law.—The tangent of the polarizing angle for a substance is equal to the index of refraction. The polarizing angle is that angle of incidence for which the reflected polarized ray is at right angles to the refracted ray.

Brightness is measured by the flux emitted per unit emissive area as projected on a plane normal to the line of sight. The unit of brightness is that of a perfectly diffusing surface giving out one lumen per square centimeter of projected surface and is called the lambert. The millilambert (0.001 lambert) is a more convenient unit. **Candle per square centimeter** is the brightness of a surface which has, in the direction considered, a luminous intensity of one candle per cm^2.

Chromatic aberration.—Due to the difference in the index of refraction for different wave lengths, light of various wave lengths from the same source cannot be focused at a point by a simple lens. This is called chromatic aberration.

Coma.—An aberration of lenses, occurring in the case of oblique, incidence, similar to spherical aberration of the axial rays. The image of a point is comet shaped, hence the name.

Conjugate foci.—Under proper conditions light divergent from a point on or near the axis of a lens or spherical mirror is focused at another point. The point of convergence and the position of the source are interchangeable and are called conjugate foci.

Diffraction.—If the light source were a point, the shadow of any object would have its maximum sharpness; a certain amount of illumination, however, would be found within the geometrical shadow due to the diffraction of the light at the edge of the object.

Diffraction grating.—If s is the distance between the rulings, d the angle of diffraction, then the wave length where the angle of incidence is 90° is (for the nth order spectrum),

$$\lambda = \frac{s \sin d}{n}.$$

If i is the angle of incidence, d the angle of diffraction, s the distance between the rulings, n the order of the spectrum, the wave length is,

$$\lambda = \frac{s}{n}(\sin i + \sin d).$$

Dispersion.—The difference between the index of refraction of any substance for any two wave lengths is a measure of the dispersion for these wave lengths, called the coefficient of dispersion.

Dispersive power.—If n_1 and n_2 are the indices of refraction for wave lengths λ_1 and λ_2 and n the mean index or that for sodium light, the dispersive power for the specified wave lengths is,

$$\omega = \frac{n_2 - n_1}{n - 1}.$$

Illumination on any surface is measured by the luminous flux incident on unit area. The units in use are: the **lux**, one lumen per square meter; the **phot**, one lumen per square centimeter and the lumen per square foot. Since at unit distance from a point source of unit intensity the illumination is unity, unit illumination may be defined as that produced by unit source at unit distance, hence the **meter-candle** or **candle-meter** which is equal to the lux and the **foot-candle** equivalent to one lumen per square foot.

Index of refraction for any substance is the ratio of the velocity of light in a vacuum to its velocity in the substance. It is also the ratio of the sine of the angle of incidence to the sine of the angle of refraction. In general, the index of refraction

for any substance varies with the wave length of the refracted light.

Intensity of illumination in candle meters of a screen illuminated by a source of illuminating power P candles at a distance r meters, for normal incidence,

$$I = \frac{P}{r^2}.$$

If two sources of illuminating power P_1 and P_2 produce equal illumination on a screen when at distances r_1 and r_2 respectively,

$$\frac{P_1}{r_1^2} = \frac{P_2}{r_2^2} \text{ or } \frac{P_1}{P_2} = \frac{r_1^2}{r_2^2}.$$

If I_o is the intensity of illumination when the screen is normal to the incident light, I the intensity when at an angle θ,

$$I = I_o \cos \theta.$$

Lambert's law.—When light is normally incident on a perfectly diffusing surface the intensity of the reflected light is proportional to the cosine of the angle made with the normal.

Lenses.—For a single thin lens whose surfaces have radii of curvature r_1 and r_2, whose principal focus is F, the index of refraction n, and conjugate focal distances f_1 and f_2,

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = (n-1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right).$$

For a thick lens, of thickness t,

$$F = \frac{n r_1 r_2}{(n-1)\,[n(r_1+r_2) - t(n-1)]}.$$

Combinations of lenses,—If f_1 and f_2 are the focal lengths of two thin lenses separated by a distance d the focal length of the system,

$$F = \frac{f_1 f_2}{f_1 + f_2 - d}.$$

Luminous intensity or candle-power is the property of a source of emitting luminous flux and may be measured by the luminous flux emitted per unit solid angle. The accepted unit of luminous intensity is the **international candle.** The **hefner unit,** which is equivalent to 0.9 international candles, is the intensity of a lamp of specified design burning amyl acetate, called the Hefner lamp.

The mean horizontal candle-power is the average intensity measured in a horizontal plane passing through the source. The mean spherical candle-power is the average candle-power measured in all directions and is equal to the total luminous flux in lumens divided by 4π.

Luminous flux.—The total visible energy emitted by a source

per unit time is called the total luminous flux from the source. The unit of flux, the **lumen**, is the flux emitted in unit solid angle (steradian) by a point source of one candle luminous intensity. A uniform point source of one candle intensity thus emits 4π lumens.

Magnifying power of an optical instrument is the ratio of the angle subtended by the image of the object seen through the instrument to the angle subtended by the object when seen by the unaided eye. In the case of the microscope or simple magnifier the object as viewed by the unaided eye is supposed to be at a distance of 25 cms (10 in.).

Minimum deviation.—The deviation or change of direction of light passing through a prism is a minimum when the angle of incidence is equal to the angle of emergence. If D is the angle of minimum deviation and A the angle of the prism, the index of refraction of the prism for the wave length used is,

$$n = \frac{\sin \frac{1}{2} (A + D)}{\sin \frac{1}{2} A}.$$

Nodal points.—Two points on the axis of a lens such that a ray entering the lens in the direction of one, leaves as if from the other and parallel to the original direction.

Numerical aperture is the sine of half the angular aperture, used as a measure of the optical power of the objective.

Photographic density.—The density D of silver deposit on a photographic plate or film is defined by the relation

$$D = \log O$$

where O is the opacity. If I_0 and I are the incident and transmitted intensities respectively, the opacity is given by I_0/I. The transparency is the reciprocal of the opacity or I/I_0.

Polarized light.—Light which exhibits different properties in different directions at right angles to the line of propagation is said to be polarized. Specific rotation is the power of liquids to rotate the plane of polarization. It is stated in terms of specific rotation or the rotation in degrees per decimeter per unit density.

Principal focus of a lens or spherical mirror is the point of convergence of light coming from a source at an infinite distance.

Radius of curvature from spherometer readings.—If l is the mean length of the sides of the triangle formed by the points of the three legs, d the spherometer readings, the radius of curvature of the surface is

$$F = \frac{l^2}{6d} + \frac{d}{2}.$$

Reflection coefficient or reflectivity is the ratio of the light reflected from a surface to the total incident light. The coefficient may refer to diffuse or to specular reflection. In

general it varies with the angle of incidence and with the wave length of the light.

Reflection of light by a transparent medium in air. (Fresnel's formulae).—If i is the angle of incidence, r the angle of refraction, n_1 the index of refraction for air (nearly equal to unity), n_2 index of refraction for a medium, then the ratio of the reflected light to the incident light is,

$$R=\frac{1}{2}\left(\frac{\sin^2 (i-r)}{\sin^2 (i+r)}+\frac{\tan^2 (i-r)}{\tan^2 (i+r)}\right).$$

If $i = 0$ (normal incidence), and $n_1 = 1$ (approximate for air),

$$R=\left(\frac{n_2-1}{n_2+1}\right)^2$$

Refraction at a spherical surface.—If u be the distance of a point source, v the distance of the point image or the intersection of the refracted ray with the axis, n_1 and n_2 the indices of refraction of the first and second medium, and r the radius of curvature of the separating surface,

$$\frac{n_2}{v}+\frac{n_1}{u}=\frac{n_2 - n_1}{r}.$$

If the first medium is air the equation becomes,

$$\frac{n}{v}+\frac{1}{u}=\frac{n - 1}{r}$$

Refraction.—*See* Index of refraction; Snell's law.

Refractivity is given by $(n-1)$ when n is the index of refraction; the **specific refractivity** is given by $\frac{n-1}{d}$ where d is the density. **Molecular refractivity** is the product of specific refractivity by the molecular weight.

Resolving power of a telescope or microscope is indicated by the minimum separation of two objects for which they appear distinct and separate when viewed through the instrument.

Rotatory power is the power of rotating the plane of polarized light, given in general by θ/l where θ is the total rotation which occurs in a distance l.

The **molecular** or **atomic rotatory power** is the product of the specific rotatory power by the molecular or atomic weight. Magnetic rotatory power is given by

$$\theta/eH \quad \cos \alpha$$

where H the intensity of the magnetic field, and α the angle between the field and the direction of the light.

Snell's law of refraction.—If i is the angle of incidence, r the angle of refraction, v the velocity of light in the first medium, v' the velocity in the second medium, the index of refraction n,

$$n=\frac{\sin i}{\sin r}=\frac{v}{v'}.$$

Specific rotation.—If there are n grams of active substance in v cubic centimeters of solution and the light passes through l centimeters, r being the observed rotation in degrees, the specific rotation (for 1 centimeter),

$$[\alpha] = \frac{rv}{nl}.$$

Spectral series are spectral lines or groups of lines which occur in an orderly sequence. Many sequences may be represented by the equation

$$\frac{1}{\lambda} = A - \frac{BN}{(m+\alpha+\beta/m^2)^2}.$$

where λ is the wave length, m an integer varying from one line to another of the series. A, B, N, α and β are constants. B is an integer, N is Rydberg's constant.

Spherical aberration.—When large surfaces of spherical mirrors or lenses are used the light divergent from a point source is not exactly focused at a point. The phenomenon is known as spherical aberration. For axial pencils the error is known as axial spherical aberration; for oblique pencils, coma.

Spherical mirrors.—If R is the radius of curvature, F principal focus, and f_1 and f_2 any two conjugate focal distances,

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{F} = \frac{2}{R}.$$

If the linear dimensions of the object and image be O and I respectively and u and v their distances from the mirror,

$$\frac{O}{I} = \frac{u}{v}.$$

Total reflection.—When light passes from any medium to one in which the velocity is greater, refraction ceases and total reflection begins at a certain critical angle of incidence θ such that

$$\sin\theta = \frac{1}{n}.$$

where n is the index of the first medium with respect to the second. If the second medium is air n has the ordinary value for the first medium. For any other second medium,

$$n = \frac{n_1}{n_2}.$$

where n_1 and n_2 are the ordinary indices of refraction for the first and second medium respectively.

Visibility is measured by the ratio of the luminous flux in lumens to the total radiant energy in ergs per second or in watts.

MEASURES AND UNITS

FUNDAMENTAL STANDARDS

The primary standard of *length* is defined as the distance between two lines at 0° C on a platinum-iridium bar known as the International Prototype Meter deposited at the International Bureau of Weights and Measures. The International Prototype Meter is 1553164.13 times the wave length of the red cadmium line in air, 760 mm. pressure, 15° C.

The primary standard of *mass* is defined as the mass of the International Prototype Kilogram of platinum-iridium kept at the International Bureau of Weights and Measures at Sèvres. It is equal to the mass of 0.001000027 cubic meter of pure water at 4° C and 760 mm. pressure.

The primary standard of *time* is the mean solar second, one eighty six thousand four hundredth (1/86400) part of a mean solar day.

The standard scale of *temperature* adopted by the International Committee of Weights and Measures 1887 is based on the variations in pressure of hydrogen at constant volume. The hydrogen is taken at an initial pressure, at the temperature of melting ice, of one meter of mercury (0° C., sea level, latitude 45°). The scale is defined by taking the temperature of melting ice as 0° and that of condensing steam under 760 mm. pressure as 100°. This is known as the Centigrade (C) scale.

The *absolute* or *thermodynamic temperature scale* proposed by Lord Kelvin is based on the average kinetic energy per molecule of a perfect gas. The temperature of melting ice is 273.13° and that of the boiling point of water 373.13°. This is frequently referred to as the Kelvin (K) scale.

WEIGHTS AND MEASURES

Metric System

Lengths

Millimeters (mm)	Centimeters (cm)	Decimeters (dm)	Meters (m)	U. S. Equivalent	British Imperial Equivalent
1	0.1	0.01	0.001	0.0393700 inch	0.03937011 inch
10	1	.1	.01	0.393700 inch	0.3937011 inch
100	10	1	.1	3.93700 inches 0.3280833 foot	3.937011 inches 0.3280843 foot
1000	100	10	1	39.3700 inches 3.280833 feet	39.37011 inches 3.28084 feet

Meters (m)	Dekameters (dkm)	Hectometers (hm)	Kilometers (km)	U. S. Equivalent	British Imperial Equivalent
1	0.1	0.01	0.001	1.093611 yards 0.198838 rod	1.09361425 yards
10	1	.1	.01	10.93611 yards 1.98838 rods	10.9361425 yards
100	10	1	.1	19.8838 rods	109.361425 yards
1000	100	10	1	0.62137 mile	0.62137 mile

1 millionth micron ($\mu\mu$) = 10^{-12} meter = 10^{-10} centimeter = 0.01 Ångström units
1 Ångström unit or Ångström (Å U or A) = .0000000001 or 10^{-10} meter
1 milli-micron or micro millimeter ($m\mu$) = one one-thousandth micron = 10^{-7} centimeter = 10 Ångström units
1 micron (μ) .001 millimeter = 10^{-6} meter = 10^{-4} centimeter = 10,000 Ångström units = 0.00003937 inch
1 myriameter = 10,000 meters = 6.2137 miles

WEIGHTS AND MEASURES (Continued)

Metric System (Continued)

Area

Sq. Millimeters (mm^2)	Sq. Centimeters (cm^2)	Sq. Decimeters (dm^2)	Sq. Meters, Centares (m^2, ca.)	U. S. Equivalent	British Imperial Equivalents
1	0.01	0.0001	0.000001	0.00155 sq. in.	0.001550 sq. in.
100	1	.01	.0001	0.154999 sq. in.	0.155001 sq. in.
10,000	100	1	.01	15.4999 sq. in.	15.5001 sq. in.
1,000,000	10,000	100	1.	10.76387 sq. ft.	10.76390 sq. ft.

Sq. Meters, Centares (m^2, ca)	Sq. Dekameters Ares (dkm^2, a)	Sq. Hectometers Hectares (hm^2, ha)	Sq. Kilometers (km^2)	U. S. Equivalents	British Imperial Equivalents
1	0.01	0.0001	0.000001	0.039537 sq. rod	1.1960 sq. yds.
100	1	.01	.0001	0.02471 acre	119.60 sq. yds.
10,000	100	1	.01	2.471 acres	2.4711 acres
1,000,000	10,000	100	1	0.3861006 sq. mile	

WEIGHTS AND MEASURES (Continued)

Metric System (Continued)

VOLUME

Cu. Millimeters (mm^3)	Cu. Centimeters (cm^3, cc)	Cu. Decimeters (dm^3)	Cu. Meters (m^3)	U. S. and British Equivalents
1	0.001	0.000001	0.000000001	0.0000610 cu. inch
1000	1.	.001	.000001	0.0610 cu. inch
1,000,000	1000	1	.001	61.024 cu. inches
1,000,000,000	1,000,000	1,000	1	35.315 cu. feet,
				1.3080 cu. yards

1 stere = 1 cubic meter

CAPACITY

1 liter is the volume of pure water at 4° C. and 760 mm. pressure which weighs 1 kilogram. 1 liter = 1.000027 cubic decimeter = 1000.027 cubic centimeters.

Milliliter (ml)	Centiliters (cl)	Deciliter (dl)	Liter (l)	U. S. Equivalents	British Imperial Equivalents
1	0.1	0.01	0.001	16.231 minims 0.0610 cu. inch	0.0610 cu. inch
10	1	.1	.01	2.70518 fl. drams	0.070 gill
100	10	1	.1	3.38147 fl. ounces	0.176 pint
1000	100	10	1	270.518 fl. drams 33.8147 fl. ounces	1.75980 pints

WEIGHTS AND MEASURES (Continued)

Metric System (Continued)

CAPACITY (Continued)

Liters (l)	Dekaliters (dkl)	Hectoliters (hl)	Kiloliters (kl)	U. S. Equivalents	British Imperial Equivalents
1	0.1	0.01	0.001	1.05671 liq. quart 0.264178 gallon 1.8162 dry pints 0.9081 dry quart	.2200 gallon
10	1	.1	.01	18.162 dry pints 9.081 dry quarts 1.13513 pecks	2.200 gallons
100	10	1	.1	2.8378 bushels	
1000	100	10	1	....	3.437 quarters

MASS

Milligrams (mg)	Centigrams (cg)	Decigrams (dg)	Grams (g)	U. S. Equivalents	British Imperial Equivalents
1	0.1	0.01	0.001	0.015432356 grain	0.01543236 grain
10	1	.1	.01	0.15432356 grain	0.1543236 grain
100	10	1	.1	1.5432356 grains	1.543236 grains
1000	100	10	1	15.432356 grains 0.5643833 dram av. 0.03527396 ounce av.	15.43236 grains 0.564383 dram av. 0.0352739 ounce av.

WEIGHTS AND MEASURES (Continued)

Metric System (Continued)

Mass (Continued)

Grams (g)	Dekagrams (dkg)	Hectograms (hg)	Kilograms (kg)	U. S. Equivalents	British Imperial Equivalents
1	0.1	0.01	0.001	0.771618 scruple 0.2572059 dram apoth. 0.03215074 ounce apoth. 0.0022046 pound av.	0.77162 scruple 0.64301 pennyweight 0.03215 ounce troy
10	1	.1	.01	5.643833 drams av.	5.64383 drams av.
100	10	1	.1	3.527396 ounces av.	3.52739 ounces av.
1000	100	10	1	2.204622341 pounds av. 2.6792285 pounds Troy or apoth.	2.2046223 pounds av.

1 kilogram = 15432.35639 grains = 0.00110231 short ton = 0.00098421 long ton.
1 metric carat = 200 milligrams = 3.0864712 grains.
1 myriagram = 10000 g. = 10 kg. = 22.04622 pounds av.
1 quintal (metric) = 100 kg. = 220.46 pounds av.
1 millier or tonne = 1000 kg. = 2204.62 pounds av. = 2679.23 pounds troy = 0.98420640 long ton = 1.1023112 short tons.

Prefixes

The prefixes mega-, meaning one million, and micro-, one millionth, are used in connection with various simple and derived units of the metric system.

WEIGHTS AND MEASURES (Continued)

U. S. System

Miscellaneous Units and Equivalents

LENGTHS

The United States standard yard is defined as 3600/3937ths meter.

Inches (in.)	Feet (ft.)	Yards (yd.)	Rods (rd.)	Miles (mi.)	Metric Equivalent
1	0.08333	0.027778	0.00505051	0.000015783	2.54001 centimeters
12	1	.33333	.0606061	.000189394	0.304801 meter
36	3	1	0.181818	.000568182	0.914402 meter
198	16.5	5.5	1	.003125	5.029210 meters
63,360	5280.	1760.	320.	1	1.60935 kilometers

1 mil = 0.001 inch = 25.4001 microns = .0254001 millimeter
1 hand = 4 inches = 10.1600 centimeters
1 span = 9 inches = 22.86005 centimeters
1 fathom (fath.) = 6 feet = 1.828804 meters
1 link (li.) = 0.66 foot = 7.92 inches = 20.11684 centimeters
1 rod (rd.) = 25 links = 5.029210 meters
1 surveyor's or Gunter's chain (ch.) = 4 rods = 100 links = 66 feet = 20.11684 meters
1 engineer's or Ramsden's chain = 100 links of one foot each = 100 feet = 30.4801 meters
1 knot or nautical mile = 1.1516 statute miles = 6080.27 feet = 1.85325 kilometers = 1′ of arc on the Earth's surface at the equator

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Lengths (Continued)

1 British yard = 3 feet = 36 inches = 0.914399 meter
1 British inch = 2.539998 centimeters
1 British mile = 1760 yards = 1.60934 kilometers
1 furlong (fur.) = 40 rods = 220 yards = 660 feet = 201.168 meters
1 pole (British) = 5.5 yards = 5.0292 meters = approximately 1 rod
1 British fathom = 6.08 feet
1 toise = 6 Paris feet = 1.94904 meters
1 Paris foot (pied) = 12 Paris inches = 0.324839 meter
1 Paris inch (pouce) = 12 Paris lines = 2.70700 centimeters
1 Paris line (ligne) = .225583 centimeter
1 light year = 5.9×10^{12} miles = 9.5×10^{12} kilometers
1 point (type sizes) = 1/72 or 0.01389 inch.
1 line = 1/12 or 0.08333 inch.
1 cubit = 18 inches

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

AREA

Sq. Inches (sq. in.)	Sq. Feet (sq. ft.)	Sq. Yards (sq. yd.)	Sq. Rods (sq. rd.)	Acres (A.)	Sq. Miles (sq. mi.)	Metric Equivalent
1	0.0069444	....	....	....	....	6.452 sq. centimeters
144	1	0.111111	....	....	....	0.09290 sq. meter
1296	9	1	0.03305785	....	....	0.8361 sq. meter
	272.25	30.25	1	0.00625	....	25.29295 sq. meters or centares
	43560	4840	160	1	0.0015625	40.46873 ares
	27,878,400	3,097,600	102,400	640	1	2.589998 sq. kilometers

1 square mil = .000001 square inch = .000645 square millimeters
1 circular mil = area of a circle whose diameter is one mil = .000000785 square inches
1 square link = 62.7264 square inches = 404.6873 square centimeters
1 square rod (sq. rd.) = 625 square links = 25.29295 square meters
1 square chain (sq. ch.) = 16 square rods = 404.6873 square meters
1 acre (A) = 10 square chains = 4046.873 square meters

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1 British square yard = 9 square feet = 0.836126 square meter
1 British square foot = 144 square inches = 9.2903 square decimeters
1 British square inch = 6.4516 square centimeters
1 square perch (British) = 30.25 square yards = 25.293 square meters
1 rood (British) = 40 square perches = 10.117 ares or square dekameters
1 acre (British) = 4 roods

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

VOLUME

Cubic Inches (cu. in.)	Cubic Feet (cu. ft.)	Cubic Yards (cu. yd.)	Metric Equivalent
1	0.00057870	....	16.387 cubic centimeters
1728	1	0.037037	0.02832 cubic meter
46,656	27	1	0.765 cubic meter

1 board foot (bd. ft.) = 144 cubic inches = 2359.8 cubic centimeters
1 cord = 128 cubic feet = 3.625 cubic meters
1 British cubic foot = 1728 cubic inches = 0.028317 cubic meter
1 British cubic yard = 27 cubic feet = 0.76455 cubic meter
1 cubic foot = 6.229 British gallons = 7.481 U. S. gallons
1 cubic yard = 168.17 British gallons

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Capacity — Liquid Measure

Gills	Pints (pt.)	Quarts (qt.)	Gallons (gal.)	Cubic Inches	Metric Equivalent
1	0.25	0.125	0.03125	7.21875	118.292 milliliters
4	1	0.5	0.125	28.875	0.473167 liter
8	2	1	0.25	57.75	0.946333 liter
32	8	4	1	231.	3.785332 liters

1 gill = 4 fluid ounces = 1.18 deciliters
1 gallon (U. S.) of water at 15° weighs about 8.337 pounds av. or 3.782 kilograms = 0.83268 British gallon
1 hogshead = 63 gallons
1 firkin = 9 gallons = 34.06799 liters
1 tun = 252 gallons
1 British gill = 1.42 deciliters
1 British pint = 4 gills = 0.568 liter
1 British quart = 2 pints = 1.136 liters
1 British gallon = 4 quarts = 277.3 cubic inches = 0.160 cubic foot = 4.5459631 liters
1 British gallon of water at 15° C. weighs 10 pounds = 1.20094 U. S. gallons

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Apothecaries' Fluid Measure

Minims (min. or ℳ)	Fluid Drams (fl. dr. or ʒ)	Fluid Ounces (fl. oz. or ℥)	Pints (pt.)	Metric Equivalent
1	0.016667	0.0020833	.....	0.0616102 milliliter
60	1	0.125	.....	3.69661 milliliters
480	8	1	0.0625	29.5729 milliliters
7680	128	16	1	0.473167 liter

1 fluid ounce = 1.80469 cubic inches
1 gallon = 128 fluid ounces = 8 pints
1 British Imperial gallon = 8 pints = 160 fluid ounces = 4.5459631 liters
1 British fluid ounce = 8 drachms = 28.4130 cubic centimeters
1 British fluid drachm = 60 minims = 3.5515 cubic centimeters
1 British minim = 0.05919 cubic centimeters

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Dry Measure

Pints (pt.)	Quarts (qt.)	Pecks (pk.)	Bushels (bu.)	Cubic Inches	Metric Equivalents
1	0.5	0.0625	0.015625	33.6003125	0.550599 liters
2	1	0.125	0.03125	67.200625	1.101198 liters
16	8	1	0.25	537.605	8.80958 liters
64	32	4	1	2150.42	35.2383 liters

1 British peck = 2 British gallons = 554.6 cubic inches = 9.092 liters
1 British bushel = 8 British gallons = 2219.3 cubic inches = 36.37 liters = 1.03151 U. S. bushels
1 British quarter = 8 bushels = 2.909 hectoliters
1 U. S. bushel = 0.96945 British bushel

Mass

Note: Three systems are in use, — avoirdupois, troy, and apothecaries'. The grain is the same in all.

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Avoirdupois — Commercial

The U. S. Standard pound avoirdupois is defined as 453.5924277 grams.

Grains (gr.)	Drams (dr. av.)	Ounces (oz. av.)	Pounds (lb. av.)	Tons (short) (tn.)	Metric Equivalents
1	0.03657	....	....	......	0.064798918 gram
27.34375	1	0.0625	....	......	1.771845 grams
437.5	16	1	0.0625	......	28.349527 grams
7000.	256	16	1	0.0005	453.5924 grams 0.4535924 kilogram
....	....	32000	2000	1	907.18486 kilograms

1 pound avoirdupois is the mass of 27.692 cubic inches of water weighed in air at 4° C., 760 mm. pressure
1 short hundredweight (cwt.) = 100 pounds = 45.359243 kilograms
1 short ton = 20 short hundredweight = 2,430.56 troy pounds = 907.18486 kilograms
1 stone (British) = 14 pounds = 6.350 kilograms
1 quarter (British) = 28 pounds = 12.70 kilograms
1 long hundredweight (British) = 4 quarters = 112 pounds = 50.802352 kilograms
1 long ton (British) = 20 long hundredweight = 1016.04704 kilograms
1 long ton = 1.12000 short tons = 2722.22 troy pounds = 1.01605 metric tons
1 short ton = 0.89287 long ton = 29,166.66 troy or apothecaries' ounces = 0.90718 metric ton
1 avoirdupois pound = 1.21528 troy or apothecaries' pounds = 14.5833 troy ounces
1 avoirdupois ounce = 0.9115 troy or apothecaries' ounce

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Troy Weight

Grains (gr.)	Pennyweights (dwt.)	Ounces (oz. t.)	Pounds (lb. t.)	Metric Equivalents
1	0.0416667	0.0020833	....	64.798918 milligrams = 0.064798918 gram
24	1	0.05	0.0041667	1.555174 grams
480	20	1	0.08333	31.103481 grams
5760	240	12	1	373.24177 grams

1 troy pound = $\frac{5760}{7000}$ or 0.822857 avoirdupois pound = 13.1657 avoirdupois ounces

1 carat (1877) = 3.168 grains = 205.6 milligrams
1 troy ounce = 1.09712 avoirdupois ounces
1 troy pound = 0.00036735 long·ton = 0.00041143short ton = 0.00037324 metric ton

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Apothecaries' Weight

Grains (gr.)	Scruples (℈ or s. ap.)	Drams (ʒ or dr. ap.)	Ounces (℥ or oz. ap.)	Pounds (lb. ap.)	Metric Equivalents
1	0.05000	0.016667	0.0020833	....	64.798918 milligrams
20	1	0.3333	0.041667	0.003472	1.2959784 grams
60	3	1	0.12500	0.010416	3.8879351 grams
480	24	8	1	0.08333	31.103481 grams
5760	288	96	12	1	373.24177 grams

Time

Seconds (sec.)	Minutes (min.)	Hours (hrs.)	Days	Years (yrs.)
1	0.016667	0.00027778		
60	1	0.016667	0.000490196	
3600	60	1	0.041667	
86400	1440	24	1	
.....	....	....	365.242218	1 (common)
.....	....	....	365.256	1 (sidereal)

1 lunar month (mo.) = 29 days 12 hr. 44 min. 1 sidereal second = 0.99727 mean solar second

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

Angle

Seconds (″)	Minutes (′)	Degrees (°)	Circumference	
1	0.016667	0.00027778	....	2π radians = 360° = circumference
60	1	0.016667	....	π radians = 180°
3600	60	1	0.0027778	$\frac{\pi}{2}$ radians = 90°
1,296,000	12,600	360	1	$\frac{\pi}{4}$ radians = 45°

1 degree = 0.017453 radian

1 radian = 57° 17′ 44.8″ = 57.2958° = 3437.75′ = 206265″ = $\frac{1}{2\pi}$ of a circumference

1 grade = $\frac{1}{400}$ circumference = 100 centesimal minutes = 0.0157079 radian

1 centesimal minute = 100″ centesimal seconds

Solid Angle

1 steradian = $\frac{1}{4\pi}$ of the solid angle around a point.

UNITS AND CONVERSION FACTORS

Each unit named is followed by its equivalent in one or more other units of the same quantity. While the list of equivalents is incomplete it is intended to include all those which will be in common use.

Symbols in the dimensional formulae given after the headings have the following significance: m, mass; l, length; t, time; θ, temperature; ϵ, dielectric constant of a vacuum; μ, permeability of a vacuum.

Mass, Length, Time, Angle, Area and Volume

Acre (A.) (U. S.).—0.0015625 square mile; 10 square chains (Gunter's); 160 square rods or square perches; 4840 square yards; 4.3560×10^4 square feet; 1×10^5 square links (Gunter's); 0.4046873 hectare or square hectometer; 40.46873 ares or square dekameters; 4046.873 square meters.

Acre (A.) (British).—4 roods (British); 4840 square yards (British); 0.4046849 hectare or square hectometer; 4046.849 square meters.

Ångström Unit (Å. or Å. U.).—3.937×10^{-9} inch; 0.003937 millionths of an inch; 1×10^{-10} meter; 1×10^{-8} centimeter; 1×10^{-4} micron (μ); 0.1 milli-micron or micro-millimeter; 100 millionth microns or micro-microns ($\mu\mu$).

Are (a).—3.8610×10^{-5} square mile; 0.02471044 acre (U. S.); 119.60 square yards; 1076.4 square feet; 0.01 hectare; 1 square dekameter; 100 square meters.

Astronomical unit.—1.495×10^8 kilometers.

Bag (British).—3 bushels (dry); 0.109107 cubic meter.

Barleycorn (British).—1/3 inch; 0.84667 centimeter.

Barrel (bbl.) (U. S., dry).—3.281 bushels; 105.0 quarts (dry); 7056 cubic inches for dry commodities except cranberry barrel which = 5826 cubic inches; 0.11562 cubic meter.

Barrel (bbl.) (U. S., liquid).—31.5 gallons; 0.11924 cubic meter.

Barrel (bbl.) (British, dry).—36 gallons (British); 0.16366 cubic meter.

Board Foot (bd. ft.).—1/12 cubic foot; 144 cubic inches (1 foot × 1 foot × 1 inch); 2359.8 cubic centimeters.

Bolt (U. S., cloth.).—120 linear feet; 36.576 meters.

Bucket (British, dry).—4 gallons (British); 1.8184×10^4 cubic centimeters.

Bushel (bu.) (U. S., dry).—0.304785 barrel; 0.96945 bushel (British); 1.2444 cubic feet, 4 pecks, 32 quarts (dry); 64 pints (dry); 2150.42 cubic inches; 0.035239 cubic meter; 0.35238 hectoliter; 3.5238 dekaliters; 35.238 liters; 3.5239×10^4 cubic centimeters.

Bushel (bu.) (British, dry).—⅛ or 0.125 quarter (British, capacity); 1/3 or 0.33333 bag (British); 1.03151 bushels (U. S.); 1.2843 cubic feet; 8 gallons (British); 2219.3 cubic inches; 0.363677 hectoliter; 3.63677 dekaliters; 36.3677 liters; 3.6369×10^4 cubic centimeters.

Butt (British, dry).—126 gallons; 0.57281 cubic meter.

Cable Length (British & U. S.).—720 feet; 219.46 meters.

Carat (c) (metric).—3.08647 grains; 0.2 gram; 200 milligrams.

Carat (c) (1877).—3.168 grains, 205.6 milligrams.

Cental.—100 pounds; 45.359 kilograms.

Centare (ca).—1.196 square yards; 10.764 square feet; 1550 square inches; 0.01 are; 1 square meter.

Centigram (cg).—0.1543236 grain; 0.01 gram.

Centiliter (cl).—0.33815 ounce (fluid, U. S.); 0.61025 cubic inch; 2.705179 drams (fluid, U. S.); 0.01 liter; 10.00027 cubic centimeters.

Centimeter (cm).—0.01093611 yard (U. S.); 0.01093614 yard (British); 0.032808 foot (U. S. or British); 0.39370 inch (U. S. or British); 4.4330 lignes (Paris lines); 393.70 mils; 0.01 meter; 10 millimeters; 1×10^4 microns; 1×10^7 milli-microns or micro-millimeters; 1×10^8 Ångström units.

Chain (ch.) (Engineer's or Ramden's).—100 feet; 100 links of 1 foot each; 30.4801 meters.

Chain (ch.) (Surveyor's or Gunter's).—0.1 furlong; 0.0125 mile; 4 rods; 22 yards; 66 feet; 100 links; 792 inches; 20.117 meters; 2011.7 centimeters.

Chaldron (U. S., dry).—*36 bushels (U. S.); 1.2686 cubic meters.

Chaldron (British, dry).—*32 bushels (British); 1.1638 cubic meters.

Circle (cir.).—2π or 6.2832 radians; 12 signs; 360 degrees.

Circular Inch.—Area of circle, diameter of which is one inch; 0.78540 square inch; 5.0671 square centimeters.

Circular Mil.—Area of circle, diameter of which is one mil

*Variable.

or 1/1000 inch; 7.854×10^{-7} square inch; 0.78540 square mil; 5.0671×10^{-6} square centimeter; 5.0671×10^{-4} square millimeter.

Circular Millimeter.—0.0078540 square centimeter; 0.78540 square millimeter.

Circumference.—2π or 6.28319 radians; 360 degrees; 400 grades; 1.2600×10^{4} minutes; 1.296000×10^{6} seconds.

Clove or Customary Stone (British).—8 pounds; 3.6287 kilograms.

Coomb (British, dry).—4 bushels; 0.14548 cubic meter.

Cord (cd.).—8 cord feet; 128 cubic feet (8 feet×4 feet×4 feet); 3.625 cubic meters.

Cord-Foot (cd. ft.)—⅛ or 0.125 cord; 16 cubic feet (4 feet×4 feet×1 foot).

Cubic Centimeter (cm³).—1.3079×10^{-6} cubic yard; 2.7496×10^{-5} bushel (British); 2.83776×10^{-5} bushel (U. S.); 3.531445×10^{-5} cubic foot (U. S.); 3.531477×10^{-5} cubic foot (British); 2.1997×10^{-4} gallon (British); 2.6417×10^{-4} gallon (U. S.); 4.2376×10^{-4} board foot; 8.7988×10^{-4} quart (liquid, British), 9.0808×10^{-4} quart (dry, U. S.); 0.0010567 quart (liquid, U. S.); 0.0018162 pint (dry, U. S.); 0.0021134 pint (liquid, U. S.); 0.033814 ounce (fluid, U. S.); 0.035195 ounce (fluid, British); 0.061023 cubic inch; 0.27051 dram (fluid, U. S.); 0.28157 drachm (fluid, British); 16.231 minims (U. S.); 16.894 minims (British); 1×10^{-6} cubic meter; 9.9997×10^{-4} liter; 0.001 cubic decimeter; 0.99997 milliliter; 1000 cubic millimeters.

Cubic Decimeter (dm³).—0.0013079 cubic yard; 0.035314 cubic foot; 61.023 cubic inches; 0.001 cubic meter; 0.99997 liter; 1000 cubic centimeters.

Cubic Dekameter (dkm³).—1000 cubic meters.

Cubic Foot (ft.³ or cu. ft.) (U. S.).—1/128 or 0.0078125 cord. 0.01 register ton (British); 1/27 or 0.037037 cubic yard; 1/16 or 0.0625 cord-foot; 0.77861 bushel (British); 0.80357 bushel (U. S.); 6.229 gallons (British); 7.481 gallons (U. S.); 12 board feet; 25.714 quarts (dry, U. S.); 29.922 quarts (liquid, U. S.); 59.844 pints (liquid, U. S.); 1728 cubic inches; 0.02831701 cubic meter; 28.316 liters; 2.8317×10^{4} cubic centimeters.

Cubic Foot (ft.³ or cu. ft.) (British).—0.02831677 cubic meter; 2.831677×10^{4} cubic centimeters.

Cubic Inch (in.³ or cu. in.) (U. S.).—2.143347×10^{-5} cubic yard; 4.65025×10^{-4} bushel (U. S.); 5.78704×10^{-4} cubic foot; 0.00186010 peck; 0.0043290 gallon (U. S.); 1/144 or 0.006944 board foot; 0.014881 quart (dry, U. S.); 0.017316 quart (liquid, U. S.); 0.0297616 pint (dry); 0.5541 ounce (fluid); 4.4329 drams

(fluid); 1.6387162×10^{-5} cubic meter; 0.0163868 liter; 1.63868 centiliters; 16.3868 milliliters; 16.387162 cubic centimeters; 1.6387162×10^{4} cubic millimeters.

Cubic Inch (in.³ or cu. in) (British).—4.5081×10^{-4} bushel (British); 5.7870×10^{-4} cubic foot (British); 0.0018031 peck (British); 0.003606 gallon (British); 16.3870253 cubic centimeters.

Cubic Hectometer (hm³).—1×10^{6} cubic meters.

Cubic Kilometer (km³).—1×10^{9} cubic meters.

Cubic Meter (m³).—0.2759 cord; 1.3079428 cubic yards (U. S.); 1.307954 cubic yards (British); 28.3776 bushels (U. S.); 35.314445 cubic feet (U. S.); 35.31477 cubic feet (British); 264.173 gallons (U. S.); 1056.7 quarts (liquid); 2113.4 pints (liquid, U. S.); 6.1023×10^{4} cubic inches; 1 stere; 999.973 liters; 1000 cubic decimeters; 1×10^{6} cubic centimeters; 1×10^{9} cubic millimeters.

Cubic Millimeter (mm³).—6.1023×10^{-5} cubic inch; 0.01623 minim (U. S.); 0.01689 minim (British); 1×10^{-9} cubic meter; 0.001 cubic centimeter.

Cubic Yard (yd.³ or cu. yd.) (U. S.).—27 cubic feet; 168.17 gallons (British); 202.0 gallons (U. S.); 807.9 quarts (liquid, U. S.); 1616 pints (liquid, U. S.); 4.6656×10^{4} cubic inches; 0.76455945 cubic meter; 764.54 liters; 7.6455945×10^{5} cubic centimeters.

Cubic Yard (yd.³ or cu. yd.) (British).—27 cubic feet; 0.76455285 cubic meter.

Cubit.—18 inches; 45.72 centimeters.

Dalton.—1/16 the mass of an atom of oxygen; 1.650×10^{-24} gram.

Day (da) **(tropical, mean solar).**—24 hours (mean solar); 1440 minutes (mean solar); 8.6400×10^{4} seconds (mean solar).

Day (da) **(sidereal).**—8.6164×10^{4} seconds (mean solar).

Decigram (dg.).—1.543236 grains; 0.1 gram.

Deciliter (dl).—0.176 pint (British); 3.38147 ounces (fluid, U. S.); 0.1 liter; 100.0027 cubic centimeters.

Decimeter (dm).—0.3280833 foot (U. S.); 0.3280843 foot (British); 3.93700 inches (U. S.); 3.937011 inches (British); 0.1 meter.

Decistere (ds).—0.1 stere or cubic meter.

Degree (°).—1/360 or 0.0027778 circumference or revolution; 1/90 or 0.01111 quadrant; 0.017453 radian; 60 minutes; 3600 seconds.

Dekagram (dkg).—0.35273957 ounce (avoirdupois); 5.64383 drams (avoirdupois); 0.01 kilogram; 10 grams.

Dekaliter (dkl).—0.27497 bushel (British); 0.28378 bushel (U. S.); 1.13513 pecks (U. S.); 9.08102 quarts (U. S., dry); 18.162 pints (dry, U. S.); 10 liters; 10.00027 cubic decimeters.

Dekameter (dkm).—1.98838 rods (U. S.); 10.93611 yards (U. S.); 10.93614 yards (British); 393.70 inches; 10 meters.

Dekastere (dks).—10 steres or cubic meters.

Drachm (fluid) (dr. fl. or ʒ fl.) (British).—⅛ or 0.125 ounce (fluid, British); 60 minims; 3.5515 cubic centimeters.

Dram (apothecaries' or troy) (dr. ap. or t. or ʒ ap. or t.)—(Same as British Drachm)—0.008571429 pound (avoidrupois); 1/96 or 0.010416667 pound (apothecary or troy); ⅛ or 0.12500 ounce (apothecary or troy); 0.1371429 ounce (avoirdupois); 2.194286 drams (avoirdupois); 2.5 pennyweights; 3 scruples; 60 grains; 3.8879351 grams.

Dram (avoirdupois) (dr. av. or ʒ av.).—1/256 or 0.00390625 pound (avoirdupois); 0.0047471788 pound (apothecary or troy); 0.056966146 ounce (apothecary or troy); 0.0625 ounce (avoirdupois); 0.4557292 dram (apothecary or troy); 1.139323 pennyweights; 1.3671875 scruples; 27.34375 grains; 1.771845 grams; 1771.845 milligram.

Dram (fluid) (dr. fl. or ʒ fl.) (U.S.).—0.00390625 quart (liquid, U. S.); 0.0078125 pint (liquid, U. S.); 0.03125 gill (U. S.); ⅛ or 0.125 ounce (fluid); 0.225586 cubic inch; 60 minims; 3.6966 milliliters; 3.6967 cubic centimeters.

Ell.—45 inches; 114.30 centimeters.

Em, Pica (printing industry).—1/6 or 0.16667 inch; 0.42333 centimeter.

Fathom (fath.) (nautical).—6 feet, 1.828804 meter.

Firkin (fir.) (U. S.).—9 gallons (U. S.); 34.068 liters.

Firkin (fir.) (British).—9 gallons (British); 40.914 liters.

Fluid Ounce (fl. oz.)—See **Ounce (Fluid)**.

Foot (ft.) (U. S.)—1.6447 $\times$ 10^{-4} mile (nautical); 1.893939 $\times$ 10^{-4} mile (statute); 0.00151515 furlong; 0.0151515 chain (Gunter's); 0.0606061 rod; 1/6 or 0.16667 fathom; 1/3 or 0.33333 yard; 12 inches; 0.3048006 meter, 30.48006 centimeter; 473404 wave-lengths of red line of cadmium.

Foot (ft.) (British).—0.4 pace (British); 30.47997 centimeters.

Foot (Paris).—(See **Pied**).

Furlong (fur.) (U. S. or British).—⅛ or 0.125 mile (U. S.); 10 chains(Gunter's); 40 rods, 220 yards; 660 feet; 201.168 meters.

Gallon (gal.) (U. S.).—1 U. S. gallon of water at 15°C (62°F) weighs 3.7820 kilograms or 8.337 pounds (avoirdupois); 0.004951 cubic yard; 0.031746 barrel (liquid, U. S.); 0.13368 cubic foot; 0.83268 gallons (British); 4 quarts (liquid); 8 pints (liquid); 32 gills; 128 ounces (fluid); 231.00 cubic inches; 6.1440×10^4 minims; 0.0037854 cubic meter; 3.7853 liters; 3785.4 cubic centimeters.

Gallon (gal.) (British Imperial) (Canadian).—1 British gallon of water at 15°C (62°F) has a mass of 10 pounds (avoirdupois); 0.02778 barrel (dry, British); ⅛ or 0.125 bushel (dry, British); 0.16054 cubic foot; 0.5 peck (British); 1.20094 gallons (U. S.); 4 quarts (liquid, British); 8 pints (liquid, British); 32 gills (liquid, British); 160 ounces (fluid, British); 277.3 cubic inches; 4.54596 liters; 4546.1 cubic centimeters.

Geepound—See **Slug.**

Gill (gi.) (U. S.).—1/32 or 0.03125 gallon (U. S.); ⅛ or 0.125 quart (liquid, U. S.); ¼ or 0.25 pint (liquid, U. S.); 4 ounces (fluid); 7.21875 cubic inches; 32 drams (fluid); 1920 minims; 0.118292 liters; 118.295 cubic centimeters.

Gill (gi.) (British).—1/32 or 0.03125 gallon (British); ¼ or 0.25 pint (liquid, British); 4 ounces (fluid, British); 0.14206 liter; 142.07 cubic centimeters.

Grade—1/400 or 0.0025, circumference; 0.0157079 radian; 0.9 degree; 100 centesimal minutes.

Grain (gr.).—1/7000 or 1.42857×10^{-4} pound (avoirdupois); 1/5760 or 1.736111×10^{-4} pound (apothecary or troy); 0.0020833 ounce (apothecary or troy); 0.0022857 ounce (avoirdupois); 0.016667 dram (apothecary or troy); 0.03657143 dram (avoirdupois); 0.0416667 pennyweight (troy); 0.05000 scruple (apothecary); 0.064798918 gram; 0.3240 carat (metric); 64.798918 milligram.

Gram (g).—0.00220462 pound (avoirdupois); 0.00267923 pound (apothecary or troy); 0.0321507 ounce (apothecary or troy); 0.0352739 ounce (avoirdupois); 0.257206 dram (apothecary or troy); 0.564383 dram (avoirdupois); 0.6430149 pennyweight; 0.771618 scruple; 15.4324 grains; 1×10^{-6} ton (metric); 1×10^{-4} myriagram; 0.001 kilogram; 5 carats (metric); 1000 milligrams; 1×10^6 microgram.

Hand.—4 inches; 10.160 centimeters.

Hectare (ha)—2.471044 acres (U. S.); 2.471058 acres (British); 395.367 square rods (U. S.); 1.195985×10^4 square yards (U. S.); 1.0764×10^5 square feet; 100 ares; 1×10^4 square meters.

Hectogram (hg).—3.52739 ounces (avoirdupois); 100 grams.

Hectoliter (hl).—2.7497 bushels (British); 2.8378 bushels (U. S.); 11.3513 pecks (U. S.); 100 liters.

Hectometer (hm).—19.8838 rods; 109.3611 yards (U. S.); 109.3614 yards (British); 328.08 feet (U. S.); 100 meters.

Hemisphere.—0.5 sphere; 4 spherical right angles; 6.2832 steradians.

Hogshead (hhd.) **(British).**—63 gallons (British); 10.114 cubic feet; 0.28640 cubic meters.

Hogshead (hhd.) **(U. S.).**—63 gallons (U. S.); 8.4218 cubic feet; 0.23848 cubic meter.

Hour (hr.) **(tropical, mean solar).**—0.0059524 week; 0.041667 day (mean solar); 60 minutes (mean solar); 3600 seconds (mean solar).

Hundredweight (cwt.) **(short).**—100 pounds; 0.044643 ton (long); 0.05 ton (short); 4 quarters (British); 1600 ounces (avoirdupois); 0.0453592 ton (metric); 45.3592 kilograms.

Hundredweight (cwt.) **(long).**—112 pounds; 0.05 ton (long); 4 quarters (British); 50.8023 kilograms.

Inch (in.) **(U. S.).**—1.57828×10^{-5} mile; 0.00126263 chain (Gunter's); 0.00505051 rod; 1/36 or 0.027778 yard; 1/12 or 0.08333 foot; 0.126263 link (Gunter's); 72 points (printer's type); 1000 mils; 2.540005 centimeter; 25.40005 millimeters; 2.5400×10^{8} Ångström unit; 39450.33 wave lengths of red line of cadmium.

Inch (in.) **(British).**—1/36 or 0.027778 yard (British); 1/9 or 0.1111 quarter (British, linear); 2.539998 centimeters; 25.39998 millimeter.

Inch (Paris).—See **Pouce.**

Kilderkin (British).—18 gallons (British); 0.081830 cubic meter.

Kilogram (kg).—9.842064×10^{-4} ton (long); 0.0011023112 ton (short); 0.019684 hundredweight (long); 0.022046223 hundredweight (short); 0.07874 quarter (British); 2.2046223 pounds (avoirdupois); 2.6792285 pounds (apothecary or troy); 32.150742 ounces (apothecary or troy); 35.273957 ounces (avoirdupois); 257.21 dram (apothecary or troy); 564.38 dram (avoirdupois); 643.01 pennyweight; 771.62 scruples; 1.54324×10^{4} grains; 0.001 ton (metric); 1000 grams.

Kiloliter (kl).—1.3080 cubic yards; 35.316 cubic feet; 264.18 gallons (liquid, U. S.); 1.000027 cubic meters; 1000 liters.

Kilometer (km).—1.0567×10^{-13} light year; 0.53961 mile (nautical); 0.62137 mile (statute); 1093.6 yards; 3280.8 feet; 0.1 myriameter; 1000 meters; 1×10^{5} centimeters.

Knot as a unit of length.—1 nautical mile, which see. The knot is properly a unit of speed or velocity. See under that heading.

Last (British).—*80 bushels; 2.9095 cubic meters.

League (statute).—3 statute miles; 4.8280 kilometers.

League (nautical).—3 nautical miles; 5.5597 kilometers.

Light Year (yr.).—5.9×10^{12} miles; 9.4637×10^{12} kilometers.

Ligne (Paris line).—1/12 or 0.083333 pouce or Paris inch; 0.225583 centimeter.

Line (British) (obsolete)—1/12 or 0.08333 inch; 0.21167 centimeters.

Link (li.) (Engineer's or Ramden's).—0.01 chain (Engineer's); 1 foot; 12 inches; 30.480 centimeter.

Link (li.) (Surveyor's or Gunter's).—1.2500×10^{-4} mile 0.01 chain (Gunter's); 0.04 rod; 0.22 yards; 0.66 foot; 7.92 inches; 0.2011684 meter; 20.11684 centimeters.

Liter (l).—0.0013080 cubic yard; 0.027497 bushel (British); 0.028378 bushel (U. S.); 0.21998 gallon (British); 0.26417762 gallon (U. S.); 0.035316 cubic foot; 0.10999 peck (British); 0.11351 peck (U. S.); 0.87990 quart (British); 0.90811 quart (dry, U. S.); 1.056710 quarts (liquid, U. S.); 1.7598 pints (British); 1.8162 pints (dry, U. S.); 2.1134 pints (liquid, U. S.); 7.0392 gills (British); 8.4538 gills (U. S.); 33.8147 ounces (fluid, U. S.); 35.196 ounces (fluid, British); 61.025 cubic inches; 270.5179 drams (fluid, U. S.); 0.001000027 cubic meter; 1.000027 cubic decimeter; 1000.027 cubic centimeter.

Megameter.—1×10^{6} meter.

Meter (m).—5.3961×10^{-4} mile (nautical); 6.2137×10^{-4} mile (statute); 0.00497096 furlong; 0.0497096 chain (Gunter's); 0.198838 rod (U. S.); 0.54681 fathom; 1.093611 yards (U. S.); 1.093614 yards (British); 3.0784 pied (French foot); 3.280833 feet (U. S.); 3.280843 feet (British); 4.970960 links (Gunter's); 39.3700 inches (U. S.); 39.3701 inches (British); 1×10^{-6} megameter; 0.001 kilometer; 100 centimeters; 1×10^{9} milli-microns or micro-millimeters; 1×10^{10} Angstrom unit; 1×10^{12} millionth microns ($\mu\mu$) 1.55316413×10^{6} wave-lengths of red line of cadmium.

Metric carat (c) See **Carat** (**metric**).

Metric Ton (t) See **Tonne.**

Microgram (μg or γ).—1×10^{-6} gram; 0.001 milligram.

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*Variable.

Microliter (μ**l or** λ).—1×10^{-6} liter.

Micromicron ($\mu\mu$).)—1×10^{-12} meter.

Micron (μ).—3.937×10^{-5} inch; 0.039370 mil; 39.37 millionths of an inch; 1×10^{-6} meter; 1×10^{-4} centimeter; 0.001 millimeter; 1000 milli-microns or micro-millimeters; 1×10^{4} Ångström units.

Mil.—0.001 inch; 0.00254001 centimeter; 0.0254001 millimeter; 25.4001 microns.

Mile (mi.) (**U. S., statute**).—1.69×10^{-13} light year; 0.86836 mile (nautical); 8 furlongs; 80 chains (Gunter's); 320 rods; 1760 yards; 5280 feet; 8000 links (Gunter's); 6.3360×10^{4} inches; 0.160935 myriameters; 1.60935 kilometers; 1609.35 meters.

Mile (mi.) (**British**).—1.60934 kilometers.

Mile (mi.) (**nautical**).—The length of 1 minute of arc on the earth's surface at the equator; 1/3 or 0.33333 league; 1.1516 miles (statute); 2026.8 yards; 6080.2 feet; 1.85325 kilometers.

Millier (t) See **Tonne.**

Milligram (**mg**). — 2.2046×10^{-6} pound (avoirdupois); 2.67923×10^{-6} pound (apothecary or troy); 3.215074×10^{-5} ounce (apothecary or troy); 3.52739×10^{-5} ounce (avoirdupois); 2.57206×10^{-4} dram (apothecary or troy); 5.64383×10^{-4} dram (avoirdupois); 6.43015×10^{-4} pennyweight; 7.71618×10^{-4} scruple; 0.01543236 grain; 1×10^{-6} kilogram; 0.001 gram; 0.005 carat (metric).

Milliliter (**ml**).—0.0084538 gill (U. S.); 0.0338147 ounce (fluid, U. S.); 0.035196 ounce (fluid, British); 0.061025 cubic inch; 0.2705179 dram (fluid, U. S.); 16.2311 minims (U. S.); 0.001 liter; 1.000027 cubic centimeter.

Millimeter (**mm**).—0.0393700 inch (U. S.); 0.0393701 inch (British); 39.37 mils; 0.001 meter; 0.1 centimeter; 100 microns.

Milli-Micron or Micro-Millimeter (mμ).—1×10^{-9} meter; 1×10^{-7} centimeter; 0.001 micron; 10 Ångström units.

Millionth Micron or Micro-Micron ($\mu\mu$).—1×10^{-12} meter; 1×10^{-10} centimeter; 0.01 Ångström units.

Minim (**min. or** ♍) (**British**).—0.059194 cubic centimeter.

Minim (**min. or** ♍) (**fluid, U. S.**).—1/61440 or 1.6276×10^{-5} gallon (U. S.); 1.3021×10^{-4} pint (liquid, U. S.); 5.2083×10^{-4} gill (U. S.); 1/480 or 0.0020833 ounce (fluid, U. S.); 1/60 or 0.016667 dram (fluid, U. S.); 0.061610 milliliter; 0.061612 cubic centimeter; 61.612 cubic millimeter.

Minute (′) (**angle**).—1.8519×10^{-4} quadrant; 2.90888×10^{-4} radian; 1/60 or 0.016667 degree; 60 seconds.

Minute (**min.**) (**time**).—9.9206×10^{-5} week; 4.90196×10^{-4} day; 0.016667 hour; 60 seconds.

Month (**mo.**) (**mean calendar**).—30.42 days; 730 hours; 4.3800×10^{4} minutes; 2.628×10^{6} seconds.

Month (**mo.**) (**lunar**).—29 days 12 hours 44 minutes.

Myriagram (**Mg**).—22.04622 pounds (avoirdupois); 10 kilograms; 1×10^{4} grams.

Myriameter (**Mm**).—6.21372 miles; 10 kilometers; 1×10^{4} meters.

Nail (**British**).—2.25 inch; 5.715 centimeters.

Noggin (**British**).—1/32 or 0.03125 gallon (liquid); 142.06 cubic centimeters.

Ounce (**Fluid**) (**oz. fl. or ℥ fl.**) (**U. S.**).—1/128 or 0.0078125 gallon (U. S.); 0.03125 quart (liquid, U. S.); 1/16 or 0.0625 pint (liquid); ¼ or 0.25 gill (U. S.); 1.80469 cubic inches; 8 drams (fluid); 480 minims; 0.0295729 liter; 0.295729 deciliter; 29.5729 milliliters; 29.5737 cubic centimeters.

Ounce (**fluid**) (**oz. fl. or ℥ fl.**) (**British**).—0.006250 gallon (British); 8 drachms (fluid, British); 480 minims; 28.4130 cubic centimeters.

Ounce (**avoirdupois**) (**oz. av. or ℥ av.**).—2.790179×10^{-5} ton (long); 3.125×10^{-5} ton (short); 6.25×10^{-4} hundredweight (short); 1/16 or 0.062500 pound (avoirdupois); 0.075954861 pound (apothecary or troy); 0.9114583 ounce (apothecary or troy); 7.29166 drams (apothecary or troy); 16 drams (avoirdupois); 18.22917 pennyweights; 21.875 scruples (apothecary); 437.5 grains; 2.83495×10^{-5} ton (metric); 28.349527 grams.

Ounce (**apothecary or troy**) (**oz. ap. or t. or ℥ ap. or t.**).—3.4285×10^{-5} ton (short); 0.06857143 pound (avoirdupois); 0.08333 pound (apothecary or troy); 1.09714 ounces (avoirdupois); 8 drams (apothecary or troy); 17.55428 drams (avoirdudupois); 20 pennyweights (troy); 24 scruples; 480 grains; 31.103481 grams; 3.1103481×10^{4} milligrams.

Pace.—2½ feet; 30 inches (British); 76.2 centimeters.

Palm (**British**).—3 inches; 7.62 centimeters.

Parsec.—19×10^{12} miles; 3.084×10^{13} kilometers.

Peck (**pk.**) (**U. S.**).—¼ or 0.25 bushel; 8 quarts; 16 pints; 537.605 cubic inches; 0.880958 dekaliter; 8.80958 liters.

Peck (**pk.**) (**British**).—2 gallons (British); 554.6 cubic inches; 9.0923 liters.

Pennyweight (**dwt.**) (**troy**).—0.003428571 pound (avoirdupois); 0.0041667 pound (apothecary or troy); 1/20 or 0.05

ounce (apothecary or troy); 0.0548571 ounce (avoirdupois); 0.8777143 dram (avoirdupois); 24 grains; 1.55517 grams; 1555.17 milligrams.

Perch (British & U. S.).—1 rod; 16.5 feet; 5.0292 meters.

Perch (masonry).—24.75 cubic feet.

Pied (French foot).—1/6 or 0.16667 toise (French); 12 Paris inches; 0.3248 meter.

Pint (pt.) (dry, U. S.).—1/64 or 0.015625 bushel; 0.0625 peck; 0.5 quart; 33.600 cubic inches; 0.550599 liter; 550.61 cubic centimeters.

Pint (pt.) (liquid, U. S.).—6.1881×10^{-4} cubic yard; 0.016711 cubic foot; 1/8 or 0.125 gallon (U. S.); 0.5 quart (U. S.); 0.83268 British pint; 4 gills (U. S.); 16 fluid ounces (U. S.); 28.875 cubic inches; 128 fluid drams; 7680 minims; 0.473167 liter; 473.167 milliliters; 473.179 cubic centimeters.

Pint (pt.) (liquid, British).—1/8 or 0.125 gallon (British); 0.5 quart (British); 1.20094 U. S. pints; 4 gills (British); 20 fluid ounces (British); 0.56825 liter; 568.25 milliliters; 568.26 cubic centimeters.

Point (printer's type).—1/72 or 0.01389 inch; 0.035278 centimeter.

Pole (British).—1 rod; 5.5 yards; 16.5 feet; 5.0292 meters.

Pottle (British).—1/2 gallon (liquid); 2.273 cubic decimeters.

Pouce (Paris inch).—1/12 or 0.083333 pied or Paris foot; 12 lignes or Paris lines; 2.70700 centimeters.

Pound (avoirdupois) (lb. av.) (U. S. or British).—Is the mass of 27.692 cubic inches of water weighed in air at 4° C, 760 mm pressure; 4.464286×10^{-4} ton (long); 5×10^{-4} ton (short); 0.0089286 hundredweight (long); 0.01 hundredweight (short); 1.2152778 pounds (apothecary or troy); 14.5833 ounces (apothecary or troy); 16 ounces (avoirdupois); 116.6667 drams (apothecary or troy); 256 drams (avoirdupois); 291.6667 pennyweights; 350.01 scruples; 7000 grains; 4.5359243×10^{-4} ton (metric); 0.4535924 kilogram; 453.5924 grams.

Pound (apothecary or troy) (lb. ap. or t.) (U. S. or British).—3.6735×10^{-4} ton (long); 4.1143×10^{-4} ton (short); 0.822857 pound (avoirdupois); 12 ounces (apothecary or troy); 13.165714 ounces (avoirdupois); 96 drams (apothecary or troy); 210.6514 drams (avoirdupois); 240 pennyweights; 288 scruples; 5760 grains; 3.7324×10^{-4} ton (metric); 0.3732418 kilogram; 373.2418 grams.

Puncheon (British).—70 gallons (British); 84 wine gallons; 0.31823 cubic meter.

Quadrant.—1.57080 radians; 90 degrees; 5400 minutes.

Quart (qt.) (U. S., dry).—1/32 or 0.03125 bushel; 0.038889 cubic foot; ⅛ or 0.125 peck; 2 pints (dry); 67.2006 cubic inches; 1.10120 liters; 1101.23 cubic centimeters.

Quart (qt.) (U. S., liquid).—0.033421 cubic foot; ¼ or 0.25 gallon; 2 pints (liquid); 8 gills; 32 ounces (fluid); 57.749 cubic inches; 256.00 drams (fluid); 0.946333 liter; 946.358 cubic centimeters.

Quart (qt.) (British, liquid).—¼ gallon (British); 2 pints (liquid, British); 1.13650 liters; 1136.52 cubic centimeters.

Quarter (U. S., mass).—¼ short ton or 500 pounds; 226.795 kilograms.

Quarter (U. S., mass).—¼ long ton or 560 pounds; 254.01 kilograms.

Quarter (British, capacity)—8 bushels; 2.909 hectoliters.

Quarter (British, linear).—1 span; ¼ yard; 9 inches; 22.860 centimeters.

Quarter (British, mass).—¼ short hundredweight or 25 pounds; 11.340 kilograms.

Quarter (British, mass).—¼ long hundredweight or 28 pounds; 12.70 kilograms.

Quartern (British, dry).—½ gallon; 2273.1 cubic centimeters.

Quartern (British, liquid).—1/32 gallon; 142.07 cubic centimeters.

Quintal (q) (metric).—1.96841 hundredweights (long); 220.46 pounds; 100 kilograms; 1×10^5 grams.

Quintal* (q) (U. S. or British).—100 or 112 pounds.

Quire.—25 sheets.

Radian.—$\frac{1}{2}\pi$ or 0.159155 circumference or revolution; 0.637 quadrant; 57.29578 degrees; 57° 17′ 44.8″; 3437.75 minutes; 2.06265×10^5 seconds.

Ream.—500 sheets.

Register Ton (British).—100 cubic feet; 2.8317 cubic meters.

Revolution.—4 quadrants; 2π or 6.2832 radians; 360 degrees.

Rod (rd.) (surveyor's measure).—0.003125 mile; 0.025 furlong; 0.25 chain (Gunter's); 1 perch; 5.5 yards; 16.5 feet; 25 links; 198 inches; 5.029210 meters.

Rod (rd.) (British, volume).—1000 cubic feet; 28.317 cubic meters.

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*Variable.

Rood (British).—¼ or 0.25 acre; 40 square perches; 1210 square yards; 10.117 ares or square dekameters.

Rope (British).—20 feet; 6.0960 meters.

Sack (British).—3 bushels; 0.10911 cubic meter.

Scruples (apothecary) (s. ap. or ℈).—0.002857143 pound (avoirdupois); 0.003472222 pound (apothecary or troy); 0.041667 ounce (apothecary or troy); 0.0457143 ounce (avoirdupois); 1/3 or 0.33333 dram (apothecary or troy); 0.7314286 dram (avoirdupois); 0.833333 pennyweight; 20 grains; 1.2959784 grams; 1295.9784 milligrams.

Seam (British).—8 bushels; 0.29095 cubic meter.

Second (Angle) (″).—4.84814×10^{-6} radian; 2.7778×10^{-4} degree; 0.016667 minute.

Second (sec) (time, mean solar).—1.1574×10^{-5} day (mean solar); 1.1606×10^{-5} day (sidereal); 2.7778×10^{-4} hour (mean solar); 0.016667 minute (mean solar); 1.00273791 seconds (sidereal).

Second (sec) (time, sidereal).—0.997270 second (mean solar).

Sign (s).—30 degrees.

Skein.—360 feet; 109.73 meters.

Slug.—1 geepound; 32.174 pounds; 14.594 kilograms.

Space, Entire (solid angle).—4π or 12.5664 steradians.

Span.—⅛ fathom; 1 quarter (British, linear); 9 inches; 22.86005 centimeters.

Sphere (solid angle).—2 hemispheres; 4π or 12.5664 steradians.

Spherical Right Angle.—⅛ or 0.125 sphere; ¼ or 0.25 hemisphere; $\pi/2$ or 1.5708 steradians.

Square Centimeter (cm^2).—2.47104×10^{-7} square chain; 3.95367×10^{-6} square rod; 1.1960×10^{-4} square yard; 0.0010764 square foot; 0.00247104 square link; 0.15500 square inch; 1.5500×10^{5} square mils; 1.9735×10^{5} circular mils; 127.32 circular millimeters; 1×10^{-4} square meter; 0.01 square decimeter; 100 square millimeters.

Square Chain (sq. ch.) (Gunter's).—1.5625×10^{-4} square mile; 16 square rods; 484 square yards; 4356 square feet; 1×10^{4} square links; 6.27264×10^{5} square inches; 404.6873 square meters.

Square Decimeter (dm^2).—15.500 square inch; 0.01 square meter; 100 square centimeters.

Square Degree.—3.0462×10^{-4} steradian.

Square Dekameter (dkm^2).—0.02471044 acre (U. S.); 119.60 square yards; 1 are; 100 square meters.

Square Foot (**ft.^{2} or sq. ft.**) (**U. S.**).—3.58701×10^{-8} square mile; 2.29568×10^{-5} acre; 2.29568×10^{-4} square chain; 0.00367309 square rod; 1/9 or 0.111111 square yard; 2.29568 square links; 144 square inches; 9.290341×10^{-4} are; 0.09290341 square meter; 929.0341 square centimeters.

Square Foot (**ft.^{2} or sq. ft.**) (**British**).—0.09290289 square meter.

Square Hectometer (hm^2).—2.471044 acres (U. S.); 2.471058 acres (British); 1×10^4 square meters.

Square Inch (**in.^{2} or sq. in.**) (**U. S.**).—1.59423×10^{-6} square chain; 1/144 or 0.0069444 square foot; 1/1296 or 0.000771605 square yard; 0.0159423 square link; 1×10^6 square mils; 1.27324×10^6 circular mils; 6.4516258×10^{-4} square meter; 6.4516258 square centimeters; 645.16258 square millimeters.

Square Inch (**in.^{2} or sq. in.**) (**British**). 6.4515898 square centimeters.

Square Kilometer (km^2).—0.3861006 square mile (U. S.); 247.1044 acres (U. S.); 247.1058 acres (British); 1.1960×10^6 square yards; 1.0764×10^7 square feet; 1×10^6 square meters.

Square Link (**li.^{2} or sq. li.**) (**Gunter's**).—1×10^{-5} acre; 1×10^{-4} square chain; 0.0016 square rod; 0.0484 square yard; 0.4356 square foot; 62.7264 square inches; 0.040469 square meter; 404.69 square centimeters.

Square Meter (m^2).—3.8610×10^{-7} square mile; 2.471044×10^{-4} acre (U. S.); 2.471058×10^{-4} acre (British); 0.00247104 square chain (Gunter's); 0.039537 square rod; 1.195985 square yards (U. S.); 1.195992 square yards (British); 10.76387 square feet (U. S.); 10.76390 square feet (British); 24.7104 square links (Gunter's); 1550.0 square inches; 1×10^{-6} square kilometer; 1×10^{-4} hectare or square hectometer; 0.01 are; 1 centare 1×10^4 square centimeters; 1×10^6 square millimeters.

Square Mil.—1×10^{-6} square inch; 1.2732 circular mils; 6.4516×10^{-6} square centimeter; 6.4516×10^{-4} square millimeter.

Square Mile (**mi.^{2} or sq. mi.**).—640 acres; 6400 square chains; 1.02400×10^5 square rods; 3.0976×10^6 square yards; 2.78784×10^7 square feet; 2.589998 square kilometers; 258.9998 hectares; 2.589998×10^6 square meters.

Square Millimeter (mm^2).—0.0015500 square inch; 1550.0 square mils; 1973.5 circular mils; 1×10^{-6} square meter; 0.01 square centimeter; 1.2732 circular millimeters.

Square Perch (British & U. S.).—1/160 or 0.00625 acre; 30.25 square yards; 25.293 square meters.

Square Pole (British).—30.25 square yards.

Square Rod (rd. ^{2} or sq. rd.).—9.765625×10^{-6} mile; 0.00625 acre; 0.0625 square chain (Gunter's); 30.25 square yards; 272.25 square feet; 625 square links (Gunter's); 3.9204×10^4 square inches; 0.0025293 hectare or square hectometer; 25.293 square meters or centares.

Square Yard (yd. ^{2} or sq. yd.) (U. S.).—3.22831×10^{-7} square mile; 2.06612×10^{-4} acre; 0.00206612 square chain; 0.0330579 square rod or square perch; 9 square feet; 20.6612 square link 1296 square inches; 8.36131×10^{-5} hectare; 0.0083613 square dekameter or are; 0.83613 square meter or centare; 8361.31 square centimeters.

Square Yard (yd. ^{2} or sq. yd.) (British).—2.0661×10^{-4} acre (British); 8.2645×10^{-4} rood (British); 0.836126 square meter.

Steradian.—$\frac{1}{4}\pi$ of the solid angle around a point; 0.07958 sphere; 0.15916 hemisphere; 0.6366 spherical right angle; 3282.8 square degrees.

Stere (s).—0.1 dekastere; 1 cubic meter; 10 decisteres; 999.973 liters.

Stone (British).—14 pounds (avoirdupois); 6.350 kilograms.

Strike (British).—2 bushels (dry); 0.072738 cubic meter.

Toise (French).—6 Paris feet; 1.9490365 meters (legal, 1799); 1.949090 meters (measured, 1887).

Ton (long) (tn. l.) (U. S. or British).—1.12000 tons (short); 22.400 hundredweights (short); 2240 pounds (avoirdupois); 2722.22 pounds (apothecary or troy); 3.5840×10^4 ounces (avoirdupois); 1.0160470 metric tons; 1016.0470 kilograms.

Ton (short) (tn. sh.) (U. S.).—0.89286 ton (long); 20 hundredweights (short); 2000 pounds (avoirdupois); 2430.56 pounds (apothecary or troy); 2.916666×10^4 ounces (apothecary or troy); 3.2000×10^4 ounces (avoirdupois); 0.907185 ton (metric); 907.185 kilograms.

Tonne (t) (metric ton, millier).—0.984206 ton (long); 1.10231 tons (short); 22.046223 hundredweights (short); 2204.62 pounds (avoirdupois); 2679.23 pounds (apothecary or troy); 3.527396×10^4 ounces (avoirdupois); 1000 kilograms; 1×10^6 grams.

Township (U. S.).—36 square miles; 2.3040×10^4 square yards; 93.240 square kilometers.

Tun.—252 gallons.

Week (wk.).—168 hours; 1.0080×10^4 minutes; 6.04800×10^5 seconds.

Wey (British, capacity).—*40 bushels.

Wey (British, mass).—*252 pounds.

Yard (yd.) (U. S.).—5.68182×10^{-4} mile; 0.00454545 furlong; 0.0454545 chain (Gunter's); 0.181818 rod; 3 feet; 4.54545 links (Gunter's); 36 inches; 3600/3937 or 0.91440183 meter; 91.440183 centimeters.

Yard (yd.) (British).—0.18182 pole (British); 4 quarters (British, linear); 0.9143992 meter (present legal equivalent of Imperial yard); 91.43992 centimeters; 1.420212×10^{6} wave lengths of red line of cadmium.

Year (yr.) (leap).—366 days; 8784 hours.

Year (yr.) (tropical, mean solar).—365.2422 day (mean solar); 8765.8128 hours (mean solar); 3.15569×10^{7} seconds (mean solar).

Year (yr.) (sidereal).—365.256 days (mean solar); 8766.144 hours (mean solar).

*Variable.

Reciprocal Units

x per **Ångström** = 1×10^{8} x per centimeter.

x per **circular mil** = 1.9735×10^{5} x per square centimeter.

x per **circular millimeter** = 127.324 x per square centimeter.

x per **circumference** = 0.159155 x per radian.

x per **cubic foot** = 3.5314×10^{-5} x per cubic centimeter.

x per **cubic inch** = 0.061023 x per cubic centimeter.

x per **cubic yard** = 1.3079 x per cubic meter.

x per **day (mean solar)** = 1.15741×10^{-5} x per second (mean solar).

x per **degree** = 57.29578 x per radian.

x per **entire space** = 0.079577 x per steradian.

x per **foot** = 0.032808 x per centimeter.

x per **gallon** (British) = 2.1997×10^{-4} x per cubic centimeter.

x per **gallon** (U. S.) = 2.6417×10^{-4} x per cubic centimeter.

x per **grain** = 0.01543236 x per milligram.

x per **hemisphere** = 0.15916 x per steradian.

x per **hour (mean solar)** = 2.77778×10^{-4} x per second (mean solar).

x per **inch** = 0.39370 x per centimeter.

x per **liter** = 9.9997×10^{-4} x per cubic centimeter.

x per **micron** = 1.0000×10^{4} x per centimeter.

x per **mil** = 393.70 x per centimeter.

x per **mile** = 0.62137 x per kilometer.

x per **minute** = 3437.75 x per radian.

x per **minute (mean solar)** = 0.0166667 x per second (mean solar).

x per **ounce (avoirdupois)** = 0.035274 x per gram.

x per **ounce (apothecary or troy)** = 0.032151 x per gram.

x per **ounce (fluid, British)** = 0.035195 x per cubic centimeter.

x per **ounce (fluid, U. S.)** = 0.033814 x per cubic centimeter.

x per **pound (avoirdupois)** = 0.00220462 x per gram.

x per **quart (dry, U. S.)** = 9.0808×10^{-4} x per cubic centimeter.

x per **quart (liquid, U. S.)** = 0.0010567 x per cubic centimeter.

x per **quart (British)** = 8.7988×10^{-4} x per cubic centimeter.

x per **second** = 2.06265×10^{5} x per radian.

x per **second (sidereal)** = 1.002738 x per second (mean solar).

x per **square degree** = 3282.8 x per steradian.

x per **square foot** = 0.0010764 x per square centimeter.

x per **square inch** = 0.15500 x per square centimeter.

x per **square meter** = 1×10^{-4} x per square centimeter.

x per **square mile** = 0.38610 x per square kilometer.

x per **square millimeter** = 100.0000 x per square centimeter.

x per **square yard** = 1.19599×10^{-4} x per square centimeter.

x per **ton (2000 pounds)** = 0.00110231 x per kilogram.

x per **ton (2240 pounds)** = 9.8421×10^{-4} x per kilogram.

x per **year (mean solar)** = 0.00273791 x per day (mean solar) = 3.16888×10^{-8} x per second (mean solar).

Velocity $[lt^{-1}]$

Centimeter per second.—3.728×10^{-4} mile per minute; 0.02237 mile per hour; 0.032808 foot per second; 0.03600 kilometer per hour; 0.6000 meter per minute; 1.9685 feet per minute.

Degree per second.—0.002778 revolution per second; 0.017453 radian per second; 0.1667 revolution per minute.

Foot per minute.—0.005080 meter per second; 0.011364 mile per hour; 0.016667 foot per second; 0.01829 kilometer per hour; 0.3048 meter per minute; 0.5080 centimeter per second.

Foot per second.—0.011364 mile per minute; 0.5921 knot per hour; 0.6818 mile per hour; 1.0973 kilometers per hour; 18.29 meters per minute; 30.4801 centimeters per second.

Kilometer per hour.—0.016667 kilometer per minute; 0.27778 meter per second; 0.5396 knot per hour; 0.6214 mile per hour; 0.9113 foot per second; 16.67 meters per minute; 27.7778 centimeters per second; 54.68 feet per minute.

Kilometer per minute.—0.6215 mile per minute; 37.284 miles per hour; 60 kilometers per hour; 1666.7 centimeters per second; 3280.8 feet per minute.

Knot (per hour).—1.152 miles per hour; 1.689 feet per second; 1.853 kilometers per hour; 51.48 centimeters per second; 6080.20 feet per hour.

Meter per minute.—0.03728 mile per hour; 0.05468 foot per second; 0.06 kilometer per hour; 1.6667 centimeters per second; 3.281 feet per minute.

Meter per second.—0.03728 mile per minute; 0.06000 kilometer per minute; 2.2369 miles per hour; 3.281 feet per second; 3.600 kilometers per hour; 196.8 feet per minute.

Mile per hour.—0.016667 mile per minute; 0.8684 knot per hour; 1.4667 feet per second; 1.6093 kilometers per hour; 26.82 meters per minute; 44.7041 centimeters per second; 88 feet per minute.

Mile per minute.—0.8684 knot per minute; 1.609 kilometers per minute; 60 miles per hour; 88 feet per second; 2682.2 centimeters per second.

Radian per second.—0.1592 revolution per second; 9.549 revolutions per minute; 57.296 degrees per second.

Revolution per day.—7.2722×10^{-5} radian per second.

Revolution per minute (R.P.M.).—0.01667 revolution per second; 0.10472 radian per second; 6 degrees per second.

Revolution per second.—6.2832 radians per second; 60 revoutions per minute; 360 degrees per second.

Velocity of light.—2.9986×10^{10} centimeters per second.

Acceleration $[l\ t^{-2}]$

Centimeter per second per second.—0.02237 mile per hour per second; 0.03281 foot per second per second; 0.03600 kilometer per hour per second.

Foot per second per second.—0.304801 meter per second per second; 0.6818 mile per hour per second; 1.097 kilometer per hour per second; 30.4801 centimeter per second per second.

Gravity, standard.—32.174 feet per second per second; 980.665 centimeters per second per second.

Kilometer per hour per second.—0.27778 meter per second per second; 0.6214 mile per hour per second; 0.9133 foot per second per second; 27.778 centimeters per second per second.

Meter per second per second.—2.237 miles per hour per second; 3.2808 feet per second per second; 3.600 kilometers per hour per second; 100.00 centimeters per second per second.

Mile per hour per minute.—0.74507 centimeter per second per second.

Mile per hour per second.—0.44704 meter per second per second; 1.467 feet per second per second; 1.609 kilometers per hour per second; 44.704 centimeters per second per second.

Radians per second per second.—0.1592 revolution per second per second; 9.549 revolutions per minute per second; 572.96 revolutions per minute per minute.

Revolution per minute per second.—0.10420 radian per second per second.

Revolution per minute per minute.—2.778×10^{-4} revolution per second per second; 0.0017453 radian per second per second; 0.01667 revolution per minute per second.

Revolution per second per second.—6.2832 radians per second per second; 60 revolutions per minute per second; 3600 revolutions per minute per minute.

Density $[m\ l^{-3}]$

Demal.—1 gram equivalent per cubic decimeter.

Grain per cubic foot.—2.288 grams per cubic meter.

Gram per cubic centimeter.—3.405×10^{-7} pound per milfoot; 0.03613 pound per cubic inch; 8.3452 pounds per gallon

(U. S.); 10.022 pounds per gallon (British); 62.43 pounds per cubic foot.

Gram per cubic meter.—1.437 grains per cubic foot.

Gram per milliliter.—(Numerically equal to specific gravity t°/4°); 0.999973 gram per cubic centimeter.

Kilogram per cubic meter.—3.613×10^{-5} pound per cubic inch; 0.001 gram per cubic centimeter; 0.06243 pound per cubic foot.

Mercury at 0°C.—13.5951 grams per cubic centimeter (Internationally accepted conventional value to be used in expressing pressures in terms of columns of mercury.)

Pound per cubic foot.—5.787×10^{-4} pound per cubic inch; 0.016018 gram per cubic centimeter; 16.018 kilograms per cubic meter.

Pound per cubic inch.—27.680 grams per cubic centimeter; 2.768×10^{4} kilograms per cubic meter.

Pound per mil foot.—2.9369×10^{6} grams per cubic centimeter.

Pound per gallon (U. S.).—0.119826 gram per cubic centimeter.

Pound per gallon (British).—0.099776 gram per cubic centimeter.

Slug per cubic foot.—0.5154 gram per cubic centimeter.

Mass Concentration

Gram per metric ton.—1.0000 milligram per kilogram.

Gram per ton (2000 pound).—1.1023 milligrams per kilogram.

Gram per ton (2240 pound).—0.9842 milligram per kilogram.

Karat (1 of gold to 24 of mixture).—41.667 milligrams per gram.

Milligram per assay ton (Equals one troy ounce per 2000 pound (avoirdupois).)—34.276 milligrams per kilogram.

Milligram per kilogram.—0.002 pound (avoirdupois) per ton (2000 pound); 0.029175 milligram per assay ton; 0.032000 ounce (avoirdupois) per ton (2000 pound); 1 gram per metric ton.

Ounce (avoirdupois) **per ton** (2000 pound.).—31.2500 milligrams per kilogram.

Ounce (avoirdupois) per ton (2240 pound).—27.9018 milligrams per kilogram.

Pound (avoirdupois) per ton (2000 pound).—500.000 milligrams per kilogram.

Pound (avoirdupois) per ton (2240 pound).—446.429 milligrams per kilogram.

Flow $[l^3t^{-1}]$

Cubic centimeter per second.—0.0021186 cubic foot per minute.

Cubic foot per minute.—0.1247 gallon per second; 0.4720 liter per second; 62.4 pounds of water per minute; 472.0 cubic centimeters per second.

Cubic foot per second.—2.2222 cubic yards per minute; 448.83 gallons per minute; 1699.3 liters per minute.

Cubic yard per minute.—0.45 cubic foot per second; 3.367 gallons per second; 12.74 liters per second.

Gallon per second.—0.297 cubic yard per minute; 8.0192 cubic feet per minute.

Gallon per minute.—0.002228 cubic foot per second; 0.06308 liter per second.

Liter per minute.—5.885×10^{-4} cubic foot per second; 0.004403 gallon per second.

Liter per second.—0.078493 cubic yard per minute; 2.12 cubic feet per minute; 15.85 gallons per minute (U. S.).

Miner's Inch.—1.2 cubic feet per minute.

Pounds of water per minute.—0.01603 cubic foot per minute.

Force $[mlt^{-2}]$

Conversion factors between the absolute and gravitational units of force, torque, energy and power are dependent on the value of g, the acceleration due to gravity. The standard value of g adopted by the International Committee on Weights and Measures is 980.665 cm / sec^2. This value or its equivalent, 32.174 ft. / sec^2, is used except where otherwise noted.

Dyne.—2.2481×10^{-6} pound weight; 7.2330×10^{-5} poundal; 0.0010197 gram weight; 0.015737 grain weight.

Grain weight.—63.546 dynes.

Gram weight—0.070932 poundal; 980.665 dynes.

Kilogram weight.—70.932 poundals; 9.80665×10^5 dynes.

Poundal.—0.031081 pound weight; 14.098 grams weight; 1.3825×10^4 dynes.

Pound weight.—32.174 poundals; 453.59 grams weight; 4.4482×10^5 dynes.

Ton weight (2000 pound).—8.8964×10^8 dynes.

Ton weight (2240 pound).—9.9640×10^8 dynes.

Reciprocal Force $[m^{-1} l^{-1} t^2]$

x per **gram weight**$=0.0010197$ x per dyne.

x per **poundal**$=7.2330 \times 10^{-5}$ x per dyne.

x per **pound weight**$=2.2481 \times 10^{-6}$ x per dyne.

Pressure $[m\, l^{-1} t^{-2}]$

Atmosphere (normal).—Pressure exerted by 76 cm of Hg, density 13.5951 g / cm³, $g=980.665$ cm / sec²; 0.0073480 ton (2000 pound) per square inch; 1.0133 bars; 1.0581 tons (2000 pound) per square foot; 14.696 pounds per square inch; 29.921 inches of mercury at 32° F; 33.899 feet of water at 39.1° F; 760 millimeters of mercury at 0° C; 1033.2 grams per square centimeter; 2116.2 pounds per square foot; 1.0332×10^4 kilograms per square meter; 1.01325×10^6 dynes per square centimeter.

Bar.—0.98692 atmosphere; 14.504 pounds per square inch, 1.01971×10^4 kilograms per square meter; 1.000×10^6 dynes per square centimeter. (This value accords with the only internationally accepted use of this term; but "bar" has also been used to denote a pressure of one dyne per square centimeter).

Barye.—1.0000 dyne per square centimeter.

Centimeter of mercury at 0°C.—0.013158 atmosphere; 0.19337 pound per square inch; 0.44604 foot of water; 27.845 pounds per square foot; 135.95 kilograms per square meter; 1.33322×10^4 dynes per square centimeter.

Centimeter of water at 4°C.—980.638 dynes per square centimeter.

Dyne per square centimeter.—9.8692×10^{-7} atmosphere; 1×10^{-6} bar; 1.4504×10^{-5} pound per square inch; 2.9530×10^{-5} inch of mercury at 32°F; 4.0148×10^{-4} inch of water at 4°C; 7.5006×10^{-4} millimeter of mercury; 0.00101971 gram per square centimeter; 0.00101974 centimeter of water at 4°C; 0.0020886 pound per square foot; 0.0101971 kilogram per square meter.

Foot of water at 4°C or 39.1°F.—0.029499 atmosphere; 0.43352 pound per square inch; 0.88265 inch of mercury at

32 °F; 62.426 pounds per square foot; 304.79 kilograms per square meter.

Gram (weight) per square centimeter.—9.6784×10^{-4} atmosphere; 0.014223 pound per square inch; 0.73556 millimeter of mercury at 0 °C; 2.0482 pound per square foot; 10 kilograms per square meter; 980.665 dynes per square centimeter.

Inch of mercury at 32 °F.—0.033421 atmosphere; 0.49116 pound per square inch; 1.13299 feet of water at 39.1 °F; 13.595 inches of water at 4 °C; 70.727 pounds per square foot; 345.31 kilograms per square meter; 3.38639×10^{4} dynes per square centimeter.

Inch of water at 4 °C.—0.0024583 atmosphere; 0.036136 pound per square inch; 0.073554 inch of mercury; 0.57818 ounce per square inch; 5.2022 pounds per square foot; 25.399 kilograms per square meter; 2490.82 dynes per square centimeter.

Kilogram (weight) per square centimeter.—14.223 pounds per square inch; 73.556 centimeters of mercury at 0 °C; 980,665 dynes per square centimeter.

Kilogram (weight) per square meter.—9.6784×10^{-5} atmosphere; 0.0014223 pound per square inch; 0.0028959 inch of mercury; 0.0032809 foot of water; 0.073556 millimeter of mercury; 0.1 gram per square centimeter; 0.20482 pound per square foot; 98.0665 dyne per square centimeter.

Kilogram (weight) per square millimeter.—0.71114 ton (2000 pounds) per square inch; 1×10^{6} kilograms per square meter; 9.80665×10^{7} dynes per square centimeter.

Millimeter of mercury at 0 °C.—0.0013158 atmosphere; 0.019337 pound per square inch; 1.3595 grams per square centimeter; 2.7845 pounds per square foot; 13.595 kilograms per square meter; 1333.22 dynes per square centimeter.

Ounce (weight) per square inch.—0.0625 pound per square inch; 4309.2 dynes per square centimeter.

Pound (weight) per square foot.—4.7254×10^{-4} atmosphere; 4.7880×10^{-4} bar; 0.0069445 pound per square inch; 0.016018 foot of water at 39.1 °F; 0.35913 millimeter of mercury at 0 °C; 0.48824 gram per square centimeter; 4.8824 kilograms per square meter; 478.80 dynes per square centimeter.

Pound (weight) per square inch.—5×10^{-4} ton (2000 pound) per square inch; 0.068046 atmosphere; 0.068947 bar; 0.070307 kilogram per square centimeter; 2.0360 inches of mercury at 32 °F; 2.3066 feet of water at 39.1 °F; 5.1715 centimeters of mercury at 0 °C; 27.673 inches of water at 4 °C; 51.715 millimeters of mercury; 70.307 grams per square centimeter; 703.07 kilograms per square meter; 6.8947×10^{4} dynes per square centimeter.

Ton (2000 pound) (weight) per square foot.—0.94509 atmosphere; 13.889 pounds per square inch; 9764.8 kilograms per square meter; 9.5760×10^5 dynes per square centimeter.

Ton (2240 pound) (weight) per square foot.—10.7251×10^5 dynes per square centimeter.

Ton (2000 pound) (weight) per square inch.—1.4062 kilograms per square millimeter; 2000 pounds per square inch; 1.4062×10^6 kilograms per square meter; 1.3789×10^8 dynes per square centimeter.

Ton (2240 pound) (weight) per square inch.—1.5749 kilograms per square millimeter; 152.42 atmospheres; 1.5444×10^8 dynes per square centimeter.

Work and Energy $[m\ l^2\ t^{-2}]$

British thermal unit (mean) (BTU).—2.930×10^{-4} kilowatt-hour; 3.9292×10^{-4} horse power-hour; 0.25198 kilogram-calorie or large calorie (mean); 0.2930 watt-hour; 10.409 liter-atmospheres; 107.56 kilogram-meters; 251.98 gram-calories (mean); 777.97 foot-pounds; 1054.8 joules (absolute); 3676 cubic foot-atmospheres; 2.5030×10^4 foot-poundals; 1.0548×10^{10} ergs.

British thermal unit (39 °F) (BTU).—1060.4 joules (absolute).

British thermal unit (60 °F) (BTU).—1054.6 joules (absolute).

Calorie.—*See* gram-calorie or kilogram-calorie.

Centigrade thermal unit (15 °C) (CTU).—1898.3 joules (absolute).

Centimeter-dyne.—*See* erg.

Centimeter-gram force.—*See* gram-centimeter.

Cheval-vapeur heure.—2.6478×10^6 joules (absolute).

Cubic centimeter-atmosphere (normal).—0.101325 joule (absolute).

Cubic foot atmosphere.—2.7203×10^{-4} British thermal unit (mean); 28.313 liter-atmospheres; 292.59 kilogram-meters; 680.74 gram-calories (mean); 2116.3 foot-pounds; 2869.4 joules (absolute).

Erg.—2.3889×10^{-11} kilogram-calorie (mean); 9.4805×10^{-11} British thermal unit (mean); 1.0197×10^{-8} kilogram-meter; 2.3889×10^{-8} gram-calorie (mean); 7.3756×10^{-8} foot-pound; 1×10^{-7} joule; 2.3730×10^{-6} foot-poundal; 0.0010197 gram-centimeter; 1 dyne-centimeter.

Foot-Pound.—3.7662×10^{-7} kilowatt-hour; 5.0505×10^{-7} horse power-hour; 3.2389×10^{-4} kilogram-calorie (mean); 3.7662×10^{-4} watt-hour; 4.7253×10^{-4} cubic foot-atmosphere; 0.0012854 Brit-

ish thermal unit (mean); 0.013381 liter-atmosphere; 0.138255 kilogram-meter; 0.32389 gram-calorie (mean); 1.35582 joule (absolute); 32.174 foot-poundals; 1.3825×10^4 gram-centimeters; 1.35582×10^7 ergs or centimeter-dynes.

Foot-poundal.—3.9952×10^{-5} British thermal unit (mean); 4.1589×10^{-4} liter-atmosphere (normal); 0.0042972 kilogram-meter; 0.010067 gram-calorie; 0.031081 foot-pound; 0.042140 joule; 4.21402×10^5 ergs.

Gram-calorie (mean).—1.5593×10^{-6} horse power hours; 0.001 kilogram-calorie; 0.0011628 watt-hour; 0.001469 cubic foot-atmosphere; 0.0039685 British thermal unit (mean); 0.041311 liter-atmosphere; 0.42685 kilogram-meter; 3.0874 foot-pounds; 4.186 joules (absolute); 99.334 foot-poundals.

Gram-calorie (15 °C).—4.185 joules (absolute).

Gram-calorie (20 °C).—4.181 joules (absolute).

Gram-centimeter.—2.3427×10^{-8} kilogram-calorie (mean); 9.2972×10^{-8} British thermal unit (mean); 1×10^{-5} kilogram-meter; 2.3427×10^{-5} gram-calorie (mean); 7.233×10^{-5} foot-pound; 9.80665×10^{-5} joule (absolute); 980.7 ergs.

Horse power hour. (**HP hr. or h. p. hr.**).—0.7457 kilowatt-hour; 641.30 kilogram-calories (mean); 745.7 watt-hours; 2545.0 British thermal units (mean); 2.7374×10^5 kilogram-meters; 1.9800×10^6 foot-pounds; 2.6845×10^6 joules (absolute).

Horse power hour (electrical, U. S. & British).—2.6856×10^6 joules (absolute).

International volt (v) electronic charge).—1.5927×10^{-19} joule (absolute).

International volt (v) Faraday.—9.6541×10^4 joules (absolute).

Joule (absolute).—2.778×10^{-7} kilowatt-hour; 3.725×10^{-7} horse power-hour; 2.3889×10^{-4} kilogram-calorie (mean); 2.778×10^{-4} watt-hour; 3.485×10^{-4} cubic foot-atmosphere; 9.480×10^{-4} British thermal unit (mean); 0.009869 liter-atmosphere; 0.10197 kilogram-meter; 0.23889 gram-calorie (mean); 0.23895 gram-calorie at 15 °C; 0.23918 gram-calorie at 20 °C; 0.73756 foot-pound; 0.999680 joule (International); 1 watt-second; 23.730 foot-poundals; 1.0197×10^4 gram-centimeters; 1×10^7 ergs.

Joule (International) (v).—1.00032 joule (absolute).

Kilogram-calorie or large calorie (mean).—0.0011628 kilowatt-hour; 0.0015593 horse power-hour; 1.1628 watt-hour; 3.9685 British thermal units (mean); 426.85 kilogram-meters; 1000 small or gram-calories; 3087.4 foot-pounds; 4186 joules; 4.2686×10^7 gram-centimeters; 4.186×10^{10} ergs.

Kilogram-meter.—2.7235×10^{-6} kilowatt hour; 3.6530×10^{-6}

horse power-hour; 0.0027235 watt-hour; 0.0034177 cubic foot-atmosphere; 0.0092972 British thermal unit (mean); 0.096782 liter-atmosphere; 2.3427 gram-calories (mean); 7.2330 foot-pounds; 9.80665 joules (absolute); 232.71 foot-poundals; 1×10^5 gram-centimeters; 9.80665×10^7 ergs.

Kilowatt-hour.—1.3410 horse power-hours; 1000 watt-hours; 3413.0 British thermal units (mean); 3.6710×10^5 kilogram-meters; 8.6001×10^5 gram-calories (mean); 2.6552×10^6 foot-pounds; 3.6000×10^6 joules (absolute).

Large Calorie.—*See* kilogram-calorie.

Liter-atmosphere (normal).—3.7745×10^{-5} horse power-hour; 0.035319 cubic foot-atmosphere; 0.09607 British thermal unit (mean); 10.333 kilogram-meters; 24.206 gram-calories (mean); 74.735 foot-pounds; 101.328 joules (absolute); 2404.5 foot-poundals.

Liter-atmosphere (lat. 45°, g=980.616).—101.323 joules (absolute).

Megalerg.—1×10^6 ergs.

Meter-kilogram.—*See* kilogram-meter.

Watt-hour.—0.001 kilowatt-hour; 0.0013410 horse power-hour; 0.86001 kilogram-calorie (mean); 3.4130 British thermal units (mean); 367.10 kilogram-meters; 860.01 gram-calories (mean); 2655.3 foot-pounds; 3600 joules.

Power $[m\, l^2\, t^{-3}]$

British thermal unit (BTU) (mean) per minute.—0.023575 horse power; 17.580 watts (absolute).

British thermal unit (BTU) (mean) per second.—1.4145 horse power; 1054.8 watts (absolute).

British thermal unit (BTU) (39 °F) per second.—1060.4 watts (absolute).

British thermal unit (BTU) (60 °F) per second.—1054.6 watts (absolute).

Cheval-vapeur.—For electrical purposes usually used as 736 watts. *See* Force de cheval.

Erg per second.—1×10^{-10} kilowatt; 1.3412×10^{-10} horse power; 1.4333×10^{-9} kilogram-calorie (mean) per minute; 5.688×10^{-9} British thermal unit (mean) per minute; 7.3756×10^{-8} foot-pound per second; 1×10^{-7} watt; 4.4254×10^{-6} foot-pound per minute; 1 dyne-centimeter per second.

Foot-pound per minute.—2.2597×10^{-5} kilowatt; 3.0303×10^{-5} horse power; 3.072×10^{-5} horse power (metric); 3.2389×10^{-4}

kilogram-calorie (mean) per minute; 0.0012854 British thermal unit (mean) per minute; 0.016667 foot-pound per second 0.022597 watt.

Foot-pound per second.—0.0013558 kilowatt; 0.0018182 horse power; 0.019433 kilogram-calorie (mean) per minute 0.077124 British thermal unit (mean) per minute; 1.35582 watt (absolute).

Force de cheval (cheval-vapeur).—*See* horse power (metric).

Gram-centimeter per second.—9.80665×10^{-5} watt (absolute).

Hectowatt.—100 watts.

Horse power (h. p. or HP).—0.70696 British thermal unit (mean) per second; 0.7452 kilowatt ($g=980$); 0.74570 ($g=980.665$) kilowatt; 1.0139 horse power (metric) or cheval-vapeur. 10.688 kilogram-calories (mean) per minute; 42.418 British thermal units (mean) per minute; 550 foot-pounds per second; 745.2 watts ($g=980$); 745.70 watts ($g=980.665$); 3.3000×10^4 foot-pounds per minute.

Horse power, electrical (U. S. & British).—746.00 watt (absolute) (Commonly used in rating electrical machinery).

Horse power, metric (cheval vapeur).—0.98632 horse power (U. S.); 75 kilogram-meters per second; 735.499 watts; 3.2549×10^4 foot-pounds per minute.

Kilogram-calorie (mean) per minute.—0.093557 horse power; 51.457 foot-pounds per second; 69.767 watts.

Kilogram calorie (mean) per second.—4.186 kilowatts.

Kilogram-meter per second.—9.80665 watts (absolute).

Kilowatt.—0.23889 kilogram-calorie (mean) per second; 0.94827 British thermal unit (mean) per second; 1.3410 horse power; 1.3597 horse power (metric); 14.333 kilogram-calories (mean) per minute; 56.896 British thermal units (mean) per minute; 737.56 foot-pounds per second; 1000 watts; 4.4254×10^4 foot-pounds per minute; 2.6552×10^6 foot-pounds per hour.

Lumen.—0.001496 watt.

Metric horse power.—*See* horse power, metric.

Watt (absolute).—0.001 kilowatt; 0.0013410 horse power; 0.0013596 force de cheval or horse power (metric); 0.01433 kilogram-calorie (mean) per minute; 0.056896 British thermal unit (mean) per minute; 0.73756 foot-pound per second; 1 joule per second; 44.254 foot-pounds per minute; 1×10^7 ergs per second.

Watt (International) (v).—1.00032 watt (absolute).

Watt of maximum visibility radiation.—668 lumens.

Action $[m\, l^2\, t^{-1}]$

Calorie (15 °C) second.—6.3854×10^{33} quanta.

Calorie (15 °C) second / N_o *—1.0535×10^{10} quanta.

Joule second.—1.5258×10^{33} quanta.

Joule second / N_o *.—2.5173×10^{9} quanta.

Planck's quantum.—6.554×10^{-27} erg second.

Volt electronic-charge second.—2.4292×10^{14} quanta.

Volt faraday second.—1.4724×10^{38} quanta.

*N_o denotes Avogadro's number, the number of molecules per gram mole.

Torque or Moment of Force $[m\, l^2\, t^{-2}]$

Dyne-centimeter.—1.0197×10^{-8} kilogram-meter; 7.3757×10^{-8} pound-foot; 8.8511×10^{-7} pound-inch; 2.3731×10^{-6} poundal-foot.

Kilogram-meter.—9.8066×10^{7} dyne-centimeters.

Pound-foot.—1.3558×10^{7} dyne-centimeters.

Poundal-foot.—4.2140×10^{5} dyne-centimeters.

Pound-inch.—1.1298×10^{6} dyne-centimeters.

Moment of Area $[l^4]$

Square centimeter-centimeter squared.—0.02402 square inch-inch squared.

Square foot-foot squared.—2.074×10^{4} square inch-inch squared.

Square inch-inch squared.—4.823×10^{-5} square foot-foot squared; 41.62 square centimeter-centimeter squared.

Moment of Inertia $[m\, l^2]$

Gram-centimeter squared ($g\, cm^2$).—2.3730×10^{-6} pound-foot squared; 3.4172×10^{-4} pound-inch squared.

Kilogram-centimeter squared.—0.0023730 pound-foot squared; 0.3417 pound-inch squared.

Pound-foot squared.—144 pound-inches squared; 421.40 kilogram-centimeters squared; 4.2140×10^{5} gram-centimeters squared.

Pound-inch squared.—0.006945 pound-foot squared; 2.9264 kilogram-centimeters squared; 2926.4 gram-centimeters squared.

Thermal Units

Temperature

Degree Centigrade (°C).—0.8 or 4 / 5 degree Réaumur; 1.00 degree absolute, Kelvin; 1.8 or 9 /5 degrees Fahrenheit.

Degree Fahrenheit (°F).—0.44444 or 4 /9 degree Réaumur; 0.55556 or 5 /9 degree Centigrade.

Degree Réaumur (°R).—1.25 or 5 /4 degrees Centigrade; 2.25 or 9 /4 degrees Fahrenheit.

Temperature, absolute Centigrade or Kelvin (K) scale.—$x°\ K = T\ °C + 273.18$.

Temperature, degrees Centigrade (°C).—$x\,°C = 5/9\ (T\,°F - 32)$; $x\,°C = 5/4\ T\,°R$.

Temperature, degrees Fahrenheit (°F).—$x\,°F = 9/5\ T\,°C + 32$; $x\,°F = 9/4\ T\,°R + 32$.

Temperature, degrees Réaumur (°R).—$x\,°R = 4/9\ (T\,°F - 32)$; $x\,°R = 4/5\ T\,°C$.

Thermal Capacity of a Substance

British thermal unit (mean) **per pound per °F.**—1 gram-calorie per gram per °C; 4.186 joules per gram per °C.

Gram-calorie (mean) **per gram per °C.**—1 British thermal unit (60 °F) per pound per °F; 4.186 joules per gram per °C.

Joule per gram per °C.—0.2389 gram-calorie (mean) per gram per °C; 0.2389 British thermal unit (mean) per pound per °F.

Thermal Capacity of a Body. Water Equivalent

British thermal unit (60 °F) **per °F.**—453.59 gram-calories per °C; 1898.3 joules per °C.

Gram-calorie (15°) **per °C.**—0.0022046 British thermal unit (60 °F) per °F; 4.185 joules per °C.

Joule per °C.—5.268×10^{-4} British thermal unit (60 °F) per °F; 0.2389 gram-calorie per °C.

Heat Equivalent. Latent Heat

British thermal unit (mean) **per pound.**—0.5556 gram-calorie (mean) per gram; 2.325 joules per gram.

Gram-calories (mean) per gram.—1.8 British thermal units (mean) per pound; 4.186 joules per gram.

Joule per gram.—0.2389 gram-calories (mean) per gram; 0.4301 British thermal unit per pound.

Thermal Conductivity

British thermal unit (mean) per square foot per second for a temperature gradient of 1 °F per inch=5.191 joules (absolute) per square centimeter per second for a temperature gradient of 1 °C per centimeter=1.2404 gram-calories (15 °C) per square centimeter per second for a temperature gradient of 1 °C per centimeter.

Gram-calorie (15 °C) per square centimeter per second for a temperature gradient of 1 °C per centimeter=4.185 joules (absolute) per square centimeter per second for a temperature gradient of 1 °C per centimeter=0.80620 British thermal units (mean) per square foot per second for a temperature gradient of 1 °F per inch.

Joule per square centimeter per second for a temperature gradient of 1 °C per centimeter=0.2389 gram-calorie (15 °C) per square centimeter per second for a temperature gradient of 1 °C per centimeter=0.1926 British thermal unit per square foot per second for a temperature gradient of 1 °F per inch.

Photometric Units

Bougie Decimale (intensity of source).—1.0 International candle (approximately).

Candle (International) (intensity of source).—0.104 Carcel unit (approximately); 1.0000 International lumen per steradian; 1 Pentane candle (approximately); 1 English sperm candle (approximately); 1.11 Hefner unit (approximately).

Candle per square centimeter (surface brightness).—3.1416 lamberts; 3141.6 millilamberts.

Candle per square inch (surface brightness).—0.48695 lambert; 486.95 millilamberts.

Carcel unit (intensity of source).—9.6 International candle (approximately).

English sperm candle (intensity of source).—1.0 International candle (approximately).

Foot-candle (illumination of a surface).—1 lumen incident per square foot; 1.0764 milliphots; 10.764 lumen per square meter; 10.764 lux.

Hefner unit (intensity of source).—0.90 International candle (approximately).

Lambert (surface brightness).—0.3183 candle per square centimeter; 2.054 candles per square inch; 1 lumen emitted per square centimeter of a perfectly diffusing surface.

Lumen (flux of luminous energy).—Is emitted by 0.07958 spherical candle power. A source of one spherical candle power emits 4π or 12.566 lumens.

Lumen per square centimeter per steradian (surface brightness).—3.1416 lambert.

Lumen per square foot (illumination of a surface).—1 foot-candle; 10.764 lumens per square meter.

Lumen per square foot per steradian (surface brightness).—3.3816 millilambert.

Lumen per square meter (surface illumination).—1×10^{-4} phot; 0.092902 foot candle or lumen per square foot.

Lux (illumination of a surface).—1×10^{-4} phot; 0.1 milliphot; 0.092902 foot-candle; 1.000 lumen per square meter.

Meter-candle (illumination of a surface).—1.000 lumen per square meter.

Millilambert (surface brightness).—0.929 lumen emitted per square foot (perfect diffusion).

Milliphot (illumination of a surface).—0.001 phot; 0.929 foot-candle.

Pentane candle (intensity of source).—1.0 International candle (approximately).

Phot (illumination of a surface).—1 lumen incident per square centimeter; 1000 milliphots; 1.000×10^4 lumens per square meter; 1×10^4 lux.

Stilb (surface brightness).—1 candle per square centimeter.

Viscosity

Viscosity $[ml^{-1} t^{-1}]$

Gram weight second per square centimeter.—980.665 poise.

Poise.—1.00 gram per centimeter per second.

Pound weight second per square foot.—478.8 poise.

Pound weight second per square inch.—6.895×10^4 poise.

Kinematic Viscosity $[l^2 t^{-1}]$

Inch squared per second.—6.451 centimeters squared per second.

Poise centimeter cubed per gram.—1.000 centimeter squared per second.

Poise foot cubed per pound.—62.43 centimeters squared per second.

Poise inch cubed per gram.—16.387 centimeters squared per second.

Reciprocal Viscosity (Fluidity) [$m^{-1} lt$]

Rhe.—1.000 per poise.

Diffusivity; Coefficient of Diffusion [$l^2 t^{-1}$]

Centimeter squared per day.—1.1574×10^{-5} centimeter squared per second.

Inch squared per second.—6.4516 centimeters squared per second.

Liter per centimeter per day.—0.011574 centimeter squared per second.

Surface Tension [mt^{-2}]

Dyne per centimeter.—0.01 erg per square millimeter; 0.10197 milligram weight per millimeter; 1 erg per square centimeter; 2.5901 milligram weight per inch.

Erg per square centimeter.—0.01000 erg per square millimeter; 1.0000 dyne per centimeter.

Erg per square millimeter.—100.00 dynes per centimeter; 100.00 ergs per square centimeter.

Milligram weight per inch.—0.38609 dyne per centimeter.

Milligram weight per millimeter.—9.80665 dynes per centimeter.

Rotatory Power [l^{-1}]

Degree per centimeter.—0.017453 radian per centimeter.

Degree per foot.—5.7261×10^{-4} radian per centimeter.

Degree per inch.—0.0068714 radian per centimeter.

Minute per centimeter.—2.9089×10^{-4} radian per centimeter.

Radian per centimeter.—57.296 degrees per centimeter; 145.50 degrees per inch; 1746.4 degrees per foot; 3437.7 minutes per centimeter.

ELECTRICAL UNITS

Electrical units are designated as "absolute" when based on the electromagnetic cgs system; "International" when based on legal definitions of the ohm, Weston cell or silver voltammeter.

The basis of International units is indicated as follows: "(a)" based on a silver deposit of 1.11800 mg per International ampere second; "(v)" based on the International ohm and Weston cell,—1.018300 volts at 20 °C.

Quantity or Charge $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-1}]$; $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}]$

Abcoulomb.—*See* electromagnetic cgs unit electrical quantity.

Ampere-hour (absolute).—3600.0 coulomb (absolute).

Coulomb (absolute).—0.1000 electromagnetic cgs unit or abcoulomb; 1.00007 International coulombs (a); 1.00010 International coulombs (v); 2.99796×10^{9} electrostatic cgs units or statcoulombs; 6.281×10^{18} electronic charges.

Electromagnetic cgs unit or abcoulomb.—10.0000 coulombs (absolute); 2.99796×10^{10} electrostatic cgs units or statcoulombs.

Electronic charge.—1.5921×10^{-20} electromagnetic cgs unit or abcoulomb; 1.5921×10^{-19} coulomb (absolute); 4.774×10^{-10} electrostatic cgs unit or statcoulomb.

Electrostatic cgs unit or statcoulomb.—3.33560×10^{-11} electromagnetic cgs unit or abcoulomb; 3.33560×10^{-10} coulomb (absolute); 2.0947×10^{9} electronic charges.

Electrostatic foot-pound second unit.—1.1952×10^{-6} coulomb (absolute); 117.58 electromagnetic cgs units or abcoulombs; 3583.9 electrostatic cgs units or statcoulombs.

Faraday.—9.6500×10^{4} coulombs (absolute); 9.6507×10^{4} International coulombs (a); 9.6510×10^{4} International coulombs (v); 2.89365×10^{14} electrostatic cgs units or statcoulombs.

International coulomb (a).—0.99993 coulomb (absolute).

International coulomb (v).—0.99990 coulomb (absolute).

Statcoulomb.—*See* electrostatic cgs unit.

Reciprocal Quantity $[\epsilon^{-\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{3}{2}}t]$; $[\mu^{\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{1}{2}}]$

x per **ampere-hour** = 2.7778×10^{-4} x per coulomb (absolute).

x per **coulomb (absolute)** = 0.99990 x per International coulomb (v); 0.99993 x per International coulomb (a).

x per **electromagnetic cgs unit**$=0.1000$ x per coulomb (absolute).

x per **electronic charge**$=6.281\times10^{18}$ x per coulomb (absolute).

x per **electrostatic cgs unit**$=2.99796\times10^{9}$ x per coulomb (absolute).

x per **faraday**$=1.0363\times10^{-5}$ x per coulomb (absolute).

Current $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-2}]$; $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$

Abampere.—*See* electromagnetic cgs unit.

Ampere (absolute).—1.0363×10^{-5} faraday per second; 0.1 electromagnetic cgs unit or abampere; 1.00007 International amperes (a); 1.00010 International amperes (v); 2.99796×10^{9} electrostatic cgs units or statamperes.

Electromagnetic cgs unit or abampere.—10.0000 amperes (absolute); 2.99796×10^{10} electrostatic cgs units or statamperes.

Electrostatic cgs unit or statampere.—3.33560×10^{-11} electromagnetic cgs unit or abampere; 3.33560×10^{-10} ampere (absolute).

Faraday per second.—9.6500×10^{4} ampere (absolute).

International ampere (a).—Based on the deposit of 0.00111800 grams of silver per second; 0.99993 ampere (absolute).

International ampere (v).—As defined by the International ohm and volt; 0.99990 ampere (absolute).

International ampere (U. S. before 1911).—0.99916 International ampere (v).

International ampere (England before 1906).—0.99870 International ampere (v).

International ampere (England 1906-8).—0.99894 International ampere (v).

International ampere (England 1909-10).—0.99990 International ampere (v).

International ampere (France before 1911).—0.9998 International ampere (v).

International ampere (Germany before 1911).—0.99968 International ampere (v).

Statampere.—*See* electrostatic cgs unit.

Electrical Field Strength $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{-\frac{1}{2}}t^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-2}]$

Electrostatic cgs unit of potential per centimeter.—299.796 volts per centimeter (absolute).

Electrostatic cgs unit of potential per inch.—118.05 volts per centimeter (absolute).

Electromagnetic cgs unit of potential per centimeter.—1.0000×10^{-8} volt per centimeter (absolute).

Electromagnetic cgs unit of potential per inch.—3.9370×10^{-9} volt per centimeter (absolute).

Volt per inch.—0.39370 volt per centimeter.

Potential $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-2}]$

Abvolt.—*See* electromagnetic cgs unit.

Electromagnetic cgs unit or abvolt.—3.33560×10^{-11} electrostatic cgs unit or statvolt; 1.0000×10^{-8} volt (absolute).

Electrostatic cgs unit or statvolt.—299.796 volts (absolute); 2.99796×10^{10} electromagnetic cgs units or abvolts.

International volt (a).—Based on the International ohm and ampere; 1.00045 volts (absolute).

International volt (v).—Based on the acceptance of the electromotive force of a Weston cell at 20 °C as 1.0183 International volts; 1.00042 volts (absolute).

International volt (U. S. before 1911).—0.99916 International volt (v).

International volt (England before 1906).—0.99870 International volt (v).

International volt (England 1906-8).—0.99894 International volt (v).

International volt (England 1909-10).—0.99990 International volt (v).

International volt (Germany and France, before 1911).—0.99968 International volt (v).

Statvolts.—*See* electrostatic cgs unit.

Volt (absolute).—0.0033356 electrostatic cgs unit or statvolts; 0.99955 International volt (a); 0.99958 International volt (v); 1×10^{8} electromagnetic cgs units or abvolts.

Resistance $[\epsilon^{-1}l^{-1}t]$; $[\mu l t^{-1}]$

Abohm.—*See* electromagnetic cgs unit.

Board of trade unit (England 1903).—0.9984 International ohm.

Electromagnetic cgs unit or abohm.—1.11263×10^{-21} electrostatic cgs unit or statohm; 1×10^{-15} megohm; 1.0000×10^{-9} ohm (absolute); 0.001 microhm.

Electrostatic cgs unit or statohm.—8.98776×10^{11} ohms (absolute); 8.98776×10^{20} electromagnetic cgs units or abohms.

International ohm.—The resistance of a uniform column of mercury at 0°C, 106.300 centimeters long, having a mass of 14.4521 grams; 1.00052 ohms (absolute); 1.0016 board of trade unit (England 1903); 1.0630 Siemens unit.

International ohm (France before 1911).—0.9999 International ohm.

"Legal ohm" of 1884 (England).—0.99718 International ohm.

Megohm.—1×10^{6} ohms.

Microhm.—1.11263×10^{-18} electrostatic cgs unit or statohm; 1×10^{-12} megohm; 1×10^{-6} ohm; 1000 electromagnetic cgs units or abohms.

Ohm (absolute).—1.11263×10^{-12} electrostatic cgs unit or statohm; 1×10^{-6} megohm (absolute); 0.99948 International ohm; 1×10^{6} microhms (absolute); 1×10^{9} electromagnetic cgs units or abohms.

Siemens unit.—0.94073 International ohm.

Statohm.—*See* electrostatic cgs unit.

Volume Resistivity $[\epsilon^{-1}t]$; $[\mu l^2 t^{-1}]$

Electromagnetic cgs unit (abohm)-centimeter.—9.9948×10^{-10} International ohm-centimeter; 0.001 microhm-centimeter; 0.0060153 ohm-mil*-foot.

Electrostatic cgs unit-centimeter.—8.98776×10^{11} International ohm-centimeters.

International annealed copper standard (20°C).—Volume resistivity of annealed copper; 1.7241 microhm-centimeters.

International ohm-centimeter.—1.00052 ohm-centimeters (absolute).

Microhm-centimeter.—1.0000×10^{-6} ohm-centimeter; 0.3937 microhm-inch; 6.0153 ohm-mil*-foot; 1000 abohm-centimeters.

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*The unit thus marked refers to the diameter of a wire of circular cross section.

Microhm-inch.—2.5400 microhm-centimeters.

Ohm-centimeter (absolute).—0.99948 International ohm-centimeter; 1×10^6 microhm-centimeters.

Ohm-inch.—2.5400×10^6 microhm-centimeters.

Ohm-meter-millimeter².—100.0000 microhm-centimeters.

Ohm-meter-millimeter*.—78.540 microhm-centimeters.

Ohm-mil*-foot.—0.16624 microhm-centimeter; 166.24 electromagnetic cgs unit (abohm) centimeters.

Mass Resistivity $[\epsilon^{-1}ml^{-3}t]$; $[\mu ml^{-1}t^{-1}]$

Electromagnetic cgs unit.—9.9948×10^{-6} International ohm-meter-gram.

Electrostatic cgs unit.—8.9869×10^{15} International ohm-meter-gram.

International ohm-meter-gram.—1.00052 ohm (absolute)-meter-gram.

Ohm (absolute)-meter-gram.—0.99948 International ohm-meter-gram.

Ohm-centimeter-gram.—D† ohm-centimeter; 1.0000×10^4 ohm-meter-gram.

Ohm-mile-pound.—1.7513×10^{-4} ohm-meter-gram.

Volume Conductivity $[\epsilon t^{-1}]$; $[\mu^{-1}l^{-2}t]$

Electromagnetic cgs unit or abmhos per centimeter cube (ohm^{-1}-centimeter^{-1}).—166.2 mhos per mil* foot; 1000 megmhos per centimeter cube; 1.00052×10^9 International ohm^{-1}-centimeter^{-1}.

Electrostatic cgs unit.—1.11273×10^{-12} International ohm^{-1}-centimeter^{-1}.

International annealed copper standard (20°C).—0.5800 $microhm^{-1}$-centimeter^{-1}.

International ohm^{-1}-centimeter^{-1}.—0.99948 ohm^{-1}-centimeter^{-1} (absolute).

Megmhos per centimeter cube.—0.001 abmhos per centi-

†D represents the density in grams per centimeter cubed.

*The unit thus marked refers to the diameter of a wire of circular cross section.

meter cube; 0.1662 mhos per mil* foot; 2.540 megmhos per inch cube; 1 microhm^{-1}-centimeter^{-1}.

Megmhos per inch cube.—0.39370 megmhos per centimeter cube; 1 microhm^{-1}-inch^{-1}.

Mho centimeter cube.—1 ohm^{-1}-centimeter^{-1}.

Microhm^{-1}-centimeter^{-1}.—1.0000×10^{6} ohm^{-1}-centimeter^{-1}; 1 megmho per centimeter cube.

Microhm^{-1}-inch^{-1}.—0.39370 microhm^{-1}-centimeter^{-1}; 1 megmho per inch cube.

Ohm^{-1}-centimeter^{-1} (absolute).—1 mho per centimeter cube; 1.00052 International ohm^{-1}-centimeter^{-1}.

Ohm^{-1}-inch^{-1}.—3.9370×10^{-7} microhm^{-1}-centimeter^{-1}.

Ohm^{-1} (meter, millimeter*)$^{-1}$.—0.012732 microhm^{-1}-centimeter^{-1}.

Ohm^{-1} (meter, millimeter^{2})$^{-1}$.—0.01000 microhm^{-1}-centimeter^{-1}.

Ohm^{-1} (mil, foot)$^{-1}$.—6.0153 microhm^{-1}-centimeter^{-1}.

100% conductivity (20 °C).—0.5800 microhm^{-1}-centimeter^{-1}.

Mass Conductivity [$\epsilon m^{-1}l^{3}t^{-1}$]; [$\mu^{-1}m^{-1}lt$]

x **per electromagnetic cgs unit**$=1.00052\times10^{5}$ x per International ohm-meter-gram.

x **per electrostatic cgs unit**$=1.1127\times10^{-16}$ x per International ohm-meter-gram.

x **per International ohm-meter-gram**$=0.99948$ x per ohm (absolute)-meter-gram.

x **per ohm (absolute)-meter-gram**$=1.00052$ x per International ohm-meter-gram.

x **per ohm-centimeter-gram**$=1.0000\times10^{-4}$ x per ohm-meter-gram.

x **per ohm-mile-pound**$=0.0057100$ x per ohm-meter-gram.

Capacity [ϵl]; [$\mu^{-1}\, l^{-1}\, t^{2}$]

Electromagnetic cgs unit or abfarad.—1.0000×10^{9} farads (absolute); 1×10^{15} microfarads; 8.98776×10^{20} electrostatic cgs units or statfarads.

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*The unit thus marked refers to the diameter of a wire of circular cross section.

Electrostatic cgs unit (statfarad or centimeter).—1.11263×10^{-21} electromagnetic cgs unit or abfarad; 1.11263×10^{-12} farad (absolute); 1.11263×10^{-6} microfarad.

Farad (absolute).—1×10^{-9} electromagnetic cgs unit or abfarad; 1.00052 International farad; 1×10^{6} microfarads; 8.98776×10^{11} electrostatic cgs units or statfarads.

International farad.—0.99948 farad (absolute).

Microfarad.—1×10^{-15} electromagnetic cgs unit or abfarad; 1×10^{-6} farad; 8.98776×10^{5} electrostatic cgs units or statfarads.

Micromicrofarad.—1×10^{-12} farad.

Statfarad.—*See* electrostatic cgs unit.

Inductance $[\epsilon^{-1} l^{-1} t^{2}]$; $[\mu l]$

Abhenry.—*See* electromagnetic cgs unit.

Electromagnetic cgs unit (abhenry or centimeter).—1.11263×10^{-21} electrostatic cgs unit or stathenry; 1.0000×10^{-9} henry (absolute); 1×10^{-6} millihenry.

Electrostatic cgs unit or stathenry.—8.98776×10^{11} henry (absolute); 8.98776×10^{14} millihenries; 8.98776×10^{20} abhenries.

Henry (absolute).—1.11263×10^{-12} electrostatic cgs unit or stathenry; 0.99948 International henry; 1000 millihenries; 1×10^{9} electromagnetic cgs units or abhenries.

International henry.—1.00052 henry (absolute).

Millihenry.—1.11263×10^{-15} stathenry; 0.001 henries; 1×10^{6} abhenries.

Stathenry.—*See* electrostatic cgs unit.

Thermoelectric Units

THERMOELECTRIC POWER $[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1}\ \theta^{-1}]$; $[\mu^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{3}{2}}\ t^{-2}\ \theta^{-1}]$

Electromagnetic cgs unit of potential per °C.—0.010000 microvolt per °C (absolute).

Electromagnetic cgs unit of potential per °F.—0.018000 microvolt per °C (absolute).

Electrostatic cgs unit of potential per °C.—2.9986×10^{8} microvolt per °C (absolute).

Electrostatic cgs unit of potential per °F.—5.3975×10^{8} microvolt per °C (absolute).

Microvolt per °F.—1.8000 microvolt per °C.

PELTIER COEFFICIENT $[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-1}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-2}]$

Calorie (15 °C) per ampere-hour.—0.011625 joule per electromagnetic unit quantity.

Calorie (15 °C) per coulomb.—41.850 joules per electromagnetic unit quantity.

Joule per ampere-hour (absolute).—9.2636×10^{-14} joule per electrostatic unit quantity; 0.0027778 joule per electromagnetic unit quantity.

Joule per coulomb.—10.000 joules per electromagnetic unit quantity.

Joule per electron.—6.2811×10^{19} joules per electromagnetic unit quantity.

Joule per faraday.—1.0363×10^{-4} joule per electromagnetic unit quantity.

COEFFICIENT OF THOMSON EFFECT

$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-1}\ \theta^{-1}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, t^{-2}\ \theta^{-1}]$

Joule per coulomb per °F.—1.8000 joules per coulomb per °C.

Joule per electromagnetic unit quantity per °F.—0.1800 joule per coulomb per °C.

Joule per electron per °C.—6.2811×10^{18} joules per coulomb per °C.

Joule per electrostatic unit quantity per °C.—2.9986×10^{9} joules per coulomb per °C.

Joule per electrostatic unit quantity per °F.—5.3975×10^{9} joules per coulomb per °C.

Joule per faraday per °C.—1.0363×10^{-5} joule per coulomb per °C.

Volt per °C.—1.0000 joule per coulomb per °C.

Piezoelectric Constant $[\epsilon^{\frac{1}{2}} m^{-\frac{1}{2}} l^{\frac{1}{2}} t]$; $[\mu^{-\frac{1}{2}} m^{-\frac{1}{2}} l^{-\frac{1}{2}} t^{2}]$

Coulomb per kilogram weight.—3057.7 electrostatic unit quantity per dyne.

Electromagnetic unit quantity per kilogram weight.—3.0577×10^{4} electrostatic unit quantity per dyne.

Electromagnetic unit quantity per pound weight—6.7411×10^{4} electrostatic unit quantity per dyne.

Electron per kilogram weight.— 4.868×10^{-16} electrostatic unit quantity per dyne.

Electrostatic unit quantity per kilogram weight.—1.0197×10^{-6} electrostatic unit quantity per dyne.

Electrostatic unit quantity per pound weight.—2.2481×10^{-6} electrostatic unit quantity per dyne.

Faraday per kilogram weight.— 2.9507×10^{8} electrostatic unit quantity per dyne.

Flux of Magnetic Induction; Magnetic Flux; Pole Strength

$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{3}{2}} t^{-1}]$

Electromagnetic cgs unit (unit pole).—4π maxwell (absolute).

Electrostatic cgs unit.—2.99796×10^{10} maxwells (absolute).

International maxwell (a).—1.00045 maxwells (absolute).

International maxwell (v).—1.00042 maxwells (absolute).

Kilolines.—1000 maxwells.

Line.—1.0000 maxwell (absolute).

Maxwell (absolute).—3.3356×10^{-11} electrostatic cgs unit; 0.99955 International maxwell (a); 0.99958 International maxwell (v); 1.0000 line.

Megaline.—1×10^{6} maxwells.

Volt-second.—1×10^{8} maxwells.

Weber.—1 volt-second; 1×10^{8} maxwells.

Magnetic Field Intensity $[\epsilon^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-2}]$; $[\mu^{-\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{1}{2}} t^{-1}]$

Ampere-turn per centimeter.—1.2566 gauss.

Ampere-turn per inch.—0.49474 gauss.

Electromagnetic cgs unit.—1.0000 gauss (absolute).

Electrostatic cgs unit.—3.33560×10^{-11} gauss (absolute).

Gamma (γ).—1.0000×10^{-5} gauss.

Gauss (absolute).—0.79580 ampere-turn per centimeter; 1 electromagnetic cgs unit; 1 gilbert per centimeter; 1.00007 International gauss (a); 1.00010 International gauss (v); 2.0213 ampere-turns per inch; 6.452 lines per square inch; 1×10^{5} gamma (γ); 2.99796×10^{10} electrostatic cgs units.

Gilbert per centimeter.—1.0000 gauss; 2.021 ampere-turns per inch.

International gauss (a).—0.99993 gauss (absolute).

International gauss (v).—0.99990 gauss (absolute).

Lines per square centimeter.—1 gauss.

Lines per square inch.—0.1550 gauss.

Magnetomotive Force; Magnetic Potential

$[\epsilon^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{3}{2}} t^{-2}]$; $[\mu^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1}]$

Abampere-turn.—10 ampere-turns; 12.566 gilberts.

Ampere-turn.—0.1 abampere-turn; 1.2566 gilberts.

Electromagnetic cgs unit.—1.00000 gilbert (absolute).

Electrostatic cgs unit.—3.33560×10^{-11} gilbert (absolute).

Gilbert (absolute).—0.07958 abampere-turn; 0.7958 ampere-turn; 1.00007 International gilbert (a); 1.00010 International gilbert (v).

International gilbert (a).—0.99993 gilbert (absolute).

International gilbert (v).—0.99990 gilbert (absolute).

Reluctance $[\epsilon\, l\, t^{-2}]$; $[\mu^{-1} l^{-1}]$

Electromagnetic cgs unit.—1.0000 oersted (absolute).

Electrostatic cgs unit.—1.1122×10^{-21} oërsted (absolute).

International oersted.—0.99948 oersted (absolute).

Oersted (absolute).—1.00052 International oersted.

Magnetic Induction; Intensity of Magnetization

$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{3}{2}}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{-\frac{1}{2}} t^{-1}]$

Electromagnetic cgs unit.—1.00000 maxwell (absolute) per square centimeter.

Electrostatic cgs unit.—2.9986×10^{10} maxwells (absolute) per square centimeter.

International maxwell per square centimeter (a).—1.00045 maxwells (absolute) per square centimeter.

International maxwell per square centimeter (v).—1.00042 maxwells (absolute) per square centimeter.

Line per square centimeter.—1.00000 maxwell per square centimeter.

Line per square inch.—0.15500 maxwell per square centimeter.

Maxwell per square centimeter (**absolute**).—0.99955 International maxwell per square centimeter (a); 0.99958 International maxwell per square centimeter (v).

Maxwell per square inch.—0.15500 maxwell per square centimeter.

Dielectric Constant; Electrical Inductivity; Magnetic Permeability; Susceptibility.

Electromagnetic cgs unit.—8.9916×10^{20} electrostatic cgs units.

Foot-pound-second electromagnetic unit.—0.0010764 electromagnetic cgs unit; 9.6784×10^{17} electrostatic cgs units.

Foot-pound-second-electrostatic unit.—1.0000 electrostatic cgs unit.

Magnetic Effects

COEFFICIENT OF LEDUC EFFECT $[\epsilon^{-\frac{1}{2}}\, m^{-\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^2]$; $[\mu^{\frac{1}{2}}\, m^{-\frac{1}{2}}\, l^{\frac{1}{2}}\, t]$

x centimeters per **ampere-turn** = 0.79577 x per gauss.

x centimeters per **gilbert** = 1.0000 x per gauss.

x per **electrostatic cgs unit** = 2.9986×10^{10} x per gauss.

x inches per **ampere-turn** = 2.0213 x per gauss.

COEFFICIENT OF HALL EFFECT $[\epsilon^{-\frac{1}{2}}\, m^{-\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^3]$; $[\mu^{\frac{1}{2}}\, m^{-\frac{1}{2}}\, l^{\frac{5}{2}}]$

Electrostatic cgs unit.—2.6962×10^{31} electromagnetic cgs unit.

Volt centimeter per ampere gauss (**absolute**).—1.0000×10^{9} electromagnetic cgs unit.

Volt inch per ampere gauss (**absolute**).—2.5400×10^{9} electromagnetic cgs unit.

COEFFICIENT OF ETTINGHAUSEN EFFECT

$[\epsilon^{-1}\, m^{-1}\, l^{-1}\, t^4\, \theta]$; $[\mu m^{-1}\, l t^2\, \theta]$

°C centimeter per ampere gauss (**absolute**).—10.000 °C centimeter per electromagnetic cgs unit.

°C centimeter per electrostatic cgs unit.—8.9916×10^{20} °C centimeter per electromagnetic cgs unit.

°F inch per ampere gauss (absolute).—45.720 °C centimeter per electromagnetic cgs unit.

COEFFICIENT OF NERNST EFFECT $[\epsilon^{-1} t\, \theta^{-1}]$; $[\mu l^2 t^{-1} \theta^{-1}]$

Electrostatic cgs unit per °C.—8.9916×10^{20} electromagnetic cgs unit per °C.

Volt per gauss °C (absolute).—1.0000×10^8 electromagnetic cgs unit per °C.

Volt per gauss °F (absolute).—1.8000×10^8 electromagnetic cgs unit per °C.

VERDET'S CONSTANT $[\epsilon^{-\frac{1}{2}} m^{-\frac{1}{2}} l^{-\frac{1}{2}} t^2]$; $[\mu^{\frac{1}{2}} m^{-\frac{1}{2}} l^{-\frac{1}{2}} t]$

Minute per ampere-turn.—1.2566 minute per electromagnetic cgs unit.

Minute per gilbert.—1.0000 minute per electromagnetic cgs unit.

Radian per gilbert.—3437.7 minute per electromagnetic cgs unit.

RELATIONS OF ELECTRICAL UNITS

1 ohm	$=10^9$ electromagnetic	$=1/9 \times 10^{-11}$ electrostatic
1 volt	$=10^8$ electromagnetic	$=1/3 \times 10^{-2}$ electrostatic
1 ampere	$=10^{-1}$ electromagnetic	$= 3 \times 10^9$ electrostatic
1 coulomb	$=10^{-1}$ electromagnetic	$= 3 \times 10^9$ electrostatic
1 farad	$=10^{-9}$ electromagnetic	$= 9 \times 10^{11}$ electrostatic
1 farad	=1,000,000 microfarads	
1 henry	$=10^9$ electromagnetic	$=1/9 \times 10^{-11}$ electrostatic

VALUE OF THE GAS CONSTANT R FOR VARIOUS UNITS

8.3136×10^7 ergs per °C per mole.
1.9864 calories per °C per mole.

Units of pressure	Units of volume.	R per gram molecule.
Atmospheres	Volume at 0° C.	0.003662
Atmospheres	cm^3	82.07
Atmospheres	liters	0.08207
Atmospheres	cubic meters	
Dynes per cm^2 [barye]	cm^3	8.3156×10^7
Kilograms per m^2 [g = 980.6]	cm^3	8.48×10^5
		R per lb. molecule.
Pounds per sq.in.	cu.in.	18510.
Pounds per sq.in.	cu.ft.	10.71
Atmospheres	cu.in.	1260.
Atmospheres	cu.ft.	0.729

FACTORS FOR CONVERSION OF ENERGY UNITS

(From Perkins' Introduction to General Thermodynamics, John Wiley & Sons, publishers, by permission.)

	Gram-calories (4° C)	B.T.U.*	Joules	Foot-pounds	Kilogr.-meters	Liter-atmos.	Cu.ft.-atmos.	Foot-poundals	Horse-power hours
Gram-calorie	1.	3.968×10^{-3}	4.185	3.087	.4267	4.130×10^{-2}	1.459×10^{-3}	99.31	1.5591×10^{-6}
B.T.U.	252.	1	1055.	777.9	107.5	10.41	.3676	25030.	3.929×10^{-4}
Joule	.2389	9.482×10^{-4}	1.	.73756	.1019	9.869×10^{-3}	3.485×10^{-4}	23.73	3.725×10^{-7}
Foot-pound	.3240	1.286×10^{-3}	1.356	1.	.13826	1.3381×10^{-2}	4.7253×10^{-4}	32.174	5.0505×10^{-7}
Kilogr.-meter	2.343	9.298×10^{-3}	9.806	7.2327	1.	9.678×10^{-2}	3.4177×10^{-3}	232.7	3.6529×10^{-6}
Liter-atmos.	24.21	9.607×10^{-2}	101.32	74.733	10.333	1.	3.5319×10^{-2}	2403.8	3.7734×10^{-5}

* At temp. of maximum density.

CONVERSION OF PRESSURE UNITS

(From Perkins' Introduction to General Thermodynamics, John Wiley & Sons, publishers, by permission.)

	Dynes per sq. cm	Grams per sq. cm	Kilo. per sq. meter	Mm of mercury	Atmospheres	Lbs. per sq. in.	Lbs. per sq. ft.
Dynes per sq. centimeter	1.	1.0198×10^{-3}	1.0198×10^{-2}	7.5010×10^{-4}	9.8697×10^{-7}	1.4504×10^{-5}	2.0887×10^{-3}
Gram per sq. centimeter	980.6	1	10	7.3551×10^{-1}	9.6777×10^{-4}	1.4223×10^{-2}	2.0481
Kilogram per sq. meter	98.06	10^{-1}	1	7.3551×10^{-2}	9.6777×10^{-5}	1.4223×10^{-3}	2.0481×10^{-1}
Millimeter of mercury	1332.	1.3595	13.595	1	1.3158×10^{-3}	1.9337×10^{-2}	2.7845
Atmosphere	1013200.	1033.3	10333	760	1	14.696	2116.32
Pound per square inch	68944	70.308	703.12	51.715	6.8046×10^{-2}	1	144
Pound per square foot	478.78	4.883×10^{-1}	4.883	3.5912×10^{-1}	4.7252×10^{-4}	6.9445×10^{-3}	1

In the two tables above the numbers show the value of the energy or pressure unit named at the left in the units named at the top. For example, 1 gram-calorie is equivalent to 3.968×10^{-3} B.T.U.

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10

Length

INCHES	MILLIMETERS	INCHES	CENTIMETERS	FEET	METERS	U. S. YARDS	METERS	U. S. MILES	KILOMETERS
0.03937	= 1	0.3937	= 1	1	= 0.304801	1	= 0.914402	0.62137	= 1
0.07874	= 2	0.7874	= 2	2	= 0.609601	1.093611	= 1	1	= 1.60935
0.11811	= 3	1	= 2.54001	3	= 0.914402	2	= 1.828804	1.24274	= 2
0.15748	= 4	1.1811	= 3	3.28083	= 1	2.187222	= 2	1.86411	= 3
0.19685	= 5	1.5748	= 4	4	= 1.219202	3	= 2.743205	2	= 3.21869
0.23622	= 6	1.9685	= 5	5	= 1.524003	3.280833	= 3	2.48548	= 4
0.27559	= 7	2	= 5.08001	6	= 1.828804	4	= 3.657607	3	= 4.82804
0.31496	= 8	2.3622	= 6	6.56167	= 2	4.374444	= 4	3.10685	= 5
0.35433	= 9	2.7559	= 7	7	= 2.133604	5	= 4.572009	3.72822	= 6
1	= 25.4001	3	= 7.62002	8	= 2.438405	5.468056	= 5	4	= 6.43739
2	= 50.8001	3.1496	= 8	9	= 2.743205	6	= 5.486411	4.34959	= 7
3	= 76.2002	3.5433	= 9	9.84250	= 3	6.561667	= 6	4.97096	= 8
4	= 101.6002	4	= 10.16002	13.12333	= 4	7	= 6.400813	5	= 8.04674
5	= 127.0003	5	= 12.70003	16.40417	= 5	7.655278	= 7	5.59233	= 9
6	= 152.4003	6	= 15.24003	19.68500	= 6	8	= 7.315215	6	= 9.65608
7	= 177.8004	7	= 17.78004	22.96583	= 7	8.748889	= 8	7	= 11.26543
8	= 203.2004	8	= 20.32004	26.24667	= 8	9	= 8.229616	8	= 12.87478
9	= 228.6005	9	= 22.86005	29.52750	= 9	9.842500	= 9	9	= 14.48412

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Area

SQUARE INCHES	SQUARE MILLIMETERS	SQUARE INCHES	SQUARE CENTIMETERS	SQUARE FEET	SQUARE METERS	SQUARE YARDS	SQUARE METERS	SQUARE MILES	SQUARE KILOMETERS
0.00155 =	1	0.1550 =	1	1	= 0.09290	1	= 0.8361	0.3861 =	1
0.00310 =	2	0.3100 =	2	2	= 0.18581	1.1960 =	1	0.7722 =	2
0.00465 =	3	0.4650 =	3	3	= 0.27871	2	= 1.6723	1 =	2.5900
0.00620 =	4	0.6200 =	4	4	= 0.37161	2.3920 =	2	1.1583 =	3
0.0075 =	5	0.7750 =	5	5	= 0.46452	3	2.5084	1.5444 =	4
0.00930 =	6	0.9300 =	6	6	= 0.55742	3.5880 =	3	1.9305 =	5
0.01085 =	7	1 =	6.452	7	= 0.65032	4	= 3.3445	2 =	5.1800
0.01240 =	8	1.0850 =	7	8	= 0.74323	4.7839 =	4	2.3166 =	6
0.01395 =	9	1.2400 =	8	9	= 0.83613	5	= 4.1807	2.7027 =	7
1	= 645.16	1.3950 =	9	10.764 =	1	5.9799 =	5	3 =	7.7700
2	= 1,290.33	2	= 12.903	21.528 =	2	6	= 5.0168	3.0888 =	8
3	= 1,935.49	3	= 19.355	32.292 =	3	7	= 5.8529	3.4749 =	9
4	= 2,580.65	4	= 25.807	43.055 =	4	7.1759 =	6	4	= 10.3600
5	= 3,225.81	5	= 32.258	53.819 =	5	8	= 6.6890	5	= 12.9500
6	= 3,870.98	6	= 38.710	64.583 =	6	8.3719 =	7	6	= 15.5400
7	= 4,516.14	7	= 45.161	75.347 =	7	9	= 7.5252	7	= 18.1300
8	= 5,161.30	8	= 51.613	86.111 =	8	9.5679 =	8	8	= 20.7200
9	= 5,806.46	9	= 58.065	96.875 =	9	10.7639 =	9	9	= 23.3100

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Volume															AREA—Continued		
CUBIC INCHES		CUBIC MILLI-METERS	CUBIC INCHES		CUBIC CENTI-METERS	CUBIC FEET		CUBIC METERS	CUBIC YARDS		CUBIC METERS	ACRES		HECTARES
0.000061	=	**1**	0.0610	=	**1**	**1**	=	0.02832	**1**	=	0.7646	**1**	=	0.4047
0.000122	=	**2**	0.1220	=	**2**	**2**	=	0.05663	1.3079	=	**1**	**2**	=	0.8094
0.000183	=	**3**	0.1831	=	**3**	**3**	=	0.08495	**2**	=	1.5291	2.471	=	**1**
0.000244	=	**4**	0.2441	=	**4**	**4**	=	0.11327	2.6159	=	**2**	**3**	=	1.2141
0.000305	=	**5**	0.3051	=	**5**	**5**	=	0.14159	**3**	=	2.2937	**4**	=	1.6187
0.000366	=	**6**	0.3661	=	**6**	**6**	=	0.16990	3.9238	=	**3**	4.942	=	**2**
0.000427	=	**7**	0.4272	=	**7**	**7**	=	0.19822	**4**	=	3.0582	**5**	=	2.0234
0.000488	=	**8**	0.4882	=	**8**	**8**	=	0.22654	**5**	=	3.8228	**6**	=	2.4281
0.000549	=	**9**	0.5492	=	**9**	**9**	=	0.25485	5.2318	=	**4**	**7**	=	2.8328
1	=	16,387.2	**1**	=	16.3872	35.314	=	**1**	**6**	=	4.5874	7.413	=	**3**
2	=	32,774.3	**2**	=	32.7743	70.629	=	**2**	6.5397	=	**5**	**8**	=	3.2375
3	=	49,161.5	**3**	=	49.1615	105.943	=	**3**	**7**	=	5.3519	**9**	=	3.6422
4	=	65,548.6	**4**	=	65.5486	141.258	=	**4**	7.8477	=	**6**	9.884	=	**4**
5	=	81,935.8	**5**	=	81.9358	176.572	=	**5**	**8**	=	6.1165	12.355	=	**5**
6	=	98,323.0	**6**	=	98.3230	211.887	=	**6**	**9**	=	6.8810	14.826	=	**6**
7	=	114,710.1	**7**	=	114.7101	247.201	=	**7**	9.1556	=	**7**	17.297	=	**7**
8	=	131,097.3	**8**	=	131.0973	282.516	=	**8**	10.4635	=	**8**	19.768	=	**8**
9	=	147,484.5	**9**	=	147.4845	317.830	=	**9**	11.7715	=	**9**	22.239	=	**9**

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10 (Continued)

Capacity

The following equivalents are computed on the basis 1 liter = 1.000027 cubic decimeters.

MILLILITERS	U. S. LIQUID OUNCES	MILLILITERS	U. S. APOTHECARIES' DRAMS	U. S. APOTHECARIES' SCRUPLES	MILLILITERS	U. S. LIQUID QUARTS	LITERS	U. S. LIQUID GALLONS	LITERS
1	0.03382	**1**	0.2705	0.8116	**1**	**1**	0.94633	0.26418	**1**
2	0.06763	**2**	0.5410	**1**	1.2322	1.05671	**1**	0.52836	**2**
3	0.10144	**3**	0.8116	1.6231	**2**	**2**	1.89267	0.79253	**3**
4	0.13526	3.6967	**1**	**2**	2.4644	2.11342	**2**	**1**	3.78533
5	0.16907	**4**	1.0821	2.4347	**3**	**3**	2.83900	1.05671	**4**
6	0.20289	**5**	1.3526	**3**	3.6967	3.17013	**3**	1.32089	**5**
7	0.23670	**6**	1.6231	3.2462	**4**	**4**	3.78533	1.58507	**6**
8	0.27052	**7**	1.8936	**4**	4.9288	4.22684	**4**	1.84924	**7**
9	0.30433	7.3932	**2**	4.0578	**5**	**5**	4.73167	**2**	7.57066
29.573	**1**	**8**	2.1641	4.8693	**6**	5.28355	**5**	2.11342	**8**
59.146	**2**	**9**	2.4347	**5**	6.1610	**6**	5.67800	2.37760	**9**
88.719	**3**	11.0898	**3**	5.6809	**7**	6.34026	**6**	**3**	11.35600
118.292	**4**	14.7864	**4**	**6**	7.3932	**7**	6.62433	**4**	15.14133
147.864	**5**	18.4831	**5**	6.4924	**8**	7.39697	**7**	**5**	18.92666
177.437	**6**	22.1797	**6**	**7**	8.6254	**8**	7.57066	**6**	22.71199
207.010	**7**	25.8763	**7**	7.3040	**9**	8.45368	**8**	**7**	26.49732
236.583	**8**	29.5729	**8**	**8**	9.8576	**9**	8.51700	**8**	30.28266
266.156	**9**	33.2695	**9**	**9**	11.0898	9.51039	**9**	**9**	34.06799

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10 (Continued)

Capacity

The following equivalents are computed on the basis 1 liter = 1.000027 cubic decimeters.

U. S. DRY QUARTS	LITERS	U. S. PECKS	LITERS	DEKA-LITERS	U. S. PECKS	U. S. BUSHELS	HECTO-LITERS	U. S. BUSHELS PER ACRE	HECTO LITERS PER HECTARE
0.9081	=1	0.11351	= 1	0.8810	= 1	1	=0.35238	1	=0.87078
1	=1.1012	0.22703	= 2	1	= 1.1351	2	=0.70477	1.14840	=1
1.8162	=2	0.34054	= 3	1.7620	= 2	2.837819	=1	2	=1.74156
2	=2.2024	0.45405	= 4	2	= 2.2703	3	=1.05715	2.29680	=2
2.7243	=3	0.56756	= 5	2.0429	= 3	4	=1.40953	3	=2.61233
3	=3.3036	0.68108	= 6	3	= 3.4054	5	=1.76192	3.44519	=3
3.6324	=4	0.79459	= 7	3.5238	= 4	5.675638	=2	4	=3.48311
4	=4.4048	0.90810	= 8	4	= 4.5405	6	=2.11430	4.59359	=4
4.5405	=5	1	= 8.80958	4.4048	= 5	7	=2.46668	5	=4.35389
5	=5.5060	1.02161	= 9	5	= 5.6756	8	=2.81907	5.74199	=5
5.4487	=6	2	=17.61916	5.2857	= 6	8.513457	=3	6	=5.22467
6	=6.6072	3	=26.42875	6	= 6.8108	9	=3.17145	6.89039	=6
6.3568	=7	4	=35.23833	6.1667	= 7	11.351276	=4	7	=6.09545
7	=7.7084	5	=44.04791	7	= 7.9459	14.189095	=5	8	=6.96622
7.2649	=8	6	=52.85749	7.0477	= 8	17.026914	=6	8.03879	=7
8	=8.8096	7	=61.66708	7.9286	= 9	19.864733	=7	9	=7.83700
8.1730	=9	8	=70.47666	8	= 9.0810	22.702552	=8	9.18719	=8
9	=9.9108	9	=79.28624	9	=10.2161	25.540371	=9	10.33558	=9

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Weight (or Mass)

GRAINS	GRAMS	AVOIRDUPOIS OUNCES	GRAMS	TROY OUNCES	GRAMS	AVOIRDUPOIS POUNDS	KILOGRAMS	TROY POUNDS	KILOGRAMS
1	= 0.06480	0.03527	= 1	0.03215	= 1	1	= 0.45359	1	= 0.37324
2	= 0.12960	0.07055	= 2	0.06430	= 2	2	= 0.90718	2	= 0.74648
3	= 0.19440	0.10582	= 3	0.09645	= 3	2.20462	= 1	2.67923	= 1
4	= 0.25920	0.14110	= 4	0.12860	= 4	3	= 1.36078	3	= 1.11973
5	= 0.32399	0.17637	= 5	0.16075	= 5	4	= 1.81437	4	= 1.49297
6	= 0.38879	0.21164	= 6	0.19290	= 6	4.40924	= 2	5	= 1.86621
7	= 0.45359	0.24692	= 7	0.22506	= 7	5	= 2.26796	5.35846	= 2
8	= 0.51839	0.28219	= 8	0.25721	= 8	6	= 2.72155	6	= 2.23945
9	= 0.58319	0.31747	= 9	0.28936	= 9	6.61387	= 3	7	= 2.61269
15.4324	= 1	1	= 28.3495	1	= 31.10348	7	= 3.17515	8	= 2.98593
30.8647	= 2	2	= 56.6991	2	= 62.20696	8	= 3.62874	8.03769	= 3
46.2971	= 3	3	= 85.0486	3	= 93.31044	8.81849	= 4	9	= 3.35918
61.7294	= 4	4	= 113.3981	4	= 124.41392	9	= 4.08233	10.71691	= 4
77.1618	= 5	5	= 141.7476	5	= 155.51740	11.02311	= 5	13.39614	= 5
92.5941	= 6	6	= 170.0972	6	= 186.62088	13.22773	= 6	16.07537	= 6
108.0265	= 7	7	= 198.4467	7	= 217.72437	15.43236	= 7	18.75460	= 7
123.4589	= 8	8	= 226.7962	8	= 248.82785	17.63698	= 8	21.43383	= 8
138.8912	= 9	9	= 255.1457	9	= 279.93133	19.84160	= 9	24.11306	= 9

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES

From 1 to 10 Units

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
0.00036735	0.00041143	0.00037324	0.37324	0.822857	1.
0.00044643	0.00050000	0.00045359	0.45359	1.	1.21528
0.00073469	0.00082286	0.00074648	0.74648	1.64571	2.
0.00089286	0.00100000	0.00090718	0.90718	2.	2.43056
0.00098421	0.00110231	0.00100000	1.	2.20462	2.67923
0.00110204	0.00123429	0.00111973	1.11973	2.46857	3.
0.00133929	0.00150000	0.00136078	1.36078	3.	3.64583
0.00146939	0.00164571	0.00149297	1.49297	3.29143	4.
0.00178571	0.00200000	0.00181437	1.81437	4.	4.86111
0.00183673	0.00205714	0.00186621	1.86621	4.11429	5.
0.00196841	0.00220462	0.00200000	2.	4.40924	5.35846
0.00220408	0.00246857	0.00223945	2.23945	4.93714	6.
0.00223214	0.00250000	0.00226796	2.26796	5.	6.07639
0.00257143	0.00288000	0.00261269	2.61269	5.76000	7.
0.00267857	0.00300000	0.00272155	2.72155	6.	7.29167
0.00293878	0.00329143	0.00298593	2.98593	6.58286	8.
0.00295262	0.00330693	0.00300000	3.	6.61387	8.03769
0.00312500	0.00350000	0.00317515	3.17515	7.	8.50694
0.00330612	0.00370286	0.00335918	3.35918	7.40571	9.
0.00357143	0.00400000	0.00362874	3.62874	8.	9.72222

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES (Continued)

From 1 to 10 Units

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
0.00393683	0.00440924	0.00400000	4.	8.81849	10.71691
0.00401786	0.00450000	0.00408233	4.08233	9.	10.93750
0.00492103	0.00551156	0.00500000	5.	11.0231	13.39614
0.00590524	0.00661387	0.00600000	6.	13.2277	16.07537
0.00688944	0.00771618	0.00780000	7.	15.4324	18.75460
0.00787365	0.00881849	0.00800000	8.	17.6370	21.43383
0.00885786	0.00992080	0.00900000	9.	19.8416	24.11306
0.89287	1.	0.90718	907.18	2,000.	2,430.56
0.98421	1.10231	1.	1,000.	2,204.62	2,679.23
1.	1.12000	1.01605	1,016.05	2,240.00	2,722.22
1.78571	2.	1.81437	1,814.37	4,000.00	4,361.11
1.96841	2.20462	2.	2,000.00	4,409.24	5,358.46
2.	2.24000	2.03209	2,032.09	4,480.00	5,444.44
2.67857	3.	2.72155	2,721.55	6,000.00	7,291.67
2.95262	3.30693	3.	3,000.00	6,613.87	8,037.69
3.	3.36000	3.04814	3,048.14	6,720.00	8,166.67
3.57143	4.	3.62874	3,628.74	8,000.00	9,722.22
3.93683	4.40924	4.	4,000.00	8,818.49	10,716.91
4.	4.48000	4.06419	4,064.19	8,960.00	10,888.89
4.46429	5.	4.53592	4,535.92	10,000.00	12,152.78

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES (Continued)

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
4.92103	5.51156	5.	5,000.00	11,023.11	13,396.14
5.	5.60000	5.08024	5,080.24	11,200.00	13,611.11
5.35714	6.	5.44311	5,443.11	12,000.00	14,583.33
5.90524	6.61387	6.	6,000.00	13,227.73	16,075.37
6.	6.72000	6.09628	6,096.28	13,440.00	16,333.33
6.25000	7.	6.35029	6,350.29	14,000.00	17,013.89
6.88944	7.71618	7.	7,000.00	15,432.36	18,754.60
7.	7.84000	7.11232	7,112.32	15,680.00	19,055.56
7.14286	8.	7.25748	7,257.48	16,000.00	19,444.44
7.87365	8.81849	8.	8,000.00	17,636.98	21,433.83
8.	8.96000	8.12838	8,128.38	17,920.00	21,777.78
8.03571	9.	8.16466	8,164.66	18,000.00	21,875.00
8.85786	9.92080	9.	9,000.00	19,841.60	24,113.06
9.	10.08000	9.14442	9,144.42	20,160.00	24,500.00

LENGTHS — CENTIMETERS TO INCHES

0.1 *to* 100 *Units*

1 centimeter = 0.393700 inches

The values found in the body of the table give, in inches, the lengths indicated in centimeters at the top and side.

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0		0.03937	0.07874	0.11811	0.15748	0.19685	0.23622	0.27559	0.31496	0.35433
1	0.39370	0.43307	0.47244	0.51181	0.55118	0.59055	0.62992	0.66929	0.70866	0.74803
2	0.78740	0.82677	0.86614	0.90551	0.94488	0.98425	1.0236	1.0630	1.1024	1.1417
3	1.1811	1.2205	1.2598	1.2992	1.3386	1.3780	1.4173	1.4567	1.4961	1.5354
4	1.5748	1.6142	1.6535	1.6929	1.7323	1.7717	1.8110	1.8504	1.8898	1.9291
5	1.9685	2.0079	2.0472	2.0866	2.1260	2.1654	2.2047	2.2441	2.2835	2.3228
6	2.3622	2.4016	2.4409	2.4803	2.5197	2.5591	2.5984	2.6378	2.6772	2.7165
7	2.7559	2.7953	2.8346	2.8740	2.9134	2.9528	2.9921	3.0315	3.0709	3.1102
8	3.1496	3.1890	3.2283	3.2677	3.3071	3.3465	3.3858	3.4252	3.4646	3.5039
9	3.5433	3.5827	3.6220	3.6614	3.7008	3.7402	3.7795	3.8189	3.8583	3.8976

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
10	3.9370	3.9764	4.0158	4.0551	4.0945	4.1339	4.1732	4.2126	4.2520	4.2913
11	4.3307	4.3701	4.4094	4.4488	4.4882	4.5276	4.5669	4.6063	4.6457	4.6850
12	4.7244	4.7638	4.8031	4.8425	4.8819	4.9213	4.9606	5.0000	5.0394	5.0787
13	5.1181	5.1575	5.1968	5.2362	5.2756	5.3150	5.3543	5.3937	5.4331	5.4724
14	5.5118	5.5512	5.5905	5.6299	5.6693	5.7087	5.7480	5.7874	5.8268	5.8661
15	5.9055	5.9449	5.9842	6.0236	6.0630	6.1024	6.1417	6.1811	6.2205	6.2598
16	6.2992	6.3386	6.3779	6.4173	6.4567	6.4961	6.5354	6.5748	6.6142	6.6535
17	6.6929	6.7323	6.7716	6.8110	6.8504	6.8898	6.9291	6.9685	7.0079	7.0472
18	7.0866	7.1260	7.1653	7.2047	7.2441	7.2835	7.3228	7.3622	7.4016	7.4409
19	7.4803	7.5197	7.5590	7.5984	7.6378	7.6772	7.7165	7.7559	7.7953	7.8346
20	7.8740	7.9134	7.9527	7.9921	8.0315	8.0709	8.1102	8.1496	8.1890	8.2283
21	8.2677	8.3071	8.3464	8.3858	8.4252	8.4646	8.5039	8.5433	8.5827	8.6220
22	8.6614	8.7008	8.7401	8.7795	8.8189	8.8583	8.8976	8.9370	8.9764	9.0157
23	9.0551	9.0945	9.1338	9.1732	9.2126	9.2520	9.2913	9.3307	9.3701	9.4094
24	9.4488	9.4882	9.5275	9.5669	9.6063	9.6457	9.6850	9.7244	9.7638	9.8031
25	9.8425	9.8819	9.9212	9.9606	10.000	10.039	10.079	10.118	10.157	10.197
26	10.236	10.275	10.315	10.354	10.394	10.433	10.472	10.512	10.551	10.591
27	10.630	10.669	10.709	10.748	10.787	10.827	10.866	10.905	10.945	10.984
28	11.024	11.063	11.102	11.142	11.181	11.220	11.260	11.299	11.339	11.378
29	11.417	11.457	11.496	11.535	11.575	11.614	11.654	11.693	11.732	11.772

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
30	11.811	11.850	11.890	11.929	11.968	12.008	12.047	12.087	12.126	12.165
31	12.205	12.244	12.283	12.323	12.362	12.402	12.441	12.480	12.520	12.559
32	12.598	12.638	12.677	12.717	12.756	12.795	12.835	12.874	12.914	12.953
33	12.992	13.031	13.071	13.110	13.150	13.189	13.228	13.268	13.307	13.346
34	13.386	13.425	13.465	13.504	13.543	13.583	13.622	13.661	13.701	13.740
35	13.780	13.819	13.858	13.898	13.937	13.976	14.016	14.055	14.094	14.134
36	14.173	14.213	14.252	14.291	14.331	14.370	14.409	14.449	14.488	14.528
37	14.567	14.606	14.646	14.685	14.724	14.764	14.803	14.842	14.882	14.921
38	14.961	15.000	15.039	15.079	15.118	15.157	15.197	15.236	15.276	15.315
39	15.354	15.394	15.433	15.472	15.512	15.551	15.591	15.630	15.669	15.709
40	15.748	15.787	15.827	15.866	15.905	15.945	15.984	16.024	16.063	16.102
41	16.142	16.181	16.220	16.260	16.299	16.339	16.378	16.417	16.457	16.496
42	16.535	16.575	16.614	16.654	16.693	16.732	16.772	16.811	16.850	16.890
43	16.929	16.968	17.008	17.047	17.087	17.126	17.165	17.205	17.244	17.283
44	17.323	17.362	17.402	17.441	17.480	17.520	17.559	17.598	17.638	17.677
45	17.717	17.756	17.795	17.835	17.874	17.913	17.953	17.992	18.031	18.071
46	18.110	18.150	18.189	18.228	18.268	18.307	18.346	18.386	18.425	18.465
47	18.504	18.543	18.583	18.622	18.661	18.701	18.740	18.779	18.819	18.858
48	18.898	18.987	18.976	19.016	19.055	19.094	19.134	19.173	19.213	19.252
49	19.291	19.331	19.370	19.409	19.449	19.488	19.528	19.567	19.606	19.646

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
50	19.685	19.724	19.764	19.803	19.842	19.882	19.921	19.961	20.000	20.039
51	20.079	20.118	20.157	20.197	20.236	20.276	20.315	20.354	20.394	20.433
52	20.472	20.512	20.551	20.591	20.630	20.669	20.709	20.748	20.787	20.827
53	20.866	20.905	20.945	20.984	21.024	21.063	21.102	21.142	21.181	21.220
54	21.260	21.299	21.339	21.378	21.417	21.457	21.496	21.535	21.575	21.614
55	21.654	21.693	21.732	21.772	21.811	21.850	21.890	21.929	21.968	22.008
56	22.047	22.087	22.126	22.165	22.205	22.244	22.283	22.323	22.362	22.402
57	22.441	22.480	22.520	22.559	22.598	22.638	22.677	22.716	22.756	22.795
58	22.835	22.874	22.913	22.953	22.992	23.031	23.071	23.110	23.150	23.189
59	23.228	23.268	23.307	23.346	23.386	23.425	23.465	23.504	23.543	23.583
60	23.622	23.661	23.701	23.740	23.779	23.819	23.858	23.898	23.937	23.976
61	24.016	24.055	24.094	24.134	24.173	24.213	24.252	24.291	24.331	24.370
62	24.409	24.449	24.488	24.528	24.567	24.606	24.646	24.685	24.724	24.764
63	24.803	24.842	24.882	24.921	24.961	25.000	25.039	25.079	25.118	25.157
64	25.197	25.236	25.276	25.315	25.354	25.394	25.433	25.472	25.512	25.551
65	25.591	25.630	25.669	25.709	25.748	25.787	25.827	25.866	25.905	25.945
66	25.984	26.024	26.063	26.102	26.142	26.181	26.220	26.260	26.299	26.339
67	26.378	26.417	26.457	26.496	26.535	26.575	26.614	26.653	26.693	26.732
68	26.772	26.811	26.850	26.890	26.929	26.968	27.008	27.047	27.087	27.126
69	27.165	27.205	27.244	27.283	27.323	27.362	27.402	27.441	27.480	27.520

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
70	27.559	27.598	27.638	27.677	27.716	27.756	27.795	27.835	27.874	27.913
71	27.953	27.992	28.031	28.071	28.110	28.150	28.189	28.228	28.268	28.307
72	28.346	28.386	28.425	28.465	28.504	28.543	28.583	28.622	28.661	28.701
73	28.740	28.779	28.819	28.858	28.898	28.937	28.976	29.016	29.055	29.094
74	29.134	29.173	29.213	29.252	29.291	29.331	29.370	29.409	29.449	29.488
75	29.528	29.567	29.606	29.646	29.685	29.724	29.764	29.803	29.842	29.882
76	29.921	29.961	30.000	30.039	30.079	30.118	30.157	30.197	30.236	30.276
77	30.315	30.354	30.394	30.433	30.472	30.512	30.551	30.590	30.630	30.669
78	30.709	30.748	30.787	30.827	30.866	30.905	30.945	30.984	31.024	31.063
79	31.102	31.142	31.181	31.220	31.260	31.299	31.339	31.378	31.417	31.457
80	31.496	31.535	31.575	31.614	31.653	31.693	31.732	31.772	31.811	31.850
81	31.890	31.929	31.968	32.008	32.047	32.087	32.126	32.165	32.205	32.244
82	32.283	32.323	32.362	32.402	32.441	32.480	32.520	32.559	32.598	32.638
83	32.677	32.716	32.756	32.795	32.835	32.874	32.913	32.953	32.992	33.031
84	33.071	33.110	33.150	33.189	33.228	33.268	33.307	33.346	33.386	33.425
85	33.465	33.504	33.543	33.583	33.622	33.661	33.701	33.740	33.779	33.819
86	23.858	33.898	33.937	33.976	33.016	34.055	34.094	34.134	34.173	34.213
87	34.252	34.291	34.331	34.370	34.409	34.449	34.488	34.527	34.567	34.606
88	34.646	34.685	34.724	34.764	34.803	34.842	34.882	34.921	34.961	35.000
89	35.039	35.079	35.118	35.157	35.197	35.236	35.276	35.315	35.354	35.394

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
90	35.433	35.472	35.512	35.551	35.590	35.630	35.669	35.709	35.748	35.787
91	35.827	35.866	35.905	35.945	35.984	36.024	36.063	36.102	36.142	36.181
92	36.220	36.260	36.299	36.339	36.378	36.417	36.457	36.496	36.535	36.575
93	36.614	36.653	36.693	36.732	36.772	36.811	36.850	36.890	36.929	36.968
94	37.008	37.047	37.087	37.126	37.165	37.205	37.244	37.283	37.323	37.362
95	37.402	37.441	37.480	37.520	37.559	37.598	37.638	27.677	37.716	37.756
96	37.795	37.835	37.874	37.913	37.953	37.992	38.031	38.071	38.110	38.150
97	38.189	38.228	38.268	38.307	38.346	38.386	38.425	38.464	38.504	38.543
98	38.583	38.622	38.661	38.701	38.740	38.779	38.819	38.858	38.898	38.937
99	38.976	39.016	39.055	39.094	39.134	39.173	39.213	39.252	39.291	39.331

LENGTHS — INCHES TO CENTIMETERS

From 0.1 *to* 100 *Units*

1 inch = 2.54001 centimeters

The values found in the body of the table give, in centimeters, the lengths indicated in inches at the top and side.

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	....	0.25400	0.50800	0.76200	1.0160	1.2700	1.5240	1.7780	2.0320	2.2860
1	2.5400	2.7940	3.0480	3.3020	3.5560	3.8100	4.0640	4.3180	4.5720	4.8260
2	5.0800	5.3340	5.5880	5.8420	6.0960	6.3500	6.6040	6.8580	7.1120	7.3660
3	7.6200	7.8740	8.1280	8.3820	8.6360	8.8900	9.1440	9.3980	9.6520	9.9060
4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
10	25.400	25.654	25.908	26.162	26.416	26.670	26.924	27.178	27.432	27.686
11	27.940	28.194	28.448	28.702	28.956	29.210	29.464	29.718	29.972	30.226
12	30.480	30.734	30.988	31.242	31.496	31.750	32.004	32.258	32.512	32.766
13	33.020	33.274	33.528	33.782	34.036	34.290	34.544	34.798	35.052	35.306
14	35.560	35.814	36.068	36.322	36.576	36.830	37.084	37.338	37.592	37.846
15	38.100	38.354	38.608	38.862	39.116	39.370	39.624	39.878	40.132	40.386
16	40.640	40.894	41.148	41.402	41.656	41.910	42.164	42.418	42.672	42.926
17	43.180	43.434	43.688	43.942	44.196	44.450	44.704	44.958	45.212	45.466
18	45.720	45.974	46.228	46.482	46.736	46.990	47.244	47.498	47.752	48.006
19	48.260	48.514	48.768	49.022	49.276	49.530	49.784	50.038	50.292	50.546
20	50.800	51.054	51.308	51.562	51.816	52.070	52.324	52.578	52.832	53.086
21	53.340	53.594	53.848	54.102	54.356	54.610	54.864	55.118	55.372	55.626
22	55.880	56.134	56.388	56.642	56.896	57.150	57.404	57.658	57.912	58.166
23	58.420	58.674	58.928	59.182	59.436	59.690	59.944	60.198	60.452	60.706
24	60.960	61.214	61.468	61.722	61.976	62.230	62.484	62.738	62.992	63.246
25	63.500	63.754	64.008	64.262	64.516	64.770	65.024	65.278	65.532	65.786
26	66.040	66.294	66.548	66.802	67.056	67.310	67.564	67.818	68.072	68.326
27	68.580	68.834	69.088	69.342	69.596	69.850	70.104	70.358	70.612	70.866
28	71.120	71.374	71.628	71.882	72.136	72.390	72.644	72.898	73.152	73.406
29	73.660	73.914	74.168	74.422	74.676	74.930	75.184	75.438	75.692	75.946

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
30	76.200	76.454	76.708	76.962	77.216	77.470	77.724	77.978	78.232	78.486
31	78.740	78.994	79.248	79.502	79.756	80.010	80.264	80.518	80.772	81.026
32	81.280	81.534	81.788	82.042	82.296	82.550	82.804	83.058	83.312	83.566
33	83.820	84.074	84.328	84.582	84.836	85.090	85.344	85.598	85.852	86.106
34	86.360	86.614	86.868	87.122	87.376	87.630	87.884	88.138	88.392	88.646
35	88.900	89.154	89.408	89.662	89.916	90.170	90.424	90.678	90.932	91.186
36	91.440	91.694	91.948	92.202	92.456	92.710	92.964	93.218	93.472	93.726
37	93.980	94.234	94.488	94.742	94.996	95.250	95.504	95.758	96.012	96.266
38	96.520	96.774	97.028	97.282	97.536	97.790	98.044	98.298	98.552	98.806
39	99.060	99.314	99.568	99.822	100.08	100.33	100.58	100.84	101.09	101.35
40	101.60	101.85	102.11	102.36	102.62	102.87	103.12	103.38	103.63	103.89
41	104.14	104.39	104.65	104.90	105.16	105.41	105.66	105.92	106.17	106.43
42	106.68	106.93	107.19	107.44	107.70	107.95	108.20	108.46	108.71	108.97
43	109.22	109.47	109.73	109.98	110.24	110.49	110.74	111.00	111.25	111.51
44	111.76	112.01	112.27	112.52	112.78	113.03	113.28	113.54	113.79	114.05
45	114.30	114.55	114.81	115.06	115.32	115.57	115.82	116.08	116.33	116.59
46	116.84	117.09	117.35	117.60	117.86	118.11	118.36	118.62	118.87	119.13
47	119.38	119.63	119.89	120.14	120.40	120.65	120.90	121.16	121.41	121.67
48	121.92	122.17	122.43	122.68	122.94	123.19	123.44	123.70	123.95	124.21
49	124.46	124.71	124.97	125.22	125.48	125.73	125.98	126.24	126.49	126.75

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
50	127.00	127.25	127.51	127.76	128.02	128.27	128.52	128.78	129.03	129.29
51	129.54	129.79	130.05	130.30	130.56	130.81	131.06	131.32	131.57	131.83
52	132.08	132.33	132.59	132.84	133.10	133.35	133.60	133.86	134.11	134.37
53	134.62	134.87	135.13	135.38	135.64	135.89	136.14	136.40	136.65	136.91
54	137.16	137.41	137.67	137.92	138.18	138.43	138.68	138.94	139.19	139.45
55	139.70	139.95	140.21	140.46	140.72	140.97	141.22	141.48	141.73	141.99
56	142.24	142.49	142.75	143.00	143.26	143.51	143.76	144.02	144.27	144.53
57	144.78	145.03	145.29	145.54	145.80	146.05	146.30	146.56	146.81	147.07
58	147.32	147.57	147.83	148.08	148.34	148.59	148.84	149.10	149.35	149.61
59	149.86	150.11	150.37	150.62	150.88	151.13	151.38	151.64	151.89	152.15
60	152.40	152.65	152.91	153.16	153.42	153.67	153.92	154.18	154.43	154.69
61	154.94	155.19	155.45	155.70	155.96	156.21	156.46	156.72	156.97	157.23
62	157.48	157.73	157.99	158.24	158.50	158.75	159.00	159.26	159.51	159.77
63	160.02	160.27	160.53	160.78	161.04	161.29	161.54	161.80	162.05	162.31
64	162.56	162.81	163.07	163.32	163.58	163.83	164.08	164.34	164.59	164.85
65	165.10	165.35	165.61	165.86	166.12	166.37	166.62	166.88	167.13	167.39
66	167.64	167.89	168.15	168.40	168.66	168.91	169.16	169.42	169.67	169.93
67	170.18	170.43	170.69	170.94	171.20	171.45	171.70	171.96	172.21	172.47
68	172.72	172.97	173.23	173.48	173.74	173.99	174.24	174.50	174.75	175.01
69	175.26	175.51	175.77	176.02	176.28	176.53	176.78	177.04	177.29	177.55

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
70	177.80	178.05	178.31	178.56	178.82	179.07	179.32	179.58	179.83	180.09
71	180.34	180.59	180.85	181.10	181.36	181.61	181.86	182.12	182.37	182.63
72	182.88	183.13	183.39	183.64	183.90	184.15	184.40	184.66	184.91	185.17
73	185.42	185.67	185.93	186.18	186.44	186.69	186.94	187.20	187.45	187.71
74	187.96	188.21	188.47	188.72	188.98	189.23	189.48	189.74	189.99	190.25
75	190.50	190.75	191.01	191.26	191.52	191.77	192.02	192.28	192.53	192.79
76	193.04	193.29	193.55	193.80	194.06	194.31	194.56	194.82	195.07	195.33
77	195.58	195.83	196.09	196.34	196.60	196.85	197.10	197.36	197.61	197.87
78	198.12	198.37	198.63	198.88	199.14	199.39	199.64	199.90	200.15	200.41
79	200.66	200.91	201.17	201.42	201.68	201.93	202.18	202.44	202.69	202.95
80	203.20	203.45	203.71	203.96	204.22	204.47	204.72	204.98	205.23	205.49
81	205.74	205.99	206.25	206.50	206.76	207.01	207.26	207.52	207.77	208.03
82	208.28	208.53	208.79	209.04	209.30	209.55	209.80	210.06	210.31	210.57
83	210.82	211.07	211.33	211.58	211.84	212.09	212.34	212.60	212.85	213.11
84	213.36	213.61	213.87	214.12	214.38	214.63	214.88	215.14	215.39	215.65
85	215.90	216.15	216.41	216.66	216.92	217.17	217.42	217.68	217.93	218.19
86	218.44	218.69	218.95	219.20	219.46	219.71	219.96	220.22	220.47	220.73
87	220.98	221.23	221.49	221.74	222.00	222.25	222.50	222.76	223.01	223.27
88	223.52	223.77	224.03	224.28	224.54	224.79	225.04	225.30	225.55	225.81
89	226.06	226.31	226.57	226.82	227.08	227.33	227.58	227.84	228.09	228.35

LENGTHS — INCHES TO CENTIMETERS (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
90	228.60	228.85	229.11	229.36	229.62	229.87	230.12	230.38	230.63	230.89
91	231.14	231.39	231.65	231.90	232.16	232.41	232.66	232.92	233.17	233.43
92	233.68	233.93	234.19	234.44	234.70	234.95	235.20	235.46	235.71	235.97
93	236.22	236.47	236.73	236.98	237.24	237.49	237.74	238.00	238.25	238.51
94	238.76	239.01	239.27	239.52	239.78	240.03	240.28	240.54	240.79	241.05
95	241.30	241.55	241.81	242.06	242.32	242.57	242.82	243.08	243.33	243.59
96	243.84	246.09	244.35	244.60	244.86	245.11	245.36	245.62	245.87	246.13
97	246.38	246.63	246.89	247.14	247.40	247.65	247.90	248.16	248.41	248.67
98	248.92	249.17	249.43	249.68	249.94	250.19	250.44	250.70	250.95	251.21
99	251.46	251.71	251.97	252.22	252.48	252.73	252.98	253.24	253.49	253.75

LENGTHS — METERS TO FEET

From 1 *to* 1,000 *Units*

Reduction factor: 1 meter = 3.280833333 feet

The values found in the body of the table give, in feet, the length indicated in meters at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	....	3.2808	6.5617	9.8425	13.123	16.404	19.685	22.966	26.247	29.527
10	32.808	36.089	39.370	42.651	45.932	49.212	52.493	55.774	59.055	62.336
20	65.617	68.897	72.178	75.459	78.740	82.021	85.302	88.583	91.863	95.144
30	98.425	101.71	104.99	108.27	111.55	114.83	118.11	121.39	124.67	127.95
40	131.23	134.51	137.80	141.08	144.36	147.64	150.92	154.20	157.48	160.76
50	164.04	167.32	170.60	173.88	177.16	180.45	183.73	187.01	190.29	193.57
60	196.85	200.13	203.41	206.69	209.97	213.25	216.53	219.82	223.10	226.38
70	229.66	232.94	236.22	239.50	242.78	246.06	249.34	252.62	255.90	259.19
80	262.47	265.75	269.03	272.31	275.59	278.87	282.15	285.43	288.71	291.99
90	295.27	298.56	301.84	305.12	308.40	311.68	314.96	318.23	321.52	324.80

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
100	328.08	331.36	334.64	337.93	341.21	344.49	347.77	351.05	354.33	357.61
110	360.89	364.17	367.45	370.73	374.01	377.30	380.58	383.86	387.14	390.42
120	393.70	396.98	400.26	403.54	406.82	410.10	413.38	416.67	419.95	423.23
130	426.51	429.79	433.07	436.35	439.63	442.91	446.19	449.47	452.75	456.04
140	459.32	462.60	465.88	469.16	472.44	475.72	479.00	482.28	485.56	488.84
150	492.12	495.41	498.69	501.97	505.25	508.53	511.81	515.09	518.37	521.65
160	524.93	528.21	531.49	534.78	538.06	541.34	544.62	547.90	551.18	554.46
170	557.74	561.02	564.30	567.58	570.86	574.15	577.43	580.71	583.99	587.27
180	590.55	593.83	597.11	600.39	603.67	606.95	610.23	613.52	616.80	620.08
190	623.36	626.64	629.92	633.20	636.48	639.76	643.04	646.32	649.61	652.89
200	656.17	659.45	662.73	666.01	669.29	672.57	675.85	679.13	682.41	685.69
210	688.97	692.26	695.54	698.82	702.10	705.38	708.66	711.94	715.22	718.50
220	721.78	725.06	728.34	731.63	734.91	738.19	741.47	744.75	748.03	751.31
230	754.59	757.87	761.15	764.43	767.71	771.00	774.28	777.56	780.84	784.12
240	787.40	790.68	793.96	797.24	800.52	803.80	807.08	810.37	813.65	816.93
250	820.21	823.49	826.77	830.05	833.33	836.61	839.89	843.17	846.45	849.74
260	853.02	856.30	859.58	862.86	866.14	869.42	872.70	875.98	879.26	882.54
270	885.82	889.11	892.39	895.67	898.95	902.23	905.51	908.79	912.07	915.35
280	918.63	921.91	925.19	928.48	931.76	935.04	938.32	941.60	944.88	948.16
290	951.44	954.72	958.00	961.28	964.56	967.85	971.13	974.41	977.69	980.97

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
300	984.25	987.53	990.81	994.09	997.37	1,000.7	1,003.9	1,007.2	1,010.5	1,013.8
310	1,017.1	1,020.3	1,023.6	1,026.9	1,030.2	1,033.5	1,036.7	1,040.0	1,043.3	1,046.6
320	1,049.9	1,053.1	1,056.4	1,059.7	1,063.0	1,066.3	1,069.6	1,072.8	1,076.1	1,079.4
330	1,082.7	1,086.0	1,089.2	1,092.5	1,095.8	1,099.1	1,102.4	1,105.6	1,108.9	1,112.2
340	1,115.5	1,118.8	1,122.0	1,125.3	1,128.6	1,131.9	1,135.2	1,138.4	1,141.7	1,145.0
350	1,148.3	1,151.6	1,154.9	1,158.1	1,161.4	1,164.7	1,168.0	1,171.3	1,174.5	1,177.8
360	1,181.1	1,184.4	1,187.7	1,190.9	1,194.2	1,197.5	1,200.8	1,204.1	1,207.3	1,210.6
370	1,213.9	1,217.2	1,220.5	1,223.8	1,227.0	1,230.3	1,233.6	1,236.9	1,240.2	1,243.4
380	1,246.7	1,250.0	1,253.3	1,256.6	1,259.8	1,263.1	1,266.4	1,269.7	1,273.0	1,276.2
390	1,279.5	1,282.8	1,286.1	1,289.4	1,292.6	1,295.9	1,299.2	1,302.5	1,305.8	1,309.1
400	1,312.3	1,315.6	1,318.9	1,322.2	1,325.5	1,328.7	1,332.0	1,335.3	1,338.6	1,341.9
410	1,345.1	1,348.4	1,351.7	1,355.0	1,358.3	1,361.5	1,364.8	1,368.1	1,371.4	1,374.7
420	1,377.9	1,381.2	1,384.5	1,387.8	1,391.1	1,394.4	1,397.6	1,400.9	1,404.2	1,407.5
430	1,410.8	1,414.0	1,417.3	1,420.6	1,423.9	1,427.2	1,430.4	1,433.7	1,437.0	1,440.3
440	1,443.6	1,446.8	1,450.1	1,453.4	1,456.7	1,460.0	1,463.3	1,466.5	1,469.8	1,473.1
450	1,476.4	1,479.7	1,482.9	1,486.2	1,489.5	1,492.8	1,496.1	1,499.3	1,502.6	1,505.9
460	1,509.2	1,512.5	1,515.7	1,519.0	1,522.3	1,525.6	1,528.9	1,532.1	1,535.4	1,538.7
470	1,542.0	1,545.3	1,548.6	1,551.8	1,555.1	1,558.4	1,561.7	1,565.0	1,568.2	1,571.5
480	1,574.8	1,578.1	1,581.4	1,584.6	1,587.9	1,591.2	1,594.5	1,597.8	1,601.0	1,604.3
490	1,607.6	1,610.9	1,614.2	1,617.5	1,620.7	1,624.0	1,627.3	1,630.6	1,633.9	1,637.1

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
500	1,640.4	1,643.7	1,647.0	1,650.3	1,653.5	1,656.8	1,660.1	1,663.4	1,666.7	1,669.9
510	1,673.2	1,676.5	1,679.8	1,683.1	1,686.3	1,689.6	1,692.9	1,696.2	1,699.5	1,702.8
520	1,706.0	1,709.3	1,712.6	1,715.9	1,719.2	1,722.4	1,725.7	1,729.0	1,732.3	1,735.6
530	1,738.8	1,742.1	1,745.4	1,748.7	1,752.0	1,755.2	1,758.5	1,761.8	1,765.1	1,768.4
540	1,771.7	1,774.9	1,778.2	1,781.5	1,784.8	1,788.1	1,791.3	1,794.6	1,797.9	1,801.2
550	1,804.5	1,807.7	1,811.0	1,814.3	1,817.6	1,820.9	1,824.1	1,827.4	1,830.7	1,834.0
560	1,837.3	1,840.5	1,843.8	1,847.1	1,850.4	1,853.7	1,857.0	1,860.2	1,863.5	1,866.8
570	1,870.1	1,873.4	1,876.6	1,879.9	1,883.2	1,886.5	1,889.8	1,893.0	1,896.3	1,899.6
580	1,902.9	1,906.2	1,909.4	1,912.7	1,916.0	1,919.3	1,922.6	1,925.8	1,929.1	1,932.4
590	1,935.7	1,939.0	1,942.3	1,945.5	1,948.8	1,952.1	1,955.4	1,958.7	1,961.9	1,965.2
600	1,968.5	1,971.8	1,975.1	1,978.3	1,981.6	1,984.9	1,988.2	1,991.5	1,994.7	1,998.0
610	2,001.3	2,004.6	2,007.9	2,011.2	2,014.4	2,017.7	2,021.0	2,024.3	2,027.6	2,030.8
620	2,034.1	2,037.4	2,040.7	2,044.0	2,047.2	2,050.5	2,053.8	2,057.1	2,060.4	2,063.6
630	2,066.9	2,070.2	2,073.5	2,076.8	2,080.0	2,083.3	2,086.6	2,089.9	2,093.2	2,096.5
640	2,099.7	2,103.0	2,106.3	2,109.6	2,112.9	2,116.1	2,119.4	2,122.7	2,126.0	2,129.3
650	2,132.5	2,135.8	2,139.1	2,142.4	2,145.7	2,148.9	2,152.2	2,155.5	2,158.8	2,162.1
660	2,165.4	2,168.6	2,171.9	2,175.2	2,178.5	2,181.8	2,185.0	2,188.3	2,191.6	2,194.9
670	2,198.2	2,201.4	2,204.7	2,208.0	2,211.3	2,214.6	2,217.8	2,221.1	2,224.4	2,227.7
680	2,231.0	2,234.2	2,237.5	2,240.8	2,244.1	2,247.4	2,250.7	2,253.9	2,257.2	2,260.5
690	2,263.8	2,267.1	2,270.3	2,273.6	2,276.9	2,280.2	2,283.5	2,286.7	2,290.0	2,293.3

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
700	2,296.6	2,299.9	2,303.1	2,306.4	2,309.7	2,313.0	2,316.3	2,319.5	2,322.8	2,326.1
710	2,329.4	2,332.7	2,336.0	2,339.2	2,342.5	2,345.8	2,349.1	2,352.4	2,355.6	2,358.9
720	2,362.2	2,365.5	2,368.8	2,372.0	2,375.3	2,378.6	2,381.9	2,385.2	2,388.4	2,391.7
730	2,395.0	2,398.3	2,401.6	2,404.9	2,408.1	2,411.4	2,414.7	2,418.0	2,421.3	2,424.5
740	2,427.8	2,431.1	2,434.4	2,437.7	2,440.9	2,444.2	2,447.5	2,450.8	2,454.1	2,457.3
750	2,460.6	2,463.9	2,467.2	2,470.5	2,473.7	2,477.0	2,480.3	2,483.6	2,486.9	2,490.2
760	2,493.4	2,496.7	2,500.0	2,503.3	2,506.6	2,509.8	2,513.1	2,516.4	2,519.7	2,523.0
770	2,526.2	2,529.5	2,532.8	2,536.1	2,539.4	2,542.6	2,545.9	2,549.2	2,552.5	2,555.8
780	2,559.0	2,562.3	2,565.6	2,568.9	2,572.2	2,575.5	2,578.7	2,582.0	2,585.3	2,588.6
790	2,591.9	2,595.1	2,598.4	2,601.7	2,605.0	2,608.3	2,611.5	2,614.8	2,618.1	2,621.4
800	2,624.7	2,627.9	2,631.2	2,634.5	2,637.8	2,641.1	2,644.4	2,647.6	2,650.9	2,654.2
810	2,657.5	2,660.8	2,664.0	2,667.3	2,670.6	2,673.9	2,677.2	2,680.4	2,683.7	2,687.0
820	2,690.3	2,693.6	2,696.8	2,700.1	2,703.4	2,706.7	2,710.0	2,713.2	2,716.5	2,719.8
830	2,723.1	2,726.4	2,729.7	2,732.9	2,736.2	2,739.5	2,742.8	2,746.1	2,749.3	2,752.6
840	2,755.9	2,759.2	2,762.5	2,765.7	2,769.0	2,772.3	2,775,6	2,778.9	2,782.1	2,785.4
850	2,788.7	2,792.0	2,795.3	2,798.6	2,801.8	2,805.1	2,808.4	2,811.7	2,815.0	2,818.2
860	2,821.5	2,824.8	2,828.1	2,831.4	2,834.6	2,827.9	2,841.2	2,844.5	2,847.8	2,851.0
870	2,854.3	2,857.6	2,860.9	2,864.2	2,867.4	2,870.7	2,874.0	2,877.3	2,880.6	2,883.9
880	2,887.1	2.890.4	2,893.7	2,897.0	2,900.3	2,903.5	2,906.8	2,910.1	2,913.4	2,916.7
890	2,919.9	2,923.2	2,926.5	2,929.8	2,933.1	2,936.3	2,939.6	2,942.9	2,946.2	2,949.5

LENGTHS—METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
900	2,952.8	2,956.0	2,959.3	2,962.6	2,965.9	2,969.2	2,972.4	2,975.7	2,979.0	2,982.3
910	2,985.6	2,988.8	2,992.1	2,995.4	2,998.7	3,002.0	3,005.2	3,008.5	3,011.8	3,015.1
920	3,018.4	3,021.6	3,024.9	3,028.2	3,031.5	3,034.8	3,038.1	3,041.3	3,044.6	3,047.9
930	3,051.2	3,054.5	3,057.7	3,061.0	3,064.3	3,067.6	3,070.9	3,074.1	3,077.4	3,080.7
940	3,084.0	3,087.3	3,090.5	3,093.8	3,097.1	3,100.4	3,103.7	3,106.9	3,110.2	3,113.5
950	3,116.8	3,120.1	3,123.4	3,126.6	3,129.9	3,133.2	3,136.5	3,139.8	3,143.0	3,146.3
960	3,149.6	3,152.9	3,156.2	3,159.4	3,162.7	3,166.0	3,169.3	3,172.6	3,175.8	3,179.1
970	3,182.4	3,185.7	3,189.0	3,192.3	3,195.5	3,198.8	3,202.1	3,205.4	3,208.7	3,211.9
980	3,215.2	3,218.5	3,221.8	3,225.1	3,228.3	3,231.6	3,234.9	3,238.2	3,241.5	3,244.7
990	3,248.0	3,251.3	3,254.6	3,257.9	3,261.1	3,264.4	3,267.7	3,271.0	3,274.3	3,277.6

LENGTHS — FEET TO METERS

From 1 *to* 1,000 *Units*

Reduction factor: 1 foot = 0.3048006096 meter

The values found in the body of the table give, in meters, the lengths indicated in feet at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	....	0.30480	0.60960	0.91440	1.2192	1.5240	1.8288	2.1336	2.4384	2.7432
10	3.0480	3.3528	3.6576	3.9624	4.2672	4.5720	4.8768	5.1816	5.4864	5.7912
20	6.0960	6.4008	6.7056	7.0104	7.3152	7.6200	7.9248	8.2296	8.5344	8.8392
30	9.1440	9.4488	9.7536	10.058	10.363	10.668	10.973	11.278	11.582	11.887
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17.983
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079
80	24.384	24.689	24.994	24.298	25.603	25.908	26.213	26.518	26.822	27.127
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175

LENGTHS — FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223
110	33.528	33.833	34.138	34.442	34.747	35.052	35.357	35.662	35.966	36.271
120	36.576	36.881	37.186	37.490	37.795	38.100	38.405	38.710	39.014	39.319
130	39.624	39.929	40.234	40.538	40.843	41.148	41.453	41.758	42.062	42.367
140	42.672	42.977	43.282	43.586	43.891	44.196	44.501	44.806	45.110	45.415
150	45.720	46.025	46.330	46.635	46.939	47.244	47.549	47.854	48.159	48.463
160	48.768	49.073	49.378	49.683	49.987	50.292	50.597	50.902	51.207	51.511
170	51.816	52.121	52.426	52.731	53.035	53.340	53.645	53.950	54.255	54.559
180	54.864	55.169	55.474	55.779	56.083	56.388	56.693	56.998	57.303	57.607
190	57.912	58.217	58.522	58.827	59.131	59.436	59.741	60.046	60.351	60.655
200	60.960	61.265	61.570	61.875	62.179	62.484	62.789	63.094	63.399	63.703
210	64.008	64.313	64.618	64.923	65.227	65.532	65.837	66.142	66.447	66.751
220	67.056	67.361	67.666	67.971	68.275	68.580	68.885	69.190	69.495	69.799
230	70.104	70.409	70.714	71.019	71.323	71.628	71.933	72.238	72.543	72.847
240	73.152	73.457	73.762	74.067	74.371	74.676	74.981	75.286	75.591	75.895
250	76.200	76.505	76.810	77.115	77.419	77.724	78.029	78.334	78.639	78.943
260	79.248	79.553	79.858	80.163	80.467	80.772	81.077	81.382	81.687	81.991
270	82.296	82.601	82.906	83.211	83.515	83.820	84.125	84.430	84.735	85.039
280	85.344	85.649	85.954	86.259	86.563	86.868	87.173	87.478	87.783	88.087
290	88.392	88.697	89.002	89.307	89.611	89.916	90.221	90.526	90.831	91.135

LENGTHS — FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	91.440	91.745	92.050	92.355	92.659	92.964	93.269	93.574	93.879	94.183
310	94.488	94.793	95.098	95.403	95.707	96.012	96.317	96.622	96.927	97.231
320	97.536	97.841	98.146	98.451	98.755	99.060	99.365	99.670	99.975	100.28
330	100.58	100.89	101.19	101.50	101.80	102.11	102.41	102.72	103.02	103.33
340	103.63	103.94	104.24	104.55	104.85	105.16	105.46	105.77	106.07	106.38
350	106.68	106.99	107.29	107.59	107.90	108.20	108.51	108.81	109.12	109.42
360	109.73	110.03	110.34	110.64	110.95	111.25	111.56	111.86	112.17	112.47
370	112.78	113.08	113.39	113.69	114.00	114.30	114.61	114.91	115.21	115.52
380	115.82	116.13	116.43	116.74	117.04	117.35	117.65	117.96	118.26	118.57
390	118.87	119.18	119.48	119.79	120.09	120.40	120.70	121.01	121.31	121.62
400	121.92	122.23	122.53	122.83	123.14	123.44	123.75	124.05	124.36	124.66
410	124.97	125.27	125.58	125.88	126.19	126.49	126.80	127.10	127.41	127.71
420	128.02	128.32	128.63	128.93	129.24	129.54	129.85	130.15	130.45	130.76
430	131.06	131.37	131.67	131.98	132.28	132.59	132.89	133.20	133.50	133.81
440	134.11	134.42	134.72	135.03	135.33	135.64	135.94	136.25	136.55	136.86
450	137.16	137.47	137.77	138.07	138.38	138.68	138.99	139.29	139.60	139.90
460	140.21	140.51	140.82	141.12	141.43	141.73	142.04	142.34	142.65	142.95
470	143.26	143.56	143.87	144.17	144.48	144.78	145.09	145.39	145.69	146.00
480	146.30	146.61	146.91	147.22	147.52	147.83	148.13	148.44	148.74	149.05
490	149.35	149.66	149.96	150.27	150.57	150.88	151.18	151.49	151.79	152.10

LENGTHS—FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	152.40	152.71	153.01	153.31	153.62	153.92	154.23	154.53	154.84	155.14
510	155.45	155.75	156.06	156.36	156.57	156.97	157.28	157.58	157.89	158.19
520	158.50	158.80	159.11	159.41	159.72	160.02	160.33	160.63	160.93	161.24
530	161.54	161.85	162.15	162.46	162.76	163.07	163.37	163.68	163.98	164.29
540	164.59	164.90	165.20	165.51	165.81	166.12	166.42	166.73	167.03	167.34
550	167.64	167.95	168.25	168.55	168.86	169.16	169.47	169.77	170.08	170.38
560	170.69	170.99	171.30	171.60	171.91	172.21	172.52	172.82	173.13	173.43
570	173.74	174.04	174.35	174.65	174.96	175.26	175.57	175.87	176.17	176.48
580	176.78	177.09	177.39	177.70	178.00	178.31	178.61	178.92	179.22	179.53
590	179.83	180.14	180.44	180.75	181.05	181.36	181.66	181.97	182.27	182.58
600	182.88	183.19	183.49	183.79	184.10	184.40	184.71	185.01	185.32	185.62
610	185.93	186.23	186.54	186.84	187.15	187.45	187.76	188.06	188.37	188.67
620	188.98	189.28	189.59	189.89	190.20	190.50	190.81	191.11	191.41	191.72
630	192.02	192.33	192.63	192.94	193.24	193.55	193.85	194.16	194.46	194.77
640	195.07	195.38	195.68	195.99	196.29	196.60	196.90	197.21	197.51	197.82
650	198.12	198.43	198.73	199.03	199.34	199.64	199.95	200.25	200.56	200.86
660	201.17	201.47	201.78	202.08	202.39	202.69	203.00	203.30	203.61	203.91
670	204.22	204.52	204.83	205.13	205.44	205.74	206.05	206.35	206.65	206.96
680	207.26	207.57	207.87	208.18	208.48	208.79	209.09	209.40	209.70	210.01
690	210.31	210.62	210.92	211.23	211.53	211.84	212.14	212.45	212.75	213.06

LENGTHS — FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	213.36	213.67	213.97	214.27	214.58	214.88	215.19	215.49	215.80	216.10
710	216.41	216.71	217.02	217.32	217.63	217.93	218.24	218.54	218.85	219.15
720	219.46	219.76	220.07	220.37	220.68	220.98	221.29	221.59	221.89	222.20
730	222.50	222.81	223.11	223.42	223.72	224.03	224.33	224.64	224.94	225.25
740	225.55	225.86	226.16	226.47	226.77	227.08	227.38	227.69	227.99	228.30
750	228.60	228.91	229.21	229.51	229.82	230.12	230.43	230.73	231.04	231.34
760	231.65	231.95	232.26	232.56	232.87	233.17	233.48	233.78	234.09	234.39
770	234.70	235.00	235.31	235.61	235.92	236.22	236.53	236.83	237.13	237.44
780	237.74	238.05	238.35	238.66	238.96	239.27	239.57	239.88	240.18	240.49
790	240.79	241.10	241.40	241.71	242.01	242.32	242.62	242.93	243.23	243.54
800	243.84	244.15	244.45	244.75	245.06	245.36	245.67	245.97	246.28	246.58
810	246.89	247.19	247.50	247.80	248.11	248.41	248.72	249.02	249.33	249.63
820	249.94	250.24	250.55	250.85	251.16	251.46	251.77	252.07	252.37	252.68
830	252.98	253.29	253.59	253.90	254.20	254.51	254.81	255.12	255.42	255.73
840	256.03	256.34	256.64	256.95	257.25	257.56	257.86	258.17	258.47	258.78
850	259.08	259.39	259.69	259.99	260.30	260.60	260.91	261.21	261.52	261.82
860	262.13	262.43	262.74	263.04	263.35	263.65	263.96	264.26	264.57	264.87
870	265.18	265.48	265.79	266.09	266.40	266.70	267.01	267.31	267.61	267.92
880	268.22	268.53	268.83	269.14	269.44	269.75	270.05	270.36	270.66	270.97
890	271.27	271.58	271.88	272.19	272.49	272.80	273.10	273.41	273.71	274.02

LENGTHS — FEET TO METERS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	274.32	274.63	274.93	275.23	275.54	275.84	276.15	276.45	276.76	277.06
910	277.37	277.67	277.98	278.28	278.59	278.89	279.20	279.50	279.81	280.11
920	280.42	280.72	281.03	281.33	281.64	281.94	282.25	282.55	282.85	283.16
930	283.46	283.77	284.07	284.38	284.68	284.99	285.29	285.60	285.90	286.21
940	286.51	286.82	287.12	287.43	287.73	288.04	288.34	288.65	288.95	289.26
950	289.56	289.87	289.17	290.47	290.78	291.08	291.39	291.69	292.00	292.30
960	292.61	292.91	293.22	293.52	293.83	294.13	294.44	294.74	295.05	295.35
970	295.66	295.96	296.27	296.57	296.88	297.18	297.49	297.79	298.10	298.40
980	298.70	299.01	299.31	299.62	299.92	300.23	300.53	300.84	301.14	301.45
990	301.75	302.06	302.36	302.67	302.97	303.28	303.58	303.89	304.19	304.50

LENGTHS — KILOMETERS TO MILES

From 1 *to* 1,000 *Units*

Reduction factor: 1 kilometer = 0.6213699495 mile

Values found in the body of the table give, in miles, the length indicated in kilometers at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	....	0.62137	1.2427	1.8641	2.4855	3.1069	3.7282	4.3496	4.9710	5.5923
10	6.2137	6.8351	7.4564	8.0778	8.6992	9.3206	9.9419	10.563	11.185	11.806
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.777	17.398	18.020
30	18.641	19.262	19.884	20.505	21.127	21.748	22.369	22.991	23.612	24.233
40	24.855	25.476	26.098	26.719	27.340	27.962	28.583	29.204	29.826	30.447
50	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.418	36.039	36.661
60	37.282	37.904	38.525	39.146	39.768	40.389	41.010	41.632	42.253	42.875
70	43.496	44.117	44.739	45.360	45.981	46.603	47.224	47.845	48.467	49.088
80	49.710	50.331	50.952	51.574	52.195	52.816	53.438	54.059	54.681	55.302
90	55.923	56.945	57.166	57.787	58.409	59.030	59.652	60.273	60.894	61.516

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
100	62.137	62.758	63.380	64.001	64.622	65.244	65.865	66.487	67.108	67.729
110	68.351	68.972	69.593	70.215	70.836	71.458	72.079	72.700	73.322	73.943
120	74.564	75.186	75.807	76.429	77.050	77.671	78.293	78.914	79.535	80.157
130	80.778	81.399	82.021	82.642	83.264	83.885	84.506	85.128	85.749	86.370
140	86.992	87.613	88.235	88.856	89.477	90.099	90.720	91.341	91.963	92.584
150	93.205	93.827	94.448	95.070	95.691	96.312	96.934	97.555	98.176	98.798
160	99.419	100.04	100.66	101.28	101.90	102.53	103.15	103.77	104.39	105.01
170	105.63	106.25	106.88	107.50	108.12	108.74	109.36	109.98	110.60	111.23
180	111.85	112.47	113.09	113.71	114.33	114.95	115.57	116.20	116.82	117.44
190	118.06	118.68	119.30	119.92	120.55	121.17	121.79	122.41	123.03	123.65
200	124.27	124.90	125.52	126.14	126.76	127.38	128.00	128.62	129.24	129.87
210	130.49	131.11	131.73	132.35	132.97	133.59	134.22	134.84	135.46	136.08
220	136.70	137.32	137.94	138.57	139.19	139.81	140.43	141.05	141.67	142.29
230	142.92	143.54	144.16	144.78	145.40	146.02	146.64	147.26	147.89	148.51
240	149.13	149.75	150.37	150.99	151.61	152.24	152.86	153.48	154.10	154.72
250	155.34	155.96	156.59	157.21	157.83	158.45	159.07	159.69	160.31	160.93
260	161.56	162.18	162.80	163.42	164.04	164.66	165.28	165.91	166.53	167.15
270	167.77	168.39	169.01	169.63	170.26	170.88	171.50	172.12	172.74	173.36
280	173.98	174.60	175.23	175.85	176.47	177.09	177.71	178.33	178.95	179.58
290	180.20	180.82	181.44	182.06	182.68	183.30	183.93	184.55	185.17	185.79

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
300	186.41	187.03	187.65	188.28	188.90	189.52	190.14	190.76	191.38	192.00
310	192.62	193.25	193.87	194.49	195.11	195.73	196.35	196.97	197.60	198.22
320	198.84	199.46	200.08	200.70	201.32	201.95	202.57	203.19	203.81	204.43
330	205.05	205.67	206.29	206.92	207.54	208.16	208.78	209.40	210.02	210.64
340	211.27	211.89	212.51	213.13	213.75	214.37	214.99	215.62	216.24	216.86
350	217.48	218.10	218.72	219.34	219.96	220.59	221.21	221.83	222.45	223.07
360	223.69	224.31	224.94	225.56	226.18	226.80	227.42	228.04	228.66	229.29
370	229.91	230.53	231.15	231.77	232.39	233.01	233.64	234.26	234.88	235.50
380	236.12	236.74	237.36	237.98	238.61	239.23	239.85	240.47	241.09	241.71
390	242.33	242.96	243.58	244.20	244.82	245.44	246.06	246.68	247.31	247.93
400	248.55	249.17	249.79	250.41	251.03	251.65	252.28	252.90	253.52	254.14
410	254.76	255.38	256.00	256.63	257.25	257.87	258.49	259.11	259.73	260.35
420	260.98	261.60	262.22	262.84	263.46	264.08	264.70	265.32	265.95	266.57
430	267.19	267.81	268.43	269.05	269.67	270.30	270.92	271.54	272.16	272.78
440	273.40	274.02	274.65	275.27	275.89	276.51	277.13	277.75	278.37	279.00
450	279.62	280.24	280.86	281.48	282.10	282.72	283.34	283.97	284.59	285.21
460	285.83	286.45	287.07	287.69	288.32	288.94	289.56	290.18	290.80	291.42
470	292.04	292.67	293.29	293.91	294.53	295.15	295.77	296.39	297.01	297.64
480	298.26	298.88	299.50	300.12	300.74	301.36	301.99	302.61	303.23	303.85
490	304.47	305.09	305.71	306.34	306.96	307.58	308.20	308.82	309.44	310.06

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
500	310.68	311.31	311.93	312.55	313.17	313.79	314.41	315.03	315.66	316.28
510	316.90	317.52	318.14	318.76	319.38	320.01	320.63	321.25	321.87	322.49
520	323.11	323.73	324.36	324.98	325.60	326.22	326.84	327.46	328.08	328.70
530	329.33	329.95	330.57	331.19	331.81	332.43	333.05	333.68	334.30	334.92
540	335.54	336.16	336.78	337.40	338.03	338.65	339.27	339.89	340.51	341.13
550	341.75	342.37	343.00	343.62	344.24	344.86	345.48	346.10	346.72	347.35
560	347.97	348.59	349.21	349.83	350.45	351.07	351.70	352.32	352.94	353.56
570	354.18	354.80	355.42	356.05	356.67	357.29	357.91	358.53	359.15	359.77
580	360.39	361.02	361.64	362.26	262.88	363.50	364.12	364.74	365.37	365.99
590	366.61	367.23	367.85	368.47	369.09	369.72	370.34	370.96	371.58	372.20
600	372.82	373.44	374.06	374.69	375.31	375.93	376.55	377.17	377.79	378.41
610	379.04	379.66	380.28	380.90	381.52	382.14	382.76	383.39	384.01	384.63
620	385.25	385.87	386.49	387.11	387.73	388.36	388.98	389.60	390.22	390.84
630	391.46	392.08	392.71	393.33	393.95	394.57	395.19	395.81	396.43	397.06
640	397.68	398.30	398.92	399.54	400.16	400.78	401.40	402.03	402.65	403.27
650	403.89	404.51	405.13	405.75	406.38	407.00	407.62	408.24	408.86	409.48
660	410.10	410.73	411.35	411.97	412.59	413.21	413.83	414.45	415.08	415.70
670	416.32	416.94	417.56	418.18	418.80	419.42	420.05	420.67	421.29	421.91
680	422.53	423.15	423.77	424.40	425.02	425.64	426.26	426.88	427.50	428.12
690	428.75	429.37	429.99	430.61	431.23	431.85	432.47	433.09	433.72	434.34

LENGTHS—KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
700	434.96	435.58	436.20	436.82	437.44	438.07	438.69	439.31	439.93	440.55
710	441.17	441.79	442.42	443.04	443.66	444.28	444.90	445.52	446.14	446.76
720	447.39	448.01	448.63	449.25	449.87	450.49	451.11	451.74	452.36	452.98
730	453.60	454.22	454.84	455.46	456.09	456.71	457.33	457.95	458.57	459.19
740	459.81	460.44	461.06	461.68	462.30	462.92	463.54	464.16	464.78	465.41
750	466.03	466.65	467.27	467.89	468.51	469.13	469.76	470.38	471.00	471.62
760	472.24	472.86	473.48	474.11	474.73	475.35	475.97	476.59	477.21	477.83
770	478.45	479.08	479.70	480.32	480.94	481.56	482.18	482.80	483.43	484.05
780	484.67	485.29	485.91	486.53	487.15	487.78	488.40	489.02	489.64	490.26
790	490.88	491.50	492.13	492.75	493.37	493.99	494.61	495.23	495.85	496.47
800	497.10	497.72	498.34	498.96	499.58	500.20	500.82	501.45	502.07	502.69
810	503.31	503.93	504.55	505.17	505.80	506.42	507.04	507.66	508.28	508.90
820	509.52	510.14	510.77	511.39	512.01	512.63	513.25	513.87	514.49	515.12
830	515.74	516.36	516.98	517.60	518.22	518.84	519.47	520.09	520.71	521.33
840	521.95	522.57	523.19	523.81	524.44	525.06	525.68	526.30	526.92	527.54
850	528.16	528.79	529.41	530.03	530.65	531.27	531.89	532.51	533.14	533.76
860	534.38	535.00	535.62	536.24	536.86	537.49	538.11	538.73	539.35	539.97
870	540.59	541.21	541.83	542.46	543.08	543.70	544.32	544.94	545.56	546.18
880	546.81	547.43	548.05	548.67	549.29	549.91	550.53	551.16	551.78	552.40
890	553.02	553.64	554.26	554.88	555.50	556.13	556.75	557.37	557.99	558.61

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
900	559.23	559.85	560.48	561.10	561.72	562.34	562.96	563.58	564.20	564.83
910	565.45	566.07	566.69	567.31	567.93	568.55	569.17	569.80	570.42	571.04
920	571.66	572.28	572.90	573.52	574.15	574.77	575.39	576.01	576.63	577.25
930	577.87	578.50	579.12	579.74	580.35	580.98	581.60	582.22	582.85	583.47
940	584.09	584.71	585.33	585.95	586.57	587.19	587.82	588.44	589.06	589.68
950	590.30	590.92	591.54	592.17	592.79	593.41	594.03	594.65	595.27	595.89
960	596.52	597.14	597.76	598.38	599.00	599.62	600.24	600.86	601.49	602.11
970	602.73	603.35	603.97	604.59	605.21	605.84	606.46	607.08	607.70	608.32
980	608.94	609.56	610.19	610.81	611.43	612.05	612.67	613.29	613.91	614.53
990	615.16	615.78	616.40	617.02	617.64	618.26	618.88	619.51	620.13	620.75

CAPACITIES—LITERS TO LIQUID QUARTS

From 1 *to* 1,000 *Units*

Reduction factor: 1 liter = 1.056710 liquid quarts (U. S.)

The values found in the body of the table give, in liquid quarts, the capacities indicated in liters at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	. . . . .	1.0567	2.1134	3.1701	4.2268	5.2836	6.3403	7.3970	8.4537	9.5104
10	10.567	11.624	12.681	13.737	14.794	15.851	16.907	17.964	19.021	20.077
20	21.134	22.191	23.248	24.304	25.361	26.418	27.474	28.531	29.588	30.645
30	31.701	32.758	33.815	34.871	35.928	36.985	38.042	39.098	40.155	41.212
40	42.268	43.325	44.382	45.439	46.495	47.552	48.609	49.665	50.722	51.779
50	52.836	53.892	54.949	56.006	57.062	58.119	59.176	60.232	61.289	62.346
60	63.403	64.459	65.516	66.573	67.629	68.686	69.743	70.800	71.856	72.913
70	73.970	75.026	76.083	77.140	78.197	79.253	80.310	81.367	82.423	83.480
80	84.537	85.594	86.650	87.707	88.764	89.820	90.877	91.934	92.990	94.047
90	95.104	96.161	97.217	98.274	99.331	100.39	101.44	102.50	103.56	104.61

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	105.67	106.73	107.78	108.84	109.90	110.95	112.01	113.07	114.12	115.18
110	116.24	117.29	118.35	119.41	120.46	121.52	122.58	123.64	124.69	125.75
120	126.81	127.86	128.92	129.98	131.03	132.09	133.15	134.20	135.26	136.32
130	137.37	138.43	139.49	140.54	141.60	142.66	143.71	144.77	145.83	146.88
140	147.94	149.00	150.05	151.11	152.17	153.22	154.28	155.34	156.39	157.45
150	158.51	159.56	160.62	161.68	162.73	163.79	164.85	165.90	166.96	168.02
160	169.07	170.13	171.19	172.24	173.30	174.36	175.41	176.47	177.53	178.58
170	179.64	180.70	181.75	182.81	183.87	184.92	185.98	187.04	188.09	189.15
180	190.21	191.26	192.32	193.38	194.43	195.49	196.55	197.60	198.66	199.72
190	200.77	201.83	202.89	203.95	205.00	206.06	207.12	208.17	209.23	210.29
200	211.34	212.40	213.46	214.51	215.57	216.63	217.68	218.74	219.80	220.85
210	221.91	222.97	224.02	225.08	226.14	227.19	228.25	229.31	230.36	231.42
220	232.48	233.53	234.59	235.65	236.70	237.76	238.82	239.87	240.93	241.99
230	243.04	244.10	245.16	246.21	247.27	248.33	249.38	250.44	251.50	252.55
240	253.61	254.67	255.72	256.78	257.84	258.89	259.95	261.01	262.06	263.12
250	264.18	265.23	266.29	267.35	268.40	269.46	270.52	271.57	272.63	273.69
260	274.74	275.80	276.86	277.91	278.97	280.03	281.08	282.14	283.20	284.25
270	285.31	286.37	287.43	288.48	289.54	290.60	291.65	292.71	293.77	294.82
280	295.88	296.94	297.99	299.05	300.11	301.16	302.22	303.28	304.33	305.39
290	306.45	307.50	308.56	309.62	310.67	311.73	312.79	313.84	314.90	315.96

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	317.01	318.07	319.13	320.18	321.24	322.30	323.35	324.41	325.47	326.52
310	327.58	328.64	329.69	330.75	331.81	332.86	333.92	334.98	336.03	337.09
320	338.15	339.20	340.26	341.32	342.37	343.43	344.49	345.54	346.60	347.66
330	348.71	349.77	350.83	351.88	352.94	354.00	355.05	356.11	357.17	358.22
340	359.28	360.34	361.39	362.45	363.51	364.56	365.62	366.68	367.74	368.79
350	369.85	370.91	371.96	373.02	374.08	375.13	376.19	377.25	378.30	379.36
360	380.42	381.47	382.53	383.59	384.64	385.70	386.76	387.81	388.87	389.93
370	390.98	392.04	393.10	394.15	395.21	396.27	397.32	398.38	399.44	400.49
380	401.55	402.61	403.66	404.72	405.78	406.83	407.89	408.95	410.00	411.06
390	412.12	413.17	414.23	415.29	416.34	417.40	418.46	419.51	420.57	421.63
400	422.68	423.74	424.80	425.85	426.91	427.97	429.02	430.08	431.14	432.19
410	433.25	434.31	435.36	436.42	437.48	438.53	439.59	440.65	441.70	442.76
420	443.82	444.87	445.93	446.99	448.05	449.10	450.16	451.22	452.27	453.33
430	454.39	455.44	456.50	457.56	458.61	459.67	460.73	461.78	462.84	463.90
440	464.95	466.01	467.07	468.12	469.18	470.24	471.29	472.35	473.41	474.46
450	475.52	476.58	477.63	478.69	479.75	480.80	481.86	482.92	483.97	485.03
460	486.09	487.14	488.20	489.26	490.31	491.37	492.43	493.48	494.54	495.60
470	496.65	497.71	498.77	499.82	500.88	501.94	502 99	504.05	505.11	506.16
480	507.22	508.28	509.33	510.39	511.45	512.50	513.56	514.62	515.67	516.73
490	517.79	518.84	519.90	520.96	522.01	523.07	524.13	525.18	526.24	527.30

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	528.36	529.41	530.47	531.53	532.58	533.64	534.70	535.75	536.81	537.87
510	538.92	539.98	541.04	542.09	543.15	544.21	545.26	546.32	547.38	548.43
520	549.49	550.55	551.60	552.66	553.72	554.77	555.83	556.89	557.94	559.00
530	560.06	561.11	562.17	563.23	564.28	565.34	566.40	567.45	568.51	569.57
540	570.62	571.68	572.74	573.79	574.85	575.91	576.96	578.02	579.08	580.13
550	581.19	582.25	583.30	584.36	585.42	586.47	587.53	588.59	589.64	590.70
560	591.76	592.81	593.87	594.93	595.98	597.04	598.10	599.15	600.21	601.27
570	602.32	603.38	604.44	605.49	606.55	607.61	608.66	609.72	610.78	611.84
580	612.89	613.95	615.01	616.06	617.12	618.18	619.23	620.29	621.35	622.40
590	623.46	624.52	625.57	626.63	627.69	628.74	629.80	630.86	631.91	632.97
600	634.03	635.08	636.14	637.20	638.25	639.31	640.37	641.42	642.48	643.54
610	644.59	645.65	646.71	647.76	648.82	649.88	650.93	651.99	653.05	654.10
620	655.16	656.22	657.27	658.33	659.39	660.44	661.50	662.56	663.61	664.67
630	665.73	666.78	667.84	668.90	669.95	671.01	672.07	673.12	674.18	675.24
640	676.29	677.35	678.41	679.46	680.52	681.58	682.63	683.69	684.75	685.80
650	686.86	687.92	688.97	690.03	691.09	692.15	693.20	694.26	695.32	696.37
660	697.43	698.49	699.54	700.60	701.66	702.71	703.77	704.83	705.88	706.94
670	708.00	709.05	710.11	711.17	712.22	713.28	714.34	715.39	716.45	717.51
680	718.56	719.62	720.68	721.73	722.79	723.85	724.90	725.96	727.02	728.07
690	729.13	730.19	731.24	732.30	733.36	734.41	735.47	736.53	737.58	738.64

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	739.70	740.75	741.81	742.87	743.92	744.98	746.04	747.09	748.15	749.21
710	750.26	751.32	752.38	753.43	754.49	755.55	756.60	757.66	758.72	759.77
720	760.83	761.89	762.94	764.00	765.06	766.11	767.17	768.23	769.28	770.34
730	771.40	772.46	773.51	774.57	775.63	776.68	777.74	778.80	779.85	780.91
740	781.97	783.02	784.08	785.14	786.19	787.25	788.31	789.36	790.42	791.48
750	792.53	793.59	794.65	795.70	796.76	797.82	798.87	799.93	800.99	802.04
760	803.10	804.16	805.21	806.27	807.33	808.38	809.44	810.50	811.55	812.61
770	813.67	814.72	815.78	816.84	817.89	818.95	820.01	821.06	822.12	823.18
780	824.23	825.29	826.35	827.40	828.46	829.52	830.57	831.63	832.69	833.74
790	834.80	835.86	836.91	837.97	839.03	840.08	841.14	842.20	843.25	844.31
800	845.37	846.42	847.48	848.54	849.59	850.65	851.71	852.76	853.82	854.88
810	855.94	856.99	858.05	859.11	860.16	861.22	862.28	863.33	864.39	865.45
820	866.50	867.56	868.62	869.67	870.73	871.79	872.84	873.90	874.96	876.01
830	877.07	878.13	879.18	880.24	881.30	882.35	883.41	884.47	885.52	886.58
840	887.64	888.69	889.75	890.81	891.86	892.92	893.98	895.03	896.09	897.15
850	898.20	899.26	900.32	901.37	902.43	903.49	904.54	905.60	906.66	907.71
860	908.77	909.83	910.88	911.94	913.00	914.05	915.11	916.17	917.22	918.28
870	919.34	920.39	921.45	922.51	923.56	924.62	925.68	926.73	927.79	928.85
880	929.90	930.96	932.02	933.07	934.13	935.19	936.25	937.30	938.36	939.42
890	940.47	941.53	942.59	943.64	944.70	945.76	946.81	947.87	948.93	949.98

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	951.04	952.10	953.15	954.21	955.27	956.32	957.38	958.44	959.49	960.55
910	961.61	962.66	963.72	964.78	965.83	966.89	967.95	969.00	970.06	971.12
920	972.17	973.23	974.29	975.34	976.40	977.46	978.51	979.57	980.63	981.68
930	982.74	983.80	984.85	985.91	986.97	988.02	989.08	990.14	991.19	992.25
940	993.31	994.36	995.42	996.48	997.53	998.59	999.65	1,000.7	1,001.8	1,002.8
950	1,003.9	1,004.9	1,006.0	1,007.0	1,008.1	1,009.2	1,010.2	1,011.3	1,012.3	1,013.4
960	1,014.4	1,015.5	1,016.6	1,017.6	1,018.7	1,019.7	1,020.8	1,021.8	1,022.9	1,024.0
970	1,025.0	1,026.1	1,027.1	1,028.2	1,029.2	1,030.3	1,031.3	1,032.4	1,033.5	1,034.5
980	1,035.6	1,036.6	1,037.7	1,038.7	1,039.8	1,040.9	1,041.9	1,043.0	1,044.0	1,045.1
990	1,046.1	1,047.2	1,048.3	1,049.3	1,050.4	1,051.4	1,052.5	1,053.5	1,054.6	1,055.7

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS

From 1 to 1,000 Units

Reduction factor: 1 kilogram = 2.204622341 avoirdupois pounds

The values found in the body of the table give, in avoirdupois pounds, the weights indicated in kilograms at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	....	2.2046	4.4092	6.6139	8.8185	11.023	13.228	15.432	17.637	19.842
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934
30	66.139	68.343	70.548	72.753	74.957	77.162	79.366	81.571	83.776	85.980
40	88.185	90.390	92.594	94.799	97.003	99.208	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.84	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.23	209.44	211.64	213.85	216.05	218.26

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	220.46	222.67	224.87	227.08	229.28	231.49	233.69	235.89	238.10	240.30
110	242.51	244.71	246.92	249.12	251.33	253.53	255.74	257.94	260.15	262.35
120	264.55	266.76	268.96	271.17	273.37	275.58	277.78	279.99	282.19	284.40
130	286.60	288.81	291.01	293.21	295.42	297.62	299.83	302.03	304.24	306.44
140	308.65	310.85	313.06	315.26	317.47	319.67	321.87	324.08	326.28	328.49
150	330.69	332.90	335.10	337.31	339.51	341.72	343.92	346.13	348.33	350.54
160	352.74	354.94	357.15	359.35	361.56	363.76	365.97	368.17	370.38	372.58
170	374.79	376.99	379.20	381.40	383.60	385.81	388.01	390.22	392.42	394.63
180	396.83	399.04	401.24	403.45	405.65	407.86	410.06	412.26	414.47	416.67
190	418.88	421.08	423.29	425.49	427.70	429.90	432.11	434.31	436.52	438.72
200	440.92	443.13	445.33	447.54	449.74	451.95	454.15	456.36	458.56	460.77
210	462.97	465.18	467.38	469.58	471.79	473.99	476.20	478.40	480.61	482.81
220	485.02	487.22	489.43	491.63	493.84	496.04	498.24	500.45	502.65	504.86
230	507.06	509.27	511.47	513.68	515.88	518.09	520.29	522.50	524.70	526.90
240	529.11	531.31	533.52	535.72	537.93	540.13	542.34	544.54	546.75	548.95
250	551.16	553.36	555.56	557.77	559.97	562.18	564.38	566.59	568.79	571.00
260	573.20	575.41	577.61	579.82	582.02	584.22	586.43	588.63	590.84	593.04
270	595.25	597.45	599.66	601.86	604.07	606.27	608.48	610.68	612.89	615.09
280	617.29	619.50	621.70	623.91	626.11	628.32	630.52	632.73	634.93	637.14
290	639.34	641.55	643.75	645.95	648.16	650.36	652.57	654.77	656.98	659.18

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	661.39	663.59	665.80	668.00	670.21	672.41	674.61	676.82	679.02	681.23
310	683.43	685.64	687.84	690.05	692.25	694.46	696.66	698.87	701.07	703.27
320	705.48	707.68	709.89	712.09	714.30	716.50	718.71	720.91	723.12	725.32
330	727.53	729.73	731.93	734.14	736.34	738.55	740.75	742.96	745.16	747.37
340	749.57	751.78	753.98	756.19	758.39	760.59	762.80	765.00	767.21	769.41
350	771.62	773.82	776.03	778.23	780.44	782.64	784.85	787.05	789.25	791.46
360	793.66	795.87	798.07	800.28	802.48	804.69	806.89	809.10	811.30	813.51
370	815.71	817.91	820.12	822.32	824.53	826.73	828.94	831.14	833.35	835.55
380	837.76	839.96	842.17	844.37	846.58	848.78	850.98	853.19	855.39	857.60
390	859.80	862.01	864.21	866.42	868.62	870.83	873.03	875.24	877.44	879.64
400	881.85	884.05	886.26	888.46	890.67	892.87	895.08	897.28	899.49	901.69
410	903.90	906.10	908.30	910.51	912.71	914.92	917.12	919.33	921.53	923.74
420	925.94	928.15	930.35	932.56	934.76	936.96	939.17	941.37	943.58	945.78
430	947.99	950.19	952.40	954.60	956.81	959.01	961.22	963.42	965.62	967.83
440	970.03	972.24	974.44	976.65	978.85	981.06	983.26	985.47	987.67	989.88
450	992.08	994.28	996.49	998.69	1,000.9	1,003.1	1,005.3	1,007.5	1,009.7	1,011.9
460	1,014.1	1,016.3	1,018.5	1,020.7	1,022.9	1,025.1	1,027.4	1,029.6	1,031.8	1,034.0
470	1,036.2	1,038.4	1,040.6	1,042.8	1,045.0	1,047.2	1,049.4	1,051.6	1,053.8	1,056.0
480	1,058.2	1,060.4	1,062.6	1,064.8	1,067.0	1,069.2	1,071.4	1,073.7	1,075.9	1,078.1
490	1,080.3	1,082.5	1,084.7	1,086.9	1,089.1	1,091.3	1,093.5	1,095.7	1,097.9	1,100.1

WEIGHTS—KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	1,102.3	1,104.5	1,106.7	1,108.9	1,111.1	1,113.3	1,115.5	1,117.7	1,119.9	1,122.2
510	1,124.4	1,126.6	1,128.8	1,131.0	1,133.2	1,135.4	1,137.6	1,139.8	1,142.0	1,144.2
520	1,146.4	1,148.6	1,150.8	1,153.0	1,155.2	1,157.4	1,159.6	1,161.8	1,164.0	1,166.2
530	1,168.4	1,170.7	1,172.9	1,175.1	1,177.3	1,179.5	1,181.7	1,183.9	1,186.1	1,188.3
540	1,190.5	1,192.7	1,194.9	1,197.1	1,199.3	1,201.5	1,203.7	1,205.9	1,208.1	1,210.3
550	1,212.5	1,214.7	1,217.0	1,219.2	1,221.4	1,223.6	1,225.8	1,228.0	1,230.2	1,232.4
560	1,234.6	1,236.8	1,239.0	1,241.2	1,243.4	1,245.6	1,247.8	1,250.0	1,252.2	1,254.4
570	1,256.6	1,258.8	1,261.0	1,263.2	1,265.5	1,267.7	1,269.9	1,272.1	1,274.3	1,276.5
580	1,278.7	1,280.9	1,283.1	1,285.3	1,287.5	1,289.7	1,291.9	1,294.1	1,296.3	1,298.5
590	1,300.7	1,302.9	1,305.1	1,307.3	1,309.5	1,311.8	1,314.0	1,316.2	1,318.4	1,320.6
600	1,322.8	1,325.0	1,327.2	1,329.4	1,331.6	1,333.8	1,336.0	1,338.2	1,340.4	1,342.6
610	1,344.8	1,347.0	1,349.2	1,351.4	1,353.6	1,355.8	1,358.0	1,360.3	1,362.5	1,364.7
620	1,366.9	1,369.1	1,371.3	1,373.5	1,375.7	1,377.9	1,380.1	1,382.3	1,384.5	1,386.7
630	1,388.9	1,391.1	1,393.3	1,395.5	1,397.7	1,399.9	1,402.1	1,404.3	1,406.5	1,408.8
640	1,411.0	1,413.2	1,415.4	1,417.6	1,419.8	1,422.0	1,424.2	1,426.4	1,428.6	1,430.8
650	1,433.0	1,435.2	1,437.4	1,439.6	1,441.8	1,444.0	1,446.2	1,448.4	1,450.6	1,452.8
660	1,455.1	1,457.3	1,459.5	1,461.7	1,463.9	1,466.1	1,468.3	1,470.5	1,472.7	1,474.9
370	1,477.1	1,479.3	1,481.5	1,483.7	1,485.9	1,488.1	1,490.3	1,492.5	1,494.7	1,496.9
680	1,499.1	1,501.3	1,503.6	1,505.8	1,508.0	1,510.2	1,512.4	1,514.6	1,516.8	1,519.0
690	1,521.2	1,523.4	1,525.6	1,527.8	1,530.0	1,532.2	1,534.4	1,536.6	1,538.8	1,541.0

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	1,543.2	1,545.4	1,547.6	1.549.8	1,552.1	1,554.3	1,556.5	1,558.7	1,560.9	1,563.1
710	1,565.3	1,567.5	1,569.7	1,571.9	1,574.1	1,576.3	1,578.5	1,580.7	1,582.9	1,585.1
720	1,587.3	1,589.5	1,591.7	1,593.9	1,596.1	1,598.4	1,600.6	1,602.8	1,605.0	1,607.2
730	1,609.4	1,611.6	1,613.8	1,616.0	1,618.2	1,620.4	1,622.6	1,624.8	1,627.0	1,629.2
740	1,631.4	1,633.6	1,635.8	1,638.0	1,640.2	1,642.4	1,644.6	1,646.9	1,649.1	1,651.3
750	1,653.5	1,655.7	1,657.9	1,660.1	1,662.3	1,664.5	1,666.7	1,668.9	1,671.1	1,673.3
760	1,675.5	1,677.7	1,679.9	1,682.1	1,684.3	1,686.5	1,688.7	1,690.9	1,693.2	1,695.4
770	1,697.6	1,699.8	1,702.0	1,704.2	1,706.4	1,708.6	1,710.8	1,713.0	1,715.2	1,717.4
780	1,719.6	1,721.8	1,724.0	1,726.2	1,728.4	1,730.6	1,732.8	1,735.0	1,737.2	1,739.4
790	1,741.7	1,743.9	1,746.1	1,748.3	1,750.5	1,752.7	1,754.9	1,757.1	1,759.3	1,761.5
800	1,763.7	1,765.9	1,768.1	1,770.3	1,772.5	1,774.7	1,776.9	1,779.1	1,781.3	1,783.5
810	1,785.7	1,787.9	1,790.2	1,792.4	1,794.6	1,796.8	1,799.0	1,801.2	1,803.4	1,805.6
820	1,807.8	1,810.0	1,812.2	1,814.4	1,816.6	1,818.8	1,821.0	1,823.2	1,825.4	1,827.6
830	1,829.8	1,832.0	1,834.2	1,836.5	1,838.7	1,840.9	1,843.1	1,845.3	1,847.5	1,849.7
840	1,851.9	1,854.1	1,856.3	1,858.5	1,860.7	1,862.9	1,865.1	1,867.3	1,869.5	1,871.7
850	1,873.9	1,876.1	1,878.3	1,880.5	1,882.7	1,885.0	1,887.2	1,889.4	1,891.6	1,893.8
860	1,896.0	1,898.2	1,900.4	1,902.6	1,904.8	1,907.0	1,909.2	1,911.4	1,913.6	1,915.8
870	1,918.0	1,920.2	1,922.4	1,924.6	1,926.8	1,929.0	1,931.2	1,933.5	1,935.7	1,937.9
880	1,940.1	1,942.3	1,944.5	1,946.7	1,948.9	1,951.1	1,953.3	1,955.5	1,957.7	1,959.9
890	1,962.1	1,964.3	1,966.5	1,968.7	1,970.9	1,973.1	1,975.3	1,977.5	1,979.8	1,982.0

WEIGHTS—KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	1,984.2	1,986.4	1,988.6	1,990.8	1,993.0	1,995.2	1,997.4	1,999.6	2,001.8	2,004.0
910	2,006.2	2,008.4	2,010.6	2,012.8	2,015.0	2,017.2	2,019.4	2,021.6	2,023.8	2,026.0
920	2,028.3	2,030.5	2,032.7	2,034.9	2,037.1	2,039.3	2,041.5	2,043.7	2,045.9	2,048.1
930	2,050.3	2,052.5	2,054.7	2,056.9	2,059.1	2,061.3	2,063.5	2,065.7	2,067.9	2,070.1
940	2,072.3	2,074.5	2,076.8	2,079.0	2,081.2	2,083.4	2,085.6	2,087.8	2,090.0	2,092.2
950	2,094.4	2,096.6	2,098.8	2,101.0	2,103.2	2,105.4	2,107.6	2,109.8	2,112.0	2,114.2
960	2,116.4	2,118.6	2,120.8	2,123.1	2,125.3	2,127.5	2,129.7	2,131.9	2,134.1	2,136.3
970	2,138.5	2,140.7	2,142.9	2,145.1	2,147.3	2,149.5	2,151.7	2,153.9	2,156.1	2,158.3
980	2,160.5	2,162.7	2,164.9	2,167.1	2,169.3	2,171.6	2,173.8	2,176.0	2,178.2	2,180.4
990	2,182.6	2,184.8	2,187.0	2,189.2	2,191.4	2,193.6	2,195.8	2,198.0	2,200.2	2,202.4

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS

From 1 *to* 1,000 *Units*

Reduction factor: 1 avoirdupois pound = 0.4535924277 kilogram

The values found in the body of the table give, in kilograms, the weights indicated in avoirdupois pounds at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	....	0.45359	0.90718	1.3608	1.8144	2.2680	2.7216	3.1751	3.6287	4.0823
10	4.5359	4.9895	5.4431	5.8967	6.3503	6.8039	7.2575	7.7111	8.1647	8.6183
20	9.0719	9.5254	9.9790	10.433	10.886	11.340	11.793	12.247	12.701	13.154
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370
90	40.823	41.277	41.731	42.184	42.638	43.091	43.545	43.998	44.452	44.906

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	45.359	45.813	46.266	46.720	47.174	47.627	48.081	48.534	48.988	49.442
110	49.895	50.349	50.802	51.256	51.710	52.163	52.617	53.070	53.524	53.978
120	54.431	54.885	55.338	55.792	56.245	56.699	57.153	57 606	58.060	58.513
130	58.967	59.421	59.874	60.328	60.781	61.235	61.689	62.142	62.596	63.049
140	63.503	63.957	64.410	64.864	65.317	65.771	66.224	66.678	67.132	67.585
150	68.039	68.492	68.946	69.400	69.853	70.307	70.760	71.214	71.668	72.121
160	72.575	73.028	73.482	73.936	74.389	74.843	75.296	75.750	76.204	76.657
170	77.111	77.564	78.018	78.471	78.925	79.379	79.832	80.286	80.739	81.193
180	81.647	82.100	82.554	83.007	83.461	83.915	84.368	84.822	85.275	85.729
190	86.183	86.636	87.090	87.543	87.997	88.451	88.904	89.358	89.811	90.265
200	90.718	91.172	91.626	92.079	92.533	92.986	93.440	93.894	94.347	94.801
210	95.254	95.708	96.162	96.615	97.069	97.522	97.976	98.430	98.883	99.337
220	99.790	100.24	100.70	101.15	101.60	102.06	102.51	102.97	103.42	103.87
230	104.33	104.78	105.23	105.69	106.14	106.59	107.05	107.50	107.96	108.41
240	108.86	109.32	109.77	110.22	110.68	111.13	111.58	112.04	112.49	112.94
250	113.40	113.85	114.31	114.76	115.21	115.67	116.12	116.57	117.03	117.48
260	117.93	118.39	118.84	119.29	119.75	120.20	120.66	121.11	121.56	122.02
270	122.47	122.92	123.38	123.83	124.28	124.74	125.19	125.65	126.10	126.55
280	127.01	127.46	127.91	128.37	128.82	129.27	129.73	130.18	130.63	131.09
290	131.54	132.00	132.45	132.90	133.36	133.81	134.26	134.72	135.17	135.62

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	136.08	136.53	136.98	137.44	137.89	138.35	138.80	139.25	139.71	140.16
310	140.61	141.07	141.52	141.97	142.43	142.88	143.34	143.79	144.24	144.70
320	145.15	145.60	146.06	146.51	146.96	147.42	147.87	148.32	148.78	149.23
330	149.69	150.14	150.59	151.05	151.50	151.95	152.41	152.86	153.31	153.77
340	154.22	154.68	155.13	155.58	156.04	156.49	156.94	157.40	157.85	158.30
350	158.76	159.21	159.66	160.12	160.57	161.03	161.48	161.93	162.39	162.84
360	163.29	163.75	164.20	164.65	165.11	165.56	166.01	166.47	166.92	167.38
370	167.83	168.28	168.74	169.19	169.64	170.10	170.55	171.00	171.46	171.91
380	172.37	172.82	173.27	173.73	174.18	174.63	175.09	175.54	175.99	176.45
390	176.90	177.35	177.81	178.26	178.72	179.17	179.62	180.08	180.53	180.98
400	181.44	181.89	182.34	182.80	183.25	183.70	184.16	184.61	185.07	185.52
410	185.97	186.43	186.88	187.33	187.79	188.24	188.69	189.15	189.60	190.06
420	190.51	190.96	191.42	191.87	192.32	192.78	193.23	193.68	194.14	194.59
430	195.04	195.50	195.95	196.41	196.86	197.31	197.77	198.22	198.67	199.13
440	199.58	200.03	200.49	200.94	201.40	201.85	202.30	202.76	203.21	203.66
450	204.12	204.57	205.02	205.48	205.93	206.38	206.84	207.29	207.75	208.20
460	208.65	209.11	209.56	210.01	210.47	210.92	211.37	211.83	212.28	212.73
470	213.19	213.64	214.10	214.55	215.00	215.46	215.91	216.36	216.82	217.27
480	217.72	218.18	218.63	219.09	219.54	219.99	220.45	220.90	221.35	221.81
490	222.26	222.71	223.17	223.62	224.07	224.53	224.98	225.44	225.89	226.34

WEIGHTS—AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	226.80	227.25	227.70	228.16	228.61	229.06	229.52	229.97	230.42	230.88
510	231.33	231.79	232.24	232.69	233.15	233.60	234.05	234.51	234.96	235.41
520	235.87	236.32	236.78	237.23	237.68	238.14	238.59	239.04	239.50	239.95
530	240.40	240.86	241.31	241.76	242.22	242.67	243.13	243.58	244.03	244.49
540	244.94	245.39	245.85	246.30	246.75	247.21	247.66	248.12	248.57	249.02
550	249.48	249.93	250.38	250.84	251.29	251.74	252.20	252.65	253.10	253.56
560	254.01	254.47	254.92	255.37	255.83	256.28	256.73	257.19	257.64	258.09
570	258.55	259.00	259.45	259.91	260.36	260.82	261.27	261.72	262.18	262.63
580	263.08	263.54	263.99	264.44	264.90	265.35	265.81	266.26	266.71	267.17
590	267.62	268.07	268.53	268.98	269.43	269.89	270.34	270.79	271.25	271.70
600	272.16	272.61	273.06	273.52	273.97	274.42	274.88	275.33	275.78	276.24
610	276.69	277.14	277.60	278.05	278.51	278.96	279.41	279.87	280.32	280.77
620	281.23	281.68	282.13	282.59	283.04	283.50	283.95	284.40	284.86	285.31
630	285.76	286.22	286.67	287.12	287.58	288.03	288.48	288.94	289.39	289.85
640	290.30	290.75	291.21	291.66	292.11	292.57	293.02	293.47	293.93	294.38
650	294.84	295.29	295.74	296.20	296.65	297.10	297.56	298.01	298.46	298.92
660	299.37	299.82	300.28	300.73	301.19	301.64	302.09	302.55	303.00	303.45
670	303.91	304.36	304.81	305.27	305.72	306.17	306.63	307.08	307.54	307.99
680	308.44	308.90	309.35	309.80	310.26	310.71	311.16	311.62	312.07	312.53
690	312.98	313.43	313.89	314.34	314.79	315.25	315.70	316.15	316.61	317.06

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	317.51	317.97	318.42	318.88	319.33	319.78	320.24	320.69	321.14	321.60
710	322.05	322.50	322.96	323.41	323.86	324.32	324.77	325.23	325.68	326.13
720	326.59	327.04	327.49	327.95	328.40	328.85	329.31	329.76	330.22	330.67
730	331.12	331.58	332.03	332.48	332.94	333.39	333.84	334.30	334.75	335.20
740	335.66	336.11	336.57	337.02	337.47	337.93	338.38	338.83	339.29	339.74
750	340.19	340.65	341.10	341.56	342.01	342.46	342.92	343.37	343.82	344.28
760	344.73	345.18	345.64	346.09	346.54	347.00	347.45	347.91	348.36	348.81
770	349.27	349.72	350.17	350.63	351.08	351.53	351.99	352.44	352.89	353.35
780	353.80	354.26	354.71	355.16	355.62	356.07	356.52	356.98	357.43	357.88
790	358.34	358.79	359.25	359.70	360.15	360.61	361.06	361.51	361.97	362.42
800	362.87	363.33	363.78	364.23	364.69	365.14	365.60	366.05	366.50	366.96
810	367.41	367.86	368.32	368.77	369.22	369.68	370.13	370.59	371.04	371.49
820	371.95	372.40	372.85	373.31	373.76	374.21	374.67	375.12	375.57	376.03
830	376.48	376.94	377.39	377.84	378.30	378.75	379.20	379.66	380.11	380.56
840	381.02	381.47	381.92	382.38	382.83	383.29	383.74	384.19	384.65	385.10
850	385.55	386.01	386.46	386.91	387.37	387.82	388.28	388.73	389.18	389.64
860	390.09	390.54	391.00	391.45	391.90	392.36	392.81	393.26	393.72	394.17
870	394.63	395.08	395.53	395.99	396.44	396.89	397.35	397.80	398.25	398.71
880	399.16	399.61	400.07	400.52	400.98	401.43	401.88	402.34	402.79	403.24
890	403.70	404.15	404.60	405.06	405.51	405.97	406.42	406.87	407.33	407.78

WEIGHTS — AVOIRDUPOIS POUNDS TO KILOGRAMS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	408.23	408.69	409.14	409.59	410.05	410.50	410.95	411.41	411.86	412.32
910	412.77	413.22	413.68	414.13	414.58	415.04	415.49	415.94	416.40	416.85
920	417.31	417.76	418.21	418.67	419.12	419.57	420.03	420.48	420.93	421.39
930	421.84	422.29	422.75	423.20	423.66	424.11	424.56	425.02	425.47	425.92
940	426.38	426.83	427.28	427.74	428.19	428.64	429.10	429.55	430.01	430.46
950	430.91	431.37	431.82	432.27	432.73	433.18	433.63	434.09	434.54	435.00
960	435.45	435.90	436.36	436.81	437.26	437.72	438.17	438.62	439.08	439.53
970	439.98	440.44	440.89	441.35	441.80	442.25	442.71	443.16	443.61	444.07
980	444.52	444.97	445.43	445.88	446.33	446.79	447.24	447.70	448.15	448.60
990	449.06	449.51	449.96	450.42	450.87	451.32	451.78	452.23	452.69	453.14

CONVERSION OF THERMOMETER SCALES

By I. Gottfried

1

FAHRENHEIT TO CENTIGRADE (WITH CONSTANT, 32.F.) (FROM 1.F. TO 9999.F.)

F.	C.	F.	C.	F.	C.	F.	C.
1	−17.22	10	−12.22	100	37.78	1000	537.78
2	−16.67	20	− 6.67	200	93.33	2000	1093.33
3	−16.11	30	− 1.11	300	148.89	3000	1648.89
4	−15.56	40	+ 4.44	400	204.44	4000	2204.44
5	−15	50	10	500	260	5000	2760
6	−14.44	60	15.56	600	315.56	6000	3315.56
7	−13.89	70	21.11	700	371.11	7000	3871.11
8	−13.33	80	26.67	800	426.67	8000	4426.67
9	−12.78	90	32.22	900	482.22	9000	4982.22

2

FAHRENHEIT TO CENTIGRADE (WITHOUT CONSTANT)

F.	C.	F.	C.	F.	C.	F.	C.
1	.56	10	5.56	100	55.56	1000	555.56
2	1.11	20	11.11	200	111.11	2000	1111.11
3	1.67	30	16.67	300	166.67	3000	1666.67
4	2.22	40	22.22	400	222.22	4000	2222.22
5	2.78	50	27.78	500	277.78	5000	2777.78
6	3.33	60	33.33	600	333.33	6000	3333.33
7	3.89	70	38.89	700	388.89	7000	3888.89
8	4.44	80	44.44	800	444.44	8000	4444.44
9	5.00	90	50.00	900	500.00	9000	5000.00

TO CONVERT DEGREES FAHRENHEIT TO DEGREES CENTIGRADE

Use the first table for one of the digits, and the second table for the others; then add.

Examples: To find the Centigrade equivalent for 35.F.

$$\begin{array}{rcll} 30 & = & 16.67 & (2) \\ \underline{5} & = & \underline{-15} & (1) \\ \underline{\underline{35}}.F & = & \underline{\underline{1.67}}.C & \end{array} \quad \text{or,} \quad \begin{array}{rcll} 30 & = & -1.11 & (1) \\ \underline{5} & = & \underline{2.78} & (2) \\ \underline{\underline{35}}.F & = & \underline{\underline{1.67}}.C & \end{array}$$

To find the C. equivalent for 355.F. and 5445.F.

$$\begin{array}{rl} 300 & 148.89(1) \\ 50 & 27.78(2) \text{ or,} \\ \underline{5} & \underline{2.78(2)} \\ 355.F & 179.45.C. \end{array}$$

CONVERSION OF THERMOMETER SCALES (Continued)

300	166.67(2)	5000	2760 (1)
50	10 (1)	400	222.22(2)
5	2.78(2)	40	22.22(2)
355. F. =	179.45. C.	5	2.78(2)
		5445. F. =	3007.22. C.

1
Centigrade to Fahrenheit (With Constant 32. F.)

C.	F.	C.	F.	C.	F.	C.	F.
				000	32		
1	33.8	10	50	100	212	1000	1832
2	35.6	20	68	200	392	2000	3632
3	37.4	30	86	300	572	3000	5432
4	39.2	40	104	400	752	4000	7232
5	41	50	122	500	932	5000	9032
6	42.8	60	140	600	1112		
7	44.6	70	158	700	1292		
8	46.4	80	176	800	1472		
9	48.2	90	194	900	1652		

2
Centigrade to Fahrenheit (Without Constant)

C.	F.	C.	F.	C.	F.	C.	F.
1	1.8	10	18	100	180	1000	1800
2	3.6	20	36	200	360	2000	3600
3	5.4	30	54	300	540	3000	5400
4	7.2	40	72	400	720	4000	7200
5	9.0	50	90	500	900	5000	9000
6	10.8	60	108	600	1080		
7	12.6	70	126	700	1260		
8	14.4	80	144	800	1440		
9	16.2	90	162	900	1620		

To Convert Degrees Centigrade to Degrees Fahrenheit

Use the first table for one digit, and the second table for the others; then add.

Examples: To find the Fahrenheit equivalents for 15.C.; 155.C.; and 5432.C.

10	= 50(1)		18(2)	
5	= 9(2)	or,	41(1)	
15.C.	= 59.F.		59.F.	

100	= 212(1)		= 180(2)
50	= 90(2)	or,	= 90(2)
5	= 9(2)		41(1)
155.C.	= 311.F		= 311.F.

5000	= 9000(2)		= 9000(2)
400	= 720(2)	or,	= 752(1)
30	= 54(2)		= 54(2)
2	= 35.6(1)		= 3.6(2)
5432.C.	= 9809.6.F.		= 9809.6.F.

THERMOMETER SCALES

Corrections to Reduce Gas Thermometer Temperature to Thermodynamic Scale.

The values below are corrections to be applied to temperatures determined by the gas thermometer indicated to give temperatures in the thermodynamic centigrade scale for an initial pressure of 100 cm.

Temp. °C	Corrections in °C					
	Constant Volume			Constant Pressure		
	Hydrogen	Nitrogen	Helium	Hydrogen	Nitrogen	Helium
+1200		+1.0			+2.3	
1000		+0.7			+1.8	
800		+ .5			+1.3	
600		+ .3			+0.9	
500		+ .2			+ .7	
450		+ .17	+0.05		+ .6	+0.008
400		+ .14	+ .04		+ .5	+ .006
350		+ .10	+ .03		+ .4	+ .005
300		+ .07	+ .02	+0.04	+ .3	+ .003
250		+ .04	+ .01	+ .03	+ .2	+ .002
200	+0.02	+ .02	+ .006	+ .02	+ .12	+ .001
150	+ .01	+ .01	+ .002	+ .01	+ .05	+ .001
100	.000	.000	.000	.000	.00	.000
75	− .001	− .005	− .001	− .003	− .02	.000
50	− .002	− .010	− .001	− .004	− .03	.000
+ 25	− .001	− .008	− .001	− .003	− .02	− .001
0	.000	.00	.000	.000	.00	.000
− 50	+ .005	+ .03	+ .002	+ .02	+ .12	+ .002
− 100	+ .015	+ .06	+ .005	+ .04	+ .4	+ .005
− 150	+ .03	+ .2	+ .01	+ .1	+1.3	+ .02
− 200	+ .06	+ .5	+ .02	+ .3		+ .04
− 250	+ .12		+ .04			

THERMOMETER SCALES (Continued)

Corrections to reduce Liquid in Glass to Standard Thermodynamic Scale.

Temp. °C	Corrections in °C					
	Mercury in			Pentane in Jena 16III	Alcohol in verre dur	Toluene in verre dur
	Jena 16III	Jena 59III	Jena 1565III			
-190				-23.4		
-180				-21.0		
-170				-18.6		
-160				-16.2		
-150				-13.9		
-140				-11.6		
-130				- 9.4		
-120				- 7.3		
-110				- 5.3		
-100				- 3.4		
- 90				- 1.7		
- 80				- 0.2		0.0
- 78.5				0.0	0.0	0.0
- 70				+ 1.0	+0.3	+ .4
- 60				+ 2.0	+ .6	+ .8
- 50				+ 2.6	+ .7	+1.1
- 40				+ 3.0	+ .9	+1.2
- 30	0.28	0.13		+ 2.9	+ .9	+1.2
- 20	.16	.07		+ 2.4	+ .8	+1.0
- 10	.07	.03		+ 1.5	+ .5	+0.6
0	.00	.00	0.00	0.0	.0	0.0
+ 10	- .06	- .02	- .03	- 2.0		
20	- .09	- .04	- .05	- 4.4		
30	- .11	- .04	- .06	- 7.6	-3.6	
40	- .12	- .03	- .06			
50	- .12	- .03	- .05			
60	- .10	- .02	- .04			
70	- .08	- .01	- .03			
80	- .06	.00	- .02			
90	- .03	+ .02	- .01			
100	.00	.00	.00			-24.4
120	+ .03	- .05	+ .06			
140	+ .02	- .16	+ .03			
160	- .02	- .31	- .13			
180	- .12	- .52	- .38			
200	- .29	- .84	- .90			
220	- .5	- 1.3	- 1.3			
240	- .9	- 1.9	- 1.8			
260	- 1.4	- 2.6	- 2.4			
280	- 2.0	- 3.4	- 3.1			
300	- 2.7	- 4.4	- 3.9			
320		- 5.8	- 4.8			
340		- 7.2	- 5.9			
360		- 8.8	- 7.3			
380		-10.6	- 8.9			
400		-12.6	-10.5			
420		-14.9	-12.4			
440		-17.4	-14.7			
460		-20.2	-17.2			
480		-23.3	-20.0			
500		-26.9	-23.1			
550			-32.			
600			-44.			
650			-58.			

TEMPERATURES — CENTIGRADE TO FAHRENHEIT

Conversion Table

The values in the body of the table give, in degrees Fahrenheit, the temperatures indicated in degrees Centigrade at the top and side.

1° C. = 1.8° F.

For temperatures below 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
0	+ 32.0	30.2	28.4	26.6	24.8	23.0	21.2	19.4	17.6	15.8
– 10	+ 14.0	12.2	10.4	8.6	6.8	5.0	3.2	+ 1.4	– 0.4	– 2.2
– 20	– 4.0	5.8	7.6	9.4	11.2	13.0	14.8	16.6	18.4	20.2
– 30	– 22.0	23.8	25.6	27.4	29.2	31.0	32.8	34.6	36.4	38.2
– 40	– 40.0	41.8	43.6	45.4	47.2	49.0	50.8	52.6	54.4	56.2
– 50	– 58.0	59.8	61.6	63.4	65.2	67.0	68.8	70.6	72.4	74.2
– 60	– 76.0	77.8	79.6	81.4	83.2	85.0	86.8	88.6	90.4	92.2
– 70	– 94.0	95.8	97.6	99.4	101.2	103.0	104.8	106.6	108.4	110.2
– 80	– 112.0	113.8	115.6	117.4	119.2	121.0	122.8	124.6	126.4	128.2
– 90	– 130.0	131.8	133.6	135.4	137.2	139.0	140.8	142.6	144.4	146.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
– 100	–148.0	149.8	151.6	153.4	155.2	157.0	158.8	160.6	162.4	164.2
– 110	–166.0	167.8	169.6	171.4	173.2	175.0	176.8	178.6	180.4	182.2
– 120	–184.0	185.8	187.6	189.4	191.2	193.0	194.8	196.6	198.4	200.2
– 130	–202.0	203.8	205.6	207.4	209.2	211.0	212.8	214.6	216.4	218.2
– 140	–220.0	221.8	223.6	225.4	227.2	229.0	230.8	232.6	234.4	236.2
– 150	–238.0	239.8	241.6	243.4	245.2	247.0	248.8	250.6	252.4	254.2
– 160	–256.0	257.8	259.6	261.4	263.2	265.0	266.8	268.6	270.4	272.2
– 170	–274.0	275.8	277.6	279.4	281.2	283.0	284.8	286.6	288.4	290.2
– 180	–292.0	293.8	295.6	297.4	299.2	301.0	302.8	304.6	306.4	308.2
– 190	–310.0	311.8	313.6	315.4	317.2	319.0	320.8	322.6	324.4	326.2
– 200	–328.0	329.8	331.6	333.4	335.2	337.0	338.8	340.6	342.4	344.2
– 210	–346.0	347.8	349.6	351.4	353.2	355.0	356.8	358.6	360.4	362.2
– 220	–364.0	365.8	367.6	369.4	371.2	373.0	374.8	376.6	378.4	380.2
– 230	–382.0	383.8	385.6	387.4	389.2	391.0	392.8	394.6	396.4	398.2
– 240	–400.0	401.8	403.6	405.4	407.2	409.0	410.8	412.6	414.4	416.2
– 250	–418.0	419.8	421.6	423.4	425.2	427.0	428.8	430.6	432.4	434.2
– 260	–436.0	437.8	439.6	441.4	443.2	445.0	446.8	448.6	450.4	452.2
– 270	–454.0	455.8	457.6	459.4	......	......	......	......	......	......

– 273° C. = –459.4° F. = absolute zero

For interpolation										
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
0	32.0	33.8	35.6	37.4	39.2	41.0	42.8	44.6	46.4	48.2
10	50.0	51.8	53.6	55.4	57.2	59.0	60.8	62.6	64.4	66.2
20	68.0	69.8	71.6	73.4	75.2	77.0	78.8	80.6	82.4	84.2
30	86.0	87.8	89.6	91.4	93.2	95.0	96.8	98.6	100.4	102.2
40	104.0	105.8	107.6	109.4	111.2	113.0	114.8	116.6	118.4	120.2
50	122.0	123.8	125.6	127.4	129.2	131.0	132.8	134.6	136.4	138.2
60	140.0	141.8	143.6	145.4	147.2	149.0	150.8	152.6	154.4	156.2
70	158.0	159.8	161.6	163.4	165.2	167.0	168.8	170.6	172.4	174.2
80	176.0	177.8	179.6	181.4	183.2	185.0	186.8	188.6	190.4	192.2
90	194.0	195.8	197.6	199.4	201.2	203.0	204.8	206.6	208.4	210.2
100	212.0	213.8	215.6	217.4	219.2	221.0	222.8	224.6	226.4	228.2
110	230.0	231.8	233.6	235.4	237.2	239.0	240.8	242.6	244.4	246.2
120	248.0	249.8	251.6	253.4	255.2	257.0	258.8	260.6	262.4	264.2
130	266.0	267.8	269.6	271.4	273.2	275.0	276.8	278.6	280.4	282.2
140	284.0	285.8	287.6	289.4	291.2	293.0	294.8	296.6	298.4	300.2
150	302.0	303.8	305.6	307.4	309.2	311.0	312.8	314.6	316.4	318.2
160	320.0	321.8	323.6	325.4	327.2	329.0	330.8	332.6	334.4	336.2
170	338.0	339.8	341.6	343.4	345.2	347.0	348.8	350.6	352.4	354.2
180	356.0	357.8	359.6	361.4	363.2	365.0	366.8	368.6	370.4	372.2
190	374.0	375.8	377.6	379.4	381.2	383.0	384.8	386.6	388.4	390.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
200	392.0	393.8	395.6	397.4	399.2	401.0	402.8	404.6	406.4	408.2
210	410.0	411.8	413.6	415.4	417.2	419.0	420.8	422.6	424.4	426.2
220	428.0	429.8	431.6	433.4	435.2	437.0	438.8	440.6	442.4	444.2
230	446.0	447.8	449.6	451.4	453.2	455.0	456.8	458.6	460.4	462.2
240	464.0	465.8	467.6	469.4	471.2	473.0	474.8	476.6	478.4	480.2
250	482.0	483.8	485.6	487.4	489.2	491.0	492.8	494.6	496.4	498.2
260	500.0	501.8	503.6	505.4	507.2	509.0	510.8	512.6	514.4	516.2
270	518.0	519.8	521.6	523.4	525.2	527.0	528.8	530.6	532.4	534.2
280	536.0	537.8	539.6	541.4	543.2	545.0	546.8	548.6	550.4	552.2
290	554.0	555.8	557.6	559.4	561.2	563.0	564.8	566.6	568.4	570.2
300	572.0	573.8	575.6	577.4	579.2	581.0	582.8	584.6	586.4	588.2
310	590.0	591.8	593.6	595.4	597.2	599.0	600.8	602.6	604.4	606.2
320	608.0	609.8	611.6	613.4	615.2	617.0	618.8	620.6	622.4	624.2
330	626.0	627.8	629.6	631.4	633.2	635.0	636.8	638.6	640.4	642.2
340	644.0	645.8	647.6	649.4	651.2	653.0	654.8	656.6	658.4	660.2
350	662.0	663.8	665.6	667.4	669.2	671.0	672.8	674.6	676.4	678.2
360	680.0	681.8	683.6	685.4	687.2	689.0	690.8	692.6	694.4	696.2
370	698.0	699.8	701.6	703.4	705.2	707.0	708.8	710.6	712.4	714.2
380	716.0	717.8	719.6	721.4	723.2	725.0	726.8	728.6	730.4	732.2
390	734.0	735.8	737.6	739.4	741.2	743.0	744.8	746.6	748.4	750.2

For interpolation	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
400	752.0	753.8	755.6	757.4	759.2	761.0	762.8	764.6	766.4	768.2
410	770.0	771.8	773.6	775.4	777.2	779.0	780.8	782.6	784.4	786.2
420	788.0	789.8	791.6	793.4	795.2	797.0	798.8	800.6	802.4	804.2
430	806.0	807.8	809.6	811.4	813.2	815.0	816.8	818.6	820.4	822.2
440	824.0	825.8	827.6	829.4	831.2	833.0	834.8	836.6	838.4	840.2
450	842.0	843.8	845.6	847.4	849.2	851.0	852.8	854.6	856.4	858.2
460	860.0	861.8	863.6	865.4	867.2	869.0	870.8	872.6	874.4	876.2
470	878.0	879.8	881.6	883.4	885.2	887.0	888.8	890.6	892.4	894.2
480	896.0	897.8	899.6	901.4	903.2	905.0	906.8	908.6	910.4	912.2
490	914.0	915.8	917.6	919.4	921.2	923.0	924.8	926.6	928.4	930.2
500	932.0	933.8	935.6	937.4	939.2	941.0	942.8	944.6	946.4	948.2
510	950.0	951.8	953.6	955.4	957.2	959.0	960.8	962.6	964.4	966.2
520	968.0	969.8	971.6	973.4	975.2	977.0	978.8	980.6	982.4	984.2
530	986.0	987.8	989.6	991.4	993.2	995.0	996.8	998.6	1000.4	1002.2
540	1004.0	1005.8	1007.6	1009.4	1011.2	1013.0	1014.8	1016.6	1018.4	1020.2
550	1022.0	1023.8	1025.6	1027.4	1029.2	1031.0	1032.8	1034.6	1036.4	1038.2
560	1040.0	1041.8	1043.6	1045.4	1047.2	1049.0	1050.8	1052.6	1054.4	1056.2
570	1058.0	1059.8	1061.6	1063.4	1065.2	1067.0	1068.8	1070.6	1072.4	1074.2
580	1076.0	1077.8	1079.6	1081.4	1083.2	1085.0	1086.8	1088.6	1090.4	1092.2
590	1094.0	1095.8	1097.6	1099.4	1101.2	1103.0	1104.8	1106.6	1108.4	1110.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
600	1112.0	1113.8	1115.6	1117.4	1119.2	1121.0	1122.8	1124.6	1126.4	1128.2
610	1130.0	1131.8	1133.6	1135.4	1137.2	1139.0	1140.8	1142.6	1144.4	1146.2
620	1148.0	1149.8	1151.6	1153.4	1155.2	1157.0	1158.8	1160.6	1162.4	1164.2
630	1166.0	1167.8	1169.6	1171.4	1173.2	1175.0	1176.8	1178.6	1180.4	1182.2
640	1184.0	1185.8	1187.6	1189.4	1191.2	1193.0	1194.8	1196.6	1198.4	1200.2
650	1202.0	1203.8	1205.6	1207.4	1209.2	1211.0	1212.8	1214.6	1216.4	1218.2
660	1220.0	1221.8	1223.6	1225.4	1227.2	1229.0	1230.8	1232.6	1234.4	1236.2
670	1238.0	1239.8	1241.6	1243.4	1245.2	1247.0	1248.8	1250.6	1252.4	1254.2
680	1256.0	1257.8	1259.6	1261.4	1263.2	1265.0	1266.8	1268.6	1270.4	1272.2
690	1274.0	1275.8	1277.6	1279.4	1281.2	1283.0	1284.8	1286.6	1288.4	1290.2
700	1292.0	1293.8	1295.6	1297.4	1299.2	1301.0	1302.8	1304.6	1306.4	1308.2
710	1310.0	1311.8	1313.6	1315.4	1317.2	1319.0	1320.8	1322.6	1324.4	1326.2
720	1328.0	1329.8	1331.6	1333.4	1335.2	1337.0	1338.8	1340.6	1342.4	1344.2
730	1346.0	1347.8	1349.6	1351.4	1353.2	1355.0	1356.8	1358.6	1360.4	1362.2
740	1364.0	1365.8	1367.6	1369.4	1371.2	1373.0	1374.8	1376.6	1378.4	1380.2
750	1382.0	1383.8	1385.6	1387.4	1389.2	1391.0	1392.8	1394.6	1396.4	1398.2
760	1400.0	1401.8	1403.6	1405.4	1407.2	1409.0	1410.8	1412.6	1414.4	1416.2
770	1418.0	1419.8	1421.6	1423.4	1425.2	1427.0	1428.8	1430.6	1432.4	1434.2
780	1436.0	1437.8	1439.6	1441.4	1443.2	1445.0	1446.8	1448.6	1450.4	1452.2
790	1454.0	1455.8	1457.6	1459.4	1461.2	1463.0	1464.8	1466.6	1468.4	1470.2

For interpolation											
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
800	1472.0	1473.8	1475.6	1477.4	1479.2	1481.0	1482.8	1484.6	1486.4	1488.2
810	1490.0	1491.8	1493.6	149 .4	1497.2	1499.0	1500.8	1502.6	1504.4	1506.2
820	1508.0	1509.8	1511.6	1513.4	1515.2	1517.0	1518.8	1520.6	1522.4	1524.2
830	1526.0	1527.8	1529.6	1531.4	1533.2	1535.0	1536.8	1538.6	1540.4	1542.2
840	1544.0	1545.8	1547.6	1549.4	1551.2	1553.0	1554.8	1556.6	1558.4	1560.2
850	1562.0	1563.8	1565.6	1567.4	1569.2	1571.0	1572.8	1574.6	1576.4	1578.2
860	1580.0	1581.8	1583.6	1585.4	1587.2	1589.0	1590.8	1592.6	1594.4	1596.2
870	1598.0	1599.8	1601.6	1603.4	1605.2	1607.0	1608.8	1610.6	1612.4	1614.2
880	1616.0	1617.8	1619.6	1621.4	1623.2	1625.0	1626.8	1628.6	1630.4	1632.2
890	1634.0	1635.8	1637.6	1639.4	1641.2	1643.0	1644.8	1646.6	1648.4	1650.2
900	1652.0	1653.8	1655.6	1657.4	1659.2	1661.0	1662.8	1664.6	1666.4	1668.2
910	1670.0	1671.8	1673.6	1675.4	1677.2	1679.0	1680.8	1682.6	1684.4	1686.2
920	1688.0	1689.8	1691.6	1693.4	1695.2	1697.0	1698.8	1700.6	1702.4	1704.2
930	1706.0	1707.8	1709.6	1711.4	1713.2	1715.0	1716.8	1718.6	1720.4	1722.2
940	1724.0	1725.8	1727.6	1729.4	1731.2	1733.0	1734.8	1736.6	1738.4	1740.2
950	1742.0	1743.8	1745.6	1747.4	1749.2	1751.0	1752.8	1754.6	1756.4	1758.2
960	1760.0	1761.8	1763.6	1765.4	1767.2	1769.0	1770.8	1772.6	1774.4	1776.2
970	1778.0	1779.8	1781.6	1783.4	1785.2	1787.0	1788.8	1790.6	1792.4	1794.2
980	1796.0	1797.8	1799.6	1801.4	1803.2	1805.0	1806.8	1808.6	1810.4	1812.2
990	1814.0	1815.8	1817.6	1819.4	1821.2	1823.0	1824.8	1826.6	1828.4	1830.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1000	1832.0	1833.8	1835.6	1837.4	1839.2	1841.0	1842.8	1844.6	1846.4	1848.2
1010	1850.0	1851.8	1853.6	1855.4	1857.2	1859.0	1860.8	1862.6	1864.4	1866.2
1020	1868.0	1869.8	1871.6	1873.4	1875.2	1877.0	1878.8	1880.6	1882.4	1884.2
1030	1886.0	1887.8	1889.6	1891.4	1893.2	1895.0	1896.8	1898.6	1900.4	1902.2
1040	1904.0	1905.8	1907.6	1909.4	1911.2	1913.0	1914.8	1916.6	1918.4	1920.2
1050	1922.0	1923.8	1925.6	1927.4	1929.2	1931.0	1932.8	1934.6	1936.4	1938.2
1060	1940.0	1941.8	1943.6	1945.4	1947.2	1949.0	1950.8	1952.6	1954.4	1956.2
1070	1958.0	1959.8	1961.6	1963.4	1965.2	1967.0	1968.8	1970.6	1972.4	1974.2
1080	1976.0	1977.8	1979.6	1981.4	1983.2	1985.0	1986.8	1988.6	1990.4	1992.2
1090	1994.0	1995.8	1997.6	1999.4	2001.2	2003.0	2004.8	2006.6	2008.4	2010.2
1100	2012.0	2013.8	2015.6	2017.4	2019.2	2021.0	2022.8	2024.6	2026.4	2028.2
1110	2030.0	2031.8	2033.6	2035.4	2037.2	2039.0	2040.8	2042.6	2044.4	2046.2
1120	2048.0	2049.8	2051.6	2053.4	2055.2	2057.0	2058.8	2060.6	2062.4	2064.2
1130	2066.0	2067.8	2069.6	2071.4	2073.2	2075.0	2076.8	2078.6	2080.4	2082.2
1140	2084.0	2085.8	2087.6	2089.4	2091.2	2093.0	2094.8	2096.6	2098.4	2100.2
1150	2102.0	2103.8	2105.6	2107.4	2109.2	2111.0	2112.8	2114.6	2116.4	2118.2
1160	2120.0	2121.8	2123.6	2125.4	2127.2	2129.0	2130.8	2132.6	2134.4	2136.2
1170	2138.0	2139.8	2141.6	2143.4	2145.2	2147.0	2148.8	2150.6	2152.4	2154.2
1180	2156.0	2157.8	2159.6	2161.4	2163.2	2165.0	2166.8	2168.6	2170.4	2172.2
1190	2174.0	2175.8	2177.6	2179.4	2181.2	2183.0	2184.8	2186.6	2188.4	2190.2

For interpolation											
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C	0	1	2	3	4	5	6	7	8	9
1200	2192.0	2193.8	2195.6	2197.4	2199.2	2201.0	2202.8	2204.6	2206.4	2208.2
1210	2210.0	2211.8	2213.6	2215.4	2217.2	2219.0	2220.8	2222.6	2224.4	2226.2
1220	2228.0	2229.8	2231.6	2233.4	2235.2	2237.0	2238.8	2240.6	2242.4	2244.2
1230	2246.0	2247.8	2249.6	2251.4	2253.2	2255.0	2256.8	2258.6	2260.4	2262.2
1240	2264.0	2265.8	2267.6	2269.4	2271.2	2273.0	2274.8	2276.6	2278.4	2280.2
1250	2282.0	2283.8	2285.6	2287.4	2289.2	2291.0	2292.8	2294.6	2296.4	2298.2
1260	2300.0	2301.8	2303.6	2305.4	2307.2	2309.0	2310.8	2312.6	2314.4	2316.2
1270	2318.0	2319.8	2321.6	2323.4	2325.2	2327.0	2328.8	2330.6	2332.4	2334.2
1280	2336.0	2337.8	2339.6	2341.4	2343.2	2345.0	2346.8	2348.6	2350.4	2352.2
1290	2354.0	2355.8	2357.6	2359.4	2361.2	2363.0	2364.8	2366.6	2368.4	2370.2
1300	2372.0	2373.8	2375.6	2377.4	2379.2	2381.0	2382.8	2384.6	2386.4	2388.2
1310	2390.0	2391.8	2393.6	2395.4	2397.2	2399.0	2400.8	2402.6	2404.4	2406.2
1320	2408.0	2409.8	2411.6	2413.4	2415.2	2417.0	2418.8	2420.6	2422.4	2424.2
1330	2426.0	2427.8	2429.6	2431.4	2433.2	2435.0	2436.8	2438.6	2440.4	2442.2
1340	2444.0	2445.8	2447.6	2449.4	2451.2	2453.0	2454.8	2456.6	2458.4	2460.2
1350	2462.0	2463.8	2465.6	2467.4	2469.2	2471.0	2472.8	2474.6	2476.4	2478.2
1360	2480.0	2481.8	2483.6	2485.4	2487.2	2489.0	2490.8	2492.6	2494.4	2496.2
1370	2498.0	2499.8	2501.6	2503.4	2505.2	2507.0	2508.8	2510.6	2512.4	2514.2
1380	2516.0	2517.8	2519.6	2521.4	2523.2	2525.0	2526.8	2528.6	2530.4	2532.2
1390	2534.0	2535.8	2537.6	2539.4	2541.2	2543.0	2544.8	2546.6	2548.4	2550.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1400	2552.0	2553.8	2555.6	2557.4	2559.2	2561.0	2562.8	2564.6	2566.4	2568.2
1410	2570.0	2571.8	2573.6	2575.4	2577.2	2579.0	2580.8	2582.6	2584.4	2586.2
1420	2588.0	2589.8	2591.6	2593.4	2595.2	2597.0	2598.8	2600.6	2602.4	2604.2
1430	2606.0	2607.8	2609.6	2611.4	2613.2	2615.0	2616.8	2618.6	2620.4	2622.2
1440	2624.0	2625.8	2627.6	2629.4	2631.2	2633.0	2634.8	2636.6	2638.4	2640.2
1450	2642.0	2643.8	2645.6	2647.4	2649.2	2651.0	2652.8	2654.6	2656.4	2658.2
1460	2660.0	2661.8	2663.6	2665.4	2667.2	2669.0	2670.8	2672.6	2674.4	2676.2
1470	2678.0	2679.8	2681.6	2683.4	2685.2	2687.0	2688.8	2690.6	2692.4	2694.2
1480	2696.0	2697.8	2699.6	2701.4	2703.2	2705.0	2706.8	2708.6	2710.4	2712.2
1490	2714.0	2715.8	2717.6	2719.4	2721.2	2723.0	2724.8	2726.6	2728.4	2730.2
1500	2732.0	2733.8	2735.6	2737.4	2739.2	2741.0	2742.8	2744.6	2746.4	2748.2
1510	2750.0	2751.8	2753.6	2755.4	2757.2	2759.0	2760.8	2762.6	2764.4	2766.2
1520	2768.0	2769.8	2771.6	2773.4	2775.2	2777.0	2778.8	2780.6	2782.4	2784.2
1530	2786.0	2787.8	2789.6	2791.4	2793.2	2795.0	2796.8	2798.6	2800.4	2802.2
1540	2804.0	2805.8	2807.6	2809.4	2811.2	2813.0	2814.8	2816.6	2818.4	2820.2
1550	2822.0	2823.8	2825.6	2827.4	2829.2	2831.0	2832.8	2834.6	2836.4	2838.2
1560	2840.0	2841.8	2843.6	2845.4	2847.2	2849.0	2850.8	2852.6	2854.4	2856.2
1570	2858.0	2859.8	2861.6	2863.4	2865.2	2867.0	2868.8	2870.6	2872.4	2874.2
1580	2876.0	2877.8	2879.6	2881.4	2883.2	2885.0	2886.8	2888.6	2890.4	2892.2
1590	2894.0	2895.8	2897.6	2899.4	2901.2	2903.0	2904.8	2906.6	2908.4	2910.2

For interpolation											
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1600	2912.0	2913.8	2915.6	2917.4	2919.2	2921.0	2922.8	2924.6	2926.4	2928.2
1610	2930.0	2931.8	2933.6	2935.4	2937.2	2939.0	2940.8	2942.6	2944.4	2946.2
1620	2948.0	2949.8	2951.6	2953.4	2955.2	2957.0	2958.8	2960.6	2962.4	2964.2
1630	2966.0	2967.8	2969.6	2971.4	2973.2	2975.0	2976.8	2978.6	2980.4	2982.2
1640	2984.0	2985.8	2987.6	2989.4	2991.2	2993.0	2994.8	2996.6	2998.4	3000.2
1650	3002.0	3003.8	3005.6	3007.4	3009.2	3011.0	3012.8	3014.6	3016.4	3018.2
1660	3020.0	3021.8	3023.6	3025.4	3027.2	3029.0	3030.8	3032.6	3034.4	3036.2
1670	3038.0	3039.8	3041.6	3043.4	3045.2	3047.0	3048.8	3050.6	3052.4	3054.2
1680	3056.0	3057.8	3059.6	3061.4	3063.2	3065.0	3066.8	3068.6	3070.4	3072.2
1690	3074.0	3075.8	3077.6	3079.4	3081.2	3083.0	3084.8	3086.6	3088.4	3090.2
1700	3092.0	3093.8	3095.6	3097.4	3099.2	3101.0	3102.8	3104.6	3106.4	3108.2
1710	3110.0	3111.8	3113.6	3115.4	3117.2	3119.0	3120.8	3122.6	3124.4	3126.2
1720	3128.0	3129.8	3131.6	3133.4	3135.2	3137.0	3138.8	3140.6	3142.4	3144.2
1730	3146.0	3147.8	3149.6	3151.4	3153.2	3155.0	3156.8	3158.6	3160.4	3162.2
1740	3164.0	3165.8	3167.6	3169.4	3171.2	3173.0	3174.8	3176.6	3178.4	3180.2
1750	3182.0	3183.8	3185.6	3187.4	3189.2	3191.0	3192.8	3194.6	3196.4	3198.2
1760	3200.0	3201.8	3203.6	3205.4	3207.2	3209.0	3210.8	3212.6	3214.4	3216.2
1770	3218.0	3219.8	3221.6	3223.4	3225.2	3227.0	3228.8	3230.6	3232.4	3234.2
1780	3236.0	3237.8	3239.6	3241.4	3243.2	3245.0	3246.8	3248.6	3250.4	3252.2
1790	3254.0	3255.8	3257.6	3259.4	3261.2	3263.0	3264.8	3266.6	3268.4	3270.2

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1800	3272.0	3273.8	3275.6	3277.4	3279.2	3281.0	3282.8	3284.6	3286.4	3288.2
1810	3290.0	3291.8	3293.6	3295.4	3297.2	3299.0	3300.8	3302.6	3304.4	3306.2
1820	3308.0	3309.8	3311.6	3313.4	3315.2	3317.0	3318.8	3320.6	3322.4	3324.2
1830	3326.0	3327.8	3329.6	3331.4	3333.2	3335.0	3336.8	3338.6	3340.4	3342.2
1840	3344.0	3345.8	3347.6	3349.4	3351.2	3353.0	3354.8	3356.6	3358.4	3360.2
1850	3362.0	3363.8	3365.6	3367.4	3369.2	3371.0	3372.8	3374.6	3376.4	3378.2
1860	3380.0	3381.8	3383.6	3385.4	3387.2	3389.0	3390.8	3392.6	3394.4	3396.2
1870	3398.0	3399.8	3401.6	3403.4	3405.2	3407.0	3408.8	3410.6	3412.4	3414.2
1880	3416.0	3417.8	3419.6	3421.4	3423.2	3425.0	3426.8	3428.6	3430.4	3432.2
1890	3434.0	3435.8	3437.6	3439.4	3441.2	3443.0	3444.8	3446.6	3448.4	3450.2
1900	3452.0	3453.8	3455.6	3457.4	3459.2	3461.0	3462.8	3464.6	3466.4	3468.2
1910	3470.0	3471.8	3473.6	3475.4	3477.2	3479.0	3480.8	3482.6	3484.4	3486.2
1920	3488.0	3489.8	3491.6	3493.4	3495.2	3497.0	3498.8	3500.6	3502.4	3504.2
1930	3506.0	3507.8	3509.6	3511.4	3513.2	3515.0	3516.8	3518.6	3520.4	3522.2
1940	3424.0	3525.8	3527.6	3529.4	3531.2	3533.0	3534.8	3536.6	3538.4	3540.2
1950	3542.0	3543.8	3545.6	3547.4	3549.2	3551.0	3552.8	3554.6	3556.4	3558.2
1900	3560.0	3561.8	3563.6	3565.4	3567.2	3569.0	3570.8	3572.6	3574.4	3576.2
1970	3578.0	3579.8	3581.6	3583.4	3585.2	3587.0	3588.8	3590.6	3592.4	3594.2
1980	3596.0	3597.8	3599.6	3601.4	3603.2	3605.0	3606.8	3608.6	3610.4	3612.2
1990	3614.0	3615.8	3617.6	3619.4	3621.2	3623.0	3624.8	3626.6	3628.4	3630.2

For interpolation										
	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2000	3632.0	3633.8	3635.6	3637.4	3639.2	3641.0	3642.8	3644.6	3646.4	3648.2
2010	3650.0	3651.8	3653.6	3655.4	3657.2	3659.0	3660.8	3662.6	3664.4	3666.2
2020	3668.0	3669.8	3671.6	3673.4	3675.2	3677.0	3678.8	3680.6	3682.4	3684.2
2030	3686.0	3687.8	3689.6	3691.4	3693.2	3695.0	3696.8	3698.6	3700.4	3702.2
2040	3704.0	3705.8	3707.6	3709.4	3711.2	3713.0	3714.8	3716.6	3718.4	3720.2
2050	3722.0	3723.8	3725.6	3727.4	3729.2	3731.0	3732.8	3734.6	3736.4	3738.2
2060	3740.0	3741.8	3743.6	3745.4	3747.2	3749.0	3750.8	3752.6	3754.4	3756.2
2070	3758.0	3759.8	3761.6	3763.4	3765.2	3767.0	3768.8	3770.6	3772.4	3774.2
2080	3776.0	3777.8	3779.6	3781.4	3783.2	3785.0	3786.8	3788.6	3790.4	3792.2
2090	3794.0	3795.8	3797.6	3799.4	3801.2	3803.0	3804.8	3806.6	3808.4	3810.2
2100	3812.0	3813.8	3815.6	3817.4	3819.2	3821.0	3822.8	3824.6	3826.4	3828.2
2110	3830.0	3831.8	3833.6	3835.4	3837.2	3839.0	3840.8	3842.6	3844.4	3846.2
2120	3848.0	3849.8	3851.6	3853.4	3855.2	3857.0	3858.8	3860.6	3862.4	3864.2
2130	3866.0	3867.8	3869.6	3871.4	3873.2	3875.0	3876.8	3878.6	3880.4	3882.2
2140	3884.0	3885.8	3887.6	3889.4	3891.2	3893.0	3894.8	3896.6	3898.4	3900.2
2150	3902.0	3903.8	3905.6	3907.4	3909.2	3911.0	3912.8	3914.6	3916.4	3918.2
2160	3920.0	3921.8	3923.6	3925.4	3927.2	3929.0	3930.8	3932.6	3934.4	3936.2
2170	3938.0	3939.8	3941.6	3943.4	3945.2	3947.0	3948.8	3950.6	3952.4	3954.2
2180	3956.0	3957.8	3959.6	3961.4	3963.2	3965.0	3966.8	3968.6	3970.4	3972.2
2190	3974.0	3975.8	3977.6	3979.4	3981.2	3983.0	3984.8	3986.6	3988.4	3990.2

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2200	3992.0	3993.8	3995.6	3997.4	3999.2	4001.0	4002.8	4004.6	4006.4	4008.2
2210	4010.0	4011.8	4013.6	4015.4	4017.2	4019.0	4020.8	4022.6	4024.4	4026.2
2220	4028.0	4029.8	4031.6	4033.4	4035.2	4037.0	4038.8	4040.6	4042.4	4044.2
2230	4046.0	4047.8	4049.6	4051.4	4053.2	4055.0	4056.8	4058.6	4060.4	4062.2
2240	4064.0	4065.8	4067.6	4069.4	4071.2	4073.0	4074.8	4076.6	4078.4	4080.2
2250	4082.0	4083.8	4085.6	4087.4	4089.2	4091.0	4092.8	4094.6	4096.4	4098.2
2260	4100.0	4101.8	4103.6	4105.4	4107.2	4109.0	4110.8	4112.6	4114.4	4116.2
2270	4118.0	4119.8	4121.6	4123.4	4125.2	4127.0	4128.8	4130.6	4132.4	4134.2
2280	4136.0	4137.8	4139.6	4141.4	4143.2	4145.0	4146.8	4148.6	4150.4	4152.2
2290	4154.0	4155.8	4157.6	4159.4	4161.2	4163.0	4164.8	4166.6	4168.4	4170.2
2300	4172.0	4173.8	4175.6	4177.4	4179.2	4181.0	4182.8	4184.6	4186.4	4188.2
2310	4190.0	4191.8	4193.6	4195.4	4197.2	4199.0	4200.8	4202.6	4204.4	4206.2
2320	4208.0	4209.8	4211.6	4213.4	4215.2	4217.0	4218.8	4220.6	4222.4	4224.2
2330	4226.0	4227.8	4229.6	4231.4	4233.2	4235.0	4236.8	4238.6	4240.4	4242.2
2340	4244.0	4245.8	4247.6	4249.4	4251.2	4253.0	4254.8	4256.6	4258.4	4260.2
2350	4262.0	4263.8	4265.6	4267.4	4269.2	4271.0	4272.8	4274.6	4276.4	4278.2
2360	4280.0	4281.8	4383.6	4285.4	4287.2	4289.0	4290.8	4292.6	4294.4	4296.2
2370	4298.0	4299.8	4301.6	4303.4	4305.2	4307.0	4308.8	4310.6	4312.4	4314.2
2380	4316.0	4317.8	4319.6	4321.4	4323.2	4325.0	4326.8	4328.6	4330.4	4332.2
2390	4334.0	4335.8	4337.6	4339.4	4341.2	4343.0	4344.8	4346.6	4348.4	4350.2

For	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
interpolation	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2400	4352.0	4353.8	4355.6	4357.4	4359.2	4361.0	4362.8	4364.6	4366.4	4368.2
2410	4370.0	4371.8	4373.6	4375.4	4377.2	4379.0	4380.8	4382.6	4384.4	4386.2
2420	4388.0	4389.8	4391.6	4393.4	4395.2	4397.0	4398.8	4400.6	4402.4	4404.2
2430	4406.0	4407.8	4409.6	4411.4	4413.2	4415.0	4416.8	4418.6	4420.4	4422.2
2440	4424.0	4425.8	4427.6	4429.4	4431.2	1433.0	4434.8	4436.6	4438.4	4440.2
2450	4442.0	4443.8	4445.6	4447.4	4449.2	4451.0	4452.8	4454.6	4456.4	4458.2
2460	4460.0	4461.8	4463.6	4465.4	4467.2	4469.0	4470.8	4472.6	4474.4	4476.2
2470	4478.0	4479.8	4481.6	4483.4	4485.2	4487.0	4488.8	4490.6	4492.4	4494.2
2480	4496.0	4497.8	4499.6	4501.4	4503.2	4505.0	4506.8	4508.6	4510.4	4512.2
2490	4514.0	4515.8	4517.6	4519.4	4521.2	4523.0	4524.8	4526.6	4528.4	4530.2
2500	4532.0	4533.8	4535.6	4537.4	4539.2	4541.0	4542.8	4544.6	4546.4	4548.2
2510	4550.0	4551.8	4553.6	4555.4	4557.2	4559.0	4560.8	4562.6	4564.4	4566.2
2520	4568.0	4569.8	4571.6	4573.4	4575.2	4577.0	4578.8	4580.6	4582.4	4584.2
2530	4586.0	4587.8	4589.6	4591.4	4593.2	4595.0	4596.8	4598.6	4600.4	4602.2
2540	4604.0	4605.8	4607.6	4609.4	4611.2	4613.0	4614.8	4616.6	4618.4	4620.2
2550	4622.0	4623.8	4625.6	4627.4	4629.2	4631.0	4632.8	4634.6	4636.4	4638.2
2560	4640.0	4641.8	4643.6	4645.4	4647.2	4649.0	4650.8	4652.6	4654.4	4656.2
2570	4658.0	4659.8	4661.6	4663.4	4665.2	4667.0	4068.8	4670.6	4672.4	4674.2
2580	4676.0	4677.8	4679.6	4681.4	4683.2	4685.0	4686.8	4688.6	4690.4	4692.2
2590	4694.0	4695.8	4697.6	4699.4	4701.2	4703.0	4704.8	4706.6	4708.4	4710.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2600	4712.0	4713.8	4715.6	4717.4	4719.2	4721.0	4722.8	4724.6	4726.4	4728.2
2610	4730.0	4731.8	4733.6	4735.4	4737.2	4739.0	4740.8	4742.6	4744.4	4746.2
2620	4748.0	4749.8	4751.6	4753.4	4755.2	4757.0	4758.8	4760.6	4762.4	4764.2
2630	4766.0	4767.8	4769.6	4771.4	4773.2	4775.0	4776.8	4778.6	4780.4	4782.2
2640	4784.0	4785.8	4787.6	4789.4	4791.2	4793.0	4794.8	4796.6	4798.4	4800.2
2650	4802.0	4803.8	4805.6	4807.4	4809.2	4811.0	4812.8	4814.6	4816.4	4818.2
2660	4820.0	4821.8	4823.6	4825.4	4827.2	4829.0	4830.8	4832.6	4834.4	4836.2
2670	4838.0	4839.8	4841.6	4843.4	4845.2	4847.0	4848.8	4850.6	4852.4	4854.2
2680	4856.0	4857.8	4859.6	4861.4	4863.2	4865.0	4866.8	4868.6	4870.4	4872.2
2690	4874.0	4875.8	4877.6	4879.4	4881.2	4883.0	4884.8	4886.6	4888.4	4890.2
2700	4892.0	4893.8	4895.6	4897.4	4899.2	4901.0	4902.8	4904.6	4906.4	4908.2
2710	4910.0	4911.8	4913.6	4915.4	4917.2	4919.0	4920.8	4922.6	4924.4	4926.2
2720	4928.0	4929.8	4931.6	4933.4	4935.2	4937.0	4938.8	4940.6	4942.4	4944.2
2730	4946.0	4947.8	4949.6	4951.4	4953.2	4955.0	4956.8	4958.6	4960.4	4962.2
2740	4964.0	4965.8	4967.6	4969.4	4971.2	4973.0	4974.8	4976.6	4978.4	4980.2
2750	4982.0	4983.8	4985.6	4987.4	4989.2	4991.0	4992.8	4994.6	4996.4	4998.2
2760	5000.0	5001.8	5003.6	5005.4	5007.2	5009.0	5010.8	5012.6	5014.4	5016.2
2770	5018.0	5019.8	5021.6	5023.4	5025.2	5027.0	5028.8	5030.6	5032.4	5034.2
2780	5036.0	5037.8	5039.6	5041.4	5043.2	5045.0	5046.8	5048.6	5050.4	5052.2
2790	5054.0	5055.8	5057.6	5059.4	5061.2	5063.0	5064.8	5066.6	5068.4	5070.2

For interpolation	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2800	5072.0	5073.8	5075.6	5077.4	5079.2	5081.0	5082.8	5084.6	5086.4	5088.2
2810	5090.0	5091.8	5093.6	5095.4	5097.2	5099.0	5100.8	5102.6	5104.4	5106.2
2820	5108.0	5109.8	5111.6	5113.4	5115.2	5117.0	5118.8	5120.6	5122.4	5124.2
2830	5126.0	5127.8	5129.6	5131.4	5133.2	5135.0	5136.8	5138.6	5140.4	5142.2
2840	5144.0	5145.8	5147.6	5149.4	5151.2	5153.0	5154.8	5156.6	5158.4	5160.2
2850	5162.0	5163.8	5165.6	5167.4	5169.2	5171.0	5172.8	5174.6	5176.4	5178.2
2860	5180.0	5181.8	5183.6	5185.4	5187.2	5189.0	5190.8	5192.6	5194.4	5196.2
2870	5198.0	5199.8	5201.6	5203.4	5205.2	5207.0	5208.8	5210.6	5212.4	5214.2
2880	5216.0	5217.8	5219.6	5221.4	5223.2	5225.0	5226.8	5228.6	5230.4	5232.2
2890	5234.0	5235.8	5237.6	5239.4	5241.2	5243.0	5244.8	5246.6	5248.4	5250.2
2900	5252.0	5253.8	5255.6	5257.4	5259.2	5261.0	5262.8	5264.6	5266.4	5268.2
2910	5270.0	5271.8	5273.6	5275.4	5277.2	5279.0	5280.8	5282.6	5284.4	5286.2
2920	5288.0	5289.8	5291.6	5293.4	5295.2	5297.0	5298.8	5300.6	5302.4	5304.2
2930	5306.0	5307.8	5309.6	5311.4	5313.2	5315.0	5316.8	5318.6	5320.4	5322.2
2940	5324.0	5325.8	5327.6	5329.4	5331.2	5333.0	5334.8	5336.6	5338.4	5340.2
2950	5342.0	5343.8	5345.6	5347.4	5349.2	5351.0	5352.8	5354.6	5356.4	5358.2
2960	5360.0	5361.8	5363.6	5365.4	5367.2	5369.0	5370.8	5372.6	5374.4	5376.2
2970	5378.0	5379.8	5381.6	5383.4	5385.2	5387.0	5388.8	5390.6	5392.4	5394.2
2980	5396.0	5397.8	5399.6	5401.4	5403.2	5405.0	5406.8	5408.6	5410.4	5412.2
2990	5414.0	5415.8	5417.6	5419.4	5421.2	5423.0	5424.8	5426.6	5428.4	5430.2

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Concluded)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
3000	5432.0	5433.8	5435.6	5437.4	5439.2	5441.0	5442.8	5444.6	5446.4	5448.2
3010	5450.0	5451.8	5453.6	5455.4	5457.2	5459.0	5460.8	5462.6	5464.4	5466.2
3020	5468.0	5469.8	5471.6	5473.4	5475.2	5477.0	5478.8	5480.6	5482.4	5484.2
3030	5486.0	5487.8	5489.6	5491.4	5493.2	5495.0	5496.8	5498.6	5500.4	5502.2
3040	5504.0	5505.8	5507.6	5509.4	5511.2	5513.0	5514.8	5516.6	5518.4	5520.2
3050	5522.0	5523.8	5525.6	5527.4	5529.2	5531.0	5532.8	5534.6	5536.4	5538.2
3060	5540.0	5541.8	5543.6	5545.4	5547.2	5549.0	5550.8	5552.6	5554.4	5556.2
3070	5558.0	5559.8	5561.6	5563.4	5565.2	5567.0	5568.8	5570.6	5572.4	5574.2
3080	5576.0	5577.8	5579.6	5581.4	5583.2	5585.0	5586.8	5588.6	5590.4	5592.2
3090	5594.0	5595.8	5597.6	5599.4	5601.2	5603.0	5604.8	5606.6	5608.4	5610.2

For interpolation	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — FAHRENHEIT TO CENTIGRADE

Conversion Table

The values in the body of the table give in degrees Centigrade the temperatures indicated in degrees Fahrenheit at the top and side.

1° F. = 0.5556° C.

Temperatures below 0° F.

Temp. ° F.	0	1	2	3	4	5	6	7	8	9
0	– 17.78	18.33	18.89	19.44	20.00	20.56	21.11	21.67	22.22	22.78
– 10	– 23.33	23.89	24.44	25.00	25.56	26.11	26.67	27.22	27.78	28.33
– 20	– 28.89	29.44	30.00	30.56	31.11	31.67	32.22	32.78	33.33	33.89
– 30	– 34.44	35.00	35.56	36.11	36.67	37.22	37.78	38.33	38.89	39.44
– 40	– 40.00	40.56	41.11	41.67	42.22	42.78	43.33	43.89	44.44	45.00
– 50	– 45.56	46.11	46.67	47.22	47.78	48.33	48.89	49.44	50.00	50.56
– 60	– 51.11	51.67	52.22	52.78	53.33	53.89	54.44	55.00	55.56	56.11
– 70	– 56.67	57.22	57.78	58.33	58.89	59.44	60.00	60.56	61.11	61.67
– 80	– 62.22	62.78	63.33	63.89	64.44	65.00	65.56	66.11	66.67	67.22
– 90	– 67.78	68.33	68.89	69.44	70.00	70.56	71.11	71.67	72.22	72.78

TEMPERATURES—FAHRENHEIT TO CENTIGRADE (Continued)

Temp. ° F.	0	1	2	3	4	5	6	7	8	9
−100	−73.33	73.89	74.44	75.00	75.56	76.11	76.67	77.22	77.78	78.33
−110	−78.89	79.44	80.00	80.56	81.11	81.67	82.22	82.78	83.33	83.89
−120	−84.44	85.00	85.56	86.11	86.67	87.22	87.78	88.33	88.89	89.44
−130	−90.00	90.56	91.11	91.67	92.22	92.78	93.33	93.89	94.44	95.00
−140	−95.56	96.11	96.67	97.22	97.78	98.33	98.89	99.44	100.00	100.56
−150	−101.11	101.67	102.22	102.78	103.33	103.89	104.44	105.00	105.56	106.11
−160	−106.67	107.22	107.78	108.33	108.89	109.44	110.00	110.56	111.11	111.67
−170	−112.22	112.78	113.33	113.89	114.44	115.00	115.56	116.11	116.67	117.22
−180	−117.78	118.33	118.89	119.44	120.00	120.56	121.11	121.67	122.22	122.76
−190	−123 33	123.89	124.44	125.00	125.56	126.11	126.67	127.22	127.78	128.33
−200	−128.89	129.44	130.00	130.56	131.11	131.67	132.22	132.78	133.33	133.89
−210	−134.44	135.00	135.56	136.11	136.67	137.22	137.78	138.33	138.89	139.44
−220	−140.00	140.56	141.11	141.67	142.22	142.78	143.33	143.89	144.44	145.00
−230	−145.56	146.11	146.67	147.22	147.78	148.33	148.89	149.44	150.00	150.56
−240	−151.11	151.67	152.22	152.78	153.33	153.89	154.44	155.00	155.56	156.11
−250	−156.67	157.22	157.78	158.33	158.89	159.44	160.00	160.56	161.11	161.67
−260	−162.22	163.78	163.33	163.89	164.44	165.00	165.56	166.11	166.67	167.22
−270	−167.78	168.33	168.89	169.44	170.00	170.56	171.11	171.67	172.22	172.78
−280	−173.33	173.89	174.44	175.00	175.56	176.11	176.67	177.22	177.78	178.33
−290	−178.89	179.44	180.00	180.56	181.11	181.67	182.22	182.78	183.33	183.89

For interpolation										
	°F	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°C	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56

TEMPERATURES — FAHRENHEIT TO CENTIGRADE (Continued)

Conversion Tables

Temperature below 0° F.

Temp. ° F.	0	1	2	3	4	5	6	7	8	9
– 300	– 184.44	185.00	185.56	186.11	186.67	187.22	187.78	188.33	188.89	189.44
– 310	– 190.00	190.56	191.11	191.67	192.22	192.78	193.33	193.89	194.44	195.00
– 320	– 195.56	196.11	196.67	197.22	197.78	198.33	198.89	199.44	200.00	200.56
– 330	– 201.11	201.67	202.22	202.78	203.33	203.89	204.44	205.00	205.56	206.11
– 340	– 206.67	207.22	207.78	208.33	208.89	209.44	210.00	210.56	211.11	211.67
– 350	– 212.22	212.78	213.33	213.89	214.44	215.00	215.56	216.11	216.67	217.22
– 360	– 217.78	218.33	218.89	219.44	220.00	220.56	221.11	221.67	222.22	222.78
– 370	– 223.33	223.89	224.44	225.00	225.56	226.11	226.67	227.22	227.78	228.33
– 380	– 228.89	229.44	230.00	230.56	231.11	231.67	232.22	232.78	233.33	233.89
– 390	– 234.44	235.00	235.56	236.11	236.67	237.22	237.78	238.33	238.89	239.44
– 400	– 240.00	240.56	241.11	241.67	242.22	242.78	243.33	243.89	244.44	245.00
– 410	– 245.56	246.11	246.67	247.22	247.78	248.33	248.89	249.44	250.00	250.56
– 420	– 251.11	251.67	252.22	252.78	253.33	253.89	254.44	255.00	255.56	256.11
– 430	– 256.67	257.22	257.78	258.33	258.89	259.44	260.00	260.56	261.11	261.67
– 440	– 262.22	262.78	263.33	263.89	264.44	265.00	265.56	266.11	266.67	267.22
– 450	– 267.78	268.33	268.89	269.44	270.00	270.56	271.11	271.67	272.22	272.78

– 459.4° F. = – 273° C. = absolute zero.

TEMPERATURES—FAHRENHEIT TO CENTIGRADE (Continued)

Temperatures above 0° F.

Temp. °F	0	1	2	3	4	5	6	7	8	9
0	−17.78	17.22	16.67	16.11	15.56	15.00	14.44	13.89	13.33	12.78
+10	−12.22	11.67	11.11	10.56	10.00	9.44	8.89	8.33	7.78	7.22
20	−6.67	6.11	5.56	5.00	4.44	3.89	3.33	2.78	2.22	1.67
30	−1.11	−0.56	0.00	+0.56	+1.11	+1.67	+2.22	+2.78	+3.33	+3.89
40	+4.44	5.00	5.56	6.11	6.67	7.22	7.78	8.33	8.89	9.44
50	10.00	10.56	11.11	11.67	12.22	12.78	13.33	13.89	14.44	15.00
60	15.56	16.11	16.67	17.22	17.78	18.33	18.89	19.44	20.00	20.56
70	21.11	21.67	22.22	22.78	23.33	23.89	24.44	25.00	25.56	26.11
80	26.67	27.22	27.78	28.33	28.89	29.44	30.00	30.56	31.11	31.67
90	32.22	32.78	33.33	33.89	34.44	35.00	35.56	36.11	36.67	37.22
100	37.78	38.33	38.89	39.44	40.00	40.56	41.11	41.67	42.22	42.78
110	43.33	43.89	44.44	45.00	45.56	46.11	46.67	47.22	47.78	48.33
120	48.89	49.44	50.00	50.56	51.11	51.67	52.22	52.78	53.33	53.89
130	54.44	55.00	55.56	56.11	56.67	57.22	57.78	58.33	58.89	59.44
140	60.00	60.56	61.11	61.67	62.22	62.78	63.33	63.89	64.44	65.00
150	65.56	66.11	66.67	67.22	67.78	68.33	68.89	69.44	70.00	70.56
160	71.11	71.67	72.22	72.78	73.33	73.89	74.44	75.00	75.56	76.11
170	76.67	77.22	77.78	78.33	78.89	79.44	80.00	80.56	81.11	81.67
180	82.22	82.78	83.33	83.89	84.44	85.00	85.56	86.11	86.67	87.22
190	87.78	88.33	88.89	89.44	90.00	90.56	91.11	91.67	92.22	92.78

For interpolation										
°F	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
°C	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56

TEMPERATURES — FAHRENHEIT TO CENTIGRADE (Continued)

Conversion Tables

Temperatures above 0° F.

Temp. °F.	0	1	2	3	4	5	6	7	8	9
200	93.33	93.89	94.44	95.00	95.56	96.11	96.67	97.22	97.78	98.33
210	98.89	99.44	100.00	100.56	101.11	101.67	102.22	102.78	103.33	103.89
220	104.44	105.00	105.56	106.11	106.67	107.22	107.78	108.33	108.89	109.44
230	110.00	110.56	111.11	111.67	112.22	112.78	113.33	113.89	114.44	115.00
240	115.56	116.11	116.67	117.22	117.78	118.33	118.89	119.44	120.00	120.56
250	121.11	121.67	122.22	122.78	123.33	123.89	124.44	125.00	125.56	126.11
260	126.67	127.22	127.78	128.33	128.89	129.44	130.00	130.56	131.11	131.67
270	132.22	132.78	133.33	133.89	134.44	135.00	135.56	136.11	136.67	137.22
280	137.78	138.33	138.89	139.44	140.00	140.56	141.11	141.67	142.22	142.78
290	143.33	143.89	144.44	145.00	145.56	146.11	146.67	147.22	147.78	148.33
300	148.89	149.44	150.00	150.56	151.11	151.67	152.22	152.78	153.33	153.89
310	154.44	155.00	155.56	156.11	156.67	157.22	157.78	158.33	158.89	159.44
320	160.00	160.56	161.11	161.67	162.22	162.78	163.33	163.89	164.44	165.00
330	165.56	166.11	166.67	167.22	167.78	168.33	168.89	169.44	170.00	170.56
340	171.11	171.67	172.22	172.78	173.33	173.89	174.44	175.00	175.56	176.11
350	176.67	177.22	177.78	178.33	178.89	179.44	180.00	180.56	181.11	181.67
360	182.22	182.78	183.33	183.89	184.44	185.00	185.56	186.11	186.67	187.22
370	187.78	188.33	188.89	189.44	190.00	190.56	191.11	191.67	192.22	192.78
380	193.33	193.89	194.44	105.00	195.56	196.11	196.67	197.22	197.78	198.33
390	198.89	199.44	200.00	200.56	201.11	201.67	202.22	202.78	203.33	203.89

TEMPERATURES—FAHRENHEIT TO CENTIGRADE (Continued)

Temp. °F.	0	1	2	3	4	5	6	7	8	9
400	204.44	205.00	205.56	206.11	206.67	207.22	207.78	208.33	208.89	209.44
410	210.00	210.56	211.11	211.67	212.22	212.78	213.33	213.89	214.44	215.00
420	215.56	216.11	216.67	217.22	217.78	218.33	218.89	219.44	220.00	220.56
430	221.11	221.67	222.22	222.78	223.33	223.89	224.44	225.00	225.56	226.11
440	226.67	227.22	227.78	228.33	228.89	229.44	230.00	230.56	231.11	231.67
450	232.22	232.78	233.33	233.89	234.44	235.00	235.56	236.11	236.67	237.22
460	237.78	238.33	238.89	239.44	240.00	240.56	241.11	241.67	242.22	242.78
470	243.33	243.89	244.44	245.00	245.56	246.11	246.67	247.22	247.78	248.33
480	248.89	249.44	250.00	250.56	251.11	251.67	252.22	252.78	253.33	253.89
490	254.44	255.00	255.56	256.11	256.67	257.22	257.78	258.33	258.89	259.44
500	260.00	260.56	261.11	261.67	262.22	262.78	263.33	263.89	264.44	265.00
510	265.56	266.11	266.67	267.22	267.78	268.33	268.89	269.44	270.00	270.56
520	271.11	271.67	272.22	272.78	273.33	273.89	274.44	275.00	275.56	276.11
530	276.67	277.22	277.78	278.33	278.89	279.44	280.00	280.56	281.11	281.67
540	282.22	282.78	283.33	283.89	284.44	285.00	285.56	286.11	286.67	287.22
550	287.78	288.33	288.89	289.44	290.00	290.56	291.11	291.67	292.22	292.78
560	293.33	293.89	294.44	295.00	295.56	296.11	296.67	297.22	297.78	298.33
570	298.89	299.44	300.00	300.56	301.11	301.67	302.22	302.78	303.33	303.89
580	304.44	305.00	305.56	306.11	306.67	307.22	307.78	308.33	308.89	309.44
590	310.00	310.56	311.11	311.67	312.22	312.78	313.33	313.89	314.44	315.00

For interpolation										
°F	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
°C	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56

TEMPERATURES — FAHRENHEIT TO CENTIGRADE (Continued)

Conversion Tables

Temperatures above 0° F.

Temp. °F.	0	1	2	3	4	5	6	7	8	9
600	315.56	316.11	316.67	317.22	317.78	318.33	318.89	319.44	320.00	320.56
610	321.11	321.67	322.22	322.78	323.33	323.89	324.44	325.00	325.56	326.11
620	326.67	327.22	327.78	328.33	328.89	329.44	330.00	330.56	331.11	331.67
630	332.22	332.78	333.33	333.89	334.44	335.00	335.56	356.11	336.67	337.22
640	337.78	338.33	338.89	339.44	340.00	340.56	341.11	341.67	342.22	342.78
650	343.33	343.89	344.44	345.00	345.56	346.11	346.67	347.22	347.78	348.33
660	348.89	349.44	350.00	350.56	351.11	351.67	352.22	352.78	353.33	353.89
670	354.44	355.00	355.56	356.11	356.67	357.22	357.78	358.33	358.89	359.44
680	360.00	360.56	361.11	361.67	362.22	362.78	363,33	363.89	364.44	365.00
690	365.56	366.11	366.67	367.22	367.78	368.33	368.89	369.44	370.00	370.56
700	371.11	371.67	372.22	372.78	373.33	373.89	374.44	375.00	375.56	376.11
710	376.67	377.22	377.78	378.33	378.89	379.44	380.00	380.56	381.11	381.67
720	382.22	382.78	383.33	383.89	384.44	385.00	385.56	386.11	386.67	387.22
730	387.78	388.33	388.89	389.44	390.00	390.56	391.11	391.67	392.22	392.78
740	393.33	393.89	394.44	395.00	395.56	396.11	396.67	397.22	397.78	398.33
750	398.89	399.44	400.00	400.56	401.11	401.67	402.22	402.78	403.33	403.89
760	404.44	405.00	405.56	406.11	406.67	407.22	407.78	408.33	408.89	409.44
770	410.00	410.56	411.11	411.67	412.22	412.78	413.33	413.89	414.44	415.00
780	415.56	416.11	416.67	417.22	417.78	418.33	418.89	419.44	420.00	420.56
790	421.11	421.67	422.22	422.78	423.33	423.89	424.44	425.00	425.56	426.11

TEMPERATURES—FAHRENHEIT TO CENTIGRADE (Concluded)

Temp. 0° F.	0	1	2	3	4	5	6	7	8	9
800	426.67	427.22	427.78	428.33	428.89	429.44	430.00	430.56	431.11	431.67
810	432.22	432.78	433.33	433.89	434.44	435.00	435.56	436.11	436.67	437.22
820	437.78	438.33	438.89	439.44	440.00	440.56	441.11	441.67	442.22	442.78
830	443.33	443.89	444.44	445.00	445.56	446.11	446.67	447.22	447.78	448.33
840	448.89	449.44	450.00	450.56	451.11	451.67	452.22	452.78	453.33	453.89
850	454.44	455.00	455.56	456.11	456.67	457.22	457.78	458.33	458.89	459.44
860	460.00	460.56	461.11	461.67	462.22	462.78	463.33	463.89	464.44	465.00
870	465.56	466.11	466.67	467.22	467.78	468.33	468.89	469.44	470.00	470.56
880	471.11	471.67	472.22	472.78	473.33	473.89	474.44	475.00	475.56	476.11
890	476.67	477.22	477.78	478.33	478.89	479.44	480.00	480.56	481.11	481.67
900	482.22	482.78	483.33	483.89	484.44	485.00	485.56	486.11	486.67	487.22
910	487.78	488.33	488.89	489.44	490.00	490.56	491.11	491.67	492.22	492.78
920	493.33	493.89	494.44	495.00	495.56	496.11	496.67	497.22	497.78	498.33
930	498.89	499.44	500.00	500.56	501.11	501.67	502.22	502.78	503.33	503.89
940	504.44	505.00	505.56	506.11	506.67	507.22	507.78	508.33	508.89	509.44
950	510.00	510.56	511.11	511.67	512.22	512.78	513.33	513.89	514.44	515.00
960	515.56	516.11	516.67	517.22	517.78	518.33	518.89	519.44	520.00	520.56
970	521.11	521.67	522.22	522.78	523.33	523.89	524.44	525.00	525.56	526.11
980	526.67	527.22	527.78	523.33	528.89	529.44	530.00	530.56	531.11	531.67
990	532.22	532.78	533.33	533.89	534.44	535.00	535.56	536.11	536.67	537.22

For interpolation										
°F	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.10
°C	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.56

MOMENT OF INERTIA FOR VARIOUS BODIES

The mass of the body is indicated by m.

Body	Axis	Moment of inertia
Uniform thin rod	Normal to the length, at one end	$m\frac{l^2}{3}$
Uniform thin rod	Normal to the length, at the center	$m\frac{l^2}{12}$
Thin rectangular sheet, sides a and b	Through the center parallel to b	$m\frac{a^2}{12}$
Thin rectangular sheet, sides a and b	Through the center perpendicular to the sheet	$m\frac{a^2+b^2}{12}$
Thin circular sheet of radius r	Normal to the plate through the center	$m\frac{r^2}{2}$
Thin circular sheet of radius r	Along any diameter	$m\frac{r^2}{4}$
Thin circular ring. Plane figure formed by two concentric circles of radius r_1 and r_2	Through center normal to plane of ring	$m\frac{r_1^2+r_2^2}{2}$
Thin circular ring. Plane figure formed by two concentric circles of radius, r_1 and r_2	Any diameter	$m\frac{r_1^2+r_2^2}{4}$
Rectangular parallelopiped, edges a, b, and c	Through center perpendicular to face ab, (parallel to edge c)	$m\frac{a^2+b^2}{12}$
Sphere, radius r	Any diameter	$m\frac{2}{5}r^2$
Spherical shell, external radius, r_1 internal, radius r_2	Any diameter	$m\frac{2}{5}\frac{(r_1^5-r_2^5)}{(r_1^3-r_2^3)}$

MOMENT OF INERTIA FOR VARIOUS BODIES (Continued)

The mass of the body is indicated by m.

Body	Axis	Moment of inertia
Spherical shell, very thin, mean radius, r	Any diameter	$m\frac{2r^2}{3}$
Right circular cylinder of radius r, length l	The longitudinal axis of the solid	$m\frac{r^2}{2}$
Right circular cylinder of radius r, length l	Through center perpendicular to the axis of the figure, (transverse diameter)	$m\left(\frac{r^2}{4}+\frac{l^2}{12}\right)$
Hollow circular cylinder, length l, external radius r_1 internal radius r_2	The longitudinal axis of the figure	$m\frac{(r_1^2+r_2^2)}{2}$
Thin cylindrical shell, length l, mean radius, r	The longitudinal axis of the figure	mr^2
Hollow circular cylinder, length l, external radius r_1, internal radius r_2	Transverse diameter	$m\left[\frac{r_1^2+r_2^2}{4}+\frac{l^2}{12}\right]$
Hollow circular cylinder, length l, very thin, mean radius r	Transverse diameter	$m\left(\frac{r^2}{2}+\frac{l^2}{12}\right)$
Elliptic cylinder, length l, transverse semiaxes a and b	Longitudinal axis	$m\left(\frac{a^2+b^2}{4}\right)$
Right cone, altitude h, radius of base r	Axis of the figure	$m\frac{3}{10}r^2$
Spheroid of revolution, equatorial radius r	Polar axis	$m\frac{2r^2}{5}$
Ellipsoid, axes $2a$, $2b$, $2c$	Axis $2a$	$m\frac{(b^2+c^2)}{5}$

RADIO FORMULÆ

A collection of formulae useful in the computation of inductance, capacity, and other constants of oscillating circuits. From Radio Instruments and Measurements, Bureau of Standards.

CAPACITY

Units. — In the following formulæ all lengths are expressed in centimeters, areas in square centimeters; the dielectric constant K, is taken as unity for air. Capacities will be given in micromicrofarads = 10^{-12} farads. The electrostatic unit of capacity, sometimes called the centimeter = 1.1124 micromicrofarads.

Parallel plate condenser. — If s be the area of one plate; t, the thickness of the dielectric; K, the dielectric constant; and N, the number of plates, — the capacity

$$C = 0.0885\, K \frac{(N-1)s}{t}.$$

Variable condenser, semicircular plates. — Where N is the total number of parallel plates; r_1 the outer, and r_2 the inner radius of the plates; t, the thickness of the dielectric, and K the dielectric constant, — the maximum capacity is given by

$$C = 0.1390K \frac{(N-1)(r_1^2 - r_2^2)}{t}.$$

Isolated thin circular disk. — If d is the diameter of the disk

$$C = 0.354d.$$

Isolated sphere. — If d is the diameter of the sphere

$$C = 0.556d.$$

Two concentric spheres. — If r_1 is the radius of the outer sphere; r_2, that of the inner sphere; K, the dielectric constant of the material between the spheres,

$$C = 1.112K \frac{r_1 r_2}{r_1 - r_2}.$$

Two coaxial cylinders. — If r_1 is the radius of the outer cylinder; r_2, that of the inner; l, the length of the cylinders; K, the dielectric constant,

$$C = K \frac{0.2416\, l}{\log_{10} \frac{r_1}{r_2}}.$$

Single long wire parallel to the ground. — For a wire of length l; diameter, d; suspended at a height h above the ground, where the diameter is small compared with the length,

For $\frac{4h}{l} = \text{or} < 1$ $\quad C = \dfrac{0.2416\ l}{\log_{10}\frac{4h}{d} - k_1}$

For $\frac{l}{4h} = \text{or} < 1$ $\quad C = \dfrac{0.2416\ l}{\log_{10}\frac{2\,l}{d} - k_2}$

In which,

$$k_1 = \log_{10}\left[\frac{1+\sqrt{1+\left(\frac{4h}{l}\right)^2}}{2}\right] \qquad k_2 = \log_{10}\left[\frac{l}{4h}+\sqrt{1+\left(\frac{l}{4h}\right)^2}\right]$$

the values of which may be found in a table at the end of this section.

Vertical wire. — For a wire of length l, relatively high above the ground; of diameter d, the approximate capacity is as follows,

$$C = \frac{0.2416\,l}{\log_{10}\frac{2l}{d}}.$$

Two horizontal parallel wires at the same height. — If d is the diameter of each wire; l, the length of each; h, the height above the ground; D, the distance between wires, — where d and D are small compared to l,

$$C = \frac{0.1208\,l}{\log_{10}\frac{2D}{d} - \frac{D^2}{8h^2}}.$$

Two parallel horizontal wires, one above the other. — Use the preceding formula for parallel wires at the same height, substituting the mean height for h.

Two parallel wires joined together, both at the same height. — Let l be the length of each wire; D, the distance between centers; h, the height above the ground; d_2 the diameter of cross section of the wire. If d^2 and D^2 are small compared with l^2 and $4h^2$ respectively

For $\frac{4h}{l} = \text{or} < 1$ $\quad C = \dfrac{0.4831\,l}{\log_{10}\frac{4h}{d} + \log_{10}\frac{2h}{D} - 2k_1}.$

For $\frac{l}{4h} = \text{or} < 1$ $\quad C = \dfrac{0.4831\,l}{\log_{10}\frac{2l}{d} + \log_{10}\frac{l}{D} - 2k_2}.$

k_1 and k_2 have the same significance as above and may be found from the tables at the end of the section.

Several wires in parallel. — If n parallel wires are joined together; D, the spacing between the wires; d, the diameter of the wire; h, the height above the ground; l, the length of the group, -- the approximate capacity is,

$$C = \frac{1.112\, l}{\frac{p_{11} + (n-1)p_{12}}{n} - k}.$$

p_{11} and p_{12} may be computed from the following:

For $\frac{4h}{l}$ = or < 1

$$p_{11} = 4.605\left[\log_{10}\frac{4h}{d} - k_1\right]$$

$$p_{12} = 4.605\left[\log_{10}\frac{2h}{D} - k_1\right]$$

For $\frac{l}{4h}$ = or < 1

$$p_{11} = 4.605\left[\log_{10}\frac{2l}{d} - k_2\right]$$

$$p_{12} = 4.605\left[\log_{10}\frac{l}{D} - k_2\right]$$

Values of k, k_1, k_2 may be found in the following table.

TABLE 1

$\frac{4h}{l}$	k_1	$\frac{l}{4h}$	k_2	n	k	n	k
0	0	0	0	2	0	11	2.22
0.1	0.001	0.1	0.043	3	0.308	12	2.37
.2	.004	.2	.086	4	.621	13	2.51
.3	.009	.3	.128	5	.906	14	2.63
.4	.016	.4	.169	6	1.18	15	2.74
.5	.025	.5	.209	7	1.43	16	2.85
.6	.035	.6	.247	8	1.66	17	2.95
.7	.045	.7	.283	9	1.86	18	3.04
.8	.057	.8	.318	10	2.05	19	3.14
.9	.069	.9	.351			20	3.24
1.0	.082	1.0	.383				

INDUCTANCE

Units. — In the following formulæ all lengths are expressed in centimeters. The inductance calculated will be in micro-henries = 10^{-6} henry.

Long straight round wire. — If l is the length; d, the diameter of cross section; μ the permeability of the material, — the inductance at zero or low frequency is,

$$L = 0.002\, l\left[2.303 \log_{10}\frac{4l}{d} - 1 + \frac{\mu}{4}\right]$$

For all except iron wire $\mu = 1$ and the last term becomes 0.25.

For wires whose length is less than about 1000 times the diameter the term $+\frac{d}{2l}$ should be added inside the brackets.

For any frequency:

$$L = 0.002\,l\left[2.303 \log_{10}\frac{4l}{d} - 1 + \mu\delta\right]$$

where δ is a quantity given in Table 2 below as a function of x. x is to be computed from the relation

$$x = 0.1405d\sqrt{\frac{\mu f}{\rho}}$$

where d and μ are as above; f, the frequency and ρ the resistivity of the material of the wire expressed in microhm-centimeters. (See Properties of Metallic Conductors.)

For copper at 20° C.

$$x = 0.1071\,d\sqrt{f}.$$

For wires other than iron, whose length is 100,000 times the diameter the inductance at infinite frequency is about 2% less than at zero frequency.

TABLE 2

Values of δ for computing inductance at any frequency.

x	δ	x	δ
0	0.250	12	0.059
0.5	.250	14	.050
1.0	.249	16	.044
1.5	.247	18	.039
2.0	.240	20	.035
2.5	.228	25	.028
3.0	211	30	.024
3.5	.191	40	.0175
4.0	.1715	50	.014
4.5	.154	60	.012
5.0	.139	70	.010
6.0	.116	80	.009
7.0	.100	90	.008
8.0	.088	100	.007
9.0	.078	∞	.000
10.0	.070		

Two parallel round wires, return circuit.—If l is the length of each wire; d, the diameter; D, the distance between centers of wires; μ the permeability,—the inductance for any frequency is

$$L=0.004\,l\left[2.303\,\log_{10}\frac{2D}{d}-\frac{D}{l}+\mu\delta\right]$$

where δ is a quantity to be obtained from the table above as a function of x which is to be computed as explained for the previous formula.

For copper and at low frequency the term δ becomes 0.25.

. **Square of round wire.**—If a is the length of the side of the square; d, the diameter of the wire; μ the permeability, the inductance for any frequency is,

$$L=0.008a\left[2.303\,\log_{10}\frac{2a}{d}+\frac{d}{2a}-0.774+\mu\delta\right]$$

where δ is obtained as above. For low frequency and for wires other than iron δ becomes 0.25; for infinite frequency the value is zero.

Grounded horizontal wire, the Earth acting as return circuit. If l is the length of wire; h, the height above the ground; l, the diameter of the wire; μ the permeability and δ the frequency constant (see table 2), the inductance,—where d is small compared with l,—is given as follows:

For $\frac{2h}{l}$ = or <1 $\qquad L=0.002\,l\left[2.3026\,\log_{10}\frac{4h}{d}-P+\mu\delta\right]$

For $\frac{l}{2h}$ = or <1 $\qquad L=0.002\,l\left[2.3026\,\log_{10}\frac{4\,l}{d}-Q+\mu\delta\right]$

P and Q may be found in the following table.

TABLE 3

$\frac{2h}{l}$	P	$\frac{l}{2h}$	Q	$\frac{2h}{l}$	P	$\frac{l}{2h}$	Q
0	0	0	1.0000	0.6	0.5136	0.6	1.2918
0.1	0.0975	0.1	1.0499	.7	.5840	.7	1.3373
.2	.1900	.2	1.0997	.8	.6507	.8	1.3819
.3	.2778	.3	1.1489	.9	.7139	.9	1.4251
.4	.3608	.4	1.1975	1.0	.7740	1.0	1.4672
.5	.4393	.5	1.2452	.....	....	.....	....

The mutual inductance of the case above may be expressed

For $\frac{2h}{l}$ = or <1 $M = 0.002\, l\left[2.3026 \log_{10} \frac{2h}{D} - P + \frac{D}{l}\right]$

For $\frac{l}{2h}$ = or <1 $M = 0.002\, l\left[2.3026 \log_{10} \frac{2l}{D} - Q + \frac{D}{l}\right]$

The values of P and Q are found in the table above.

Grounded wires in parallel. — Compute by the above formulae the inductance L_1 per unit length of a single wire and the mutual inductance M_1 per unit length of two adjacent wires, using the actual length in determining the ratios $\frac{2h}{l}$, $\frac{2l}{d}$ etc. Then the inductance of n parallel wires will be,

$$L = l\left[\frac{L_1 + (n-1)M_1}{n} - 0.001k\right]$$

where k is a function of n found in Table 1 under capacity formulae.

Circular ring of round wire. — If a is the mean radius of the ring; d, the diameter of the wire, the inductance at any frequency is

$$L = 0.01257a\left[2.303 \log_{10} \frac{16a}{d} - 2 + \mu\delta\right]$$

where δ is determined from the table above.

Circular coil of circular cross section. — For a coil of n fine wires wound with mean radius of the turns a, the cross section of whose winding is a circle of diameter d, the inductance at low frequency, for wire other than iron, neglecting insulation space is,

$$L = 0.01257an^2\left[2.303 \log_{10} \frac{16a}{d} - 1.75\right]$$

Torus with a single layer transverse winding, — a circular solenoid of circular cross section. If r is the distance from the center of the torus to the center of the transverse section; a, the radius of the turns of the winding; n, the number of turns the inductance at low frequency is

$$L = 0.01257n^2\left[r - \sqrt{r^2 - a^2}\right]$$

Solenoid, single layer. If n is the number of turns; a the radius of the coil; b, the length, the approximate inductance at any frequency is,

$$L = \frac{0.03948a^2n^2}{b}K$$

where K is a function of $\frac{2a}{b}$ given in the table below.

TABLE 4

$\frac{2a}{b}$	K	$\frac{2a}{b}$	K	$\frac{2a}{b}$	K
0.00	1.0000	2.00	0.5255	7.00	0.2584
.05	.9791	2.10	.5137	7.20	.2537
.10	.9588	2.20	.5025	7.40	.2491
.15	.9391	2.30	.4918	7.60	.2448
.20	.9201	2.40	.4816	7.80	.2406
.25	.9016	2.50	.4719	8.00	.2366
.30	.8838	2.60	.4626	8.50	.2272
.35	.8665	2.70	.4537	9.00	.2185
.40	.8499	2.80	.4452	9.50	.2106
.45	.8337	2.90	.4370	10.00	.2035
.50	.8181	3.00	.4292	......	......
.55	.8031	3.10	.4217	11.0	.1903
.60	.7885	3.20	.4145	12.0	.1790
.65	.7745	3.30	.4075	13.0	.1692
.70	.7609	3.40	.4008	14.0	.1605
.75	.7478	3.50	.3944	15.0	.1527
.80	.7351	3.60	.3882	16.0	.1457
.85	.7228	3.70	.3822	17.0	.1394
.90	.7110	3.80	.3764	18.0	.1336
.95	.6995	3.90	.3708	19.0	.1284
1.00	.6884	4.00	.3654	20.0	.1236
1.05	.6777	4.10	.3602	22.0	.1151
1.10	.6673	4.20	.3551	24.0	.1078
1.15	.6573	4.30	.3502	26.0	.1015
1.20	.6475	4.40	.3455	28.0	.0959
1.25	.6381	4.50	.3409	30.0	.0910
1.30	.6290	4.60	.3364	35.0	.0808
1.35	.6201	4.70	.3321	40.0	.0728
1.40	.6115	4.80	.3279	45.0	.0664
1.45	.6031	4.90	.3238	50.0	.0611
1.50	.5950	5.00	.3198	60.0	.0528
1.55	.5871	5.20	.3122	70.0	.0467
1.60	.5795	5.40	.3050	80.0	.0419
1.65	.5721	5.60	.2981	90.0	.0381
1.70	.5649	5.80	.2916	100.0	.0350
1.75	.5579	6.00	.2854	......	......
1.80	.5511	6.20	.2795	......	......
1.85	.5444	6.40	.2739	......	......
1.90	.5379	6.60	.2685	......	......
1.95	.5316	6.80	.2633	......	......

Long multiple layer solenoid. — The inductance is given approximately by,

$$L = L_1 - \frac{0.01257n^2ac}{b}(0.693 + B_s)$$

where L_1 is the inductance calculated from the formula for a single layer solenoid, n being the number of turns of the winding; a, the radius of the coil measured from the axis to the center of the cross section of the winding; b, the length of the coil; c, the radial depth of the winding; B_s a correction given in table below as a function of b/c.

TABLE 5

b/c	B_s	b/c	B_s
1	0.0000	16	0.3017
2	.1202	17	.3041
3	.1753	18	.3062
4	.2076	19	.3082
5	.2292	20	.3099
6	.2446	21	.3116
7	.2563	22	.3131
8	.2656	23	.3145
9	.2730	24	.3157
10	.2792	25	.3169
11	.2844	26	.3180
12	.2888	27	.3190
13	.2927	28	.3200
14	.2961	29	.3209
15	.2991	30	.3218

Square coil of rectangular cross section. — If a be the side of the square measured to the center of the rectangular section which has sides b and c and if n be the number of turns,

$$L = 0.008an^2\left[2.303 \log_{10} \frac{a}{b+c} + 0.2235 \frac{b+c}{a} + 0.726\right]$$

If the cross section is a square $b = c$ and the expression becomes

$$L = 0.008an^2\left[2.303 \log_{10} \frac{a}{b} + 0.447 \frac{b}{a} + 0.033\right]$$

Mutual Inductance

Two parallel wires. — If l be the length of each wire; D, the distance between, the inductance is

$$M = 0.002\,l\left[2.303 \log_{10} \frac{2l}{D} - 1 + \frac{D}{l}\right]$$

Coaxial solenoids, single layer coils, not concentric. If a is the radius of the smaller coil; A, the radius of the larger: n_1 and n_2 the number of turns on the smaller and larger coil respectively; $2l$ the length of the smaller coil; $2x$, the length of

the larger; D, the distance between the centers of the coils measured along the common axis,

$$M = 0.009870\frac{a^2A^2n_1n_2}{2x.2\,l}\left[K_1k_1 + K_3k_3 + K_5k_5\right]$$

where

$$K_1 = \frac{2}{A^2}\left(\frac{x_2}{r_2} - \frac{x_1}{r_1}\right) \qquad k_1 = 2\,l$$

$$K_3 = \frac{1}{2}\left(\frac{x_1}{r_1^5} - \frac{x_2}{r_2^5}\right) \qquad k_3 = a^2\,l\left(3 - 4\frac{l^2}{a^2}\right)$$

$$K_5 = -\frac{A^2}{8}\left[\frac{x_1}{r_1^9}\left(3 - 4\frac{x_1^2}{A^2}\right) - \frac{x_2}{r_2^9}\left(3 - 4\frac{x_2^2}{A^2}\right)\right]$$

$$k_5 = a^4\,l\left(\frac{5}{2} - 10\frac{l^2}{a^2} + 4\frac{l^4}{a^4}\right)$$

where

$$x_1 = D - x \qquad r_1 = \sqrt{x_1^2 + A^2}$$

$$x_2 = D + x \qquad r_2 = \sqrt{x_2^2 + A^2}$$

The above is most accurate for short coils with relatively great distance between.

Coaxial, concentric solenoids, outer coil the longer. If a be the radius of the smaller coil; A, that of the larger; $2l$, the length of the inner coil; $2x$, the length of the outer; n_1 and n_2 the number of turns on the inner and outer coil respectively,

$$M = \frac{0.01974a^2n_1n_2}{g}\left[1 + \frac{A^2a^2}{8g^4}\left(3 - 4\frac{l^2}{a^2}\right)\right]$$

where $g = \sqrt{x^2 + A^2}$.

Coaxial, concentric solenoids, outer coil the shorter. Assuming the symbols as before except

$$g = \sqrt{l^2 + A^2}$$

$$M = 0.01974\frac{a^2n_1n_2}{g}\left[1 + \frac{A^2a^2}{8g^4}\left(3 - 4\frac{x^2}{a^2}\right)\right]$$

High Frequency Resistance

Cylindrical straight wires.—The ratio R/R_0 of the high frequency resistance to the resistance at low frequency may be found from the table below, by calculating first the value of x from the relation,

$$x = \pi d\sqrt{\frac{2\mu f}{\rho}}\sqrt{\frac{1}{1000}}$$

where d is the diameter of the wire in centimeters; μ, the magnetic permeability; f, the frequency; ρ, the resistivity in microhm-centimeters.

For copper wire $x = 10da$ where a has a value given by $a = 0.01071$ The value of a for various frequencies may be found in the second of the two tables below. The above method gives the high-frequency resistance of simple circuits of any shape where the length is great compared with the diameter of the wire and the different portions of the circuit are not close to each other.

TABLE 6

Ratio of High-Frequency Resistance to the Direct-Current Resistance.

x	R/R_0	x	R/R_0	x	R/R_0
0	1.0000	5.2	2.114	14.0	5.209
0.5	1.0003	5.4	2.184	14.5	5.386
.6	1.0007	5.6	2.254	15.0	5.562
.7	1.0012	5.8	2.324	16.0	5.915
.8	1.0021	6.0	2.394	17.0	6.268
.9	1.0034	6.2	2.463	18.0	6.621
1.0	1.005	6.4	2.533	19.0	6.974
1.1	1.008	6.6	2.603	20.0	7.328
1.2	1.011	6.8	2.673	21.0	7.681
1.3	1.015	7.0	2.743	22.0	8.034
1.4	1.020	7.2	2.813	23.0	8.387
1.5	1.026	7.4	2.884	24.0	8.741
1.6	1.033	7.6	2.954	25.0	9.094
1.7	1.042	7.8	3.024	26.0	9.447
1.8	1.052	8.0	3.094	28.0	10.15
1.9	1.064	8.2	3.165	30.0	10.86
2.0	1.078	8.4	3.235	32.0	11.57
2.2	1.111	8.6	3.306	34.0	12.27
2.4	1.152	8.8	3.376	36.0	12.98
2.6	1.201	9.0	3.446	38.0	13.69
2.8	1.256	9.2	3.517	40.0	14.40
3.0	1.318	9.4	3.587	42.0	15.10
3.2	1.385	9.6	3.658	44.0	15.81
3.4	1.456	9.8	3.728	46.0	16.52
3.6	1.529	10.0	3.799	48.0	17.22
3.8	1.603	10.5	3.975	50.0	17.93
4.0	1.678	11.0	4.151	60.0	21.47
4.2	1.752	11.5	4.327	70.0	25.00
4.4	1.826	12.0	4.504	80.0	28.54
4.6	1.899	12.5	4.680	90.0	32.07
4.8	1.971	13.0	4.856	100.0	35.61
5.0	2.043	13.5	5.033	.....	......

As an extension of the above table the following relation may be used:

$$R/R_o = x/2.828 + 0.25.$$

The equation is valid for values of x greater than 7 at which point the error is about 1 % and decreasing with increasing values of x.

TABLE 7

Values of a ($=0.01071\sqrt{f}$) for various frequencies.

f	a	Wave-length meters	f	a	Wave-length meters
100	0.1071	......	50,000	2.395	6,000
200	.1514	......	60,000	2.624	5,000
300	.1855	......	70,000	2.834	4,286
400	.2142	......	80,000	3.029	3,750
500	.2395	......	90,000	3.213	3,333
600	.2624	......	100,000	3.387	3,000
700	.2834	......	150,000	4.148	2,000
800	.3029	......	200,000	4.790	1,500
900	.3213	......	250,000	5.355	1,200
1,000	.3387	......	300,000	5.866	1,000
2,000	.4790	......	333,333	6.184	900
3,000	.5866	......	375,000	6.564	800
4,000	.6774	......	428,570	7.012	700
5,000	.7573	......	500,000	7.573	600
6,000	.8296	......	600,000	8.296	500
7,000	.8960	......	700,000	8.960	429
8,000	.9579	......	750,000	9.275	400
9,000	1.0160	......	800,000	9.579	375
10,000	1.071	30,000	900,000	10.16	333
15,000	1.312	20,000	1,000,000	10.71	300
20,000	1.514	15,000	1,500,000	13.12	200
30,000	1.855	10,000	3,000,000	18.55	100
40,000	2.142	7,500	....	....	.....

Wave Length

The wave length in meters is given by the following expression when L, the inductance, is in microhenries and C, the capacity, is in microfarads. The resistance is assumed negligible.

$$\lambda = 1884\sqrt{LC}$$

VALUES OF "L C"

The following table gives values of the product of the inductance and capacity (L C) in microhenries and microfarads for wave lengths from 1 to 20,000 meters, and the corresponding frequencies in kilocycles.

Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads	Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads
1	300,000.	.00000028	570	526.3	.09141
10	30,000.	.00002816	580	517.2	.09467
20	15,000.	.0001129	590	508.5	.09803
30	10,000.	.0002530	600	500.	.1014
40	7,500.	.0004503	610	491.8	.1047
50	6,000.	.0007039	620	483.7	.1082
60	5,000.	.001014	630	476.2	.1117
70	4,286.	.001378	640	468.7	.1154
80	3,750.	.001801	650	461.5	.1188
90	3,333.	.002280	660	454.5	.1225
100	3,000.	.002816	670	447.8	.1263
110	2,727.	.003404	680	441.2	.1302
120	2,500.	.004052	690	434.8	.1341
130	2,308.	.004757	700	428.6	.1378
140	2,144.	.005518	710	422.5	.1419
150	2,000.	.006335	720	416.7	.1459
160	1,875.	.007204	730	411.	.1501
170	1,765.	.008134	740	405.4	.1540
180	1,667.	.009120	750	400.	.1583
190	1,579.	.01016	760	394.7	.1625
200	1,500.	.01129	770	389.6	.1668
210	1,428.5	.01239	780	384.6	.1714
220	1,364.	.01362	790	379.8	.1756
230	1,304.2	.01490	800	375.	.1801
240	1,250.	.01624	810	370.4	.1847
250	1,200.	.01755	820	365.9	.1893
260	1,153.8	.01901	830	361.4	.1941
270	1,111.	.02052	840	357.1	.1985
280	1,071.3	.02209	850	352.9	.2034
290	1,034.3	.02372	860	348.8	.2082
300	1,000.	.02530	870	344.8	.2132
310	967.7	.02704	880	340.9	.2179
320	937.5	.02884	890	337.1	.2229
330	909.1	.03069	900	333.3	.2280
340	882.4	.03250	910	329.7	.2332
350	859.1	.03446	920	326.1	.2381
360	833.3	.03648	930	322.6	.2434
370	810.8	.03856	940	319.1	.2487
380	789.5	.04070	950	315.9	.2541
390	769.2	.04277	960	312.5	.2595
400	750.	.04503	970	309.3	.2647
410	731.7	.04733	980	306.1	.2704
420	714.3	.04968	990	303.	.2759
430	697.7	.05198	1,000	300.	.2816
440	681.8	.05446	1,010	297.03	.2870
450	666.7	.05700	1,020	294.12	.2927
460	652.2	.05960	1,030	291.26	.2986
470	638.3	.06225	1,040	288.45	.3045
480	625.	.06485	1,050	285.71	.3105
490	612.2	.06757	1,060	283.	.3161
500	600.	.07039	1,070	280.37	.3222
510	588.2	.07327	1,080	277.78	.3283
520	576.9	.07606	1,090	275.23	.3345
530	566.	.07903	1,100	272.73	.3404
540	555.6	.08208	1,110	270.27	.3467
550	545.4	.08518	1,120	267.85	.3531
560	535.7	.08836	1,130	265.48	.3595

VALUES OF "L C" (Continued)

Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads	Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads
1,140	263.15	.3660	1,740	172.41	.8520
1,150	260.86	.3721	1,750	171.43	.8620
1,160	258.61	.3787	1,760	170.46	.8720
1,170	256.4	.3853	1,770	169.49	.8821
1,180	254.23	.3921	1,780	168.54	.8916
1,190	252.1	.3988	1,790	167.6	.9019
1,200	250.	.4052	1,800	166.67	.912
1,210	247.93	.4121	1,810	165.75	.9224
1,220	245.9	.4190	1,820	164.84	.9327
1,230	243.9	.4260	1,830	163.94	.9425
1,240	241.93	.4326	1,840	163.04	.9530
1,250	240.	.4397	1,850	162.22	.9634
1,260	238.09	.4469	1,860	161.29	.9741
1,270	236.22	.4541	1,870	160.43	.9844
1,280	234.37	.4610	1,880	159.58	.9948
1,290	232.56	.4683	1,890	158.73	1.0056
1,300	230.76	.4757	1,900	157.89	1.0164
1,310	229.01	.4831	1,910	157.06	1.0265
1,320	227.27	.4906	1,920	156.30	1.0375
1,330	225.56	.4978	1,930	155.44	1.0485
1,340	223.87	.5053	1,940	154.63	1.0597
1,350	222.22	.5130	1,950	153.84	1.0706
1,360	220.59	.5208	1,960	153.06	1.0811
1,370	218.97	.5281	1,970	152.28	1.0923
1,380	217.39	.5359	1,980	151.51	1.1035
1,390	215.83	.5438	1,990	150.75	1.1148
1,400	214.38	.5518	2,000	150.	1.1256
1,410	212.76	.5598	2,100	142.85	1.2412
1,420	211.26	.5674	2,200	136.36	1.3624
1,430	209.79	.5755	2,300	130.43	1.4893
1,440	208.34	.5837	2,400	125.00	1.6218
1,450	206.90	.5919	2,500	120.	1.7597
1,460	205.47	.5998	2,600	115.38	1.9026
1,470	204.08	.6081	2,700	111.11	2.0520
1,480	202.70	.6165	2,800	107.14	2.207
1,490	201.34	.6250	2,900	103.45	2.3663
1,500	200.	.6335	3,000	100.	2.533
1,510	198.68	.6416	3,100	96.77	2.705
1,520	197.36	.6502	3,200	93.75	2.883
1,530	196.07	.6590	3,300	90.91	3.085
1,540	194.80	.6670	3,400	88.24	3.255
1,550	193.56	.6760	3,500	85.91	3.448
1,560	192.31	.6849	3,600	83.33	3.648
1,570	191.06	.6938	3,700	81.08	3.854
1,580	189.86	.7028	3,800	78.95	4.065
1,590	188.67	.7118	3,900	76.92	4.281
1,600	187.5	.7204	4,000	75.00	4.500
1,610	186.34	.7295	4,100	73.17	4.732
1,620	185.19	.7387	4,200	71.43	4.966
1,630	184.05	.7480	4,300	69.77	5.206
1,640	182.93	.7573	4,400	68.18	5.451
1,650	181.82	.7662	4,500	66.67	5.700
1,660	180.73	.7756	4,600	65.22	5.956
1,670	179.64	.7852	4,700	63.83	6.219
1,680	178.57	.7946	4,800	62.500	6.486
1,690	177.51	.8037	4,900	61.22	6.759
1,700	176.46	.8134	5,000	60.00	7.038
1,710	175.44	.8231	5,100	58.82	7.32
1,720	174.42	.8329	5,200	57.69	7.61
1,730	173.41	.8422	5,300	56.60	7.91

VALUES OF "L C" (Continued)

Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads	Wave length, meters	Frequency, kilocycles	L C Microhenries Microfarads
5,400	55.56	8.21	10,600	28.30	31.6
5,500	54.55	8.51	10,800	27.78	32.8
5,600	53.57	8.83	11,000	27.275	34.0
5,700	52.63	9.15	11,200	26.785	35.3
5,800	51.72	9.47	11,400	26.315	36.6
5,900	50.85	9.81	11,600	25.86	37.9
6,000	50.	10.1	11,800	25.425	39.2
6,100	49.18	10.5	12,000	25.0	40.4
6,200	48.55	10.8	12,200	24.590	42.0
6,300	47.62	11.1	12,400	24.275	43.3
6,400	46.87	11.5	12,600	23.86	44.4
6,500	46.15	11.9	12,800	23.435	46.0
6,600	45.45	12.3	13,000	23.075	47.6
6,700	44.78	12.6	13,200	22.275	49.2
6,800	44.12	13.0	13,400	22.39	50.4
6,900	43.48	13.4	13,600	22.06	52.0
7,000	42.86	13.8	13,800	21.74	53.2
7,100	42.25	14.2	14,000	21.43	55.2
7,200	41.67	14.6	14,200	21.125	56.8
7,300	41.1	15.0	14,400	20.835	58.4
7,400	40.54	15.4	14,600	20.55	60.0
7,500	40.	15.8	14,800	20.27	61.6
7,600	39.47	16.3	15,000	20.00	63.2
7,700	38.96	16.7	15,200	19.735	65.2
7,800	38.46	17.1	15,400	19.48	66.1
7,900	37.98	17.6	15,600	19.23	68.4
8,000	37.50	18.0	15,800	18.990	70.4
8,100	37.04	18.5	16,000	18.75	72.0
8,200	36.59	18.9	16,200	18.52	74.0
8,300	36.14	19.4	16,400	18.295	75.6
8,400	35.71	19.9	16,600	18.07	77.6
8,500	35.29	20.3	16,800	17.855	79.6
8,600	34.88	20.8	17,000	17.645	81.2
8,700	34.48	21.3	17,200	17.440	83.2
8,800	34.09	21.8	17,400	17.24	85.2
8,900	33.71	22.3	17,600	17.045	87.2
9,000	33.33	22.8	17,800	16.855	89.2
9,100	32.97	23.3	18,000	16.665	91.2
9,200	32.61	23.8	18,200	16.485	93.2
9,300	32.26	24.3	18,400	16.305	95.2
9,400	31.91	24.9	18,600	16.13	97.2
9,500	31.59	25.4	18,800	15.955	99.6
9,600	31.25	25.9	19,000	15.795	101.6
9,700	30.93	26.5	19,200	15.625	103.6
9,800	30.61	27.0	19,400	15.465	106.0
9,900	30.31	27.6	19,600	15.305	108.0
10,000	30.00	28.1	19,800	15.155	110.4
10,200	29.41	29.3	20,000	15.00	112.4
10,400	28.845	30.4			

CHARACTERISTICS OF

Compiled by

RECEIVING

The following table gives the average characteristics of various receiving tubes designated by number. The last two figures only are required to identify the tube. For example; tube 301-A or 201-A will appear in the table as 01-A.

Type No.	Purpose	Base	Cathode			Plate voltage	Plate current, ma
			Type	Voltage	Current, amp.		
00-A	Detector	4-1	Fil.	5.0	0.25	45	1.5
01-A	Gen. purpose	4-1	Fil.	5.0	0.25	90	2.5
11	Gen. purpose	4-1	Fil.	1.1	0.25	135	3.0
12	Gen. purpose	4-1	Fil.	1.1	0.25	135	3.0
12-A	Gen. purpose	4-1	Fil.	5.0	0.25	180	7.6
20	Power output	4-1	Fil.	3.3	0.13	135	6.5
22	R. F. amplifier	5-2	Heat.	15.0	0.35	135	1.0
22	R. F. amplifier	4-2	Fil.	3.3	0.13	135	1.5
24-A	R. F. amplifier	5-2	Heat.	2.5	1.75	180	4.0
26	Amplifier	4-1	Fil.	1.5	1.05	135	5.5
26	Detector	5-1	Heat.	15.0	0.35	90	4.5
27	Gen. purpose	5-1	Heat.	2.5	1.75	135	4.5
28	Gen. purpose	5-1	Heat.	15.0	0.35	90	7.5
29	Spec. det.	5-1	Heat.	2.5	1.00	180	4.5
30	Power amp.	5-1	Heat.	15.0	0.35	180	22.0
30	Gen. purpose	4-1	Fil.	2.0	0.06	180	3.1
31	Power amp.	4-1	Fil.	2.0	0.13	135	8.0
32	R. F. amplifier	4-2	Fil.	2.0	0.06	180	1.7
32	Volt. amplifier	5-1	Heat.	15.0	0.35	135	1.5
33	Power amp.	4-2	Fil.	2.0	0.26	135	14.5
34	Variable-mu	4-2	Fil.	2.0	0.06	135	2.8
35	Variable-mu	5-2	Heat.	2.5	1.75	250	6.5
36	R. F. amplifier	5-2	Heat.	6.3	0.30	180	3.1
37	Gen. purpose	5-1	Heat.	6.3	0.30	180	4.7
38	Power amp.	5-2	Heat.	6.3	0.30	135	9.0
39	Variable-mu	5-2	Heat.	6.3	0.30	180	4.5
40	Power amp.	5-1	Heat.	15.0	0.40	180	21.0
40	Voltage amp.	4-1	Fil.	5.0	0.25	180	0.2
41	Pow. pentode	6-3	Heat.	6.3	0.65	167	16.5
42	Pow. pentode	6-3	Heat.	6.3	0.65	250	34.0
43	Pow. pentode	6-3	Heat.	25.0	0.30	95	20.0
44	R. F. amplifier	5-2	Heat.	6.30	0.30	90	6.0
						180	6.4
						250	6.5
45	Power amp.	4-1	Fil.	2.5	1.50	180	27.0
						250	34.0
46	Power amp.	5-4	Fil.	2.5	1.75	250	22.0
						300	4.0
						400	6.0
47	Power pentode	5-4	Fil.	2.5	1.75	250	31.0
48	Gen. purpose	5-1	Heat.	15.0	0.35	90	4.5
48	Output tetrode	5-2	Heat.	30.0	0.40	95	47.0
49	Power amp.	5-3	Fil.	2.0	0.12	135	5.7
50	Power amp.	4-1	Fil.	7.5	1.25	350	45.0
						450	55.0
51	Variable-mu	5-2	Fil.	2.5	1.75	180	5.8
						250	6.3
52	Output amp.	4-1	Fil.	6.3	0.30	100	42.0

THERMIONIC VACUUM TUBES

J. R. Martin

TUBES

The type of base is indicated by two figures, the first of which is the number of prongs. See illustration at end of table.

Type No.	Screen voltage	Grid bias, volts	Plate resist., ohms	Amp. factor	Mutual cond. μ mho	Power output m watts	Load resist. ohms
00-A	...	0	30000	20.0	666		
01-A	...	4.5	11000	8.0	725		
11	...	10.5	15000	6.6	440		
12	...	10.5	15000	6.6	440		
12-A	...	13.5	5000	8.5	1700	260	10800
20	...	22.5	6300	3.3	525	110	6500
22	30	1.5	700000	400	570		
22	45	1.5	850000	350	300		
24-A	90	3.0	400000	400	1000		
26	...	10.0	7600	8.3	1100		
26	...	1.5	9000	10.5	1165		
27	...	9.0	9000	9.0	1000		
28	...	1.5	9000	10.5	1165		
29	...	3.0	20700	30.0	1450		
30	...	27.0	3500	3.8	1100		
30	...	13.5	10300	9.3	900		
31	...	22.5	4100	3.8	925	185	7000
32	67	3.0	1.2 meg.	780	650	375	5700
32	...	3.0	32000	30.0	940		
33	135	13.5	50000	70.0	1450	700	7000
34	67	3.0	600000	360	600		
35	90	3.0	350000	370	1050		
36	90	3.0	350000	370	1050		
37	...	13.5	10000	9.0	900		
38	135	13.5	102000	100	975	525	13500
39	90	3.0	750000	750	1000		
40	...	40.5	2000	3.0	1500		
40	...	3.0	150000	30	200		
41	167	12.5	120000	215	1800	1200	11000
42	250	16.5	100000	220	2200	3000	9000
43	95	15.0	45000	90	2000	900	4500
44	90	3.0	150000	152	1010		
	90	3.0	410000	426	1040		
	90	3.0	600000	630	1050		
45	...	34.5	1900	3.5	1850	780	3500
		50.0	1750	3.5	2000	1600	3900
46	250	33.0	2380	5.6	2350	1250	6400
	0	0	Class B Operation		....	16000	1300
	0	0	60000	150	2400	20000	1450
47	...	16.5	60000	150	2500	2500	7000
48	...	4.5	9000	10.5	1185		
48	95	20.0	10000	28.0	2800	1600	2000
49	...	20.0	4000	4.5	1125	170	
50	...	63.0	1900	3.8	2000	2400	4100
		84.0	1800	3.8	2100	4600	4350
51	75	1.5	500000	525	1050		
	90	3.0	500000	525	1050		
52	...	0	Class B Operation				

RECEIVING

Type No.	Purpose	Base	Cathode Type	Cathode Voltage	Cathode Current, amp.	Plate voltage	Plate current, ma
55	Diode-triode	6-4	Heat.	2.5	1.00	250	8.0
56	Amplifier	5-1	Heat.	2.5	1.00	250	5.0
	Detector	5-1	Heat.	2.5	1.00	250	0.2
57	R. F. amplifier	6-1	Heat.	2.5	1.00	250	2.0
	Detector	6-1	Heat.	2.5	1.00	250	0.1
	A. F. amplifier	6-1	Heat.	2.5	1.00	250	0.5
58	Variable-mu	6-1	Heat.	2.5	1.00	250	8.2
59	Three grid	7-1	Heat.	2.5	2.00	250	30.0
	Pow. amp	...	....	.....	....	400	15.0
	(As pentode)	...	....	.....	....	250	35.0
64	R. F. amp	5-2	Heat.	6.3	0.40	135	3.0
65	R. F. amp	5-2	Heat.	6.3	0.40	135	3.5
67	Power amp	5-1	Heat.	6.3	0.40	135	5.0
68	Output pentode	6-3	Heat.	6.3	0.40	135	14.0
69	Spec. detector	6-2	Heat.	6.3	0.30	180	4.5
71-A	Power amp	4-1	Fil.	5.0	0.25	180	20.0
85	Diode-triode	6-4	Heat.	6.3	0.30	250	7.0
89	3-Grid amp	6-1	Heat.	6.3	0.40	160	17.0
	(B amplifier)	...	....	.....	....	...	3.0
	(As pentode)	...	....	.....	....	...	20.0
99	Gen. purpose	4-1	Fil.	3.3	0.06	90	2.5
182B	Power amp	4-1	Heat.	5.0	1.25	200	18.0
183	Power amp	4-1	Fil.	5.0	1.25	250	25.0
210	Power amp	4-1	Fil.	7.5	1.25	250	10.0
						350	16.0
						425	18.0
257	Power pentode	5-4	Fil.	5.0	0.30	110	20.0
401	Gen. purpose	4-1	Fil.	3.0	1.00	90	3.0
402	Power output	4-1	Fil.	3.0	1.50	180	20.0
291	A. F. amp	5-1	Heat.	12.3	0.30	120	3.0
		(Output	Stage)	.....	....	120	30.0
293	A. F. amp	5-1	Heat.	6.3	0.60	173	4.0
		(Output	Stage)	.....	....	180	17.5
295	A. F. amp	5-1	Heat.	2.5	4.0	250	4.0
		(Output	Stage)	.....	....	250	52.0
483	Power output	4-1	Fil.	5.0	1.35	180	15.3
484	Gen. purpose	4-1	Fil.	3.0	1.30	135	6.0
485	Gen. purpose	5-1	Heat.	3.0	1.30	135	5.5
LA	Output tube	...	Fil.	6.3	0.30	135	12.0
KR-5	Output pentode	...	Fil.	6.3	0.30	165	17.0
KR20	Two-grid det	...	Heat.	2.5	1.00	250	3.5
KR22	Two-grid det	...	Heat.	6.3	0.40	250	3.5
KR25	Output pentode	...	Heat.	2.5	1.75	250	34.0
GA	Pentode	...	Fil.	5.0	0.25	180	7.5
18	Output pentode	6-3	Heat.	14.0	0.30	250	34.0
75	Double diode	6-4	Heat.	6.3	0.30	250	0.8
	High mu triode						
77	Triple grid	6-4	Heat.	6.3	0.3	250	2.3
	Amp. and det	...	....	.....	....	250	0.1
78	3-Grid amp	6-4	Heat.	6.3	0.3	180	4.0
						250	10.5
2A5	Output pentode	6-2	Heat.	2.5	1.75	250	34.0
2A7	Pentagrid	7-2	Heat.	2.5	0.8	250	4.0
6A7	Pentagrid	7-2	Heat.	6.3	0.3	250	4.0
2B7	2-Diode pentode	7-2	Heat.	2.5	0.8	250	6.0
6B7	2-Diode pentode	7-2	Heat.	6.3	0.3	250	6.0
864	Amp. and det	4-1	Fil.	1.1	0.25	135	
						90	2.9

TUBES (Continued)

Type No.	Screen voltage	Grid bias, volts	Plate resist., ohms	Amp. factor	Mutual cond. μ mho	Power output m watts	Load resist. ohms
55	...	20.0	7500	8.3	1100		
56	...	13.5	9500	13.8	1450		
	...	20.0	......	13.8			
57	100	3.0	1.5 meg.	1500	1225		
	100	6.0	......	1500			
	50	1.0	3 meg.	1800	600		
58	100	3.0	800000	1280	1600		
59	...	28.0	2500	6.0	1200	1250	5000
	...	0	......	6.0	....	20000	1500
	250	18.0	45000	100	2220	3000	7000
64	67	1.5	350000	370	1050		
65	67	1.5	320000	320	1000		
67	...	9.0	8200	9.0	1100		
68	135	13.5	64500	90.0	1400		
69	...	3.0	20700	30.0	1450		
71-A	...	43.0	1850	3.0	1620	700	5350
85	...	20.0	8300	8.3			
89	...	20.0	3000	9.7	1570	300	7000
	...	0	......	......	....	6000	2350
	180	18.0	82500	135	1635	1500	8000
99	...	4.5	15500	6.6	425		
182B	...	29.0	3330	5.0	1500		
183	...	60.0	1670	3.0	1800		
210	...	22.0	6000	8.0	1330	400	13000
	...	31.0	5150	8.0	1550	900	11000
	...	39.0	5000	8.0	1600	1600	10200
257	110	21.5	41000	55.0	1350	800	6000
401	...	4.5	10000	8.0	1000		
402	...	40.0	2000	3.0	1000		
291	...	11.0	8700	6.8	780	.....	20000
	...	11.0	4400	11.2	2550	1250	3000
293	...	6.5	......	......	....	.....	100000
	...	6.5	......	......	....	1250	8000
295	...	14.0	12000	14.4	1200	.....	7500
	...	3.0	3000	13.0	4350	4500	4000
483	...	40.5	2450	3.3	1340		
484	...	6.0	8900	12.5	1400		
485	...	6.0	8900	12.5	1400		
LA	135	9.0	5260	100	1900	700	9500
KR-5	165	11.0	47000	100	2100	1200	8000
KR20	...	0	10000	14.0	1400	.....	100000
KR22	...	0	10000	14.0	1400	.....	100000
KR25	250	16.5	100000	220	2200	3000	9000
GA	180	10.0	30000	60.0	2000	800	7000
18	250	16.5	75000	165	2200	3000	9000
75	...	2.0	91000	100	1100		
77	100	3.0	1.5 meg.	1875	1250		
	100	6.0	......	1875			
78	75	3.0	1 meg.	1100	1100		
	125	3.0	600000	990	1650		
2A5	250	16.5	7500	165	2200	3000	9000
2A7	100	3.0	300000	......	475		
6A7	100	3.0	300000	......	475		
2B7	100	3.0	800000	800	1000		
6B7	100	3.0	800000	800	1000	.....	200000
864	...	9.0	......	8.2			
	...	4.5	13500	8.2	610		

TELEPHONE AND INDUSTRIAL TUBES

General information						Average characteristics				
		Cathode								
Model	Description	Type	Voltage	Current amp.	Plate voltage	Grid bias, volts	Plate current, ma	Plate resist., ohms	Amplification factor	Mutual conductance μ mho
101-D	Repeater	Coat.	4.5	1.00	130	9.0	7.5	5700	5.9	1030
101-F	Repeater	Coat.	4.0	0.50	150	15.0	15.0	6000	6.5	1120
101-H	Repeater	Coat.	4.5	1.00	130	9.0	7.5	5700	5.9	1030
102-D	Volt. amp	Coat.	2.25	0.95	130	1.5	0.65	60000	30.0	500
102-F	Volt. amp	Coat.	2.0	0.50	130	1.5	0.65	60000	30.0	550
102-G	Volt. amp	Coat.	2.0	1.00	130	1.5	0.65	60000	30.0	500
104-H	Cable amp	Coat.	4.5	1.00	130	20	20.5	2100	2.5	1190
105-A	Amplifier	Coat.	4.0	0.50	150	0	40.0	3000	5.0	1500
107-A	18-cm osc.	Tung.	4.0	3.00	−50	250	10.0	......	grid cur. = 60 ma	...
203-D	Gen. pur	Coat.	2.6	1.00	60	3	1.8	10000	6.8	680
205-D, E	Output tube	Coat.	4.5	1.60	350	20.0	35.0	3500	7.3	2080
215-A	Gen. pur	Coat.	1.0	0.25	60	3.0	1.8	18000	5.8	320
216-A	Gen. pur	Coat.	6.0	1.05	130	9.0	6.5	6000	5.8	970
230-D	Gen. pur	Coat.	3.1	0.06	90	3.0	2.1	16000	8.0	500
231-D	Gen. pur	Coat.	3.0	0.06	90	3.0	2.1	16000	8.0	500
239-A	Gen. pur	Coat.	1.1	0.27	100	8.0	2.3	15000	6.2	410
235-D	Gen. pur	Coat.	5.0	0.25	135	6.0	5.0	7000	9.0	1280
244-A	Heat. type amp	Heat.	2.0	1.60	135	6.0	5.5	10000	10.0	1000
247-A	Gen. pur	Heat.	2.0	1.60	135	4.5	3.3	16000	14.9	930
252-A	A. F. pwr. amp	Coat.	5.0	2.00	450	60.0	60.0	1500	5.1	3400
257-A	Amplifier	Coat.	10.0	3.20	135	4.5	2.8	16000	15.0	940
262-A	A. F. amp	Heat.	3.1	0.06	90	3.0	2.1	16000	8.0	500
264	A. F. amp	Coat.	1.1	0.25	90	4.5	2.9	13400	8.2	610
264-A	Non-microphonic	Coat.	1.5	0.30	100	8.0	2.1	13000	6.9	530
268-A	R. F. osc. or amp	Thor.	5.0	3.20	500	50.0	60.0	5000	5.0	1000
271-A	Pwr. amp	Heat.	5.0	2.00	350	22.5	40.0	3750	8.6	2800
272-A	Pwr. amp	Heat.	10.0	0.32	100	7.0	5.7	6400	6.0	940
273-A	Detector	Heat.	2.0	1.60	135	1.5	50.0	320000	102.0	320
275-A	A. F. pwr. amp	Coat.	5.0	1.20	200	45.0	45.0	1000	2.9	2900
864	Non-microphonic	Coat.	1.1	0.25	90	4.5	2.7	15000	8.2	560

TELEPHONE AND INDUSTRIAL TUBES (Continued)

General information		Cathode				Average characteristics				
Model	Description	Type	Voltage	Current amp.	Plate voltage	Grid bias, volts	Plate current, ma	Plate resist., ohms	Amplification factor	Mutual conductance μ mho
DRH-500	Ionization gauge	Tung.	5.5	1.15	180	12.0	3.5	19000	6.6	350
DRH-501	Ionization gauge	Tung.	5.0	3.00	180	12.0	4.5	16500	6.6	400
DRH-505	Electrometer tube	Coat.	2.5	0.25	6	4.5	0.2	20000	1.0	50
DRJ-521	Interstage amp	Coat.	2.5	1.00	250	9.0	13.0	6000	12.0	2000
DRJ-522	Interstage amp	Coat.	2.5	1.00	250	13.5	5.0	9500	13.8	1450
DRJ-524	Non-microphonic	Coat.	1.1	0.25	90	4.5	2.5	15000	8.0	530
RJ-526	Interstage amp	Coat.	1.25	0.92	135	9.0	5.2	8000	8.2	1050
DRJ-528	Low-filament cur	Coat.	10.0	0.06	135	9.0	9.0	5000	5.7	1150
RJ-544	Non-microphonic	Coat.	1.1	0.25	180	1.5	1.0	75000	35.0	465
DRJ-546	Volt. amp	Coat.	2.5	1.5	450	4.5	13.5	13500	30.0	2200
DRJ-548	Volt. amp	Coat.	5.0	0.25	180	1.5	1.4	40000	37.0	925
DRJ-549	Volt. amp	Coat.	2.5	1.00	180	1.5	4.0	25000	30.0	1200
RJ-550	Low grid cur	Coat.	2.5	0.92	95	5.0	6.0	5150	8.5	1650
DRJ-551	Cur. amp	Coat.	7.5	1.25	450	32.0	38.0	2900	8.0	2750
DRJ-552	Cur. amp	Coat.	7.5	0.50	425	30.0	20.0	4000	8.4	2100
RJ-553	Low grid cur. amp	Coat.	6.0	1.05	95	12.0	8.5	3200	3.85	1200
DRJ-554	Cur. amp	Coat.	1.1	0.25	135	15.0	8.0	7000	3.5	5000
DRJ-555	Osc. cur. amp	Coat.	7.5	1.25	450	80.0	55.0	1800	3.8	2100
DRJ-556	Low grid cur. amp	Coat.	2.5	0.25	95	5.0	4.5	7500	6.8	900
DRJ-557	Cur. amp	Heat.	2.5	1.00	180	22.5	20.0	3500	3.5	1000
DRJ-559	Low grid cur	Coat.	2.5	0.25	95	5.0	3.5	8800	8.4	950
DRJ-562	Cur. amp	Coat.	2.5	1.00	180	22.5	17.5	2500	4.8	1925
RJ-563	Cur. amp	Coat.	2.5	3.00	250	5.0	200	800	4.0	5000
DRJ-564	Cur. amp	Coat.	2.5	4.00	250	5.0	320	500	3.5	7000
DRJ-571	3 grid tube	Heat.	2.5	1.00	250	3.0	4.0	200000	200	1000
FP-54	Low grid cur	Thor.	2.5	0.09	6.0	4.0	0.04	40000	1.0	25.0
FP-62	Ionization gauge	Tung.	4.5	1.48	grd 112.5	22.5 coll.	10. grd	......	......	....
PJ-2	Volt. amp	Thor.	4.5	1.10	350	4.0	4.5	26800	30.0	1120
PJ-4	Pwr. amp	Thor.	4.5	1.10	350	20.0	19.0	6400	8.5	1330
PJ-7	Volt. amp	Thor.	4.5	1.10	350	6.0	4.5	26800	30.0	1120
PJ-8	Gen. pur	Thor.	4.5	1.10	350	30.0	19.0	6400	8.5	1330
PJ-21	Mod	Thor.	4.5	1.10	350	8.3	19.5	3160	3.0	950

TRANSMITTING

Three-

General information							Oscillator or	
Type No.	Description and use	Cooling	Cathode			Amp. factor	Max. d.c. volts	
			Type	Voltage	Current, amp.		Mod.	Unmod.
203-A	Osc. & r. f. pwr. amp.	Air	Tung.	10.0	3.25	25	1000	1250
204-A	Osc. & r. f. pwr. amp.	Air	Thor.	11.0	3.85	25	2000	2500
206	Osc. & r. f. pwr. amp.	Air	Tung.	11.0	14.75	350	12000	15000
207	Osc. & r. f. pwr. amp.	Water	Tung.	22.0	52.00	20	12000	15000
211	Gen. pur.	Air	Thor.	10.0	3.25	12	1000	1250
211-D, E	A. F. amp.	Air	Coat.	10.0	3.00	12	.....	.....
212-D	250-w amp.	Air	Coat.	14.0	6.00	16	.....	.....
220-B	10 kw amp.	Water	Tung.	22.0	41.00	40	.....	.....
228-A	5 kw amp.	Water	Tung.	22.0	41.00	16	.....	.....
232-A	25 kw amp.	Water	Tung.	21.0	61.00	40	.....	.....
236-A	Amplifier.	Water	Tung.	21.5	41.00	40	.....	.....
240-A	H. F. osc.	Water	Tung.	21.0	41.00	40	.....	.....
241-A	H. F. amp.	Air	Coat.	14.0	6.00	16	.....	.....
242-A	50-w amp.	Air	Thor.	10.0	3.25	13	.....	.....
243-A	R. F. amp.	Water	Tung.	10.5	41.00	40	.....	.....
248-A	50-w amp.	Air	Coat.	10.0	3.00	12	.....	.....
251-A	1000-w amp.	Air	Thor.	10.0	15.60	11	.....	.....
261-A	50-w amp.	Air	Thor.	10.0	3.25	12	.....	.....
265-A	R. F. amp.	Water	Tung.	22.0	183.00	32	.....	.....
270-A	R. F. amp. or mod.	Air	Thor.	10.0	9.75	16	.....	.....
276-A	Gen. pur.	Air	Thor.	10.0	3.00	12	.....	.....
279-A	R. F. amp. or mod.	Air	Thor.	10.0	21.00	10	.....	.....
520-B	Osc. & r. f. amp.	Water	Tung.	22.0	34.00	16	7500	10000
520-M	Modulator.	Water	Tung.	22.0	34.00	8	.....	.....
525	H. F. osc. & amp.	Air	.....	7.5	2.50	6	.....	.....
571	Osc. & r. f. pwr. amp.	Air	Thor.	11.0	10.0	16	.....	.....
831	Shortwave osc.	Air	Thor.	11.0	10.0	14.5	3000	3500
841	Volt. amp.	Air	Thor.	7.5	1.25	30	.....	.....
842	A. F. pwr. amp.	Air	Thor.	7.5	1.25	3	350	450
843	A. F. or r. f. amp.	Air	Heat.	2.5	2.50	8.5	.....	.....
845	A. F. pwr. amp. or mod	Air	Thor.	10.0	3.25	5	.....	.....
846	Shortwave osc.	Water	Tung.	11.0	49.0	38	6000	7500
848	Gen. pur.	Water	Tung.	22.0	52.0	8	12000	15000
849	Gen. pur.	Air	Thor.	11.0	5.0	19	2000	2500
851	Gen. pur.	Air	Thor.	11.0	15.50	20	2000	2500
852	Osc. & r. f. pwr. amp.	Air	Thor.	10.0	3.25	12	2000	3000
853	Osc. & r. f. pwr. amp.	Air	Tung.	10.0	16.75	12	2000	2500
858	Osc. & r. f. pwr. amp.	Water	Tung.	22.0	52.00	42	16000	20000
862	Osc. & r. f. pwr. amp.	Water	Tung.	33.0	207.0	48	.....	20000
863	Osc. & r. f. pwr. amp.	Water	Tung.	22.0	52.00	50	12000	15000
1652	Gen. pur.	Water	Tung.	14.5	52.00	14	6000	7500
AW-220	Osc. & r. f. pwr. amp.	Water	Tung.	30.0	325	10.5	18000	22000
100-A	Osc. & r. f. pwr. amp.	Air	Tung.	11.0	25.00	14	.....	.....
101-A	Osc. & r. f. pwr. amp.	Water	Tung.	28.0	51.0	18	.....	.....
102-A	Osc. & r. f. pwr. amp.	Air	Tung.	10.0	11.0	8	.....	.....
348-A	Modulator.	Water	Tung.	22.0	52.0	8	.....	.....
358-A	H. F. osc. & amp.	Water	Tung.	22.0	52.0	42	.....	.....
363-A	Osc. & pwr. amp.	Water	Tung.	22.0	52.0	50	.....	.....
510	Osc. or amp.	.....	Oxide	7.5	1.25	8	425	500
545	A. F. amp. or mod.	.....	Thor.	10	3.25	5	.....	.....
504	Osc. or r. f. amp.	.....	Thor.	11.0	14.75	25	2000	2500
500	Osc. or r. f. amp.	Water	Tung.	22	30	.....	10000	10000

TUBES
Electrode

Type No.	r. f. amplifier			Average characteristics			
	Max. plate diss. watts	Max. r. f. grid amp.	Normal plate voltage	Grid bias volts	Plate curr. amp.	Ave. a.c. plate resist. ohms	Ave., G. M., μ mho
203-A	100	7.5	1000	10	0.072	6000	4200
204-A	250	10.0	2000	32	0.125	6300	4000
206	350	10.0	10000	0	0.023	300000	1170
207	10000	30.0	10000	310	0.750	3500	5700
211	100	7.5	1000	50	0.072	3400	3530
211-D, E	65	....	750	30	0.065	3200	3900
212-D	250	....	1500	60	0.015	2150	7500
220-B	10000	....	10000	250	1.500	8000	5000
228-A	5000	....	5000	300	1.500	2000	8000
232-A	25000	....	18000	450	3.000	7000	5700
236-A	15000	....	15000	400	1.500	8000	5000
240-A	10000	....	10000	250	1.500	9000	4450
241-A	200	....	1500	100	0.200	2150	7500
242-A	100	....	1000	80	0.085	3500	3600
243-A	2000	....	10000	250	0.400	20000	2000
248-A	65	....	750	30	0.065	3500	3400
251-A	1000	....	3000	300	0.275	2500	4650
261-A	100	....	1000	80	0 0725	3500	3400
265-A	100000	....	18000	550	8.000	2250	14000
270-A	350	....	2500	150	0.200	1800	8900
276-A	100	....	1000	80	0.125	3600	3300
279-A	1200	....	3000	300	0 600	1800	5550
520-B	5000	20	7500	300	0.400	4000	4000
520-M	......	....	6000	400	0.800	1600	5000
525	......	....	425	35	....	......	.....
571	5000	....	3000	50	0.250	5000	3200
831	400	10.0	3000	121	0.133	6450	2250
841	......	....	425	8	0.0075	21500	1400
842	15	....	425	100	0.028	2500	1200
843	......	....	500	40	0.025	4250	2000
845	......	....	1000	147	0.075	1800	3000
846	2.5 kw	30.0	6600	70	0.15	......	.....
848	10 kw	30.0	10000	1000	0.750	2400	3300
849	400	10.0	3000	132	0.100	3200	6000
851	750	10.0	2000	65	0.300	1400	15000
852	100	10.0	2000	108	0.05	10000	1200
853	250	....	2000	100	0.130	4100	2900
858	20 kw	60.0	18000	155	0.750	8700	4800
862	100 kw	60.0	18000	35	3.000	2800	17150
863	10 kw	30.0	10000	20	0.750	7200	7000
1652	5 kw	10.0	6000	235	0.750	2600	5400
AW-220	150 kw	....	18000	1300	5.00	640	21000
100-A	500	8.0	2000	0	0.175	7000	2000
101-A	35 kw	50.0	1000	0	1.100	3000	6000
102-A	150	30.0	7000	0	0.150	3000	1500
348-A	10 kw	30.0	5000	0	3.00	2400	3300
358-A	20 kw	60.0	15000	0	1.20	8700	4800
363-A	10 kw	30.0	10000	0	0.80	7800	6400
510	15	5	.....	....	0.06	5450	1550
545	......	....	1000	150	....	2100	2380
504	250	10	.....	....	0.275	5000	5000
500	5000	20	.....	....	0.800	3800	3950

General information					Oscillator and R. F.		
Model	Description and use	Cathode Type	Cathode Voltage	Cathode Current, amp.	Max. d.c. plate volts mod.	Max. d.c. plate volts unmod.	Max. plate diss. watts
844	Gen. pur.	Heat.	2.5	2.50	500	500	15
850	Osc. & r. f. pwr. amp.	Thor.	10.0	3.25	1000	1250	100
860	Osc. & r. f. pwr. amp.	Thor.	10.0	3.25	2000	3000	100
861	Osc. & r. f. pwr. amp.	Thor.	11.0	10.0	3500	4000	400
865	Osc. & r. f. pwr. amp.	Thor.	7.5	2.0	750	750	15
DRJ-571	. . . .	Heat.	2.5	1.0	....	....	...
245-A	H. F. amp.	Heat.	2.0	1.6	....	....	...
246-A	H. F. amp.	Coat.	3.4	0.1	....	....	...
254-A	R. F. amp.	Thor.	5.0	3.2	....	....	20
254-B	R. F. amp.	Thor.	7.5	3.2	....	....	25
259-A	R. F. amp.	Heat.	2.0	1.6	....	....	...
260-A	Osc. & r. f. pwr. amp.	Thor.	10.0	3.2	2000	....	100
278-A	H. F. amp.	Thor.	10.0	15.6	....	....	800
281-A	Amplifier.	Oxide	5.0	1.6	....	....	...
282-A	R. F. amp.	Thor.	10.0	3.0	....	....	70
283-A	R. F. amp.	Heat.	2.0	1.6	....		...

GASEOUS RECTIFIERS

Model	Maximum dimensions Length	Maximum dimensions Diam.	Cathode Type	Cathode Voltage	Cathode Current, amp.	Max. peak inverse volt.	Peak cur. amp.	Max. average amp.
249-A	8.75	2.688	Coat.	2.5	7.0	6500	1.1	......
253-A	6.813	2.188	Coat.	2.5	3.0	3500	0.5	......
255-A	......	....	Coat.	5.0	20.0	.....	3.0	......
258-A	8.938	2.688	Coat.	2.5	7.0	6300	1.1	......
263-A	10.750	3.250	Coat.	2.5	16.0	100	6.0	......
266-A	......	....	Coat.	5.0	60.0	.....	12.0	......
267-A	11.000	3.875	Coat.	5.0	10.0	5000	2.5	......
280-A	6.563	2.188	Coat.	2.5	3.0	.....	0.3	......
857	19.875	7.125	Coat.	5.0	37.0	20000	20.0	......
866	6.625	2.438	Coat.	2.5	5.0	7500	0.6	......
869	14.375	5.063	Coat.	5.0	20.0	20000	5.0	......
871	4.500	1.187	Coat.	2.5	2.0	5000	0.3	......
872	8.500	2.313	Coat.	5.0	10.0	7500	2.5	......
985	4.625	1.750	Coat.	5.0	0.5	500	0.1	......
PJ-26	14.375	5.063	Coat.	5.0	20.0	20000	10.0	2.5
PJ-28	6.625	2.438	Coat.	2.5	5.0	7500	2.0	0.5
FG-15	19.875	7.125	Heat.	5.0	37.0	20000	40.0	10.0
FG-19	8.500	2.313	Coat.	5.0	10.0	7500	5.0	1.25
FG-26	7.000	2.438	Coat.	5.0	7.0	1000	10.0	2.5
FG-28	14.625	5.063	Heat.	5.0	17.5	3500	75.0	12.5
FG-32	7.000	3.000	Heat.	5.0	4.5	1000	15.0	2.5
FG-42	29.375	10.125	Heat.	5.0	80.0	15000	450.0	75.0
FG-52	25.500	8.75	Heat.	5.0	80.0	1500	600.0	100.0
FG-64	4.625	1.1875	Coat.	2.5	2.0	1000	0.5	0.12
KI-605	5.000	1.438	Coat.	2.5	2.0	5000	0.3	0.2
DKI-606	25.000	18.000	Mercury pool 3-phase			15000	50.0	20.0
KI-620	9.000	3.25	Coat.	5.0	11.5	5000	10.0	4.0
DKI-624	19.75	7.125	Coat.	5.0	40.0	5000	65.0	25.0
KI-625	14.375	5.125	Coat.	5.0	20.0	5000	22.5	10.0
KI-626	6.75	2.438	Coat.	2.5	6.0	5000	1.2	0.64
82	4.688	1.813	Coat.	2.5	3.0	1400	0.4	0.12
83	5.375	2.063	Coat.	5.0	3.0	1400	0.8	0.25
KR-1	4.25	1.563	Heat.	6.3	0.3	500	0.2	0.05
BA	4.625	2.438	....	...	...	350	.....	0.35
BH	4.625	1.813	....	...	...	350	.....	0.12
BR	3.75	1.563	....	...	...	600	.....	0.05

Four Electrode

Model	Pwr. amplifier: Max. screen diss. watts	Max. grid amp.	Normal output watts	Max. d.c. plate amp.	Average characteristics: Plate voltage	Screen volts	Grid bias volts	Plate resist. ohms	Amplification factor
844	3	2.0	5	0.030	500	180	6	125000	75
850	10	7.5	100	0.175	1000	200	0	200000	550
860	10	10.0	100	0.100	2000	500	30	180000	200
861	35	10 0	540	0.350	3000	750	20	143000	300
865	3	5.0	12.5	0.06	500	125	0	200000	150
DRJ-571	..	....	.....	.....	250	100	3.0	200000	200
245-A	..	....	.....	.....	180	45	1.5	160000	170
246-A	..	....	.....	.....	180	45	1.5	700000	385
254-A	..	....	.....	.....	500	175	40	80000	80
254-B	..	....	.....	.....	750	150	60	75000	100
259-A	..	....	.....	.....	180	75	1.5	400000	550
260-A	15	....	.....	.....	2000	300	100	175000	200
278-A	..	....	.....	.....	3000	500	125	85000	400
281-A	..	....	.....	.....	130	60	50	3500	5
282-A	..	....	.....	.....	1000	200	100	70000	100
283-A	..	....	.....	.....	180	75	1.5	475000	650

HIGH VACUUM RECTIFIERS

Type	Cooling	Cathode: Type	Voltage	Current, amp.	Max. peak inverse volt.	Max. peak plate current amp.
214	Water	Tung.	22.0	52.00	50000	7.500
214-E	Air	Thor.	10.0	3.20	......	0.150
217-A	Air	Coat.	6.0	1.00	......	0.025
217-A	Air	Thor.	10.0	3.25	3500	0.600
217-C	Air	Thor.	10.0	3.25	7500	0.600
218	Air	Tung.	11.0	14.75	50000	0.750
219	Air	Tung.	22.00	24.50	50000	2.500
219-D	Air	Coat.	14.0	6.00	......	0.250
222-A	Water	Tung.	21.5	41.00	......	3.500
233-A	Water	Tung.	21.5	41.00	......	2.000
234-A	Air	Thor.	11.0	3.90	......	1.000
237-A	Water	Tung.	20.0	61.00	......	5.000
274-A	Air	Coat.	5.0	2.00	......	0.150
280	Air	Coat.	5.0	2.00	550	0.135
281	Air	Coat.	7.5	1.25	700	0.085
1651	Air	Tung.	11.0	14.75	4000	0.250
DRO-580	Air	Oxide	5.0	0.25	600	0.040
DRO-581	Air	Tung.	5.0	2.20	3000	0.010
DRO-582	Air	Tung.	5.0	2.50	7500	0.015
DRO-583	Air	Tung.	5.0	4.50	15000	0.025
DRO-584	Air	Tung.	5.0	5.50	30000	0.035
DRO-587	Air	Oxide	2.5	4.00	750	0.450
DRO-588	Air	Oxide	2.5	4.00	1500	0.450
WL-608	Air	Tung.	10.0	10.00	50000	0.200
WL-612	Air	Tung.	10.0	50.00	150000	0.100
WL-613	Air	Tung.	10.0	10.00	140000	0.200
WL-660	Air	Tung.	10.0	10.00	230000	0.100
FP-78	Air	Tung.	10.0	10.00	125000	0.300
FP-84	Oil & air	Tung.	10.0	14.50	75000	0.300
FP-92	Air	Tung.	10.0	14.50	140000	0.300
KC-1	Air	Tung.	9.0	32.00	100000	1.000
KC-3	Air	Tung.	12.5	32.00	150000	1.000
KC-4	Air	Tung.	20.0	25.00	140000	1.000
KP-2	Air	Tung.	10.0	10.00	75000	0.300
103-A	Water	Tung.	28.0	51.00	60000	6.500
104-A	Air	Tung.	11.0	25.00	30000	1.250
282	Air	Coat.	2.5	3.00	1400	0.400
283	Air	Coat.	2.5	5.00	500	0.250
866	Air	Coat.	2.5	5.00	7500	0.600

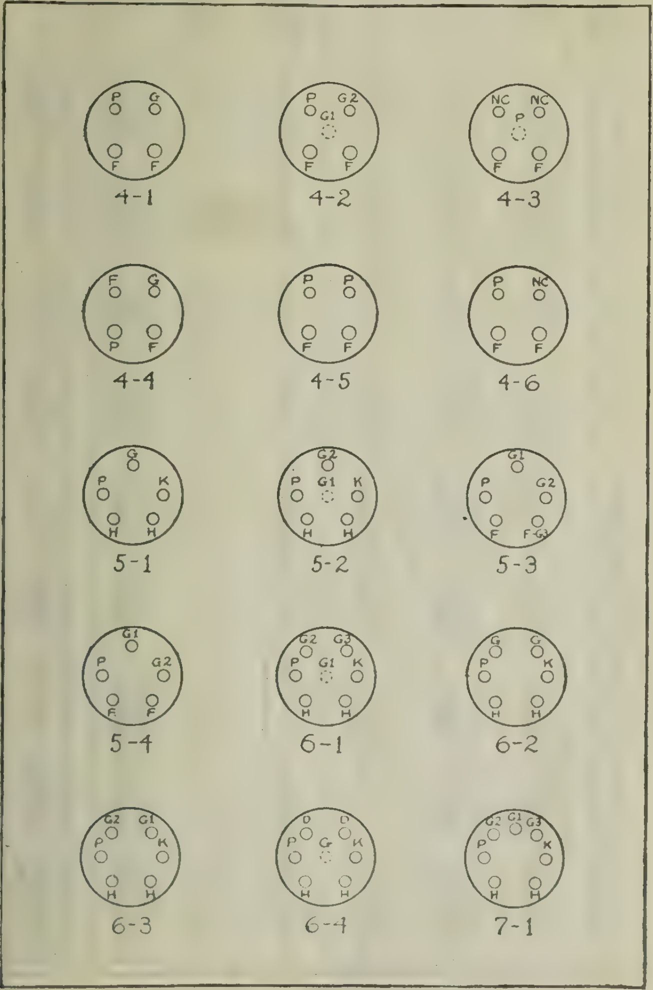
GRID-CONTROLLED RECTIFIERS
Thyrations, Grid-glow Tubes, Etc.

Model	Maximum dimensions		Cathode			Max. peak inverse volt.	Max. peak amp.	Max. average amp.
	Length	Diam.	Type	Voltage	Current, amp.			
256-A	4.875	1.8125	Heat.	2.3	1.7	.....	......	....
269-A	4.5625	2.375	Coat.	2.2	0.55	.....	......	....
277-A	6.75	2.0625	Heat.	5.0	2.0	350	0.5	....
KU-610	6.5	2.4375	Coat.	2.5	6.5	1500	0.80	0.40
DKU-632	5.75	2.125	Coat.	2.5	2.0	1500	0.30	0.10
KU-618	5.75	2.125	Cold	.....	.....	800	0.1	0.015
DKU-622	19.75	7.125	Coat.	5.0	40	5000	65	25
DKU-623	14.375	5.125	Coat.	5.0	20	5000	22.5	10
KU-627	7	2.4375	Coat.	2.5	6	5000	1.2	0.64
KU-628	9	3.25	Coat.	5.0	11.5	5000	10.0	4.0
FG-17	6.625	2.4375	Coat.	2.5	5.0	2500	2.0	0.5
FG-27	7	3	Coat.	5.0	7.0	1000	10.0	2.5
FG-29	14.625	5.0625	Heat.	5.0	17.5	3500	75.0	12.5
FG-33	8	3	Heat.	5.0	4.5	1000	15.0	2.5
FG-37	7.5	3	Heat.	115.0	0.2	1000	15.0	2.5
FG-41	17.625	5.0625	Heat.	5.0	17.5	15000	75.0	12.5
FG-43	30.25	10.125	Heat.	5.0	80.0	15000	450.0	75.0
FG-53	28	8.75	Heat.	5.0	60.0	1500	600.0	100.0
FG-57	7	3	Heat.	5.0	4.5	1000	15.0	2.5
FG-65	4.625	1.1875	Coat.	2.5	2.0	1000	0.5	0.125
FG-67	7	3	Heat.	5.0	4.5	1000	15.0	2.50
FG-81	6.625	2.4375	Coat.	2.5	5.0	180	2.0	0.50

BASE CONNECTIONS

Looking at Bottom of Tube

Symbols: D, Diode Plate; F, Filament; G, Grid; G1, Inner Grid; G2, Screen Grid; G3, Suppressor Grid; H, Heater; K, Cathode; NC, No Connection; P, Plate.



CONVERSION TABLE FOR TRANSMISSION UNITS

Decibels: For current or voltage ratio	Decibels: For power ratio	Amplf'n ratio	Attenu'n ratio
0.1	0.05	1.012	0.989
0.2	0.1	1.023	0.977
0.3	0.15	1.035	0.966
0.4	0.2	1.047	0.955
0.5	0.25	1.059	0.944
0.6	0.3	1.072	0.933
0.7	0.35	1.084	0.923
0.8	0.4	1.096	0.912
0.9	0.45	1.109	0.902
1.0	0.5	1.122	0.891
1.1	0.55	1.135	0.881
1.2	0.6	1.148	0.871
1.3	0.65	1.162	0.861
1.4	0.7	1.175	0.851
1.5	0.75	1.188	0.841
1.6	0.8	1.202	0.832
1.7	0.85	1.216	0.822
1.8	0.9	1.230	0.813
1.9	0.95	1.245	0.804
2.0	1.0	1.259	0.794
2.1	1.05	1.274	0.785
2.2	1.1	1.288	0.776
2.3	1.15	1.303	0.767
2.4	1.2	1.318	0.759
2.5	1.25	1.334	0.750
2.6	1.3	1.349	0.741
2.7	1.35	1.365	0.733
2.8	1.4	1.380	0.724
2.9	1.45	1.396	0.716
3.0	1.5	1.413	0.708
3.1	1.55	1.429	0.700
3.2	1.6	1.445	0.692
3.3	1.65	1.462	0.684
3.4	1.7	1.479	0.676
3.5	1.75	1.496	0.668
3.6	1.8	1.514	0.661
3.7	1.85	1.531	0.653
3.8	1.9	1.549	0.645
3.9	1.95	1.567	0.638
4.0	2.0	1.585	0.631
4.1	2.05	1.603	0.624
4.2	2.1	1.622	0.617
4.3	2.15	1.641	0.610
4.4	2.2	1.660	0.603
4.5	2.25	1.679	0.596

Decibels: For current or voltage ratio	Decibels: For power ratio	Amplf'n ratio	Attenu'n ratio
4.5	2.25	1.679	0.596
4.6	2.3	1.698	0.589
4.7	2.35	1.718	0.582
4.8	2.4	1.738	0.575
4.9	2.45	1.758	0.569
5.0	2.5	1.778	0.562
5.1	2.55	1.799	0.556
5.2	2.6	1.820	0.550
5.3	2.65	1.841	0.543
5.4	2.7	1.862	0.537
5.5	2.75	1.884	0.531
5.6	2.8	1.906	0.525
5.7	2.85	1.928	0.519
5.8	2.9	1.950	0.513
5.9	2.95	1.972	0.507
6.0	3.0	1.995	0.501
6.1	3.05	2.018	0.495
6.2	3.1	2.04	0.490
6.3	3.15	2.06	0.484
6.4	3.2	2.09	0.479
6.5	3.25	2.11	0.473
6.6	3.3	2.14	0.468
6.7	3.35	2.16	0.462
6.8	3.4	2.19	0.457
6.9	3.45	2.21	0.452
7.0	3.5	2.24	0.447
7.1	3.55	2.26	0.442
7.2	3.6	2.29	0.437
7.3	3.65	2.32	0.432
7.4	3.7	2.34	0.427
7.5	3.75	2.37	0.422
7.6	3.8	2.40	0.417
7.7	3.85	2.42	0.412
7.8	3.9	2.45	0.407
7.9	3.95	2.48	0.403
8.0	4.0	2.51	0.398
8.1	4.05	2.54	0.394
8.2	4.1	2.57	0.389
8.3	4.15	2.60	0.385
8.4	4.2	2.63	0.380
8.5	4.25	2.66	0.376
8.6	4.3	2.69	0.372
8.7	4.35	2.72	0.367
8.8	4.4	2.75	0.363
8.9	4.45	2.79	0.359
9.0	4.5	2.82	0.355

CONVERSION TABLE FOR TRANSMISSION UNITS

Decibels For current or voltage ratio	Decibels For power ratio	Amplf'n ratio	Attenu'n ratio	Decibels For current or voltage ratio	Decibels For power ratio	Amplf'n ratio	Attenu'n ratio
9.0	4.5	2.82	0.355	**14.0**	7.0	5.01	0.200
9.1	4.55	2.85	0.351	14.1	7.05	5.07	0.197
9.2	4.6	2.88	0.347	14.2	7.1	5.13	0.195
9.3	4.65	2.91	0.343	14.3	7.15	5.19	0.193
9.4	4.7	2.95	0.339	14.4	7.2	5.25	0.191
9.5	4.75	2.98	0.335	**14.5**	7.25	5.31	0.188
9.6	4.8	3.02	0.331	14.6	7.3	5.37	0.186
9.7	4.85	3.05	0.327	14.7	7.35	5.43	0.184
9.8	4.9	3.09	0.324	14.8	7.4	5.50	0.182
9.9	4.95	3.13	0.320	14.9	7.45	5.56	0.180
10.0	5.0	3.16	0.316	**15.0**	7.5	5.62	0.178
10.1	5.05	3.20	0.313	15.1	7.55	5.69	0.176
10.2	5.1	3.24	0.309	15.2	7.6	5.75	0.174
10.3	5.15	3.27	0.305	15.3	7.65	5.82	0.172
10.4	5.2	3.31	0.302	15.4	7.7	5.89	0.170
10.5	5.25	3.35	0.298	**15.5**	7.75	5.96	0.168
10.6	5.3	3.39	0.295	15.6	7.8	6.03	0.166
10.7	5.35	3.43	0.291	15.7	7.85	6.10	0.164
10.8	5.4	3.47	0.288	15.8	7.9	6.17	0.162
10.9	5.45	3.51	0.285	15.9	7.95	6.24	0.160
11.0	5.5	3.55	0.282	**16.0**	8.0	6.31	0.158
11.1	5.55	3.59	0.279	16.1	8.05	6.38	0.157
11.2	5.6	3.63	0.275	16.2	8.1	6.45	0.155
11.3	5.65	3.67	0.272	16.3	8.15	6.53	0.153
11.4	5.7	3.72	0.269	16.4	8.2	6.61	0.151
11.5	5.75	3.76	0.266	**16.5**	8.25	6.68	0.150
11.6	5.8	3.80	0.263	16.6	8.3	6.76	0.148
11.7	5.85	3.85	0.260	16.7	8.35	6.84	0.146
11.8	5.9	3.89	0.257	16.8	8.4	6.92	0.144
11.9	5.95	3.94	0.254	16.9	8.45	7.00	0.143
12.0	6.0	3.98	0.251	**17.0**	8.5	7.08	0.141
12.1	6.05	4.03	0.248	17.1	8.55	7.16	0.140
12.2	6.1	4.07	0.245	17.2	8.6	7.24	0.138
12.3	6.15	4.12	0.242	17.3	8.65	7.33	0.136
12.4	6.2	4.17	0.240	17.4	8.7	7.41	0.135
12.5	6.25	4.22	0.237	**17.5**	8.75	7.50	0.133
12.6	6.3	4.27	0.234	17.6	8.8	7.59	0.132
12.7	6.35	4.32	0.232	17.7	8.85	7.67	0.130
12.8	6.4	4.37	0.229	17.8	8.9	7.76	0.129
12.9	6.45	4.42	0.226	17.9	8.95	7.85	0.127
13.0	6.5	4.47	0.224	**18.0**	9.0	7.94	0.126
13.1	6.55	4.52	0.221	18.1	9.05	8.04	0.124
13.2	6.6	4.57	0.219	18.2	9.1	8.13	0.123
13.3	6.65	4.62	0.216	18.3	9.15	8.22	0.122
13.4	6.7	4.68	0.214	18.4	9.2	8.32	0.120
13.5	6.75	4.73	0.211	**18.5**	9.25	8.41	0.119
13.6	6.8	4.79	0.209	18.6	9.3	8.51	0.118
13.7	6.85	4.84	0.206	18.7	9.35	8.61	0.116
13.8	6.9	4.90	0.204	18.8	9.4	8.71	0.115
13.9	6.95	4.95	0.202	18.9	9.45	8.81	0.114
14.0	7.0	5.01	0.200	**19.0**	9.5	8.91	0.112

CONVERSION TABLE FOR TRANSMISSION UNITS
(Continued)

Decibels		Amplf'n ratio	Attenu'n ratio	Decibels		Amplf'n ratio	Attenu'n ratio
For current or voltage ratio	For power ratio			For current or voltage ratio	For power ratio		
19.0	9.5	8.91	0.112	**55**	27.5	562.	0.00178
19.1	9.55	9.02	0.111	56	28.0	631.	0.00158
19.2	9.6	9.12	0.110	57	28.5	708.	0.00141
19.3	9.65	9.23	0.108	58	29.0	794.	0.00126
19.4	9.7	9.33	0.107	59	29.5	891.	0.00112
19.5	9.75	9.44	0.106	**60**	30.0	1000.	0.00100
19.6	9.8	9.55	0.105	61	30.5	1120.	0.000891
19.7	9.85	9.66	0.104	62	31.0	1260.	0.000794
19.8	9.9	9.77	0.102	63	31.5	1410.	0.000708
19.9	9.95	9.89	0.101	64	32.0	1580.	0.000631
20	10.0	10.00	0.100	**65**	32.5	1780.	0.000562
21	10.5	11.2	0.0891	66	33.0	2000.	0.000501
22	11.0	12.6	0.0794	67	33.5	2240.	0.000447
23	11.5	14.1	0.0708	68	34.0	2510.	0.000398
24	12.0	15.8	0.0631	69	34.5	2820.	0.000355
25	12.5	17.8	0.0562	**70**	35.0	3160.	0.000316
26	13.0	20.0	0.0501	71	35.5	3550.	0.000282
27	13.5	22.4	0.0447	72	36.0	3980.	0.000251
28	14.0	25.1	0.0398	73	36.5	4470.	0.000224
29	14.5	28.2	0.0355	74	37.0	5010.	0.000200
30	15.0	31.6	0.0316	**75**	37.5	5620.	0.000178
31	15.5	35.5	0.0282	76	38.0	6310.	0.000158
32	16.0	39.8	0.0251	77	38.5	7080.	0.000141
33	16.5	44.7	0.0224	78	39.0	7940.	0.000126
34	17.0	50.1	0.0200	79	39.5	8910.	0.000112
35	17.5	56.2	0.0178	**80**	40.0	10000.	0.000100
36	18.0	63.1	0.0158	81	40.5	11200.	0.0000891
37	18.5	70.8	0.0141	82	41.0	12600.	0.0000794
38	19.0	79.4	0.0126	83	41.5	14100.	0.0000708
39	19.5	89.1	0.0112	84	42.0	15800.	0.0000631
40	20.0	100.	0.0100	**85**	42.5	17800.	0.0000562
41	20.5	112.	0.00891	86	43.0	20000.	0.0000501
42	21.0	126.	0.00794	87	43.5	22400.	0.0000447
43	21.5	141.	0.00708	88	44.0	25100.	0.0000398
44	22.0	158.	0.00631	89	44.5	28200.	0.0000355
45	22.5	178.	0.00562	**90**	45.0	31600.	0.0000316
46	23.0	200.	0.00501	91	45.5	35500.	0.0000282
47	23.5	224.	0.00447	92	46.0	39800.	0.0000251
48	24.0	251.	0.00398	93	46.5	44700.	0.0000224
49	24.5	282.	0.00355	94	47.0	50100.	0.0000200
50	25.0	316.	0.00316	**95**	47.5	56200.	0.0000178
51	25.5	355.	0.00282	96	48.0	63100.	0.0000158
52	26.0	398.	0.00251	97	48.5	70800.	0.0000141
53	26.5	447.	0.00224	98	49.0	79400.	0.0000126
54	27.0	501.	0.00200	99	49.5	89100.	0.0000112
55	27.5	562.	0.00178	**100**	50.0	100000.	0.0000100

LABORATORY ARTS AND RECIPES

Many of the following recipes have been contributed by users of the Handbook. To those who have cooperated in this way we extend our grateful acknowledgment.

BLUING STEEL AND IRON

The metal is cleaned with a potassium bichromate-sulfuric acid mixture, then washed with ammonium hydroxide and rubbed dry. Apply ammonium polysulfide until the desired depth of color is obtained, allowing the object to dry after each application and rubbing briskly with soft clean cloth. The result is a deep blue which may be made very nearly black by repeated applications. Rubbing with boiled linseed oil will deepen this color more. The finish thus obtained is very resistant to oxidation.

CEMENTS AND ADHESIVES

Acid Proof Cement

1

A handy acid resisting cement can be made by mixing sodium silicate and asbestos powder to the consistency of a thin paste. If allowed to dry for a day, the resulting cement will resist the strongest acids.

2

Barium sulfate 4 parts, water glass 3 parts, asbestos 1 part. Sodium fluosilicate or sodium fluoroborate is advised in addition when the cement is used on glass.

Aquarium Cement

1

Glazier's putty	10 lb.
Litharge	1 lb.
Red lead	1 lb.
Asphaltum	4 oz. fl.

Mix with boiled linseed oil to the proper consistency. Lamp black may be added to give a gray color.

2

Red lead	3 parts
Litharge	7 parts
Fine sand	10 parts
Powdered rosin	1 part

Add sufficient spar varnish to give the proper consistency.

Cement for Cellophane

The following is said to be a very satisfactory glue or cement for cellophane:

Gum acacia (gum arabic)	16.5 parts by weight
Glycerin	29.5 parts by weight
Water	49.5 parts by weight
Formaldehyde (40 %)	4.5 parts by weight

Cupric Oxide Cement

For a strong adhesive cement for attaching metal articles to each other or for cementing glass, a paste of cupric oxide and phosphoric acid is very satisfactory. The cement is adhesive, strong and sets quite rapidly.

De Khotinsky Cement

1

About 70 grams of light brown orange shellac is added in small amounts to 30 grams of heated pine tar. The mixture is stirred at frequent intervals for a period of two hours (or four hours) and maintained at a temperature of 130° C. or slightly lower. (The longer heating period gives a cement that is suitable for high vacuum work.) The product may be tested at intervals by dropping some of it into cold water and then subjecting it to bending pressure. Under such treatment, the product should not bend but break with a conchoidal fracture.

If a harder product is desired, 85 grams of light brown shellac may be mixed and heated with 30 grams of pine tar.

The finished product, while still warm, may be spread on a stone slab or a smooth surface and rolled into small sticks.

This sealing cement will be found useful whenever two pieces of apparatus are to be cemented together. The cementing is effected by warming the surfaces and applying melted cement. The removal of the cement may be facilitated by softening it with alcohol.

2

A handy water-proof laboratory cement of the type "Kotinsky Cement" is made from:

Dry yellow or orange shellac	3 parts by weight
Pine tar	1 part by weight

Place the shellac in a double boiler using water in the outer member. Add the pine tar and permit to digest with occasional stirring until the mass is homogeneous; this will take about five hours. Pull out like taffy and make into sticks. The cement can be made harder or softer by varying the amount of tar.

General Hints

Glues of all kinds are useful for wood, leather, paper and glass, where the joints are not required to be waterproof.

For waterproof joints of nearly all substances, including metals, shellac may be used. Flakes of solid shellac may be used with heat or it may be used as a solution in alcohol.

Kotinsky cement, Chatterton's compound and other resinous cements are used for similar purposes and in the same way as solid shellac. Glass cells made up with compounds of this nature may be made impervious to alcohol by painting over the joints with a rubber cement made by melting up small pieces of rubber tubing and adding carbon disulfide to make a thin syrup.

For celluloid a cement made by dissolving celluloid shavings in acetone is recommended.

Brass fittings are usually cemented on glass tubing with sealing wax. The glass tube should be wound with thread or twine to secure a close fit. The glass and the brass fitting should be warmed

slightly above the melting point of wax. (Thick or pressed glass should be warmed slowly.) Wax may be applied to both parts and the thread well saturated with the melted wax. Enough should be used to insure filling the space completely. Join the parts while the wax is very soft and clamp in position until it is thoroughly cold.

For optical purposes, cementing glass, etc., Canada balsam is universally employed, and makes a permanent and nearly invisible joint.

Laboratory Adhesive

Nitrated cotton (3 sec)	20 grams
Nitrated cotton (30 sec)	10 grams

Make up a solution of:

Di methyl ketone (acetone)	100 milliliters (c.c.)
Amyl acetate	45 milliliters (c.c.)
Methyl acetate	15 milliliters (c.c.)
Ethyl acetate	15 milliliters (c.c.)
*Ethyl abietate	1.5 milliliters (c.c.)

* ½ above of castor oil is a substitute.

Using the latter solution as solvent, add the above mixture of the two cottons until the solution is of the consistency of syrup. Dissolving the cotton takes about two hours. If the mixture is too thick, a little more of the above solvent, which should be kept on hand, is added.

The above solution should not blush when applied to any surface. It should dry quickly into a tough film which is stable over a long period owing to the plasticizer, ethyl abietate.

The above is useful for cementing cross hairs, coating labels, sealing rubber to tubing, etc.

In case a more flexible film is desired the amount of the plasticizer may be doubled. In case of blushing increase amyl acetate.

Litharge Cement for Joining Metal to Glass

In the preparation of tanks with glass sides or bottom, it is desired to make these water tight by cementing the glass to the iron frame or to repair the leaks that may occur.

Litharge (PbO)	260 grams
Glycerin solution (glycerin 2 parts, water 1 part)	100 milliliters (c.c.)

Place the litharge in a mortar, add the diluted glycerin slowly while grinding. Mix thoroughly by grinding a short time. Heat will be evolved and the mixture will begin to set. While still soft, pour it into place and by means of a spatula work it into position as in the case of putty. Allow to stand for a day when it will be thoroughly hard.

If desired, it may be covered with a layer of white lead or aluminum paint.

Mucilage or Paste

Gum arabic (gum acacia)	1 part
Rice starch	1 part
Sugar	4 parts
Water	10 parts

Warm the gum arabic with some of the water until it has a jelly-like consistency. Mix the sugar and starch with enough water to make a smooth paste. Combine these two mixtures, and boil until the starch is clear.

Shellac Cement

De Khotinsky Type

(Benzene Resistant)

Note: Most recipes for de Khotinsky cement call for pine tar, to the amount of 40 to 50 %, as the material with which shellac is plasticized for the application in question. Recent investigation indicates that pine tar is inferior to the creosote plasticizer recommended below.

Prepare the plasticizer by mixing one volume of terpineol with three volumes of beechwood creosote (alkali-soluble). Coal-tar creosote, not completely alkali-soluble, will not do.

Heat from 12 to 25 grams of the plasticizer to about 130° C. With constant stirring add 85 grams of shellac as fast as it dissolves smoothly. When the mixture is homogeneous, allow to cool until it will barely flow from the vessel, and pour into molds which have been lightly but completely covered with petrolatum. The use of only 12 grams of plasticizer gives a very hard cement; 25 grams gives a very soft product.

Shellac-Wax Cement

(Benzene Soluble)

Rosin	35 grams
Shellac	20 grams
Beeswax	20 grams
Talc, fibrous (asbestine pulp)	0 to 30 grams

Melt the rosin in a large (6 or 8 in.) hemispherical iron pan, add the shellac and beeswax with stirring. Heat strongly with a large Bunsen flame so that the temperature reaches 360° C. in six minutes; then extinguish the burner. When the temperature has reached about 275° C., add the talc, if any is to be used. Finally when the mixture is so viscous that it will barely pour from the pan, pour into metal molds which have previously been very thoroughly scoured with washing powder and thickly coated with aqueous dextrine paste which is still wet. The talc gives a more viscous cement at temperatures just above the melting point.

Transparent Sealing Resin

A transparent resin which adheres well to glass, quartz and metals may be made by heating together equimolal quantities of phthallic anhydride and ethylene glycol for 24 hours at 200° C. The resin softens at 95°–110° C. It is unaffected by water but slowly dissolved by organic solvents and is particularly useful for high-vacuum seals.

Vacuum Wax

Wax for coating joints which may be used for ordinary vacuum distillations etc. where the temperature does not get too high:

Melt together equal parts (by weight) of beeswax and rosin. The product is pliable and easily removed from apparatus by simply using hot water.

CLEANING COMPOUNDS AND METHODS

Alcoholic Sodium Hydroxide Solution for Cleaning

Dissolve 120 grams sodium hydroxide in 120 c.c. water. Dilute to 1 liter with 95 % alcohol.

Burette Cleaning Assembly

A burette cleaning assembly may consist of a 300 c.c. beaker of cleaning solution mounted on a ring stand having a 7 × 9″ base. Higher on the stand is a clamp for engaging the burette to be cleaned and still higher a mounting of $\frac{3}{16}$″ rubber tubing connected with an aspirator. The cleaning solution is heated, the burette placed with its top dipping into the cleaning solution while the aspirator tubing is slipped on the delivery end of the burette. When hot cleaning liquid has been aspirated to near the glass stopcock or pinch-cock, the cock is closed and the aspirator tubing slipped off, leaving the cleaning solution in the burette. After a minute or so, the cock is opened and the cleaning solution is allowed to run out of the burette, which will leave a uniform film if the burette is clean. The burette is transferred to a sink and after cooling is rinsed with tap and distilled water. By this means 50 burettes per hour may be made ready for use.

Brown Stains on Burettes

Brown stains left on the inside of burettes used for $KMnO_4$ solutions may be removed by filling the burette with $FeSO_4$ solution after which the liquid is removed and completely washed out. A convenient, ready for use, solution of $FeSO_4$ may be made by placing small nails in a dilute H_2SO_4 solution, keeping the flask closed except for a hydrogen vent, thus preventing oxidation of the iron.

Cleaning Engler Flasks

To thoroughly remove all of the carbonaceous deposit baked in the bottom of an Engler flask from gasoline distillation, place 2 or 3 grams of commercial Na_2SO_4 in the flask to be cleaned; apply heat directly to the flask from a Bunsen burner. Heat until all the carbon residue has been loosened. Cool, rinse and drain.

Cleaning Fermentation Tubes and Other Glassware

Fermentation tubes (used in water testing) and other glassware difficult to clean in the ordinary way, may be cleaned as follows:

Moisten the inside of the tube with ethyl alcohol. Pour off the excess alcohol, leaving not to exceed two c.c. of the liquid in the tube. Add ten c.c. of concentrated nitric acid and let it stand. Soon a vigorous reaction takes place with the elimination of large quantities of nitrogen dioxide. When the reaction stops, wash with water. As some nitric acid may be blown out of the tube, it should be placed in a sink (preferably in a hood) until the reaction ceases. Do not close the tube.

Cleaning Fluid

An excellent solution for cleaning grease stains from cloth or leather consists of the following:

CCl_4	80 %
Ligroin	16 %
Amyl alcohol (ter.)	4 %

Cleaning Mercury

Mercury may be cleaned sufficiently for many laboratory purposes without distilling. Allow the mercury to fall in a fine spray into a quantity of dilute nitric acid, 25 parts of acid to 75 parts of distilled water. After being passed through the acid one or more times it should be passed through distilled water and dried. Most of the water may be removed with a clean filter, and the mercury heated in a porcelain dish to about 110° C. To produce the spray the stem of a glass funnel may be drawn down so as to leave only a small opening for the escape of mercury or a glass tube with a capillary point attached to a funnel with a tightly fitting rubber tube.

A three- to four-foot length of one-inch glass tube closed at one end and supported in a vertical position may be used to contain the acid solution. If a small glass tube be fused into the lower closed end of the large tube, and bent so as to stand up for a distance a little greater than 1/13.6 the column of acid solution in the large tube, a U-tube is formed in which a short column of mercury supports the long column of acid solution.

The end of the small tube should be bent over at the top so as to facilitate the delivery of the mercury and a short piece of clean rubber tubing with a pinch-cock put on at the start; as soon as mercury enough has collected in the bottom of the tube the pinch-cock may be opened. The mercury will rise nearly or quite to the top of the small tube, and as the quantity increases will be delivered from the small tube as fast as it falls in the spray.

The reversed end of the small tube should be short to avoid forming a siphon, which would completely empty the apparatus.

An efficient procedure, especially if the mercury is greasy, consists in spraying the mercury by means of the above apparatus, first, through a dilute solution (10 %) of potassium hydroxide, then through dilute nitric acid (10–15 %) and finally through distilled water.

Cleaning Optical Surfaces for Silvering

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

Probably the most important part of the silvering process is the proper cleaning of the surface to be silvered.

The surface is thoroughly cleaned of grease or other organic matter by the usual methods, using alcohol or chromic acid. Then it should be carefully cleansed with strong nitric acid, the whole surface being firmly rubbed with clean cotton tied to a rod of wood or glass. Care should be taken not to injure the surface. Rinse with water, and then wash the surface thoroughly with a strong solution of caustic potash, rubbing with a cotton brush as before. Finally, rinse with distilled water, and keep the surface wet until it is placed in the silvering solution. If the distilled water wets the whole surface uniformly the cleaning may be sufficient; if it does not wet uniformly, the operations must be repeated. The fingers should not touch the edges of the glass during the latter cleaning operations, as a layer of organic matter is apt to spread over the surface and render the silvering uneven.

Dr. Brashear recommends that the surface, after the washings described above, be rubbed with prepared chalk on a cotton wad until it is thoroughly dry and clean. It may then be put into the silvering solution at one's convenience.

Cleaning Solution for Glass

35 c.c. saturated sodium dichromate (technical)
1 liter conc. sulfuric acid poured into the dichromate solution

Avoid contact with the flesh or clothing.

Cleaning Solution

Trisodium phosphate	2 oz.
Sodium oleate	1 oz.
Distilled water	1 pint

Soak apparatus in the warm solution 10–15 minutes, then brush with a stiff brush.

Iodine Stains

Iodine stains can readily be removed from clothing by washing the stain with a 10 % solution of sodium thiosulfate ("hypo") in water.

Paint Brush Cleaner

(1)	Kerosene	2 pints
	Oleic acid	1 pint
(2)	Aqueous ammonia (conc.)	¼ pint
	Denatured alcohol	¼ pint

Stir (2) into (1) until uniform. To clean brushes, place in the mixture over night. Wash thoroughly with warm water.

Removal of Carbonaceous Matter

A 10–15 % solution of NaOH or KOH removes carbon etc. quickly. Rinse well with acid and H_2O.

Removing Carbon Deposits from Flasks

First rinse flask with acetone or carbon disulfide to remove traces of oil or tar. Add a few grams of magnesium nitrate. Heat gradually over a free Bunsen flame till water is all expelled and the magnesium nitrate melts. Rotate the flask to distribute the melt and continue the heating till the brown fumes of nitric oxide cease to evolve. Finally cool and dissolve the residual magnesium oxide in dilute acid by boiling.

Large deposits of carbon or tar will require a repetition of the above procedure.

Removing Carbon Residue from Glassware

Tri-sodium phosphate (Na_3PO_4)	2 tablespoonfuls
Sodium oleate	1 tablespoonful
Soft water	1 quart

Allow to stand in the solution for several minutes, brush off the incrustation and rinse with water.

COLORED LIQUIDS

For rendering columns of water easily visible, add a few drops of one per cent alcoholic solution of fluorescein to a liter of water. The dilute solution of fluorescein is bright green by reason of its fluorescence, although colorless by transmitted light.

A small quantity of an aqueous (1 %) solution of uranine (the sodium salt of fluorescein) may be used in place of the alcoholic solution mentioned above.

If liquids showing color by transmission are desired, dilute aqueous solutions may be made with any of the following dyes:

Dye	Color
Erythrosine	Pink
Eosine	Pink (green fluorescence)
Rhodamine B	Pink (red fluorescence)
Ponceau 2R	Scarlet
Naphthol green	Green
Methylene green	Bluish green
Methylene blue	Blue
Methyl violet	Purple

CROSS HAIRS

The spider lines which serve as an index in reading telescopes may be quickly replaced in an emergency by single silk fibers (from ordinary sewing silk) attached by soft wax. Single fibers may easily be removed from an untwisted strand.

Spider web should be used in permanent work. The fibers of the egg nest of certain species are employed and may be obtained of most dealers in scientific apparatus. In mounting them the following suggestions may be useful: The cross hair diaphragm of the telescope should be removed and clamped in a horizontal position. A bow of brass wire, about No. 28, should be employed to stretch the fiber. A background of black velvet makes the fibers more easily visible. With soft wax or other convenient adhesive ready on both tips of the bow, a fiber of the required length is to be disentangled with tweezers and wrapped several times about the ends of the bow under tension sufficient to straighten the fiber. The fiber, now conveniently handled by the wire bow, should be cautiously lowered onto the diaphragm in the proper position, the wire left hanging.

A small drop of shellac varnish applied at each side will hold the fiber in position as soon as it is thoroughly dry, after which the ends of the fiber should be cut away.

DIALYZERS

As a substitute for parchment and similar natural membranes, it has been found that those made from cellulose trinitrate are superior. Parlodion (DuPont) may be used, dissolving one part of the nitrate in 2 each of ethanol and ethyl ether. The water adhering to the Parlodion should first be removed (the shreds are preserved by covering with water), otherwise a clear solution will not be obtained. Cut the round end off a $\frac{3}{4}''$ or $1''$ test tube, and dip the flared end of the tube into the alcohol-ether solution of Parlodion. Upon removing the tube from the solution a film will be found across the tube and after evaporation of the solvents the film will be found to be of sufficient strength to meet the purposes of a dialyzer. The liquid to be dialyzed is poured into the tube and contents are then set in a beaker of water. In a short time the working of the semi-permeable membrane will be shown by the rise of the level of the liquid inside the tube.

EXPANSION OF GLASSES, TEST FOR EQUALITY OF

In order to compare the coefficients of expansion of two pieces of glass, prior to sealing them together, melt the drawn out ends of each piece to beads; press these molten beads together with tweezers and draw into a thread. If the glasses can be sealed

together, the thread will be straight; otherwise, it will curve because of the different coefficients of expansion.

FLUORESCENT SCREENS

For observations of the ultraviolet spectrum, moisten a small quantity of anthracene with water and brush a thin layer over a ground-glass surface. On drying most of the anthracene will adhere to the glass. The prepared surface should be placed so as to receive the radiation directly, glass being comparatively opaque to the shorter wave lengths.

GLASS GRINDING FLUID

Turpentine	45	c.c.
Ether (ethyl oxide)	22.5	c.c.
Camphor gum	31	g

To be used with powdered emery for grinding glass.

For smoothing edges a sheet of emery cloth moistened with the above solution may be used.

Plane surfaces should be ground on thick plate glass.

For grinding glass stoppers use coarse emery, turn in one direction, finish with fine emery.

GLASS GRINDING MEDIUM

Glycerin may be used instead of a camphor-turpentine mixture for a medium in which to suspend emery powder for grinding glass. Glycerin has body enough and is sufficiently viscous to carry the emery well, and besides this it is water-soluble, thus making it very easy to wash away the excess grinding agent when the job is done or when it is desirable to make a close inspection of the work done.

HEATING BATH

A bath fluid at temperatures above 150° G. and which does not appreciably affect glass is prepared by fusing 10 parts of potassium nitrate with 8.5 parts of sodium nitrite.

HEATING BATHS

For uniform heating of reactions the following materials have proven satisfactory:

For temperatures up to 100° C.	Steam
For temperatures from 100° − 250° C.	Crisco or Nujol
For temperatures from 200° − 300° C.	*o*-tolyl phosphate
For temperatures above 250° C.	Wood's metal.

HECTOGRAPH FILLER

Ingredients: ½ oz. of ground (dried) glue; 2 oz. of dried gelatine; 18 fluid oz. glycerin. These amounts should provide sufficient filler for a pan 12″ × 9″ × ½″.

Mix the glue with water and digest it on a water bath (a double boiler may be used) until it has the consistency of cream and is thoroughly melted. Soak the gelatine in cold water till soft free it from as much water as is possible by pressure in a cheesecloth and then melt it on a water bath or in a double boiler. Pour the three liquids together, and after they are thoroughly mixed, pour them into the pan. If any bubbles appear on the surface

of the filler, scrape them off with the edge of a piece of cardboard while the filler is hot. Do not use the filler until at least six hours after it has been poured into the pan. The materials gel slowly. Keep the pan level and covered until its contents is no longer fluid.

HECTOGRAPH INK

Violet

Aniline violet	1 oz.
Hot water	7 oz. fl.

On cooling, add:

Alcohol	1 oz.
Glycerin	$\frac{1}{4}$ oz.
Carbolic acid (phenol)	a few drops

Black

Nigrosine	1 part
Water	14 parts
Glycerin	4 parts

HYDROGEN SULFIDE

Pure hydrogen sulfide may be generated by allowing distilled water to drop on aluminum sulfide.

HYDROGEN SULFIDE SUPPLY

Mix and heat slightly 3 parts by weight of sulfur with 1 part by weight of paraffin. Then mix with sufficient shredded asbestos to make a porous mass. Partly fill an 8″ Pyrex test tube, connect with delivery tube and safety bottle. Heat. Furnishes good supply of H_2S. No leakage into the room as generation of H_2S ceases as soon as heat is removed. Mixture keeps. Test tube may be heated over again until reactants are used up.

INK FOR GLASS MARKING

Barium sulfate	15 parts by weight
Ammonium bifluoride	15 parts by weight
Ammonium sulfate	10 parts by weight
Oxalic acid	8 parts by weight
Glycerin	40 parts by weight
Water	12 parts by weight

If too thick, add more water. If the action is too slow, up to 5 % of sodium fluoride may be added. Use in a hood or well ventilated room.

LABEL PROTECTION

Collodion for Labels on Bottles

Dissolve 3–4 grams pyroxylin in 100 c.c. 1:3 mixture of alcohol and ether (25 c.c. absolute alcohol, 75 c.c. dry ether).
First soak the pyroxylin in the alcohol, then add the ether.

Labels for Bottles

Labels should be written in India Ink. They can be made waterproof and durable by coating with a saturated solution of paraffin in benzene.

Lacquer for Protecting Labels

An excellent lacquer for protecting labels may be made by dissolving 20 grams of vinyl acetate polymer (Vinylite A) in 100 c.c. of a mixture of 3 parts of toluene and 1 part of 95 % alcohol. This lacquer forms a colorless, transparent film which resists most reagents very well.

Protecting Varnish for Labels

Typed labels may be protected by several coats of a varnish made by dissolving ordinary tooth brush handles in acetone. The quantity of solvent should be adjusted to give a convenient viscosity. The varnish is water and acid resistant.

LOW MELTING ALLOY

The following alloy, Wood's metal, melts at about 65° C.:

Bismuth	50	parts by weight
Lead	25	parts by weight
Tin	12.5	parts by weight
Cadmium	12.5	parts by weight

LUBRICANT, DRY

Melt a quantity of paraffin and add as much fine flake or powdered graphite as is readily moistened by the melted wax. Cool and cut while soft into convenient sticks.

This lubricant when rubbed on the surfaces involved, adheres and greatly reduces friction. It is particularly useful when one or both of the surfaces are of wood or other non-metallic substance.

MILDEW PREVENTION ON LEATHER BOOK BINDINGS

Make a 2 % to 5 % solution—not more than 5 %—of copper sulfate. Immerse a soft towel or cloth in this solution. Remove the cloth and thoroughly wring out. Then hang out to dry. When thoroughly dried, it can be used to rub leather bound books. One treatment of the cloth will easily take care of scores or a hundred volumes, and the leather will not be marked by the chemical.

MIRRORS FOR SPECTROMETER ADJUSTMENT

A small square of thick plate glass with edges ground smooth and silvered on one surface affords a means of accurate adjustment.

To avoid the necessity of frequently resilvering, which arises where the mirrors are in constant use, the following course is suggested:

From selected German plate mirror 2 to 3 mm thick, cut two pieces of the same size, say 4 × 5 cm. Remove the protective layer of varnish or paint from both pieces by soaking in alcohol and rubbing with cotton, being careful not to injure the silver surface. From one piece remove every trace of varnish by repeated rinsing, dry and polish the silver surface thus exposed by stroking lightly with a chamois rouge pad. From the other piece remove the silver by nitric acid, wash thoroughly in distilled water and dry. Cement the clear piece on the silver face of the other with Canada balsam. This is accomplished by placing two or three drops of Canada balsam in xylol (obtained in collapsible tubes) on the center of the silver face, and evenly lowering upon it the clear glass. The balsam should spread rapidly to the edges of

the plates. Minute bubbles of air in the balsam film are harmless: if large bubbles are present the plates should be slipped apart, cleaned with alcohol and the process repeated.

The balsam will be sufficiently hard in a few days to allow the excess to be scraped from the edges and the plates bound together with lantern slide binding strip. Gentle heat may be used to harden the balsam more rapidly.

PHENOL (CARBOLIC ACID) BURNS

To c. p. glycerin add bromine until slightly colored or saturated. Keep in glass stoppered bottle and apply quickly to phenol burns. The bromide reacts instantly with the phenol to form phenyl bromides.

POLARITY TEST PAPER

Dissolve one gram of phenolphthalein in a small quantity of alcohol. Add the solution of phenolphthalein to 100 c.c. of a 10 per cent solution of potassium chloride in distilled water. Filter paper should be soaked in the solution and dried. A strip of paper moistened with water and placed in contact with the two terminals will show a bright red stain at the negative terminal.

PURIFICATION OF ALCOHOL

To remove aldehydes from alcohol intended for use in the preparation of alcoholic solutions of sodium or potassium hydroxide, add to one liter of alcohol 5 to 10 grams of aluminum or zinc and 8 to 10 grams of potassium hydroxide; boil under reflux for 20 minutes, and distil. Best results are obtained if an all-glass apparatus is used. Alcoholic solutions, prepared with alcohol so treated, will not discolor if the purification of the alcohol has been carefully carried out.

RESISTANT PAINTS AND VARNISHES

Acid Proof Wood Stain

Solution No. 1	Solution No. 2
125 grams of copper sulfate	150 grams of good fresh anilin oil
125 grams of potassium chlorate	180 grams of concentrated hydrochloric acid
1000 grams of water	1000 grams of water

Wood must be free from paint, varnish, grease or chemicals. Apply two coats of solution No. 1 boiling hot with a paint brush, allowing each coat to dry thoroughly before the next coat is applied. Then apply two coats of solution No. 2 in the same way. When the wood is completely dried wash off excess chemicals with hot soapsuds. Finish with raw linseed oil. Polish comes from rubbing the oil down well with a cloth or sponge. Whenever the tables get dingy again go over them with a coat of linseed oil and rub smooth.

Resistant Coal Tar Varnish

A resistant varnish is made from coal tar pitch as follows:

Coal tar pitch....................	65 parts by weight
Phenol....................	5 parts by weight
Benzene....................	30 parts by weight

Resistant Paint

The following paint when used on galvanized iron has been found to hold up well, without cracking or peeling in a three year's test. It can also be used on black iron, tin, copper, or stone such as is used for laboratory desk tops. It withstands dilute acids.

Formula: Stir in 10 parts by weight of benzol into 30 parts by weight of ordinary thin coal tar. Then add with vigorous stirring 10 parts by weight of Silica Black (a new product patented under U. S. No. 1,940,352).

SCALE POLISH

To brighten up refractometer and polarimeter scales without injury to the metal rub with bone black or clarifying charcoal. A dry cloth with a little of the bone black is rubbed on the scale until a bright polish is produced. The divisions then stand out clearly and are easily read. The great advantage is that the fine lines are not worn away and no corrosive material is left to cause discolorations.

SILVERING GLASS

Brashear's Process

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

Two solutions are required, one, the reducing solution, should be prepared at least a week before it is used, and it may be made in large quantity and kept in stock with advantage; the other solution is to be prepared when used.

Reducing Solution

Distilled water	700 c.cm.
Pure sugar (loaf, granulated or rock candy)	80 g.

When dissolved add

Alcohol	175 c.cm.
Strong nitric acid (sp. gr. 1.42)	3 c.cm.
Add water to make	1000 c.cm.

For silvering, the mirror may rest face up on the bottom of a suitable dish; it may stand on edge, or be supported in any manner, face downward, dipping into the upper part of the solution. In the latter case, the mirror may be fastened with wax to a stick laid across the dish, or it may be supported on glass feet or on paraffined wood wedges. Dr. Brashear recommends that the mirror, if round, form the botton of the silvering dish, which is completed by wrapping a strip of paraffined paper around the edge of the mirror, this being held in place by rubber bands or fastened with several wrappings of cord.

Having selected a dish and support for the mirror, measure with water the quantity of solution that will be required to make a layer a centimeter or two thick over the surface to be silvered. For each 150 c.cm. of final solution, 1 g. of silver nitrate and 0.5 g. of caustic potash (purified by alcohol) will be required. Dissolve the silver and potash separately, using quantities of water of the proportion of 100 c.cm. to 1 g. of the solid. Ordinary graduates or flasks are the most convenient form of vessel in which to mix the solutions. Into the silver nitrate solution pour a few drops of dilute aqua ammonia. The solution will turn to a dark brown color; add ammonia little by little till the precipitate is nearly but not quite redissolved. Now add the potash solution,

when a precipitate will again be formed. This is to be nearly, but not entirely, redissolved by the addition of more ammonia, a few drops being sufficient this time. After the ammonia has been added shake or stir the solution well and wait a minute or two to be certain that it does not entirely clear. If by chance too much ammonia has been used, a little silver nitrate is to be dissolved and added, a few drops at a time, till a permanent precipitate is formed. This excess of silver must be present, the solution showing a decided brown tint. The solution may be filtered, though usually this is not necessary.

A quantity of reducing solution equal to about a twenty-fifth part of the solution just prepared is measured out. The mirror, having been properly cleaned and rinsed with distilled water, is placed in position. The reducing solution is poured into the silver and potash solution, and mixed by a quick shaking of the graduate or stirring with a glass rod; the whole is then poured into the dish. If the mirror is immersed face down, care is necessary to remove air bubbles; the mirror may well be immersed after the solution is in, being dipped in at one side first. If the mirror is at the bottom of the dish, after cleaning it is covered with a thin layer of water, and the prepared solutions are poured into the dish without further trouble. In the latter case the dish must be rocked during the time of deposition.

The solution soon turns to a black color, which in a few minutes will turn to a brown; and when it becomes a light gray and the precipitate is flocculent, which may be in ten or fifteen minutes, the operation is at an end. If the mirror is allowed to remain in the solution too long, the surface will have a bleached appearance, which polishing will hardly remove. Remove the mirror, rinse with water, and carefully wipe off the sediment with a tuft of absorbent cotton. It is then set on edge to dry; a rinsing with alcohol will facilitate the drying, or all water may be safely taken up by pressing clean blotting paper over the surface.

When dry, the surface may be polished, if necessary, with a small pad of chamois leather stuffed with cotton, on which is spread a little rouge. Small, circular strokes of the pad, with light pressure, will soon bring out the deep luster of the silver.

A uniform temperature of the bath and the glass, of about 20° is essential to success.

Since fulminating silver is liable to be produced by the action of ammonia on silver oxide, especially in a warm room, all solutions should be thrown away as soon as the silvering operation is completed. The used solutions may be poured into a large jar, in which is thrown some common salt; this causes the silver to be precipitated as the chloride, and about 90 per cent of the original silver may be recovered.

Rochelle Salts Process

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

For depositing the uniform thin film of silver required on the half-silvered glass of the interferometer, the following method is more suitable than the one described above, as the silver is deposited more slowly. If a thick film is desired, two or more successive deposits may be made, each of which may require an hour's time.

Dissolve 5 g. of silver nitrate in 300 c.cm. of distilled water, and add dilute aqua ammonia until the precipitate formed is nearly, *but not entirely*, redissolved in the manner explained in

the preceding method. Filter the solution and add water to make 500 c.cm.

Dissolve one g. of silver nitrate in a small quantity of water and pour into about half a liter of boiling water; dissolve 0.83 g. of Rochelle salts in a small quantity of water, and add to the boiling solution. Continue the boiling for half an hour, till the gray precipitate collects as a powder in the bottom of the flask. Filter hot, and add water to make 500 c.cm.

These solutions may be kept in the dark for a month or two.

For silvering, equal volumes of the two solutions are mixed, and the glass is supported in the mixture in whatever fashion is convenient. Various methods are mentioned in the preceding article. The thickest possible deposit may require an hour's time. A second deposit may be made upon the first if necessary to secure the desired thickness. The drying and polishing may be carried out as described above.

A half-silvered film will be produced in about a minute; only experience can determine when the proper thickness has been secured. The glass appears as though it were very lightly smoked. A film that reflects a little more than half the light incident at 45° is desirable for interferometer use. A simple method of testing is to look at two similar gas flames, one seen through the film and the other seen reflected by it. It is well to silver at once all four surfaces of the two plane-parallel plates of the interferometer and to select for use that film which is of the proper and most uniform thickness.

SOAP SOLUTION FOR SOAP FILM EXPERIMENTS

Pure castile or palm-oil soap	1 oz.
Distilled water	8 oz.
Pure glycerin	4 oz.

Cut the soap in thin shavings and dissolve in the water. When the solution is complete, add the glycerin and mix very thoroughly. On standing the liquid becomes clear at the bottom. The clear portion may conveniently be removed by a siphon and preserved indefinitely.

SODIUM FLAME

An intense sodium flame is readily obtained by placing a small lump of rock salt in the center of the screen on a lighted Meker burner.

SODIUM LIGHT

Paper is to be soaked in a saturated solution of common salt, borax or other salt of sodium, and dried. When wrapped around a Bunsen burner, secured by a twist of wire and pushed up into the edge of the flame, a sodium flame of considerable intensity is obtained. As the ash of the paper breaks away it must be occasionally raised. Lithium chloride may be used in place of or with sodium salt to give the lithium line for spectrometric measurement. Sheet asbestos (thin) may replace the paper if desired. Since the asbestos is not consumed it is necessary to moisten the mantle with salt solution at intervals.

SOLDERING PYREX GLASS TO METAL

Dip the Pyrex glass tube to be soldered into a solution of chlorplatinic acid (or platinic chloride may be substituted) made by

preparing a mixture consisting of 0.2 gram of the acid with 5 c.c. each of alcohol and ethyl ether to which 4 or 5 drops of turpentine have been added. After dipping the tube, carefully burn all the adhering liquid away leaving a film of platinum metal. That film will serve to hold the solder to the Pyrex glass and in doing so makes a very satisfactory gas-tight joint for a metal to glass connection.

SOLDERS

Composition by weight						Temperature of fusion	Metals for which it is used	Flux commonly used
Lead	Tin	Copper	Zinc	Silver	Gold			
1	1	....	....	....	..	188° C.	Lead	Tallow
3	5	....	....	....	..	176	Zinc	Zinc chloride 25% HCl
2	5	....	....	....	..	170	Copper brass	Zinc chloride (neutral) or resin
							Iron	Zinc chloride or NH_4Cl
		2	1	....	..	....	Fe, Cu,	Borax
		55	45	....	..	880	Fe, Cu, brass	Borax
		4.5	0.5	15.0	..	1005	Fe, Cu, Au,	Borax
		6.5	2.0	11.0	..	983	Fe, Cu, Au,	Borax
		4	....	6	10	....	Gold	

STOPCOCK LUBRICANTS

Seal for Ground Glass Joints

Glycerin makes a very satisfactory seal for ground glass joints to prevent leakage of petroleum ether, ethyl ether or any other fluid in which glycerin is insoluble. Glycerin on the ground glass surface prevents sticking and so allows for the easy dismantling of the apparatus.

Stopcock Grease

Shepherd and Ledig (J. Ind. Eng. Chem. 19, 1059, 1927) prepare stopcock grease from the following ingredients by mixing with continuous stirring for 190 hours at 155° C., then placing the mixture in small 2 oz. containers, immediately chilling the contents on ice and allowing to age for 10 days before use. For high vacuum: 31 parts crepe rubber, 24 parts white vaseline, 5 parts paraffin (m. p. 36° C.); for general lubricant: 6 parts crepe rubber, 7 parts vaseline, 1 part paraffin; for light lubricant: 10 parts smoked sheet or pale crepe rubber, 18 parts vaseline and 1 part paraffin (m. p. 30° C.).

Stopcock Grease

Black rubber (red or pure gum)	1 part
Paraffin	2 parts
Vaseline	4 parts

Melt the paraffin and vaseline together, add the rubber slowly and in small pieces taking care not to burn the rubber. A larger quantity of vaseline may be desirable.

Stopcock Lubricant

Petrolatum (500 grams) and raw crepe rubber (50 grams) are stirred together and kept in an oven at 125°–150° C. for several days, or until the mixture is homogeneous.

Stopcock Lubricant

Standard Viscous Oil No. 32 (Standard Oil Co. of California)	200 grams
Aluminum stearate	50 grams

Dissolve the stearate in the oil, heated to about 150° C., and cool. This makes an extremely sticky, ropy, tough adhesive for ground glass surfaces.

Stopcock Lubricant

In the laboratory it is often desirable to have a stopcock lubricant that will not dissolve away with the ordinary fat solvents such as the hydrocarbons or chlorinated hydrocarbons. In some set-ups the ordinary stopcock greases are quite useless, and syrupy phosphoric acid is very unsatisfactory.

A paste of Bentonite (colloidal clay) and glycerin may be used for such a purpose. One can adjust the viscosity of the paste to suit his needs. Such a lubricant is entirely unaffected by the non-aqueous solvents, and even in the presence of water holds remarkably long, probably due to the fact that the Bentonite makes a jelly with either glycerin or water. In addition it has the very decided advantage of permitting a stopcock lubricant to be used at temperatures up to or even well above 100° C. The viscosity does not diminish very much with rise in temperature.

UNIVERSAL WAX

(1) A soft wax useful in the laboratory may be made by melting together paraffin, vaseline and paraffin oil in various proportions according to the pliability desired.

(2) Another authority recommends equal quantities of beeswax and turpentine (by weight). It is customary to color the wax by adding finely-powdered Venetian red.

(3) Melt together 1 part of Venice turpentine and 5 parts of beeswax. Color with vermilion.

PHOTOGRAPHIC FORMULAE

Pure water, preferably distilled, should be used in all solutions. Chemicals should be dissolved in the order given.

Desiccated or anhydrous sodium carbonate and sodium sulfite are specified in the following formulae. If the crystalline forms are employed, a larger quantity must be used.

Sodium carbonate exists in three forms: the anhydrous or desiccated, Na_2CO_3; the monohydrate, $Na_2CO_3 \cdot H_2O$; "washing soda," $Na_2CO_3 \cdot 10H_2O$. If the monohydrate is substituted for the desiccated, 1.7 times the specified quantity should be used. If the "crystal" form $Na_2CO_3 \cdot 10H_2O$ is substituted for the desiccated, 2.7 times the specified quantity should be used.

Sodium sulfite exists in two forms; the anhydrous or desiccated, Na_2SO_3, and a form, $Na_2SO_3 \cdot 7H_2O$. If the latter "crystal" form is substituted for the desiccated, 2 times the specified amount should be used.

Quantities required are given in both English and metric units. The values are, in most cases, not interchangeable since the amounts of water are not the same. In deference to recent usage quantities of liquid are specified in millimeters (ml). The milliliter is 1.000027 cubic centimeters; the units are, of course, interchangeable for photographic formulae. The U. S. avoirdupois system of weights is used.

The following abbreviations are employed:

anh.	anhydrous
c.c.	cubic centimeter
g	gram
gal.	gallon
gr.	grain
l	liter
min.	minim
ml	milliliter (equivalent to cubic centimeter, cm^3 or c.c.)
oz. (av.)	ounce (avoirdupois)
oz. fl.	fluid ounce
qt.	quart

DEVELOPERS FOR PLATES AND FILMS

When a time of development is suggested, it is intended to serve as a guide only. Individual requirements as to density and contrast vary. Greater or less contrast may be obtained by developing for a longer or a shorter time respectively.

Normal Developers

AMIDOL (Diaminophenol hydrochloride)

1

Water	10 oz. fl.	1000 ml
Sodium sulfite, anh	120 gr.	29 g
Amidol	30 gr.	7 g
Potassium bromide	6–10 gr.	1.4–2 g

Amidol oxidizes so rapidly in solution that it is customary to make up this developer immediately before it is to be used. The time required for development is from 3 to 5 minutes at 18° C. or 65° F.

2

Stock solution of sodium sulfite may be prepared:

Sodium sulfite, anh	2 oz.	100 g
Potassium metabisulfite	0.5 oz.	25 g
Water	20 oz.	1000 c.c.

Boil after dissolving in warm water. Developer is made when needed by adding dry amidol to the stock solution of sulfite which keeps for a long period.

Stock solution of sodium sulfite	2 oz.	200 c.c.
Water	10 oz.	1000 c.c.
Amidol	20–30 gr.	4.5–7 g

Athenon. See *Glycin*

Elon-Pyro (Eastman D-7 *)

Stock Solution A

Water (about 125° F.) (52° C.)	16 oz.	500 c.c.
Elon	$\frac{1}{4}$ oz.	7.5 g
Sodium bisulfite	$\frac{1}{4}$ oz.	7.5 g
Pyro	1 oz.	30 g
Potassium bromide	60 gr.	4.2 g
Water to make	32 oz.	1 l

Stock Solution B

Water	32 oz.	1 l
Sodium sulfite, anh	5 oz.	150 g

Stock Solution C

Water	32 oz.	1 l
Sodium carbonate, anh	$2\frac{1}{2}$ oz.	75 g

For tray development take 1 part of A, 1 part of B, 1 part of C and 8 parts of water. Develop about 7 to 9 minutes at 65° F. (18° C.).

For tank development take 1 part of A, 1 part of B, 1 part of C and 13 parts of water. Develop about 9 to 12 minutes at 65° F. (18° C.).

This developer can be used for two or three weeks if the volume is maintained by adding fresh developer in the proportion of 1 part each of A, B, and C to 4 parts of water. It is usually necessary to increase the development time as the developer ages.

Glycin (Parahydroxyphenyl glycin)

Stock Solution

Water	10 oz. fl.	1000 ml
Sodium sulfite, anh	300 gr.	68.5 g
Glycin	120 gr.	27.5 g
Sodium carbonate, anh	240 gr.	54.8 g

For tray development dilute with 4 parts of water to 1 of stock solution. Develop 6 to 10 minutes.

* For a complete collection of photographic formulae see "Elementary Photographic Chemistry," Eastman Kodak Company, Rochester, N. Y.

For tank development use 15 parts of water to 1 of stock solution and develop 20 to 30 minutes. Glycin has better keeping qualities than any other single solution developer. The image is free from fog and stain and has a fine grain.

Hydroquinone

Water	10 oz. fl.	1000 ml
Sodium sulfite, anh	220 gr.	50 g
Hydroquinone	50 gr.	11.5 g
Sodium carbonate, anh	162 gr.	37 g

For use take 1 part of water to 1 part of stock solution. This is a slow acting developer. The temperature should not be allowed to fall below 60° F. (15° C.) as the developer becomes inert.

Metol

Water, warm	20 oz.	1000 c.c.
Metol	150 gr.	17 g
Sodium sulfite, anh	1.25 oz.	63 g
Sodium carbonate, anh	1.75 oz.	88 g
Potassium bromide	16 gr.	1.8 g

Always dissolve metol first.

For use dilute with equal part of water for portraiture; for landscape use two parts of water to one of stock solution. Gives detail without density except by prolonged development.

Metol-Hydroquinone

1

Note: Elon may be used with hydroquinone in place of metol, in equal quantity.

Solution A

Water	64 oz.	1820 c.c.
Metol	120 gr.	7.8 g
Hydroquinone	120 gr.	7.8 g
Sodium sulfite, anh	2 oz.	57 g

Solution B

Water	16 oz.	455 c.c.
Sodium carbonate, anh	2 oz.	57 g

For use take A, 4 oz.; B, 1 oz.; water, 4 oz.

2 (Eastman D-72)

For tray development of roll films and film packs and press work on fast orthochromatic and panchromatic films and plates.

Stock Solution

Water (about 125° F.) (52° C.)	16 oz.	500 c.c.
Elon	45 gr.	3.1 g
Sodium sulfite, anh	1½ oz.	45 g
Hydroquinone	175 gr.	12 g
Sodium carbonate, anh	2¼ oz.	67.5 g
Potassium bromide	27 gr.	1.9 g
Water to make	32 oz.	1 l

For general use take 1 part of stock solution to 2 parts of water. Develop for 4 to 6 minutes at 65° F. (18° C.) according to the con-

trast desired. For greater contrast, dilute 1:1 or use without dilution.

3 (Eastman D-61a)

For general tray or tank use.

Stock Solution

Water (125° F.) (52° C.)	16 oz.	500 g
Elon	45 gr.	3.1 g
Sodium sulfite, anh	3 oz.	90 g
Sodium bisulfite	30 gr.	2.1 g
Hydroquinone	85 gr.	5.9 g
Sodium carbonate, anh	165 gr.	11.5 g
Potassium bromide	24 gr.	1.7 g
Cold water to make	32 oz.	1 l

For tray use take 1 part of stock solution to 1 part of water. Develop for about 7 minutes at 65° F. (18° C.).

For tank use take 1 part of stock solution and 3 parts of water. At a temperature of 65° F. (18° C.), the development time is about 14 minutes. It is advisable to make up a greater quantity than is needed to fill the tank. If the developer in the tank is of normal strength, but the volume of solution has been reduced, add a sufficient quantity of the surplus solution to fill the tank.

If the strength of the solution, as well as the volume, has been reduced, add a sufficient quantity of the replenisher (formula below) to adjust the development time satisfactorily.

Replenisher Solution

Stock Solution A

Water (about 125° F.) (52° C.)	96 oz.	3 l
Elon	85 gr.	5.9 g
Sodium sulfite, anh	6 oz.	180 g
Sodium bisulfite	55 gr.	3.8 g
Hydroquinone	170 gr.	11.9 g
Potassium bromide	45 gr.	3.1 g
Cold water to make	1½ gal.	6 l

Stock Solution B

Sodium carbonate, anh	8 oz.	240 g
Water to make	64 oz.	2 l

For use take 3 parts of A and 1 part of B and add to the tank of developer as needed. Do not mix these solutions until ready for use.

Ortol

Solution A

Ortol	140 gr.	16 g
Potassium metabisulfite	70 gr.	8 g
Cold water	20 oz.	1000 c.c

Solution B

Sodium carbonate, anh	1.25 oz.	63 g
Sodium sulfite, anh	1.75 oz.	88 g
Potassium bromide	10–20 gr.	1.1–2.3 g
Water	20 oz.	1000 c.c.

For rapid developer take A, 1 part; B, 1 part. For slower, softer development take A, 1 part; B, 1 part; water, 1 part.

Paraminophenol

Water, boiling	20 oz.	1000 c.c.
Potassium metabisulfite	6 oz.	300 g
Paraminophenol	2 oz.	100 g

Add sodium or potassium hydroxide in small quantities to dissolve the precipitate first formed.

For use take 1 part stock solution with 20 parts water.

Pyro

1

Solution A

Water	16 oz.	455 c.c.
Oxalic acid	12 gr.	0.8 g
Pyrogallic acid	1 oz.	28 g

Solution B

Water	16 oz.	455 c.c.
Sodium sulfite, anh	2 oz.	57 g

Solution C

Water	16 oz.	455 c.c.
Sodium carbonate, anh	1 oz.	28 g

For immediate use mix 1 part each of A, B, and C with 10 parts of water.

2

Hurter and Driffield standard developer for plate testing:

Pyro	8 parts
Sodium sulfite, crystal	40 parts
Sodium carbonate, crystal	40 parts
Water to make	1000 parts

3 (Eastman D-1)

Stock Solution A

Sodium bisulfite	140 gr.	9.8 g
Pyro	2 oz.	60 g
Potassium bromide	16 gr.	1.1 g
Water to make	32 oz.	1 l

Stock Solution B

Water	32 oz.	1 l
Sodium sulfite, anh	3½ oz.	105 g

Stock Solution C

Water	32 oz.	1 l
Sodium carbonate, anh	2½ oz.	75 g

For tray development take 1 part of A, 1 part of B, 1 part of C, and 7 parts of water. Develop about 5 to 7 minutes at 65° F. (18° C.).

For tank development take 1 part of A, 1 part of B, 1 part of C, and 11 parts of water. Develop about 12 minutes at 65° F. (18° C.).

4 (Eastman D-90)

Stock Solution A

Sodium sulfite, anh	2 oz. 145	gr.	70 g
Sodium bisulfite	245	gr.	17 g
Pyro	290	gr.	20 g
Water to make	32	oz.	1 l

Stock Solution B

Sodium carbonate, anh	2½	oz.	75 g
Potassium bromide	15	gr.	1 g
Water to make	32	oz.	1 l

For average use take 1 part of stock solution A, 1 part of stock solution B, and 2 parts of water. Develop 4 to 6 minutes at 65° F. (18° C.). For greater contrast, use 1 part of A, 1 part of B, and 1 part of water; for less contrast, use 1 part of A, 1 part of B, and 4 parts of water.

Developers for Special Purposes

Tank Developers

1 Pyro

Water	48 oz.	1360 c.c.
Sodium sulfite, anh	115 gr.	7.5 g
Sodium carbonate, anh	90 gr.	5.8 g
Pyro	45 gr.	2.9 g

Dissolve immediately before use. Use full strength.
Develop 15 minutes at 65° F. (18° C.).

2 Pyro

Solution A

Water	16 oz.	455 c.c.
Oxalic acid	10 gr.	0.65 g
Pyro	1 oz.	28 g

Solution B

Water	16 oz.	455 c.c.
Sodium sulfite, anh	3 oz.	85 g

Solution C

Water	16 oz.	455 c.c.
Sodium carbonate, anh	1 oz.	28 g

For use take A, 1 part; B, 1 part; C, 1 part; water, 61 parts. Develop 30 minutes at 65° F. (18° C.) for best results.
For temperature 60° F. develop 35 minutes.
For temperature 65° F. develop 30 minutes.
For temperature 70° F. develop 25 minutes.

3 Pyro (Eastman D-79)

For negative motion picture film.

Water	2.5 qt.	750 c.c.
Sodium sulfite, anh	3.3 oz.	25 g
Pyro	145.8 gr.	2.5 g
Sodium carbonate, anh	291.6 gr.	5 g
Potassium bromide	29.2 gr.	0.5 g
Water to make	1 gal.	1 l

Time of development: 9 to 12 minutes at 65° F. (18° C.).

4 Elon-Hydroquinone-Pyro (Eastman D-75)

A long life deep tank developer for roll film.

Solution No. 1

Water (about 125° F.) (52° C.)	16 oz.	500 c.c.
Elon	44 gr.	3 g

Solution No. 2

Water (about 125° F.) (52° C.)	16 oz.	500 c.c.
Sodium sulfite, anh	260 gr.	18 g
Sodium bisulfite	1 oz. 85 gr.	36 g

Solution No. 3

Hot water (about 160° F.) (71° C.)	16 oz.	500 c.c.
Sodium sulfite, anh	260 gr.	18 g
Hydroquinone	175 gr.	12 g
Pyro	44 gr.	3 g

Solution No. 4

Water (about 125° F.) (52° C.)	16 oz.	500 c.c.
Sodium carbonate, anh	2 oz. 175 gr.	72 g

Mix each solution separately and add to the tank at once in the order given.

Then add water to make	1 gal.	4 l

Develop 7 to 14 minutes at 65° F. (18° C.), in the fresh developer according to the contrast desired. Greater or less contrast may be obtained by developing for longer or shorter times than those specified. Avoid the use of galvanized ware when mixing, or trouble from fog will be encountered. Cool the mixture of the first three solutions, before adding the cooled solution No. 4 to it, to avoid effervescence.

For small scale mixing, that is, less than 1 gallon (4 liters), all the chemicals may be dissolved in the order given in one-half the total volume of water (125° F.) (52° C.) and cold water added to make up to volume.

Replenisher Stock Solution

Water (about 125° F.) (52° C.)	64 oz.	2 l
Elon	½ oz.	15 g
Sodium sulfite, anh	3 oz.	90 g
Sodium bisulfite	3 oz.	90 g
Hydroquinone	1 oz.	30 g
Sodium carbonate, anh	8 oz.	240 g
Water to make	1 gal.	4 l

Dilute 1 part of stock solution with 1 part of water and add to the tank as required.

5 Glycin

Stock Solution

Hot water (200° F.)	60	oz.	1700 c.c.
Sodium carbonate, anh.	2	oz.	57 g
Glycin	0.5	oz.	14 g
Sodium sulfite, anh.	0.5	oz.	14 g

Dissolve in order. For use take stock solution, 6 parts; water, 58 parts.

For temperature 60° F. develop 30 minutes.
For temperature 65° F. develop 25 minutes.
For temperature 70° F. develop 20 minutes.

6 Glycin (Eastman D-78)

Water	2.5	qt.	750 c.c.
Sodium sulfite, anh.	175	gr.	3 g
Glycin	175	gr.	3 g
Sodium carbonate, anh.	350	gr.	6 g
Water to make	1	gal.	1 l

Time of development: 15 to 25 minutes at 65° F. (18° C.).

FINE GRAIN DEVELOPERS

1 An Automatic System of Development for Fine Grain

This is done by the use of two solutions as follows:

A

Water	1 qt.
Metol	95 gr.
Sulfite of soda, anh.	750 gr.
Hydroquinone	95 gr.

B

Saturated solution of borax

To mix solution A take one-half of the water, add the metol and, when dissolved, add one-half of the sulfite. To the other half of the water, hot, add the rest of the sulfite and, when dissolved, add the hydroquinone. Cool and add this second solution to the first, making solution A.

To use pour enough of solution A into a tray to well cover the film or plate, add drops of saturated solution of potassium bromide, enough for the kind of material in use. Some do not require any, others do. Use only enough to keep the whites clear. Soak the film or plate in the A solution for at least two minutes, drain but do not rinse, and then soak in solution B for at least two minutes. Rinse, fix and wash as usual. If a tank is used, the time in each solution must be at least two minutes after the tank is filled. It is necessary to give a full exposure as the high lights cannot be over developed and the shadows will go as far as the exposure will permit. This system gives a gamma of about 0.7 and will be found to produce a very fine negative for enlarging. It is especially good for work in microscopic photography.

These solutions are very concentrated and must not be allowed to go below 60° F. They can be used repeatedly and keep well. Results are best at about 70° F., but it makes very little difference between 65° and 80° F.

2 Elon-Hydroquinone-Borax (Eastman D-76)

For low contrast and greatest shadow detail on panchromatic films and plates.

Water (about 125° F.) (52° C.)	96	oz.	3 l
Elon	116	gr.	8 g
Sodium sulfite, anh.	13¼	oz.	400 g
Hydroquinone	290	gr.	20 g
*Borax	116	gr.	8 g
Water to make	1	gal.	4 l

*Such as 20-Mule Team Borax.

Use without dilution. For tank use, develop 15 to 25 minutes at 65° F. (18° C.) in the fresh developer according to the contrast desired; for tray use, decrease the time about 20 %. A faster working developer can be obtained by increasing the quantity of borax.

Still finer grained results may be secured by adding potassium bromide to the developer. The maximum quantity which may be added without too great a loss of speed is 300 grains per gallon (20 grams per 4 liters). As bromide is added, it will be necessary to increase both the time of development and the exposure for best results.

Replenisher Solution

Water (about 125° F.) (52° C.)	96	oz.	3 l
Elon	175	gr.	12 g
Sodium sulfite, anh.	13¼	oz.	400 g
Hydroquinone	1	oz.	30 g
*Borax	2 oz. 290	gr.	80 g
Water to make	1	gal.	4 l

*Such as 20-Mule Team Borax.

Use the replenisher without dilution and add to the tank to maintain the level of the solution.

3 Paraphenylene Diamine

Paraphenylene diamine	10 g
Sodium sulfite, anh.	60 g
Tribasic sodium phosphate (10 %)	20 c.c.
Potassium bromide (10 %)	10 c.c.
Water	1000 c.c.

Develop one hour at 65° F.

CONTRAST DEVELOPERS

1 Developer of Line Work (Black and White)

Also for lantern slides, or wherever increased contrast is desired.

A

Distilled water	32 oz.
Hydroquinone	1½ oz.
Sodium sulfite, anh.	1 oz.
Sulfuric acid (conc.)	60 min.

B

Distilled water	32 oz.
Sodium carbonate, anh.	1 oz.
Potassium carbonate, anh.	3 oz.
Potassium bromide	130 gr.
Sodium sulfite, anh.	3 oz.

For tray or tank development, use equal parts of A and B without further dilution. Develop at 65° F. for 5 to 10 minutes according to exposure or density desired.

2 Contrast Developer for Photomicrography

Water (52° C.)	16	oz.	500 c.c.
Elon	14	gr.	1 g
Sodium sulfite	2½	oz.	75 g
Hydroquinone	130	gr.	9 g
Sodium carbonate	360	gr.	25 g
Potassium bromide	70	gr.	5 g
Water to make	32	oz.	1 l

3 Process Tray Developer

Hydroquinone-Caustic Soda (Eastman D-9)

Stock Solution A

Water (about 125° F.) (52° C.)	16	oz.	500 c.c.
Sodium bisulfite	¾	oz.	22.5 g
Hydroquinone	¾	oz.	22.5 g
Potassium bromide	¾	oz.	22.5 g
Cold water to make	32	oz.	1 l

Stock Solution B

Cold water	32	oz.	1 l
Sodium hydroxide (caustic soda)	1¾	oz.	52.5 g

Use equal parts of A and B and develop not more than two minutes at 65° F. (18° C.). Wash thoroughly after development and before fixing, otherwise stains and dichroic fog will result. Development slows up greatly below 55° F. (13° C.).

Cold water should always be used when dissolving sodium hydroxide (caustic soda) because considerable heat is evolved. If hot water is used, the solution will boil with explosive violence and may cause serious burns if the hot alkali spatters on the hands or face. Solution A should be stirred thoroughly when the caustic alkali is added to it; otherwise the heavy caustic solution will sink to the bottom.

4 Process Tank or Tray Developer

Elon-Hydroquinone (Eastman-D-11)

Water (about 125° F.) (52° C.)	16	oz.	500 c.c.
Elon	15	gr.	1 g
Sodium sulfite, anh	2½	oz.	75 g
Hydroquinone	130	gr.	9 g
Sodium carbonate, anh	365	gr.	25 g
Potassium bromide	73	gr.	5 g
Cold water to make	32	oz.	1 l

This formula used at 65° F. (18° C.), in either tank or tray, will give very good contrast in five minutes. The developer is recommended for use with Process and Process Panchromatic films or plates.

When less contrast is desired, the developer should be diluted with an equal volume of water.

Maximum Energy Developer

For High Speed Films or Plates (Eastman D-82)

Water (about 125° F.) (52° C.)	24	oz.	750	c.c.
Wood alcohol	1½	oz.	48	c.c.
Elon	200	gr.	14	g
Sodium sulfite, anh	1¾	oz.	52.5	g
Hydroquinone	200	gr.	14	g
Sodium hydroxide (caustic soda)	125	gr.	8.8	g
Potassium bromide	125	gr.	8.8	g
Cold water to make	32	oz.	1	l

Develop about four to five minutes at 65° F. (18° C.).

The prepared developer does not keep more than a few days. If wood alcohol is not added and the developer is diluted, the solution is not so active as in the concentrated form. This developer gives the greatest possible density with negatives having a minimum exposure.

X-ray Film Developer

Elon-Hydroquinone (Eastman D-19b)

Water (about 125° F.) (52° C.)	16 oz.		500	c.c.
Elon	32 gr.		2.2	g
Sodium sulfite, anh	2 oz.	175 gr.	72	g
Hydroquinone	128 gr.		8.8	g
Sodium carbonate, anh	1 oz.	265 gr.	48	g
Potassium bromide	60 gr.		4	g
Cold water to make	32 oz.		1	l

Use without dilution. Develop for 5 minutes at 65° F. (18° C.).

Developer for Lantern Slides

1 For Blue Black Tones (Eastman D-34)

Stock Solution A

Water (about 125° F.) (52° C.)	16	oz.	500	c.c.
Elon	60	gr.	4.2	g
Sodium sulfite, anh	½	oz.	15	g
Hydroquinone	½	oz.	15	g
Cold water to make	32	oz.	1	l

Stock Solution B

Water	32	oz.	1	l
Sodium carbonate, anh	½	oz.	15	g
Potassium bromide	30	gr.	2.1	g

For use, take equal parts of A and B.

For softer tones, dilute with an equal volume of water.

Develop 1½ to 3 minutes at 70° F. (21° C.).

2 For Warm Black Tones (Eastman D-32)

Stock Solution A

Water (about 125° F.) (52° C.)	16	oz.	500	c.c.
Sodium sulfite, anh	90	gr.	6.3	g
Hydroquinone	100	gr.	7	g
Potassium bromide	50	gr.	3.5	g
Citric acid	10	gr.	0.7	g
Cold water to make	32	oz.	1	l

Stock Solution B

Cold water	32 oz.	1 l
Sodium carbonate, anh	1 oz.	30 g
Sodium hydroxide (caustic soda)	60 gr.	4.2 g

For use, take 1 part of A and 1 part of B. For still warmer tones, 1 part of A and 2 parts of B.

Develop about 4 to 6 minutes at 70° F. (21° C.).

DEVELOPERS FOR PAPERS

Metol-Hydroquinone

1 For Ordinary Contact Printing Paper

Water	16 oz.	455 c.c.
Metol	18 gr.	1.2 g
Hydroquinone	18 gr.	1.2 g
Sodium sulfite, anh	204 gr.	13 g
Sodium carbonate, anh	408 gr.	26 g
Potassium bromide	10 gr.	0.6 g

If the whites fail to develop without fog, 10 % potassium bromide solution may be added, a few drops at a time, until the desired results are obtained.

2 For Ordinary Contact Printing Paper

Water (soft or distilled)	40 oz.	1000 c.c.
Metol	15 gr.	1 g
Sodium sulfite, anh	1 oz.	28 g
Hydroquinone	60 gr.	4 g
Sodium carbonate, anh	¾ oz.	21 g
Potassium bromide (10 % solution)	40 min.	40 min.

3 Universal Paper Developer

For Contact Prints and Enlargements (Eastman D-72)

Stock Solution

Water (about 125° F.) (52° C.)	16 oz.	500 c.c.
Elon	45 gr.	3.1 g
Sodium sulfite, anh	1½ oz.	45 g
Hydroquinone	175 gr.	12 g
Sodium carbonate, anh	2¼ oz.	67.5 g
Potassium bromide	27 gr.	1.9 g
Cold water to make	32 oz.	1 l

For fast chloride papers such as Velox: stock solution 1 part, water 1 part. Develop 45 seconds at 70° F. (21° C.).

For chloride papers such as Azo: stock solution 1 part, water 2 parts. Develop 45 seconds at 70° F. (21° C.).

For bromide papers: stock solution 1 part, water 4 parts. Develop not less than 1½ minutes at 70° F. (21° C.).

4 Portrait Paper Developer (Eastman D-52)

Stock Solution

Water (about 125° F.) (52° C.)	16 oz.	500 c.c.
Elon	22 gr.	1.5 g
Sodium sulfite, anh	¾ oz.	22.5 g
Hydroquinone	90 gr.	6.3 g
Sodium carbonate, anh	½ oz.	15 g
Cold water to make	32 oz.	1 l

For professional contact papers such as Vitava Athena, use stock solution 1 part, water 1 part. To each 32 ounces (1 liter) of this developer, add ¼ ounce (8 c.c.) of a 10 % potassium bromide solution.

For professional enlarging papers and bromide papers, use full strength stock solution. To each 32 ounces (1 liter) of developer add ½ ounce (16 c.c.) of 10 % potassium bromide solution.

Develop all papers not less than 1½ minutes at 70° F. (21° C.).

Note: More bromide may be added if warmer tones are desired.

Amidol

Developer for Bromide Papers (Eastman D-51)

Stock Solution

Water (about 125° F.) (52° C.)	24 oz.	750 c.c.
Sodium sulfite, anh	4 oz.	120 g
Di-aminophenol hydrochloride (amidol)	1¼ oz.	37.5 g
Cold water to make	32 oz.	1 l

For use, take 6 ounces (180 c.c.) stock solution, ¾ dram (3 c.c.) 10 % potassium bromide solution, and 24 ounces (750 c.c.) of water. This developer oxidizes rapidly when exposed to the air so that only a quantity sufficient for immediate use should be mixed.

UNIVERSAL DEVELOPER

The following developer will give excellent results for plates, films, lantern slides, bromide paper or gaslight paper. It should be dissolved immediately before using, since it keeps only a few hours in solution.

Amidol	25 gr.	1.6 g
Sodium sulfite	120 gr.	7.8 g
Water	10 oz.	300 c.c.

For lantern slides, bromide paper or gaslight papers add to the above,

Potassium bromide	7 gr.	0.5 g

The concentration given is satisfactory for any of the purposes mentioned. Develop three to five minutes at a temperature of 65° F. or 18° C.

RINSING AND HARDENING BATHS

Rinsing Bath or Short Stop

After development rinse prints (or negatives) for five seconds before fixing.

Water	32 oz.	10 l
Acetic acid (glacial)	0.5 oz.	6 c.c.

Hardening Bath

For Films or Plates (Eastman SB-3)

In hot weather, the following hardening bath should be used after development and before fixation in conjunction with fixing baths which do not harden sufficiently:

Water	32 oz.	1 l
Potassium chrome alum	1 oz.	30 g

Agitate the negatives for a few seconds when first immersed in hardener. Leave them in the bath for three minutes. This bath should be renewed frequently.

FIXING BATHS

Plain Non-hardening Fixing Bath

Water	32 oz.	852 c.c.
Hypo (sodium thiosulfate)	8 oz.	227 g

Do not use the bath when it is discolored; it must be made fresh each day.

Chrome Alum for Plates or Films

A

Water	128 oz.	3600 c.c.
Hypo (sodium thiosulfate)	32 oz.	850 g

B

Water	32 oz.	852 c.c.
Sodium sulfite, anh	3 oz.	85 g
Sulfuric acid, C. P.	0.5 oz.	14 c.c.
Chrome alum, anh	2 oz.	56 g

Note: Be sure to mix solution B exactly in given proportions and rotation.

Always pour B into A while stirring well. If this is not done, precipitation will take place.

During the cold season one half the quantity of solution B is sufficient for full quantity of solution A.

This bath remains clear after frequent use, does not discolor the negatives and hardens the film to such a degree that the negatives can be washed in warm water and dried by artificial heat if necessary. They should be left in the bath ten to twenty minutes after the bromide of silver appears to have been dissolved, to insure permanency, freedom from stain and perfect hardening.

It is not advisable to use this bath, which contains sulfuric acid, in metal developing tanks.

Acid Hardening Fixing Bath

For Films and Plates (Eastman F-5)

Water (about 125° F.) (52° C.)	20 oz.	600 c.c.
Sodium thiosulfate (hypo)	8 oz.	240 g
Sodium sulfite, anh	$\frac{1}{2}$ oz.	15 g
*Acetic acid (28 % pure)	$1\frac{1}{2}$ oz. fl.	47 c.c.
**Boric acid, crystals	$\frac{1}{4}$ oz.	7.5 g
Potassium alum	$\frac{1}{2}$ oz.	15 g
Cold water to make	32 oz.	1 l

* To make 28 % acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

** Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

Dissolve the hypo in about one-half the required volume of water (about 125° F.) (52° C.) and then add the remaining chemicals in the order given, taking care that each chemical is dissolved before adding the next. Then dilute with water to the required volume.

Non-hardening Fixing Bath (Eastman F-24)

Water (about 125° F.) (52° C.)	16 oz.	500 c.c.
Sodium thiosulfate (hypo)	8 oz.	240 g
Sodium sulfite, anh	145 gr.	10 g
Sodium bisulfite	365 gr.	25 g
Cold water to make	32 oz.	1 l

This bath is recommended for films, plates or paper when no hardening is desired.

Acid Fixing Bath for Papers

(May also be used for plates or films)

Water	64 oz.
Hypo	16 oz.

Dissolve, then add the following acid hardener:

Water	5 oz.
Sodium sulfite, anh	$\frac{1}{2}$ oz.
Acetic acid, 25 %	3 oz.
Alum, anh	$\frac{1}{2}$ oz.

This fixing bath is also excellent for dry plates and films, and will keep indefinitely before using; therefore it can be made up some time in advance. One pint of the bath should fix at least fifty 4 × 5 prints. The acid fixing bath can be used repeatedly. It keeps with but little care. It will by degrees become alkaline by the gradual addition of developer adhering to the prints. It should be discarded entirely when it becomes frothy, and a fresh bath prepared.

INTENSIFIERS

Mercury

1

Prepare the following solution, which will keep and work well until exhausted.

Solution No. 1

Water	16 oz.	455 c.c.
Mercuric chloride, $HgCl_2$	120 gr.	7.8 g
Potassium bromide	120 gr.	7.8 g

Solution No. 2

Number 2 should be mixed fresh.

Water	8 oz.	227 c.c.
Sodium sulfite, anh	1 oz.	28 g

After the negative is well fixed and washed, immerse in No. 1 until it has become thoroughly whitened, and after rinsing carefully, place it in No. 2, leaving it there until entirely cleared. In case sufficient intensification has not been gained, wash for ten minutes, repeat the operation and finally wash well. If after intensification the negative is too dense it may be reduced by placing it for a few seconds in water 16 oz., hypo 1 oz.

If the negative has not been thoroughly fixed and washed before intensification, stains will ensue.

2

Mercuric chloride, $HgCl_2$, 2 % solution	100 c.c.
Potassium iodide, KI, 10 % solution	25 c.c.
Sodium thiosulfate (hypo), 10 % solution	40 c.c.
Water	300 c.c.

Part of the mercury solution is added to the water and then part of the iodide solution, continuing until all the mercury and iodide have been added to the water.

When the solution is clear, add the hypo.

Use the complete solution at full strength.

Chromium

(Eastman In-4)

Stock Solution

Potassium bichromate	3 oz.	90 g
Hydrochloric acid, C. P.	2 oz. fl.	64 c.c.
Water to make	32 oz.	1 l

For use, take 1 part of stock solution to 10 parts of water. Bleach thoroughly, then wash five minutes and re-develop fully (about 5 minutes) in artificial light or daylight in any quick-acting, non-staining developer containing the normal proportion of bromide. Then wash thoroughly and dry. Greater intensification can be secured by repeating the process. The degree of intensification can be controlled by varying the time of re-development.

REDUCERS

1 Farmer's Reducer

A

Water	16 oz.	455 c.c.
Hypo (sodium thiosulfate)	1 oz.	28 g

B

Water	16 oz.	455 c.c.
Potassium ferricyanide	1 oz.	28 g

As this solution is affected by light, the bottle containing it should be of amber color or wrapped in opaque paper and kept in the dark when not in use.

Mix for immediate use:

A	8 parts
B	1 part

Use in subdued daylight.

The negative can be placed in this solution directly after fixing. If a dry negative is to be reduced, it must be soaked in water for at least half an hour before applying the solution. To avoid streaks, always rinse the negative before holding it up for examination. As soon as sufficiently reduced wash thoroughly.

2 Proportional Reducer (Eastman R-5)

Stock Solution A

Water	32 oz.	1 l
Potassium permanganate	4 gr.	0.3 g
Sulfuric acid (10 % solution)	½ oz. fl.	16 c.c.

Stock Solution B

Water	96	oz.	3	l
Ammonium persulfate	3	oz.	90	g

For use, take one part of A to three parts of B. When sufficient reduction is secured the negative should be cleared in a 1 % solution of sodium bisulfite. Wash the negative thoroughly before drying.

STAIN REMOVERS

1 Iron Clearing Solution

To remove yellow stain caused by pyro or hydroquinone developer, wash well to free from hypo and place in

Water	20 oz.	568 c.c.
Ferrous sulfate, pure	3 oz.	85 g
Sulfuric acid, C. P	1 oz.	28 g
Powdered alum	1 oz.	28 g

until stain is gone, then wash well.

2 (Eastman S-6)

Developer or oxidation stain may be removed by first hardening the film for 2 or 3 minutes in a 5 % formalin solution, then washing for 5 minutes and bleaching in:

Stock Solution A

Potassium permanganate	75	gr.	5.3	g
Water to make	32	oz.	1	l

Stock Solution B

Sodium chloride (table salt)	$2\frac{1}{2}$	oz.	75	g
Sulfuric acid, C. P	$\frac{1}{2}$	oz. fl.	16	c.c.
Water to make	32	oz.	1	l

Use equal parts of A and B. The solutions should not be mixed until ready for immediate use since they do not keep long after mixing. All particles of permanganate should be dissolved completely when preparing solution A, since undissolved particles are likely to produce spots on the negative. Bleaching should be complete in 3 or 4 minutes at 65° F. (18° C.). The brown stain of manganese dioxde formed in the bleaching bath is best removed by immersing the negative in a 1 % sodium bisulfite solution. Then rinse well and develop in strong light with any non-staining developer.

Warning: Developers containing high sulfite and low alkali should not be used for re-development, because the sulfite tends to dissolve the silver image before the developer can act upon it.

BLUE PRINT PAPER, FORMULAE FOR SENSITIZING

1

Solution A

Water	8.5 oz.	50 c.c.
Iron and ammonium citrate	1.7 oz.	10 g

Solution B

Water	8.5 oz.	50 c.c.
Potassium ferricyanide	1.4 oz.	8 g

Filter separately. The solutions, which may be preserved separately for some time, are best kept in the dark. For use, mix, in a dark room or by an artificial light of low intensity, equal quantities of the two solutions.

Any non-absorbent paper may be sensitized by brushing the solution over it rapidly with a soft, wide, flat brush, going over the surface twice, the second coat being applied in a direction at right angles to the first. An alternative method is to lower the paper, beginning at one edge, on to the surface of the solution in a tray and allow it to float for a few seconds. Care must be taken to exclude air bubbles. After sensitizing by either method, the paper should be hung by one edge in a dark room to dry.

2

Blue printing depends to a large extent upon surface of paper. The following formula is recommended as producing clear whites:

Solution 1

Potassium ferricyanide, $K_3Fe(CN)_6$	10 g
Distilled water	100 c.c.

Solution 2

Iron and ammonium citrate (ferric)	30 g
Water	100 c.c.
Gum arabic (gum acacia)	5 g

Equal parts of the above solutions are mixed just before use. The paper to be sensitized may be floated on the surface or the liquid may be applied with a tuft of absorbent cotton using cross strokes to insure an even coating. The sensitized paper must be dried in the dark and should be used within 36 hours.

ULTRAVIOLET SENSITIZATION

Photographic plates can be made sensitive to short-wave ultraviolet light by immersion in a dilute solution of citric acid in 95 % ethyl alcohol (1 % citric acid). (Sodium salicylate may be substituted for the citric acid.) The plate is immersed in the citric acid solution and immediately withdrawn and dried in less than one minute by waving in the air before putting in the holder. After exposure the plate can be developed without previous washing and without special precautions. The coating of citric acid adheres to the plate so that a number of plates may be treated and stored away for future use. Citric acid has no detrimental action on the emulsion or the developer. The sharpness of the image is not diminished.

FACTORIAL DEVELOPMENT

If the image first appears after immersion in the developer for a certain time, then this period of time multiplied by the "factor" for the particular developer used will give the total time required for full, normal development. The factor for the degree of development desired may well be determined by experiment; the following are suggested:

Amidol, 2 gr. per oz.	18
Glycin	8–12
Hydroquinone	$4\frac{1}{2}$–5
Metol	30
Metol-hydroquinone	14
Ortol	10

Pyro, without bromide:

1 gr. per oz	18
2 gr. per oz	12
3 gr. per oz	10
4 gr. per oz	8
5 gr. per oz	6

With 1 part bromide to 4 parts pyro:

1 gr. pyro per oz	9
2 gr. pyro per oz	5
3 gr. pyro per oz	4½
4 gr. pyro per oz	4

DIAPHRAGM OR STOP NUMBERS

F System	f/2	f/3	f/3.5	f/4	f/4.5	f/5.6	f/6.3
Rel. Exp.	1/16	1/7	1/5		1/3		5/8
U. S. No.				1		2	

F System	f/8	f/11.3	f/16	f/22.6	f/32	f/45	f/64
Rel. Exp.	1	2	4	8	16	32	
U. S. No.	4	8	16	32	64	128	256

PLATE AND FILM SPEEDS

Compiled by Chas. H. Shipman

It is pertinent to state that there is at present no exact way to indicate plate and film speeds. Also since different manufacturers do not use identical methods in their speed determinations the stated speeds vary among the different makes.

In 1900 two English amateurs, Messrs. Hurter and Driffield, proposed a system of plate speeds based on the assumption that, if a plate is given a series of graded exposures, and developed in a pyro developer free from bromide, a density-log exposure curve may be plotted from which a speed value may be determined which is supposed to be inversely proportional to the exposure required to produce average density. The Scheiner system is based upon the assumption that speeds are inversely proportional to the exposure necessary to produce a just visible image. It will be evident that these two systems cannot be compared exactly. Nor is either system correct since the assumptions upon which they are based are not exactly true. Nevertheless the results obtained by these methods are well within the latitude of the emulsions and will serve well as a starting point for all ordinary work. The exposures may be easily altered after a trial to produce the type of result desired.

In general, emulsions under 18 American Scheiner (400 H & D) are considered slow and are used for work requiring contrast, or for copying and commercial work. Those from 18 to 21 American Scheiner (400 to 800 H & D) are of average speed and are used for general portrait, commercial and amateur work. Those over 21 American Scheiner (800 H & D) are for special work requiring extreme speed. They should be used only when necessary as they have small latitude and are not of as fine grain as the slower emulsions.

COMPARISON OF PLATE SPEEDS

The table below gives the approximate values of the different speed systems used here and abroad as compared with each other. No exact values can be given due to the variation in manufacturers' methods of getting their speed ratings.

Scheiner American	Scheiner European	Din	Weston	H & D American	H & D European	Relative Exposure
8		1/10	0.75	35		32
9		2/10	1	45		27
10		3/10	1.3	56		21
11		4/10	1.5	72		16
12		5/10	2	91		13
13		6/10	2.5	117		11
14		7/10	3	150		8
15		8/10	4	190		7
16		9/10	5	240		5
17	23	10/10	6	308	1300	4
18	24	11/10	8	390	1700	3.3
19	25	12/10	10	500	2100	2.7
20	26	13/10	12	636	2700	2.0
21	27	14/10	16	800	3500	1.7
22	28	15/10	20	1050	4400	1.3
23	29	16/10	24	1300	5600	1.0
24	30	17/10	32	1700	7200	.80
25		18/10	40	2100		.67
26		19/10	50	2700		.50
27		20/10	64	3500		.40
28		21/10		4400		.33
29		22/10		5600		.25
30		23/10		7200		.20

SHUTTER SPEEDS OF MOVING PICTURE CAMERAS

Cine Kodak	1/30 sec.
De Vry	1/30
Filmo Regular 70	1/25
Filmo A C D & Da 70	1/25
Filmo 3 Speed & Golf 70	1/40
Filmo 3 Speed 71	1/40
Filmo 2 Speed 71	1/30
Filmo 75	1/50
Filmo 8 & 121	1/30 sec.
Keystone	1/50
Simplex	1/40
Stewart Warner 8 mm	1/50
Stewart Warner 16 mm	1/40
Victor	1/30
Zeiss Kinamo	1/30

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
8 mm Cine Film				
Bell and Howell Co.				
Filmopan Straight Eight Reversible...	20	17	12	6
Eastman Kodak Co.				
Regular Panchromatic Reversible.....	16	13	8	5
16 mm Cine Film				
Agfa Ansco				
Fine Grain Panchromatic Negative....	20	15	12	4
Fine Grain Plenachrome Reversible...	20	..	12	..
Fine Grain Superpan Reversible......	23	21	24	16
Panchromatic Negative.............	18	15	8	4
Panchromatic Reversible.............	20	17	12	6
Positive.........................	..	4	..	0.3
Dufaycolor				
Dufay Color (No Filter in Daylight)..	17	14	6	3
DuPont				
Ortho............................	18	14	8	3
Positive.........................	11	6	1.5	..
Regular Panchromatic Negative......	20	16	12	8
Safety Sound Recording............	20	12	12	2
Sound Recording Positive...........	14	9	3	1
Special N H Panchromatic..........	24	21	32	16
Special Panchromatic Negative.......	21	18	16	8
Superior.........................	24	21	24	16
Eastman Kodak Co.				
Regular Ortho Safety...............	17	13	12	8
Regular Panchromatic..............	18	15	16	8
Super-Sensitive Panchromatic........	23	20	24	16
Ilford				
Kinolux #1........................	14	9	3	1
Kinolux #2........................	17	12	6	2
Macy				
Special Panchromatic...............	19	17	10	6
Mono				
Mono............................	18	14	8	3
Pellex				
Orthochrome......................	18	14	8	3
Panchromatic......................	20	18	12	8
Super-Speed.......................	23	20	24	12
Perutz				
Rectepan.........................	17	13	6	2.5
Sears				
Panchromatic......................	21	19	16	10
Selo				
Panchromatic......................	18	15	8	4
Supersensitive Panchromatic.........	21	20	16	12
Zeiss				
Orthochromatic....................	18	..	8	..
Panchromatic......................	24	..	32	..
35 mm Cine Film, Leica Etc.				
Agfa Ansco and Agfa (German)				
Fine Grain Plenachrome.............	21	18	16	8
Fine Grain Superpan Reversible......	21	20	16	12

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
35 mm Cine Film, Leica Etc. (Continued)				
Agfa Ansco and Agfa (German) (Continued)				
Fine Grain Superpan	23	21	24	16
Finopan	20	15	12	4
Infrared	12	..	2	..
Isochromatic	18	14	8	3
Magazine	20	17	12	6
Positive	11	4	1.5	0.3
Standard Extra-Rapid	20	15	12	4
Standard Panchromatic	21	20	16	12
DuPont				
Apex Superspeed	23	19	24	10
Background Panchromatic	21	20	16	12
Dupac	16	..	5	..
Infrared D	17	..	8	..
Micropan	15	14	4	3
Ortho	18	14	10	4
Panchromatic	19	16	10	5
Positive	11	6	2	0.2
Sound Recording Positive	14	9	3	1
Special Panchromatic	21	18	16	8
Superior High Red	26	23	50	24
Superior Panchromatic	23	21	24	16
Eastman Kodak Co.				
Panatomic Background	15	12	10	6
Panatomic Retina, Leica Etc	21	19	16	10
Panchromatic Type 2	21	18.	16	8
Par Speed	21	16	16	5
Positive	8	..	0.75	0.3
Sound A & B	..	8	..	0.8
Special Negative	15	11	4	1.5
Super-Sensitive Panchromatic Type 2	23	21	24	16
Super-X Panchromatic	24	22	32	20
Zelcras	15	12	4	2
Gevaert				
Express Ortho F Leica	21	17	16	6
Panchromosa Leica	21	20	16	12
Panchromatic Reversal Safety	19	..	10	..
Reversal Safety	13	..	2.5	..
Special Negative Fine Grain	19	..	10	..
Special Negative Safety	15	..	4	..
Special Panchromatic Safety	17	..	6	..
Superchrome Leica	20	16	12	5
Hauff				
Ortho	20	..	12	..
Pancola Panchromatic	19	..	10	..
Special Fine Grain	13	..	2.5	..
Ultra	17	..	6	..
Ilford and Selo				
Extra Fine Grain Panchromatic	18	..	8	..
Fine Grain Hypersensitive Panchromatic	21	..	16	..
Special Fine Grain	17	..	6	..

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Day-light	Tung-sten or Photo-flood	Day-light	Tung-sten or Photo-flood
35 mm Cine Film, Leica Etc. (Continued)				
Lainer and Hrdliczka				
Tizian 3000	20	..	12	..
Tizian Panchromatic	25	..	40	.
Mimosa				
Extreme Ortho	22	17	20	6
Panchroma	24	..	32	..
Perutz				
Finecorn A H	17	13	6	2.5
Neo Persenso	21	19	16	10
Peromnia	24	21	32	16
Perpantic	22	19	20	10
Selo				
Fine Grain Hypersensitive Panchromatic	22	19	20	10
Fine Grain Panchromatic	19	16	10	5
Selochrome Special Fine Grain	18	13	8	2.5
Zeiss				
Orthochromatic Cine	23	..	24	..
Orthochromatic Contax	22	..	20	..
Panchromatic	24	..	32	..
Roll Film and Film Pack				
Agfa Ansco and Agfa (German)				
Fine Grain Plenachrome Roll	21	17	16	6
Isopan JJS Roll	25	22	40	20
Isopan Regular	23	21	24	16
Isochrome	20	18	12	8
Plenachrome Roll	21	17	16	6
Standard Roll	19	14	8	3
Superpan	23	22	24	16
Super-Plenachrome Pack	24	21	32	16
Bauchet				
30 Orthochromatic	26	21	50	16
Eastman Kodak Co.				
Panatomic	20	18	12	8
Panatomic R F (German)	23	21	24	16
Panatomic Super-Green (German)	23	21	24	16
Regular Non-Curling	18	13	8	4
Super-Sensitive Panchromatic	23	21	24	16
Verichrome	21	17	16	6
Eisenberger				
F & D	20	..	12	..
Flavirid	20	..	12	..
Oka	19	..	10	..
Panchromatic	21	..	16	..
Ensign				
Lukos	21	17	16	6
Ultrachrome	23	19	24	10
Gebhardt				
Blau-Gold	20	..	12	..
Gevaert				
Express Superchrome Roll	23	..	19	..

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Day-light	Tung-sten or Photo-flood	Day-light	Tung-sten or Photo-flood
Roll Film and Film Pack (Continued)				
Gevaert (Continued)				
Express Superchrome Pack	24	..	32	..
Marvelchrome	23	20	24	12
Panchromosa	20	..	17	..
Panchromosa Special Roll	17	..	6	..
Guilleminot				
Roll Film	23	17	24	6
Hauff				
Flavin	20	..	12	..
Pancola	24	21	32	16
Ultra	24	20	32	12
Ilford and Selo				
Fine Grain Panchromatic	22	19	16	10
Hypersensitive Panchromatic	24	21	32	16
Ortho	20	15	12	4
Selochrome	23	18	24	8
Kranseder				
Panchromatic	24	..	32	..
Lainer and Hrdliczka				
Tizian 1500	17	..	6	..
Tizian 3000	20	..	12	..
Tizian Panchromati.	25	..	40	..
Lomberg				
M S Film	25	..	40	..
Macy				
Multichrome	21	17	16	6
Mimosa				
Extrema	22	..	20	..
Panchroma	24	..	32	..
Perutz				
Fine Grain Roll	20	17	12	6
Peromnia F G Panchromatic	24	21	32	16
Perpantic Roll	22	19	20	10
Persenso	23	21	24	16
Schleussner				
Tempo-Gold	25	..	40	..
Voigtlander				
Bessapan	24	..	32	..
Bessapan F	20	..	12	..
Brilliant	18	..	8	..
Illustra	22	..	20	..
Zeiss				
Fine Grain Panchromatic	23	..	24	..
Ortho	23	..	24	..
Panchromatic	22	..	20	..
Pernox Fine Grain Ortho	23	18	24	8
Standard	20	..	12	..
Professional Film				
Agfa Ansco and Agfa (German)				
Commercial	20	12	12	2
Commercial Ortho	21	17	16	6
Commercial Panchromatic	20	17	12	6
Infrared (With Filter)	8	..	0.8	..

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
Professional Film (Continued)				
Agfa Ansco and Agfa (German) (Continued)				
Isochrome	23	..	24	..
Isochrome Portrait	25	..	40	..
Isopan	22	21	20	16
Portrait	21	17	16	6
Process	14	4	3	0.3
Process Panchromatic	11	5	3	0.3
Superpan Portrait	23	22	24	20
Super-Plenachrome	23	21	24	16
Supersensitive Panchromatic	23	22	24	20
Supersensitive Plenachrome	23	21	24	16
Barnett				
Ordinary	13	..	2.5	..
Process	4	..	0.8	..
Super-Speed Portrait	20	..	12	..
Defender				
Commercial	17	14	6	3
Commercial Ortho	19	15	10	4
Commercial Panchromatic	17	14	6	3
Dupac	20	17	12	6
Fine Grain Panchromatic	20	18	12	8
High Green Sensitive Portrait	21	17	16	6
Panchromatic	17	14	6	3
Pentagon Portrait	20	17	12	6
Portrait	20	15	12	4
Special Extra-Fast Panchromatic	23	21	24	16
Eastman Kodak Co.				
Aero Ortho	17	13	6	2.5
Aero Panatomic	19	16	10	5
Aero Panchromatic	20	17	12	6
Aero Super-Sensitive Panchromatic	23	20	24	12
Commercial	15	9	4	1
Commercial Matte	15	9	4	1
Commercial Ortho	19	15	10	4
Commercial Panchromatic	20	17	12	6
Kodak Cut Film Regular	20	15	12	4
Kodak Cut Film Super-Speed	22	18	20	8
Kodalith Regular	4	..	0.3	..
Kodalith Ortho	6	..	0.5	
Ortho Press	21	17	16	6
Panatomic	20	18	12	8
Portrait Panchromatic	22	20	20	12
Portrait Par	20	15	12	4
Portrait Super-Speed	22	18	20	8
Process	9	4	1	0.3
Process Panchromatic	11	8	1.5	0.8
Super-Speed Panchromatic	22	20	20	12
Gevaert				
Commercial Ortho	14	10	3	1.3
High Speed	17	13	6	2.5
Superchrome	21	17	16	6
Ultra Panchromatic	21	18	16	8

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
Professional Film (Continued)				
Hammer				
Extra Fast	17	13	6	2.5
Extreme Contrast	3	2	0.5	0.2
Medium Commercial	17	12	6	2
Medium Commercial Ortho	17	12	6	2
Process	6	4	0.5	0.3
Slow	14	9	3	1
Slow Ortho	14	9	3	1
Super-Speed Ortho	23	19	24	10
Hauff				
Modula	21	..	16	..
Panchromatic	21	..	16	..
Ilford				
Commercial Ortho	17	12	6	2
Fine Grain Ordinary	8	..	0.7	..
Hyperchromatic	21	..	16	..
Hypersensitive Panchromatic	23	20	24	12
Panchromatic	18	15	8	4
Portrait Ortho Fast	20	16	12	5
Portrait Ortho Medium	18	15	8	4
Process	4	..	0.3	..
Lainer and Hrdliczka				
Tizian 3000	20	..	12	..
Tizian Panchromatic	25	..	40	..
Mimosa				
Extrema	22	..	20	..
Perutz				
Peromnia	24	21	32	16
Persenso	23	21	24	16
Plates				
Agfa (German)				
Andresa	23	..	24	..
Chromo	18	..	8	..
Chromo Isolar	16	..	5	..
Extra Rapid	19	..	10	..
Isochrome	23	..	24	..
Iso Panchromatic Super-Special	26	..	50	..
Iso Rapid	18	..	8	..
Normal	19	..	10	..
Panchromatic	17	..	6	..
Process	5	..	0.3	..
Special Rapid Ortho	23	..	24	..
Special Rapid Panchromatic	23	..	24	..
Standard	16	..	5	..
Ultra Special	20	..	12	..
Barnett				
Dry Stripping Fine Grain Ordinary	10	..	1.3	..
Dry Stripping Process	5	..	0.3	..
Fine Grain Ordinary	10	6	1.3	0.5
Fine Grain Ordinary	11	7	1.5	..
Line Tone Panchromatic Process Thin	6	..	0.5	..
Line Tone Process Thin	4	1	0.3	..

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
Plates (Continued)				
Barnett (Continued)				
Ordinary	13	9	2.5	1
Press Ortho	21	17	16	6
Process	11	7	1.5	..
Process Ortho	10	6	1.3	0.5
Rapid Panchromatic Process	13	10	2.5	1.3
Rapid Panchromatic Process Extra Green	13	10	2.5	2.3
Self Screen Ortho	17	13	6	2.5
Soft Panchromatic	21	13	16	2.5
Special Rapid	16	..	5	..
Special Rapid Panchromatic	18	15	8	4
Studio	18	..	8	..
Studio	19	15	10	4
Studio Ortho	18	14	8	3
Summer Press	21	..	16	..
Super-Iso	23	19	24	10
Super-Press	24	20	32	12
Super-Speed Ortho	19	..	10	..
Super-Speed Ortho	20	15	12	4
X L Super-Speed Ortho	21	17	16	6
Bauchet				
A	11	..	1.5	..
B	13	..	2.5	..
Celia	16	..	5	..
Dyna	20	..	12	..
Hyperchrome	23	..	24	..
Hyper Non-Screen	19	..	10	..
Special Studio	19	..	10	..
Criterion				
Enelite	19	..	10	..
Enelite Iso	19	..	10	..
Extra Rapid	17	..	6	..
Extra Rapid Iso	17	..	6	..
Ordinary	12	..	2	..
Press	19	..	10	..
Process	10	..	1.3	..
Rapid Screenless Ortho	18	..	8	..
700	20	..	12	..
700 Iso	20	..	12	..
Special Extra Rapid	18	..	8	..
Special Extra Rapid Iso	18	..	8	..
Defender				
Seed L Ortho	18	15	8	4
Seed L Ortho Non Halation	18	15	8	4
Seed Panchromatic	13	10	2.5	1.3
Seed Process	9	4	1	0.3
Seed 23	12	8	2	0.7
Seed 26X	18	14	8	4
Seed 27	19	16	10	5
Standard Orthonon	18	14	8	4
Standard Post Card	14	12	3	1.5

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Day-light	Tung-sten or Photo-flood	Day-light	Tung-sten or Photo-flood
Plates (Continued)				
Defender (Continued)				
Stanley Extra Imperial	18	14	8	4
Stanley Regular	18	14	8	4
Eastman Kodak Co.				
Commercial	14	10	3	1.3
Double Coated Ortho	16	12	5	2
Eastman 33	14	8	3	0.7
Eastman 40	17	12	6	2
Eastman 50	20	15	12	4
Hyper-Press Ortho	22	19	20	10
Hypersensitive Panchromatic	24	21	32	16
Infrared	9	..	1	..
Lantern Slide Regular	4	1	0.3	..
Lantern Slide Slow	2	0.5	..	..
Polychrome	15	10	4	1.3
Process	6	2	0.5	..
Single Coated Ortho	16	12	5	2
Universal	15	10	4	1.3
Wratten M	14	11	3	1.5
Wratten Metallograph	10	6	1.3	0.5
Wratten Panchromatic	20	17	12	6
Wratten Process Panchromatic	16	13	5	2.5
Eisenberg				
Flavirid	20	12	12	2
O K	20	12	12	2
Panchrom	21	16	16	5
Ultra Rapid	20	12	12	2
Empire				
Iso Press	20	..	12	..
Special Rapid	17	..	6	..
Gevaert				
Chromosa	15	..	4	..
Super-Chromosa	20	16	12	5
Super-Press A H	21	18	20	8
Super-Press 2000 A. H	23	20	24	12
Super-Sensima Special Blue Label	15	..	4	..
Super-Sensima Special	17	..	6	..
Super-Sensima Special 2000	21	17	16	6
Ultra Panchro	18	..	8	..
Ultra Rapid	14	..	4	..
Hammer				
Extra Fast	17	13	6	2.5
Extreme Contrast	3	2	0.5	0.2
Lantern Slides Yellow Label	6	..	0.5	..
Lantern Slides White Label	6	..	0.5	..
Medium Commercial	17	12	6	2
Medium Commercial Ortho	17	12	6	2
Opal	6	..	0.3	..
Ortho D. C	17	13	6	2.5
Ortho Special D. C	18	14	8	3
Process	6	4	0.5	0.3
Slow	14	9	3	1

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
Plates (Continued)				
Hammer (Continued)				
Slow Ortho	14	9	3	1
Special	18	14	8	3
Super-Press	20	16	12	5
Super-Sensitive Ortho	23	19	24	10
Transparency	6	..	0.3	..
Hauff				
Analo Flavin	17	..	6	..
Diapositive	2	..	..	..
Extra Rapid	14	..	3	..
Modula	22	..	20	..
Ortho N H	14	..	3	..
Pancola	18	..	8	..
Prozess	4	..	..	..
Ulcroma	20	..	12	..
Ulcroma N. H	22	..	20	..
Ultra	20	..	12	..
Ilford				
Auto-Filter	18	..	8	..
Chromatic	14	..	3	..
Double-X-Press	23	..	24	..
Golden Iso Zenith	23	18	24	8
Hypersensitive Panchromatic	23	20	24	12
Infrared (With Filter)	14	..	3	..
Iso-Zenith	20	15	12	4
Ordinary	12	..	2	..
Press Ortho	20	..	12	..
Process	5	..	..	..
Rapid Chromatic	18	..	8	..
Rapid Process Panchromatic	14	..	3	..
Screened Chromatic	17	..	6	..
Soft Gradation Panchromatic	21	18	12	8
Special Rapid	17	..	6	..
Special Rapid Panchromatic	18	..	8	..
Topographical	14	..	3	..
Zenith	19	..	10	..
Illingworth				
Fleet	18	14	8	3
Lightning Fleet Ortho	22	18	20	8
Pan Fleet	20	19	12	10
Super-Fleet	19	15	10	4
Super-Fleet Ortho	20	16	12	5
Super-Lightning Fleet Ortho	23	19	24	10
Kranseder				
Derby	23	..	24	..
Kranz Meister Klasse	21	..	16	..
Kranz Sonderklasse	22	..	20	..
Lainer and Hrdliczka				
Diapositive	2	..	..	..
Extra Rapid	11	..	1.5	..
Germania	10	..	1.3	..
Lainos Panchromatic	17	..	6	..
Lurol	17	..	6	..

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
Plates (Continued)				
Lainer and Hrdliczka (Continued)				
Orthoton	12	..	2	..
Orthoton Rapid	17	..	6	..
Reproduction	3	..	..	..
Tizian 1500	17	..	6	..
Tizian 3000	20	..	12	..
Tizian Panchromatic	26	..	50	..
Tizian Ultra Rapid	16	..	5	..
Mimosa				
Extrema Ortho	17	..	6	..
Extrema Ortho A. H.	16	..	5	..
Extrema Studio	17	..	6	..
Optima	21	..	16	..
Pressa	20	..	12	..
Perutz				
Braunsiegel	22	..	20	..
Perchrome B	19	..	10	..
Perfo	22	..	20	..
Peromnia	26	..	50	..
Persenso	25	..	40	..
Pervola	24	..	32	..
Silber Eosin	17	..	6	..
Spezial Flieger	23	..	24	..
Super-Ortho	25	..	40	..
Super-Rapid	25	..	40	..
Voigtlander				
Illustra	23	..	24	..
Sigurd	21	..	16	..
Spezial Portrait	23	..	24	..
Wellington				
Anti-Screen	19	..	10	..
Contrasty Ortho Process	7	..	..	..
Iso	20	..	12	..
Iso Speedy	16	..	5	..
Ordinary	13	..	2.5	..
Ortho Process	11	..	1.5	..
Spectrum	19	..	10	..
Speedy	16	..	5	..
Studio Anti-Screen	19	..	10	..
Super-Xtreme	19	..	10	..
X Press	19	..	10	..
Xtra Speedy	17	..	6	..
Xtreme	18	..	8	..
Color Plates and Films				
Agfa (German)				
Color Plates	17 × 30	27 × 60	64 × 60	40 × 60
Ultracolor Film	13	..	2.5	..
Dufay (American)				
Daylight, No Filter	17	..	6	..
Daylight, #51 Filter	15	..	4	..
Photoflood, #78A Filter	..	14	..	3

PLATE AND FILM SPEEDS (Continued)

Maker and kind	American Scheiner		Weston	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
Color Plates and Films (Continued)				
Eastman Kodak Co.				
Kodachrome, No Filter	15	12	4	2
Kodachrome, With Filter	..	9	..	1
Kodachrome A	..	15	..	4
Finlay				
Eastman Special Panchromatic Plates.				
Sunlight, With Filter	12	..	2	..
Photoflood, With Filter	..	9	..	1
Lumiere				
Filmcolor, Old Style, Filter	17 × 60	..	20 × 60	..
Filmcolor, Old Style, Filter	..	18 × 60	.	8 × 60
Filmcolor, New Style				

WIRE TABLES

COMPARISON OF WIRE GAUGES

Diameter of Wire in Inches

Gauge No.	Brown & Sharpe	Birmingham or Stub's.	Washburn & Moen.	Imperial or Brit. Std.	Stub's Steel	U. S. Std. plate	Music wire
00000000	......	......	......	......	......	......	.0083
0000000	......	......	......	.500	......	......	.0087
000000	......	......	......	.464	......	.46875	.0095
00000	......	......	......	.432	......	.4375	.0100
0000	.4600	.454	.3938	.400	......	.40625	.0110
000	.4096	.425	.3625	.372	......	.375	.0120
00	.3648	.380	.3310	.348	......	.34375	.0133
0	.3249	.340	.3065	.324	......	.3125	.0144
1	.2893	.300	.2830	.300	.227	.28125	.0156
2	.2576	.284	.2625	.276	.219	.265625	.0166
3	.2294	.259	.2437	.252	.212	.25	.0178
4	.2043	.238	.2253	.232	.207	.234375	.0188
5	.1819	.220	.2070	.212	.204	.21875	.0202
6	.1620	.203	.1920	.192	.201	.203125	.0215
7	.1443	.180	.1770	.176	.199	.1875	.0230
8	.1285	.165	.1620	.160	.197	.171875	.0243
9	.1144	.148	.1483	.144	.194	.15625	.0256
10	.1019	.134	.1350	.128	.191	.140625	.0270
11	.09074	.120	.1205	.116	.188	.125	.0284
12	.08081	.109	.1055	.104	.185	.109375	.0296
13	.07196	.095	.0915	.092	.182	.09375	.0314
14	.06408	.083	.0800	.080	.180	.078125	.0326
15	.05707	.072	.0720	.072	.178	.0703125	.0345
16	.05082	.065	.0625	.064	.175	.0625	.0360
17	.04526	.058	.0540	.056	.172	.05625	.0377
18	.04030	.049	.0475	.048	.168	.05	.0395
19	.03589	.042	.0410	.040	.164	.04375	.0414
20	.03196	.035	.0348	.036	.161	.0375	.0434
21	.02846	.032	.0318	.032	.157	.034375	.0460
22	.02535	.028	.0286	.028	.155	.03125	.0483
23	.02257	.025	.0258	.024	.153	.028125	.0515
24	.02010	.022	.0230	.022	.151	.025	.0550

COMPARISON OF WIRE GAUGES (Continued)

Diameter of Wire in Inches

Gauge No.	Brown & Sharpe	Birmingham or Stub's	Washburn & Moen	Imperial or Brit. Std.	Stub's steel	U. S. Std. plate	Music wire
25	0.01790	0.020	0.0204	0.020	0.148	0.021875	0.0586
26	0.01594	0.018	0.0181	0.018	0.146	0.01875	0.0626
27	0.01419	0.016	0.0173	0.0164	0.143	0.0171875	0.0658
28	0.01264	0.014	0.0162	0.0149	0.139	0.015625	0.0720
29	0.01126	0.013	0.0150	0.0136	0.134	0.0140625	0.0760
30	0.01003	0.012	0.0140	0.0124	0.127	0.0125	0.0800
31	0.008928	0.010	0.0132	0.0116	0.120	0.0109375	0.0820
32	0.007950	0.009	0.0128	0.0108	0.115	0.01015625	0.0860
33	0.007080	0.008	0.0118	0.0100	0.112	0.009375	0.0900
34	0.006304	0.007	0.0104	0.0092	0.110	0.00859375	0.0950
35	0.005614	0.005	0.0095	0.0084	0.108	0.0078125	......
36	0.005000	0.004	0.0090	0.0076	0.106	0.00703125	......
37	0.004453	.....	0.0085	0.0068	0.103	0.006640625	......
38	0.003965	.....	0.0080	0.0060	0.101	0.00625	......
39	0.003531	.....	0.0075	0.0052	0.099	....	......
40	0.003145	.....	0.0070	0.0048	0.097	....	......
41	....	.....	0.0066	0.0044	0.095	....	......
42	....	.....	0.0062	0.0040	0.092	....	......
43	....	.....	0.0060	0.0036	0.088	....	......
44	....	.....	0.0058	0.0032	0.085	....	......
45	....	.....	0.0055	0.0028	0.081	....	......
46	....	.....	0.0052	0.0024	0.079	....	......
47	....	.....	0.0050	0.0020	0.077	....	......
48	....	.....	0.0048	0.0016	0.075	....	......
49	....	.....	0.0046	0.0012	0.072	....	......
50	....	.....	0.0044	0.0010	0.069	....	......

COMPARISON OF WIRE GAUGES

Diameter of Wire in Centimeters

Gauge No.	Brown & Sharpe	Birmingham or Stub's	Washburn & Moen	Imperial or Brit. Std.	Stub's steel	U. S. Std. plate	Music wire
0000000	......	.....	......	......	.....	....	0.0211
000000	....	.....	1.245	1.27	.....	1.27	0.0221
00000	....	.....	1.172	1.18	.....	1.191	0.0241
0000	....	.....	1.093	1.10	.....	1.111	0.0254
0000	1.168	1.15	1.000	1.02	.....	1.032	0.0279
000	1.040	1.08	0.9208	0.945	.....	0.9525	0.0305
00	0.9266	0.965	0.8407	0.884	.....	0.8731	0.0338
0	0.8252	0.864	0.7785	0.823	.....	0.7938	0.0366
1	0.7348	0.762	0.7188	0.762	0.577	0.7144	0.0396
2	0.6543	0.721	0.6668	0.701	0.556	0.6747	0.0422
3	0.5827	0.658	0.6190	0.640	0.538	0.6350	0.0452
4	0.5189	0.605	0.5723	0.589	0.526	0.5953	0.0478
5	0.4620	0.559	0.5258	0.538	0.518	0.5556	0.0513
6	0.4115	0.516	0.4877	0.488	0.511	0.5159	0.0546
7	0.3665	0.457	0.4496	0.447	0.505	0.4763	0.0584
8	0.3264	0.419	0.4115	0.406	0.500	0.4366	0.0617
9	0.2906	0.376	0.3767	0.366	0.493	0.3969	0.0650
10	0.2588	0.340	0.3429	0.325	0.485	0.3572	0.0686
11	0.2305	0.305	0.3061	0.295	0.478	0.3175	0.0721
12	0.2053	0.277	0.2680	0.264	0.470	0.2778	0.0752
13	0.1828	0.241	0.232	0.234	0.462	0.2381	0.0798
14	0.1628	0.211	0.203	0.203	0.457	0.1984	0.0828
15	0.1450	0.183	0.183	0.183	0.452	0.1786	0.0876
16	0.1291	0.165	0.159	0.163	0.445	0.1588	0.0914
17	0.1150	0.147	0.137	0.142	0.437	0.1429	0.0958
18	0.1024	0.124	0.121	0.122	0.427	0.1270	0.100
19	0.09116	0.107	0.104	0.102	0.417	0.1111	0.105
20	0.08118	0.089	0.0884	0.0914	0.409	0.09525	0.110
21	0.07229	0.081	0.0808	0.0813	0.399	0.08731	0.117
22	0.06439	0.071	0.0726	0.0711	0.394	0.07938	0.123
23	0.05733	0.064	0.0655	0.0610	0.389	0.07144	0.131
24	0.05105	0.056	0.0584	0.0559	0.384	0.06350	0.140

COMPARISON OF WIRE GAUGES (Continued)

Diameter of Wire in Centimeters

Gauge No.	Brown & Sharpe	Birmingham or Stub's	Washburn & Moen	Imperial or Brit. Std.	Stub's steel	U. S. Std. plate	Music wire
25	0.04547	0.051	0.0518	0.0508	0.376	0.05556	0.149
26	0.04049	0.046	0.0460	0.0457	0.371	0.04763	0.159
27	0.03604	0.041	0.0439	0.0417	0.363	0.04366	0.167
28	0.03211	0.036	0.0411	0.0378	0.353	0.03969	0.183
29	0.02860	0.033	0.0381	0.0345	0.340	0.03572	0.193
30	0.02548	0.030	0.0356	0.0315	0.323	0.03175	0.203
31	0.02268	0.025	0.0335	0.0295	0.305	0.02778	0.208
32	0.02019	0.023	0.0325	0.0274	0.292	0.02580	0.218
33	0.01798	0.020	0.0300	0.0254	0.284	0.02381	0.229
34	0.01601	0.018	0.0264	0.0234	0.279	0.02183	0.241
35	0.01426	0.013	0.024	0.0213	0.274	0.01984	......
36	0.01270	0.010	0.023	0.0193	0.269	0.01786	......
37	0.01131	......	0.022	0.0173	0.262	0.01687	......
38	0.01007	......	0.020	0.0152	0.257	0.01588	......
39	0.008969	......	0.019	0.0132	0.251	....	......
40	0.007988	......	0.018	0.0122	0.246	....	......
41	....	......	0.017	0.0112	0.241	....	......
42	....	......	0.016	0.0102	0.234	....	......
43	....	......	0.015	0.0091	0.224	....	......
44	....	......	0.015	0.0081	0.216	....	......
45	....	......	0.014	0.0071	0.206	....	......
46	....	......	0.013	0.0061	0.201	....	......
47	....	......	0.013	0.0051	0.196	....	......
48	....	......	0.012	0.0041	0.191	....	......
49	....	......	0.012	0.0030	0.183	....	......
50	....	......	0.011	0.0025	0.175	....	......

TWIST DRILL AND STEEL WIRE GAUGE

Inches

No.	Size	No.	Size	No.	Size	No.	Size	No.	Size
1	0.2280	17	0.1730	33	0.1130	49	0.0730	65	0.0350
2	0.2210	18	0.1695	34	0.1110	50	0.0700	66	0.0330
3	0.2130	19	0.1660	35	0.1100	51	0.0670	67	0.0320
4	0.2090	20	0.1610	36	0.1065	52	0.0635	68	0.0310
5	0.2055	21	0.1590	37	0.1040	53	0.0595	69	0.02925
6	0.2040	22	0.1570	38	0.1015	54	0.0550	70	0.0280
7	0.2010	23	0.1540	39	0.0995	55	0.0520	71	0.0260
8	0.1990	24	0.1520	40	0.0980	56	0.0465	72	0.0250
9	0.1960	25	0.1495	41	0.0960	57	0.0430	73	0.0240
10	0.1935	26	0.1470	42	0.0935	58	0.0420	74	0.0225
11	0.1910	27	0.1440	43	0.0890	59	0.0410	75	0.0210
12	0.1890	28	0.1405	44	0.0860	60	0.0400	76	0.0200
13	0.1850	29	0.1360	45	0.0820	61	0.0390	77	0.0180
14	0.1820	30	0.1285	46	0.0810	62	0.0380	78	0.0160
15	0.1800	31	0.1200	47	0.0785	63	0.0370	79	0.0145
16	0.1770	32	0.1160	48	0.0760	64	0.0360	80	0.0135

Centimeters

No.	Size	No.	Size	No.	Size	No.	Size	No.	Size
1	0.5791	17	0.4394	33	0.2870	49	0.1854	65	0.0889
2	0.5613	18	0.4305	34	0.2819	50	0.1778	66	0.0838
3	0.5410	19	0.4216	35	0.2794	51	0.1702	67	0.0813
4	0.5309	20	0.4089	36	0.2705	52	0.1613	68	0.0787
5	0.5220	21	0.4039	37	0.2642	53	0.1511	69	0.0743
6	0.5182	22	0.3988	38	0.2578	54	0.1397	70	0.0711
7	0.5105	23	0.3912	39	0.2527	55	0.1321	71	0.0660
8	0.5055	24	0.3861	40	0.2489	56	0.1181	72	0.0635
9	0.4978	25	0.3797	41	0.2438	57	0.1092	73	0.0610
10	0.4915	26	0.3734	42	0.2375	58	0.1067	74	0.0572
11	0.4851	27	0.3658	43	0.2261	59	0.1041	75	0.0533
12	0.4801	28	0.3569	44	0.2184	60	0.1016	76	0.0508
13	0.4699	29	0.3454	45	0.2083	61	0.0991	77	0.0457
14	0.4623	30	0.3264	46	0.2057	62	0.0965	78	0.0406
15	0.4572	31	0.3048	47	0.1994	63	0.0940	79	0.0368
16	0.4496	32	0.2946	48	0.1930	64	0.0914	80	0.0343

DIMENSIONS OF WIRE

STUB'S GAUGE

Giving the diameter and cross-section in English and metric system for the Birmingham or Stub's gauge.

Gauge No.	Diameter in in.	Section in sq. in.	Diameter in cm	Section in sq. cm
0000	0.454	0.16188	1.1532	1.0444
000	.425	.14186	1.0795	0.9152
00	.380	.11341	0.9652	.7317
0	0.340	0.09079	0.8636	0.5858
1	.300	.07069	.7620	.4560
2	.284	.06335	.7214	.4087
3	.259	.05269	.6579	.3399
4	.238	.04449	.6045	.2870
5	0.220	0.03801	0.5588	0.2452
6	.203	.03237	.5156	.20881
7	.180	.02545	.4572	.16147
8	.165	.02138	.4191	.13795
9	.148	.01720	.3759	.11099
10	0.134	0.01410	0.3404	0.09098
11	.120	.011310	.3048	.07297
12	.109	.009331	.2769	.06160
13	.095	.007088	.2413	.04573
14	.083	.005411	.2108	.03491
15	0.072	0.004072	0.1829	0.02627
16	.065	.0033183	.16510	.021409
17	.058	.0026421	.14732	.017046
18	.049	.0018857	.12446	.012166
19	.042	.0013854	.10668	.008938
20	0.035	0.0009621	0.08890	0.006207
21	.032	.0008042	.08128	.005189
22	.028	.0006158	.07112	.003973
23	.025	.0004909	.06350	.003167
24	.022	.0003801	.05588	.002452
25	0.020	0.0003142	0.05080	0.002027
26	.018	.0002545	.04572	.0016417
27	.016	.0002011	.04064	.0012972
28	.014	.0001539	.03556	.0009932
29	.013	.0001327	.03302	.0008563
30	0.012	0.0001181	0.03048	0.0007297
31	.010	.00007854	.02540	.0005067
32	.009	.00006362	.02286	.0004104
33	.008	.00005027	.02032	.0003243
34	.007	.00003848	.01778	.0002483
35	0.005	0.00001963	0.01270	0.0001267
36	.004	.00001257	.01016	.0000811

DIMENSIONS OF WIRE (Continued)

British Standard Gauge

Giving the diameter and cross-section in English and metric system for the British Standard Gauge.

Gauge No.	Diameter in in.	Section in sq. in.	Diameter in cm	Section in sq. cm
0000000	0.500	0.1963	1.2700	1.267
000000	.464	.1691	1.1786	1.091
00000	0.432	0.1466	1.0973	0.9456
0000	.400	.1257	1.0160	.8107
000	.372	.1087	0.9449	.7012
00	.348	.0951	.8839	.6136
0	0.324	0.0825	0.8230	0.5319
1	.300	.07069	.7620	.4560
2	.276	.05983	.7010	.3858
3	.252	.04988	.6401	.3218
4	.232	.04227	.5893	.2727
5	0.212	0.03530	0.5385	0.2277
6	.192	.02895	.4877	.18679
7	.176	.02433	.4470	.15696
8	.160	.02010	.4064	.12973
9	.144	.01629	.3658	.10507
10	0.128	0.01287	0.3251	0.08302
11	.116	.010568	.2946	.06818
12	.104	.008495	.2642	.05480
13	.092	.006648	.2337	.04289
14	.080	.005027	.2032	.03243
15	0.072	0.004071	0.1829	0.02627
16	.064	.003217	.16256	.020755
17	.056	.002463	.14224	.015890
18	.048	.001810	.12192	.011675
19	.040	.001257	.10160	.008107
20	0.036	0.001018	0.09144	0.006567
21	.032	.0008042	.08128	.005189
22	.028	.0006158	.07112	.003973
23	.024	.0004524	.06096	.002922
24	.022	.0003801	.05588	.002452
25	0.020	0.0003142	0.05080	0.002027
26	.0180	.0002545	.04572	.0016417
27	.0164	.0002112	.04166	.0013628
28	.0148	.0001728	.03759	.0011099
29	.0136	.0001453	.03454	.0009363
30	0.0124	0.0001208	0.03150	0.0007791
31	.0116	.00010568	.02946	.0006818
32	.0108	.00009161	.02743	.0005910
33	.0100	.00007854	.02540	.0005067
34	.0092	.00006648	.02337	.0004289
35	0.0084	0.00005542	0.02134	0.0003575
36	.0076	.00004536	.01930	.0002927
37	.0068	.00003632	.01727	.0002343
38	.0060	.00002827	.01524	.0001824
39	.0052	.00002124	.01321	.0001370
40	0.0048	0.00001810	0.01219	0.0001167
41	.0044	.00001521	.01118	.0000982
42	.0040	.00001257	.01016	.0000811
43	.0036	.00001018	.00914	.0000656
44	.0032	.00000804	.00813	.0000519
45	0.0028	0.00000616	0.00711	0.0000397
46	.0024	.00000452	.00610	.0000212
47	.0020	.00000314	.00508	.0000203
48	.0016	.00000201	.00406	.0000129
49	.0012	.00000113	.00305	.0000073
50	0.0010	0.00000079	0.00254	0.0000051

PLATINUM WIRE

Mass in Grams per Foot

B. &. S Gauge	Diameter, inches	Mass, g per ft.	B. & S. Gauge	Diameter, inches	Mass, g per ft.
10	.1019	37.5	23	.02257	1.8
11	.09074	28.0	24	.02010	1.4
12	.08081	22.0	25	.01790	1.1
13	.07196	17.5	26	.01594	0.9
14	.06408	14.0	27	.01420	0.7
15	.05707	11.0	28	.01264	0.6
16	.05082	9.0	29	.01126	0.45
17	.04526	7.0	30	.01003	0.35
18	.04030	5.7	31	.008928	0.28
19	.03589	4.4	32	.007950	0.22
20	.03196	3.4	33	.007080	0.17
21	.02846	2.9	34	.006305	0.15
22	.02535	2.3	35	.005615	0.11

ALLOWABLE CARRYING CAPACITIES OF COPPER WIRE

(Regulations of the National Board of Fire Underwriters)

Size, B. & S. Gauge	Diameter, mils	Cross section, circular mils	Amperes	
			Rubber insulation	Other insulation
0000	460.0	211600	225	325
000	409.6	167800	175	275
00	364.8	133100	150	225
0	324.9	105500	125	200
1	289.3	83690	100	150
2	257.6	66370	90	125
4	204.3	41740	70	90
6	162.0	26250	50	70
8	128.5	16510	35	50
10	101.9	10380	25	30
12	80.81	6530	20	25
14	64.08	4107	15	20
16	50.82	2583	6	10
18	40.30	1624	3	5

WIRE TABLE, STANDARD ANNEALED COPPER

American Wire Gauge (B. & S.) English Units

Gauge No.	Diameter in mils at 20°C	Cross section at 20°C		Ohms per 1000 feet*			
		Circular mils	Sq. inches	0°C (32°F)	20°C (68°F)	50°C (122°F)	75°C (167°F)
0000	460.0	211600	0.1662	0.04516	0.04901	0.05479	0.05961
000	409.6	167800	.1318	.05695	.06180	.06909	.07516
00	364.8	133100	.1045	.07181	.07793	.08712	.09478
0	324.9	105500	.08289	.09055	.09827	.1099	.1195
1	289.3	83690	.06573	.1142	.1239	.1385	.1507
2	257.6	66370	.05213	.1440	.1563	.1747	.1900
3	229.4	52640	.04134	.1816	.1970	.2203	.2396
4	204.3	41740	.03278	.2289	.2485	.2778	.3022
5	181.9	33100	.02600	.2887	.3133	.3502	.3810
6	162.0	26250	.02062	.3640	.3951	.4416	.4805
7	144.3	20820	.01635	.4590	.4982	.5569	.6059
8	128.5	16510	.01297	.5788	.6282	.7023	.7640
9	114.4	13090	.01028	.7299	.7921	.8855	.9633
10	101.9	10380	.008155	.9203	.9989	1.117	1.215
11	90.74	8234	.006467	1.161	1.260	1.408	1.532
12	80.81	6530	.005129	1.463	1.588	1.775	1.931
13	71.96	5178	.004067	1.845	2.003	2.239	2.436
14	64.08	4107	.003225	2.327	2.525	2.823	3.071
15	57.07	3257	.002558	2.934	3.184	3.560	3.873
16	50.82	2583	.002028	3.700	4.016	4.489	4.884
17	45.26	2048	.001609	4.666	5.064	5.660	6.158
18	40.30	1624	.001276	5.883	6.385	7.138	7.765
19	35.89	1288	.001012	7.418	8.051	9.001	9.792
20	31.96	1022	.0008023	9.355	10.15	11.35	12.35
21	28.45	810.1	.0006363	11.80	12.80	14.31	15.57
22	25.35	642.4	.0005046	14.87	16.14	18.05	19.63
23	22.57	509.5	.0004002	18.76	20.36	22.76	24.76
24	20.10	404.0	.0003173	23.65	25.67	28.70	31.22
25	17.90	320.4	.0002517	29.82	32.37	36.18	39.36
26	15.94	254.1	.0001996	37.61	40.81	45.63	49.64
27	14.20	201.5	.0001583	47.42	51.47	57.53	62.59
28	12.64	159.8	.0001255	59.80	64.90	72.55	78.93
29	11.26	126.7	.00009953	75.40	81.83	91.48	99.52
30	10.03	100.5	.00007894	95.08	103.2	115.4	125.5
31	8.928	79.70	.00006260	119.9	130.1	145.5	158.2
32	7.950	63.21	.00004964	151.2	164.1	183.4	199.5
33	7.080	50.13	.00003937	190.6	206.9	231.3	251.6
34	6.305	39.75	.00003122	240.4	260.9	291.7	317.3
35	5.615	31.52	.00002476	303.1	329.0	367.8	400.1
36	5.000	25.00	.00001964	382.2	414.8	463.7	504.5
37	4.453	19.83	.00001557	482.0	523.1	584.8	636.2
38	3.965	15.72	.00001235	607.8	659.6	737.4	802.2
39	3.531	12.47	.000009793	766.4	831.8	929.8	1012
40	3.145	9.888	.000007766	966.5	1049	1173	1276

* Resistance at the stated temperatures of a wire whose length is 1000 feet at 20°C.

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) English Units (Continued)

Gauge No.	Pounds per 1000 feet	Feet per pound	Feet per ohm* 0°C (32°F)	20°C (68°F)	50°C (122°F)	75°C (167°F)
0000	640.5	1.561	22140	20400	18250	16780
000	507.9	1.968	17560	16180	14470	13300
00	402.8	2.482	13930	12830	11480	10550
0	319.5	3.130	11040	10180	9103	8367
1	253.3	3.947	8758	8070	7219	6636
2	200.9	4.977	6946	6400	5725	5262
3	159.3	6.276	5508	5075	4540	4173
4	126.4	7.914	4368	4025	3600	3309
5	100.2	9.980	3464	3192	2855	2625
6	79.46	12.58	2747	2531	2264	2081
7	63.02	15.87	2179	2007	1796	1651
8	49.98	20.01	1728	1592	1424	1309
9	39.63	25.23	1370	1262	1129	1038
10	31.43	31.82	1087	1001	895.6	823.2
11	24.92	40.12	861.7	794.0	710.2	652.8
12	19.77	50.59	683.3	629.6	563.2	517.7
13	15.68	63.80	541.9	499.3	446.7	410.6
14	12.43	80.44	429.8	396.0	354.2	325.6
15	9.858	101.4	340.8	314.0	280.9	258.2
16	7.818	127.9	270.3	249.0	222.8	204.8
17	6.200	161.3	214.3	197.5	176.7	162.4
18	4.917	203.4	170.0	156.6	140.1	128.8
19	3.899	256.5	134.8	124.2	111.1	102.1
20	3.092	323.4	106.9	98.50	88.11	80.99
21	2.452	407.8	84.78	78.11	69.87	64.23
22	1.945	514.2	67.23	61.95	55.41	50.94
23	1.542	648.4	53.32	49.13	43.94	40.39
24	1.223	817.7	42.28	38.96	34.85	32.03
25	0.9699	1031	33.53	30.90	27.64	25.40
26	.7692	1300	26.59	24.50	21.92	20.15
27	.6100	1639	21.09	19.43	17.38	15.98
28	.4837	2067	16.72	15.41	13.78	12.67
29	.3836	2607	13.26	12.22	10.93	10.05
30	.3042	3287	10.52	9.691	8.669	7.968
31	.2413	4145	8.341	7.685	6.875	6.319
32	.1913	5227	6.614	6.095	5.452	5.011
33	.1517	6591	5.245	4.833	4.323	3.974
34	.1203	8310	4.160	3.833	3.429	3.152
35	.09542	10480	3.299	3.040	2.719	2.499
36	.07568	13210	2.616	2.411	2.156	1.982
37	.06001	16660	2.075	1.912	1.710	1.572
38	.04759	21010	1.645	1.516	1.356	1.247
39	.03774	26500	1.305	1.202	1.075	0.9886
40	.02993	33410	1.035	0.9534	0.8529	.7840

* Length at 20°C of a wire whose resistance is 1 ohm at the stated temperatures.

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) English Units (Continued)

Gauge No.	Diameter in mils at 20°C	Ohms per pound			Lbs. per ohm
		0°C (32°F)	20°C (68°F)	50°C (122°F)	20°C (68°F)
0000	460.0	0.00007051	0.00007652	0.00008554	13070
000	409.6	.0001121	.0001217	.0001360	8219
00	364.8	.0001783	.0001935	.0002163	5169
0	324.9	.0002835	.0003076	.0003439	3251
1	289.3	.0004507	.0004891	.0005468	2044
2	257.6	.0007166	.0007778	.0008695	1286
3	229.4	.001140	.001237	.001383	808.6
4	204.3	.001812	.001966	.002198	508.5
5	181.9	.002881	.003127	.003495	319.8
6	162.0	.004581	.004972	.005558	201.1
7	144.3	.007284	.007905	.008838	126.5
8	128.5	.01158	.01257	.01405	79.55
9	114.4	.01842	.01999	.02234	50.03
10	101.9	.02928	.03178	.03553	31.47
11	90.74	.04656	.05053	.05649	19.79
12	80.81	.07404	.08035	.08983	12.45
13	71.96	.1177	.1278	.1428	7.827
14	64.08	.1872	.2032	.2271	4.922
15	57.07	.2976	.3230	.3611	3.096
16	50.82	.4733	.5136	.5742	1.947
17	45.26	.7525	.8167	.9130	1.224
18	40.30	1.197	1.299	1.452	0.7700
19	35.89	1.903	2.065	2.308	.4843
20	31.96	3.025	3.283	3.670	.3046
21	28.46	4.810	5.221	5.836	.1915
22	25.35	7.649	8.301	9.280	.1205
23	22.57	12.16	13.20	14.76	.07576
24	20.10	19.34	20.99	23.46	.04765
25	17.90	30.75	33.37	37.31	.02997
26	15.94	48.89	53.06	59.32	.01885
27	14.20	77.74	84.37	94.32	.01185
28	12.64	123.6	134.2	150.0	.007454
29	11.26	196.6	213.3	238.5	.004688
30	10.03	312.5	339.2	379.2	.002948
31	8.928	497.0	539.3	602.9	.001854
32	7.950	790.2	857.6	958.7	.001166
33	7.080	1256	1364	1524	.0007333
34	6.305	1998	2168	2424	.0004612
35	5.615	3177	3448	3854	.0002901
36	5.000	5051	5482	6128	.0001824
37	4.453	8032	8717	9744	.0001147
38	3.965	12770	13860	15490	.00007215
39	3.531	20310	22040	24640	.00004538
40	3.145	32290	35040	39170	.00002854

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) Metric Units (Continued)

Gauge No.	Diameter in mm at 20°C	Cross section in mm^2 at 20°C	Ohms per kilometer*			
			0°C	20°C	50°C	75°C
0000	11.68	107.2	0.1482	0.1608	0.1798	0.1956
000	10.40	85.03	.1868	.2028	.2267	.2466
00	9.266	67.43	.2356	.2557	.2858	.3110
0	8.252	53.48	.2971	.3224	.3604	.3921
1	7.348	42.41	.3746	.4066	.4545	.4944
2	6.544	33.63	.4724	.5127	.5731	.6235
3	5.827	26.67	.5956	.6465	.7227	.7862
4	5.189	21.15	.7511	.8152	.9113	.9914
5	4.621	16.77	.9471	1.028	1.149	1.250
6	4.115	13.30	1.194	1.296	1.449	1.576
7	3.665	10.55	1.506	1.634	1.827	1.988
8	3.264	8.366	1.899	2.061	2.304	2.506
9	2.906	6.634	2.395	2.599	2.905	3.161
10	2.588	5.261	3.020	3.277	3.663	3.985
11	2.305	4.172	3.807	4.132	4.619	5.025
12	2.053	3.309	4.801	5.211	5.825	6.337
13	1.828	2.624	6.054	6.571	7.345	7.991
14	1.628	2.081	7.634	8.285	9.262	10.08
15	1.450	1.650	9.627	10.45	11.68	12.71
16	1.291	1.309	12.14	13.17	14.73	16.02
17	1.150	1.038	15.31	16.61	18.57	20.20
18	1.024	0.8231	19.30	20.95	23.42	25.48
19	0.9116	.6527	24.34	26.42	29.53	32.12
20	.8118	.5176	30.69	33.31	37.24	40.51
21	.7230	.4105	38.70	42.00	46.95	51.08
22	.6438	.3255	48.80	52.96	59.21	64.41
23	.5733	.2582	61.54	66.79	74.66	81.22
24	.5106	.2047	77.60	84.21	94.14	102.4
25	.4547	.1624	97.85	106.2	118.7	129.1
26	.4049	.1288	123.4	133.9	149.7	162.9
27	.3606	.1021	155.6	168.9	188.8	205.4
28	.3211	.08098	196.2	212.9	238.0	258.9
29	.2859	.06422	247.4	268.5	300.1	326.5
30	.2546	.05093	311.9	338.6	378.5	411.7
31	.2268	.04039	393.4	426.9	477.2	519.2
32	.2019	.03203	496.0	538.3	601.8	654.7
33	.1798	.02540	625.5	678.8	758.8	825.5
34	.1601	.02014	788.7	856.0	956.9	1041
35	.1426	.01597	994.5	1079	1207	1313
36	.1270	.01267	1254	1361	1522	1655
37	.1131	.01005	1581	1716	1919	2087
38	.1007	.007967	1994	2164	2419	2632
39	.08969	.006318	2514	2729	3051	3319
40	.07987	.005010	3171	3441	3847	4185

* Resistance at the stated temperatures of a wire whose length is 1 kilometer at 20°C.

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) Metric Units (Continued)

Gauge No.	Diameter in mm at 20°C	Kilograms per kilometer	Meters per gram	Meters per ohm*			
				0°C	20°C	50°C	75°C
0000	11.68	953.2	0.001049	6749	6219	5563	5113
000	10.40	755.9	.001323	5352	4932	4412	4055
00	9.266	599.5	.001668	4245	3911	3499	3216
0	8.252	475.4	.002103	3366	3102	2774	2550
1	7.348	377.0	.002652	2669	2460	2200	2022
2	6.544	299.0	.003345	2117	1951	1745	1604
3	5.827	237.1	.004217	1679	1547	1384	1272
4	5.189	188.0	.005318	1331	1227	1097	1009
5	4.621	149.1	.006706	1056	972.9	870.2	799.9
6	4.115	118.2	.008457	837.3	771.5	690.1	634.4
7	3.665	93.78	.01066	664.0	611.8	547.3	503.1
8	3.264	74.37	.01345	526.6	485.2	434.0	399.0
9	2.906	58.98	.01696	417.6	384.8	344.2	316.4
10	2.588	46.77	.02138	331.2	305.1	273.0	250.9
11	2.305	37.09	.02696	262.6	242.0	216.5	199.0
12	2.053	29.42	.03400	208.3	191.9	171.7	157.8
13	1.828	23.33	.04287	165.2	152.2	136.1	125.1
14	1.628	18.50	.05406	131.0	120.7	108.0	99.24
15	1.450	14.67	.06816	103.9	95.71	85.62	78.70
16	1.291	11.63	.08595	82.38	75.90	67.90	62.41
17	1.150	9.226	.1084	65.33	60.20	53.85	49.50
18	1.024	7.317	.1367	51.81	47.74	42.70	39.25
19	0.9116	5.803	.1723	41.09	37.86	33.86	31.13
20	.8118	4.602	.2173	32.58	30.02	26.86	24.69
21	.7230	3.649	.2740	25.84	23.81	21.30	19.58
22	.6438	2.894	.3455	20.49	18.88	16.89	15.53
23	.5733	2.295	.4357	16.25	14.97	13.39	12.31
24	.5106	1.820	.5494	12.89	11.87	10.62	9.764
25	.4547	1.443	.6928	10.22	9.417	8.424	7.743
26	.4049	1.145	.8736	8.105	7.468	6.680	6.141
27	.3606	0.9078	1.102	6.428	5.922	5.298	4.870
28	.3211	.7199	1.389	5.097	4.697	4.201	3.862
29	.2859	.5709	1.752	4.042	3.725	3.332	3.063
30	.2546	.4527	2.209	3.206	2.954	2.642	2.429
31	.2268	.3590	2.785	2.542	2.342	2.095	1.926
32	.2019	.2847	3.512	2.016	1.858	1.662	1.527
33	.1798	.2258	4.429	1.599	1.473	1.318	1.211
34	.1601	.1791	5.584	1.268	1.168	1.045	0.9606
35	.1426	.1420	7.042	1.006	0.9265	0.8288	.7618
36	.1270	.1126	8.879	0.7974	.7347	.6572	.6041
37	.1131	.08931	11.20	.6324	.5827	.5212	.4791
38	.1007	.07083	14.12	.5015	.4621	.4133	.3799
39	.08969	.05617	17.80	.3977	.3664	.3278	.3013
40	.07987	.04454	22.45	.3154	.2906	.2600	.2390

* Length at 20°C of a wire whose resistance is 1 ohm at the stated temperatures.

WIRE TABLE, STANDARD ANNEALED COPPER (Continued)

American Wire Gauge (B. & S.) Metric Units (Continued)

Gauge No.	Ohms per kilogram			Grams per ohm
	0°C	20°C	50°C	20°C
0000	0.0001554	0.0001687	0.0001886	5928000
000	.0002472	.0002682	.0002999	3728000
00	.0003930	.0004265	.0004768	2344000
0	.0006249	.0006782	.0007582	1474000
1	.0009936	.001078	.001206	927300
2	.001580	.001715	.001917	583200
3	.002512	.002726	.003048	366800
4	.003995	.004335	.004846	230700
5	.006352	.006893	.007706	145100
6	.01010	.01096	.01225	91230
7	.01606	.01743	.01948	57380
8	.02553	.02771	.03098	36080
9	.04060	.04406	.04926	22690
10	.06456	.07007	.07833	14270
11	.1026	.1114	.1245	8976
12	.1632	.1771	.1980	5645
13	.2595	.2817	.3149	3550
14	.4127	.4479	.5007	2233
15	.6562	.7122	.7961	1404
16	1.043	1.132	1.266	883.1
17	1.659	1.801	2.013	555.4
18	2.638	2.863	3.201	349.3
19	4.194	4.552	5.089	219.7
20	6.670	7.238	8.092	138.2
21	10.60	11.51	12.87	86.88
22	16.86	18.30	20.46	54.64
23	26.81	29.10	32.53	34.36
24	42.63	46.27	51.73	21.61
25	67.79	73.57	82.25	13.59
26	107.8	117.0	130.8	8.548
27	171.4	186.0	207.9	5.376
28	272.5	295.8	330.6	3.381
29	433.3	470.3	525.7	2.126
30	689.0	747.8	836.0	1.337
31	1096	1189	1329	0.8410
32	1742	1891	2114	.5289
33	2770	3006	3361	.3326
34	4404	4780	5344	.2092
35	7003	7601	8497	.1316
36	11140	12090	13510	.08274
37	17710	19220	21480	.05204
38	28150	30560	34160	.0327[illegible]
39	44770	48590	54310	.02058
40	71180	77260	86360	.01294

ALUMINUM WIRE TABLE

Hard-Drawn Aluminum Wire at 20°C (or, 68°F)

American Wire Gauge (B. & S.) English Units

Gauge No.	Diameter in mils	Cross section		Ohms per 1000 ft.	Pounds per 1000 ft.	Pounds per ohm	Feet per ohm
		Circular mils	Square inches				
0000	460	212000	0.166	0.0804	195	2420	12400
000	410	168000	.132	.101	154	1520	9860
00	365	133000	.105	.128	122	957	7820
0	325	106000	.0829	.161	97.0	602	6200
1	289	83700	.0657	.203	76.9	379	4920
2	258	66400	.0521	.256	61.0	238	3900
3	229	52600	.0413	.323	48.4	150	3090
4	204	41700	.0328	.408	38.4	94.2	2450
5	182	33100	.0260	.514	30.4	59.2	1950
6	162	26300	.0206	.648	24.1	37.2	1540
7	144	20800	.0164	.817	19.1	23.4	1220
8	128	16500	.0130	1.03	15.2	14.7	970
9	114	13100	.0103	1.30	12.0	9.26	770
10	102	10400	.00815	1.64	9.55	5.83	610
11	91	8230	.00647	2.07	7.57	3.66	484
12	81	6530	.00513	2.61	6.00	2.30	384
13	72	5180	.00407	3.29	4.76	1.45	304
14	64	4110	.00323	4.14	3.78	0.911	241
15	57	3260	.00256	5.22	2.99	.573	191
16	51	2580	.00203	6.59	2.37	.360	152
17	45	2050	.00161	8.31	1.88	.227	120
18	40	1620	.00128	10.5	1.49	.143	95.5
19	36	1290	.00101	13.2	1.18	.0897	75.7
20	32	1020	.000802	16.7	0.939	.0564	60.0
21	28.5	810	.000636	21.0	.745	.0355	47.6
22	25.3	642	.000505	26.5	.591	.0223	37.8
23	22.6	509	.000400	33.4	.468	.0140	29.9
24	20.1	404	.000317	42.1	.371	.00882	23.7
25	17.9	320	.000252	53.1	.295	.00555	18.8
26	15.9	254	.000200	67.0	.234	.00349	14.9
27	14.2	202	.000158	84.4	.185	.00219	11.8
28	12.6	160	.000126	106.	.147	.00138	9.39
29	11.3	127	.0000995	134.	.117	.000868	7.45
30	10.0	101	.0000789	169.	.0924	.000546	5.91
31	8.9	79.7	.0000626	213.	.0733	.000343	4.68
32	8.0	63.2	.0000496	269.	.0581	.000216	3.72
33	7.1	50.1	.0000394	339.	.0461	.000136	2.95
34	6.3	39.8	.0000312	428.	.0365	.0000854	2.34
35	5.6	31.5	.0000248	540.	.0290	.0000537	1.85
36	5.0	25.0	.0000196	681.	.0230	.0000338	1.47
37	4.5	19.8	.0000156	858.	.0182	.0000212	1.17
38	4.0	15.7	.0000123	1080.	.0145	.0000134	0.924
39	3.5	12.5	.00000979	1360.	.0115	.00000840	.733
40	3.1	9.9	.00000777	1720.	.0091	.00000528	.581

ALUMINUM WIRE TABLE (Continued)
Hard-Drawn Aluminum Wire at 20°C (or, 68°F)
American Wire Gauge (B. & S.) English Units (Continued)

Gauge No.	Diameter in mm	Cross section in mm²	Ohms per kilometer	Kilograms per kilometer	Grams per ohm	Meters per ohm
0000	11.7	107	0.264	289	1100000	3790
000	10.4	85.0	.333	230	690000	3010
00	9.3	67.4	.419	182	434000	2380
0	8.3	53.5	.529	144	273000	1890
1	7.3	42.4	.667	114.	172000	1500
2	6.5	33.6	.841	90.8	108000	1190
3	5.8	26.7	1.06	72.0	67900	943
4	5.2	21.2	1.34	57.1	42700	748
5	4.6	16.8	1.69	45.3	26900	593
6	4.1	13.3	2.13	35.9	16900	470
7	3.7	10.5	2.68	28.5	10600	373
8	3.3	8.37	3.38	22.6	6680	296
9	2.91	6.63	4.26	17.9	4200	235
10	2.59	5.26	5.38	14.2	2640	186
11	2.30	4.17	6.78	11.3	1660	148
12	2.05	3.31	8.55	8.93	1050	117
13	1.83	2.62	10.8	7.08	657	92.8
14	1.63	2.08	13.6	5.62	413	73.6
15	1.45	1.65	17.1	4.46	260	58.4
16	1.29	1.31	21.6	3.53	164	46.3
17	1.15	1.04	27.3	2.80	103	36.7
18	1.02	0.823	34.4	2.22	64.7	29.1
19	0.91	.653	43.3	1.76	40.7	23.1
20	.81	.518	54.6	1.40	25.6	18.3
21	.72	.411	68.9	1.11	16.1	14.5
22	.64	.326	86.9	0.879	10.1	11.5
23	.57	.258	110	.697	6.36	9.13
24	.51	.205	138	.553	4.00	7.24
25	.45	.162	174	.438	2.52	5.74
26	.40	.129	220	.348	1.58	4.55
27	.36	.102	277	.276	0.995	3.61
28	.32	.0810	349	.219	.626	2.86
29	.29	.0642	440	.173	.394	2.27
30	.25	.0509	555	.138	.248	1.80
31	.227	.0404	700	.109	.156	1.43
32	.202	.0320	883	.0865	.0979	1.13
33	.180	.0254	1110	.0686	.0616	0.899
34	.160	.0201	1400	.0544	.0387	.712
35	.143	.0160	1770	.0431	.0244	.565
36	.127	.0127	2230	.0342	.0153	.448
37	.113	.0100	2820	.0271	.00963	.355
38	.101	.0080	3550	.0215	.00606	.282
39	.090	.0063	4480	.0171	.00381	.223
40	.080	.0050	5640	.0135	.00240	.177

CROSS-SECTION AND MASS OF WIRES

U. S. Measure

Diameters are given in mils (1 mil = .001 in.), and area in square mils (1 sq. mil = .000001 sq. in.). For sections and masses for one-tenth the diameters given, divide by 100 and for sections and masses for ten times the diameter multiply by 100.

Diam. in mils	Cross-sec. in sq. mils	Pounds per foot			
		Copper, density 8.90	Iron, density 7.80	Brass, density 8.56	Aluminum, density 2.67
10	78.54	0.000303	0.0002656	0.0002915	0.0000909
11	95.03	0367	03214	03527	01100
12	113.10	0436	03825	04197	01309
13	132.73	0512	04488	04926	01536
14	153.94	0594	05206	05713	01782
15	176.71	0.000682	0.0005976	0.0006558	0.0002045
16	201.06	0776	06799	07461	02327
17	226.98	0876	07675	08423	02627
18	254.47	0982	08605	09443	02946
19	283.53	1094	09588	10522	03282
20	314.16	0.001212	0.001062	0.001166	0.0003636
21	346.36	1336	1171	1285	04009
22	380.13	1467	1286	1411	04400
23	415.48	1603	1405	1542	04809
24	452.39	1746	1530	1679	05237
25	490.87	0.001894	0.001660	0.001822	0.0005682
26	530.93	2046	1795	1970	06147
27	572.56	2209	1936	2125	06628
28	615.75	2376	2082	2285	07127
29	660.52	2549	2234	2451	07646
30	706.86	0.002727	0.002390	0.002623	0.0008182
31	754.77	2912	2552	2801	08737
32	804.25	3103	2720	2985	09309
33	855.30	3300	2892	3174	09900
34	907.92	3503	3070	3369	10509
35	962.11	0.003712	0.003253	0.003570	0.001114
36	1017.88	3927	3442	3777	1178
37	1075.21	4149	3636	3990	1245
38	1134.11	4376	3844	4218	1316
39	1194.59	4609	4040	4433	1383
40	1256.64	0.004849	0.004249	0.004664	0.001455
41	1320.25	5094	4465	4900	1528
42	1385.44	5346	4685	5141	1604
43	1452.20	5603	4911	5389	1681
44	1520.53	5867	5142	5643	1760
45	1590.43	0.006137	0.005378	0.005902	0.001841
46	1661.90	6412	5620	6167	1924
47	1734.94	6694	5867	6438	2008
48	1809.56	6982	6119	6715	2095
49	1885.74	7276	6377	6998	2183
50	1963.50	0.007576	0.006640	0.007287	0.002273
51	2042.82	7882	6908	7581	2365
52	2123.72	8194	7181	7881	2458
53	2206.18	8512	7460	8187	2554
54	2290.22	8837	7744	8499	2651

CROSS-SECTION AND MASS OF WIRES (Continued)

U. S. Measure (Continued)

Diameters are given in mils (1 mil = .001 in.), and area in square mils (1 sq. mil = .000001 sq. in.). For sections and masses for one-tenth the diameters given, divide by 100 and for sections and masses for ten times the diameter multiply by 100.

Diam. in mils	Cross-sec. in sq. mils	Pounds per foot			
		Copper, density 8.90	Iron, density 7.80	Brass, density 8.56	Aluminum, density 2.67
55	2375.83	0.009167	0.008034	0.008817	0.002750
56	2463.01	09504	08329	09140	2851
57	2551.76	09846	08629	09470	2954
58	2642.08	10195	08934	09805	3058
59	2733.97	10549	09245	10146	3165
60	2827.43	0.01091	0.00956	0.01049	0.003273
61	2922.47	1128	0988	1085	3383
62	3019.07	1165	1021	1120	3495
63	3117.25	1203	1054	1157	3608
64	3216.99	1241	1088	1194	3724
65	3318.31	0.01280	0.01122	0.01231	0.003841
66	3421.19	1320	1157	1270	3960
67	3525.65	1360	1192	1308	4081
68	3631.68	1401	1228	1348	4204
69	3739.28	1443	1264	1388	4328
70	3848.45	0.01485	0.01302	0.01429	0.004456
71	3959.19	1528	1339	1469	4583
72	4071.50	1571	1377	1511	4713
73	4185.39	1615	1415	1553	4845
74	4300.84	1660	1454	1596	4978
75	4417.86	0.01705	0.01494	0.01639	0.005114
76	4536.46	1751	1534	1684	5251
77	4656.63	1797	1575	1728	5390
78	4778.36	1844	1616	1773	5531
79	4901.67	1892	1658	1819	5674
80	5026.55	0.01939	0.01700	0.01865	0.005818
81	5153.00	1988	1743	1912	5965
82	5281.02	2038	1786	1960	6113
83	5410.61	2088	1830	2008	6263
84	5541.77	2138	1874	2057	6415
85	5674.50	0.02189	0.01919	0.02106	0.006568
86	5808.80	2241	1964	2156	6724
87	5944.68	2294	2010	2206	6881
88	6082.12	2347	2057	2257	7040
89	6221.14	2400	2104	2309	7201
90	6361.73	0.02455	0.02151	0.02360	0.007364
91	6503.88	2509	2199	2414	7528
92	6647.61	2565	2248	2467	7695
93	6792.91	2621	2297	2521	7863
94	6939.78	2678	2347	2575	8033
95	7088.22	0.02735	0.02397	0.02630	0.008205
96	7238.23	2793	2448	2686	8378
97	7389.81	2851	2499	2742	8554
98	7542.96	2910	2551	2799	8731
99	7697.69	2970	2603	2857	8910
100	7853.98	0.03030	0.02656	0.02915	0.009091

CROSS-SECTION AND MASS OF WIRES (Continued)

Metric Measure

Diameters are given in thousandths of a centimeter and area of section in square thousandths of a centimeter. 1 $(cm/1000)^2$ = .000001 sq. cm For sections and masses for diameters 1/10 or 10 times those of the table, divide or multiply by 100.

Diam. in thousandths of a cm	Cross-section in square thousandths of a cm	Grams per meter			
		Copper, density 8.90	Iron, density 7.80	Brass, density 8.56	Aluminum, density 2.67
10	78.54	0.06990	0.06126	0.06723	0.02097
11	95.03	.08458	.07412	.08135	.02537
12	113.10	.10065	.08822	.09681	.03020
13	132.73	.11813	.10353	.11362	.03544
14	153.94	.13701	.12008	.13177	.04110
15	176.71	0.1573	0.1378	0.1513	0.04718
16	201.06	.1789	.1568	.1721	.05368
17	226.98	.2020	.1770	.1943	.06060
18	254.47	.2265	.1985	.2178	.06794
19	283.53	.2523	.2212	.2427	.07570
20	314.16	0.2796	0.2450	0.2689	0.08388
21	346.36	.3083	.2702	.2965	.09248
22	380.13	.3383	.2965	.3254	.10149
23	415.48	.3698	.3241	.3557	.11093
24	452.39	.4026	.3529	.3872	.12079
25	490.87	0.4369	0.3829	0.4202	0.1311
26	530.93	.4725	.4141	.4545	.1418
27	572.56	.5096	.4466	.4901	.1529
28	615.75	.5480	.4803	.5271	.1644
29	660.52	.5879	.5152	.5654	.1764
30	706.86	0.6291	0.5514	0.6051	0.1887
31	754.77	.6717	.5887	.6461	.2015
32	804.25	.7158	.6273	.6884	.2147
33	855.30	.7612	.6671	.7321	.2284
34	907.92	.8081	.7082	.7772	.2424
35	962.11	0.856	0.7504	0.8236	0.2569
36	1017.88	.906	.7939	.8713	.2718
37	1075.21	.957	.8387	.9204	.2871
38	1134.11	1.012	.8866	.9730	.3035
39	1194.59	.063	.9318	1.0230	.3190
40	1256.64	1.118	0.980	1.076	0.3355
41	1320.25	.175	1.030	.130	.3525
42	1385.44	.233	.081	.186	.3699
43	1452.20	.292	.133	.243	.3877
44	1520.53	.353	.186	.302	.4060
45	1590.43	1.415	1.241	1.361	0.4246
46	1661.90	.479	.296	.423	.4437
47	1734.94	.544	.353	.485	.4632
48	1809.56	.611	.411	.549	.4832
49	1885.74	.678	.471	.614	.5035
50	1963.50	1.748	1.532	1.681	.5243
51	2042.82	.818	.593	.753	.5454
52	2123.72	.890	.657	.818	.5670
53	2206.18	.964	.721	.888	.5891
54	2290.22	2.038	.786	.960	.6115

CROSS-SECTION AND MASS OF WIRES (Continued)

Metric Measure (Continued)

Diameters are given in thousandths of a centimeter and area of section in square thousandths of a centimeter. 1 $(cm/1000)^2$ = .000001 sq. cm. For sections and masses for diameters 1/10 or 10 times those of the table, divide or multiply by 100.

Diam. in. thousandths of a cm	Cross-section in square thousandths of a cm	Grams per meter			
		Copper, density 8.90	Iron, density 7.80	Brass, density 8.56	Aluminum, density 2.67
55	2375.83	2.114	1.853	2.034	0.6343
56	2463.01	.192	.921	.108	.6576
57	2551.76	.271	.990	.184	.6813
58	2642.08	.351	2.061	.262	.7054
59	2733.97	.433	.132	.340	.7300
60	2827.43	2.516	2.205	2.420	0.7549
61	2922.47	.601	.280	.502	.7803
62	3019.07	.687	.355	.584	.8061
63	3117.25	.774	.431	.668	.8323
64	3216.99	.863	.509	.760	.8589
65	3318.31	2.953	2.588	2.840	0.8860
66	3421.19	3.045	.669	.929	.9135
67	3525.65	.138	.750	3.018	.9413
68	3631.68	.232	.833	.109	.9697
69	3739.28	.328	.917	.201	.9984
70	3848.45	3.426	3.003	3.295	1.028
71	3959.19	.524	.088	.389	.057
72	4071.50	.624	.176	.485	.087
73	4185.39	.725	.265	.583	.117
74	4300.84	.828	.355	.682	.148
75	4417.86	3.932	3.446	3.782	1.180
76	4536.46	4.037	.538	.883	.211
77	4656.63	.144	.632	.986	.243
78	4778.36	.253	.727	4.090	.276
79	4901.67	.362	.823	.177	.309
80	5026.55	4.474	3.921	4.303	1.342
81	5153.00	.586	4.019	.411	.376
82	5281.02	.700	.119	.521	.410
83	5410.61	.815	.220	.631	.445
84	5541.77	.932	.323	.744	.480
85	5674.50	5.050	4.426	4.857	1.515
86	5808.80	.170	.531	.972	.551
87	5944.68	.291	.637	5.089	.587
88	6082.12	.413	.744	.206	.624
89	6221.14	.537	.852	.325	.661
90	6361.73	5.662	4.962	5.446	1.699
91	6503.88	.788	5.073	.567	.737
92	6647.61	.916	.185	.690	.775
93	6792.91	6.046	.298	.815	.814
94	6939.78	.176	.413	.940	.853
95	7088.22	6.309	5.529	6.068	1.893
96	7238.23	.442	.646	.196	.933
97	7389.81	.577	.764	.326	.973
98	7542.96	.713	.884	.457	2.014
99	7697.69	.851	6.004	.589	.055
100	7853.98	6.990	6.126	6.723	2.097

RESISTANCE OF WIRES

The following table gives the approximate resistance of various metallic conductors. The values have been computed from the resistivities at 20°C, except as otherwise stated, and for the dimensions of wire indicated. Owing to differences in purity in the case of elements and of composition in alloys, the values can be considered only as approximations.

The following dimensions have been adopted in the computations.

B. & S. gauge	Diameter		B. & S. gauge	Diameter	
	mm	mils 1 mil = .001 in.		mm	mils 1 mil = .001 in.
10	2.588	101.9	26	0.4049	15.94
12	2.053	80.81	27	0.3606	14.20
14	1.628	64.08	28	0.3211	12.64
16	1.291	50.82	30	0.2546	10.03
18	1.024	40.30	32	0.2019	7.950
20	0.8118	31.96	34	0.1601	6.305
22	0.6438	25.35	36	0.1270	5.000
24	0.5106	20.10	40	0.07987	3.145

B. & S. No.	Ohms per cm	Ohms per ft.	B. & S. No.	Ohms per cm	Ohms per ft.
Advance (0°C) $\rho = 48. \times 10^{-6}$ ohm cm			Aluminum $\rho = 2.828 \times 10^{-6}$ ohm cm		
10	.000912	.0278	10	.0000538	.00164
12	.00145	.0442	12	.0000855	.00260
14	.00231	.0703	14	.000136	.00414
16	.00367	.112	16	.000216	.00658
18	.00583	.178	18	.000344	.0105
20	.00927	.283	20	.000546	.0167
22	.0147	.449	22	.000[illegible]69	.0265
24	.0234	.715	24	.00138	.0421
26	.0373	1.14	26	.00220	.0669
27	.0470	1.43	27	.00277	.0844
28	.0593	1.81	28	.00349	.106
30	.0942	2.87	30	.00555	.169
32	.150	4.57	32	.00883	.269
34	.238	7.26	34	.0140	.428
36	.379	11.5	36	.0223	.680
40	.958	29.2	40	.0564	1.72

RESISTANCE OF WIRES (Continued)

Brass $\rho = 7.00 \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.000133	.00406
12	.000212	.00645
14	.000336	.0103
16	.000535	.0163
18	.000850	.0259
20	.00135	.0412
22	.00215	.0655
24	.00342	.104
26	.00543	.166
27	.00686	.209
28	.00864	.263
30	.0137	.419
32	.0219	.666
34	.0348	1.06
36	.0552	1.68
40	.140	4.26

Constantan (0°C) $\rho = 44.1 \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.000838	.0255
12	.00133	.0406
14	.00212	.0646
16	.00337	.103
18	.00536	.163
20	.00852	.260
22	.0135	.413
24	.0215	.657
26	.0342	1.04
27	.0432	1.32
28	.0545	1.66
30	.0866	2.64
32	.138	4.20
34	.219	6.67
36	.348	10.6
40	.880	26.8

Eureka (0°C) $\rho = 47. \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.000893	.0272
12	.00142	.0433
14	.00226	.0688
16	.00359	.109
18	.00571	.174
20	.00908	.277
22	.0144	.440
24	.0230	.700
26	.0365	1.11
27	.0460	1.40
28	.0580	1.77
30	.0923	2.81
32	.147	4.47
34	.233	7.11
36	.371	11.3
40	.938	28.6

Climax $\rho = 87. \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.00165	.0504
12	.00263	.0801
14	.00418	.127
16	.00665	.203
18	.0106	.322
20	.0168	.512
22	.0267	.815
24	.0425	1.30
26	.0675	2.06
27	.0852	2.60
28	.107	3.27
30	.171	5.21
32	.272	8.28
34	.432	13.2
36	.687	20.9
40	1.74	52.9

Copper, annealed $\rho = 1.724 \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.0000328	.000999
12	.0000521	.00159
14	.0000828	.00253
16	.000132	.00401
18	.000209	.00638
20	.000333	.0102
22	.000530	.0161
24	.000842	.0257
26	.00134	.0408
27	.00169	.0515
28	.00213	.0649
30	.00339	.103
32	.00538	.164
34	.00856	.261
36	.0136	.415
40	.0344	1.05

Excello $\rho = 92. \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.00175	.0533
12	.00278	.0847
14	.00442	.135
16	.00703	.214
18	.0112	.341
20	.0178	.542
22	.0283	.861
24	.0449	1.37
26	.0714	2.18
27	.0901	2.75
28	.114	3.46
30	.181	5.51
32	.287	8.75
34	.457	13.9
36	.726	22.1
40	1.84	56.0

RESISTANCE OF WIRES (Continued)

German silver $\rho = 33. \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.000627	.0191
12	.000997	.0304
14	.00159	.0483
16	.00252	.0768
18	.00401	.122
20	.00638	.194
22	.0101	.309
24	.0161	.491
26	.0256	.781
27	.0323	.985
28	.0408	1.24
30	.0648	1.97
32	.103	3.14
34	.164	4.99
36	.260	7.94
40	.659	20.1

Iron $\rho = 10. \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.000190	.00579
12	.000302	.00921
14	.000481	.0146
16	.000764	.0233
18	.00121	.0370
20	.00193	.0589
22	.00307	.0936
24	.00489	.149
26	.00776	.237
27	.00979	.299
28	.0123	.376
30	.0196	.598
32	.0312	.952
34	.0497	1.51
36	.0789	2.41
40	.200	6.08

Magnesium $\rho = 4.6 \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.0000874	.00267
12	.000139	.00424
14	.000221	.00674
16	.000351	.0107
18	.000559	.0170
20	.000889	.0271
22	.00141	.0431
24	.00225	.0685
26	.00357	.109
27	.00451	.137
28	.00568	.173
30	.00903	.275
32	.0144	.438
34	.0228	.696
36	.0363	1.11
40	.0918	2.80

Gold $\rho = 2.44 \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.0000464	.00141
12	.0000737	.00225
14	.000117	.00357
16	.000186	.00568
18	.000296	.00904
20	.000471	.0144
22	.000750	.0228
24	.00119	.0363
26	.00189	.0577
27	.00239	.0728
28	.00301	.0918
30	.00479	.146
32	.00762	.232
34	.0121	.369
36	.0193	.587
40	.0487	1.48

Lead $\rho = 22. \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.000418	.0127
12	.000665	.0203
14	.00106	.0322
16	.00168	.0512
18	.00267	.0815
20	.00425	.130
22	.00676	.206
24	.0107	.328
26	.0171	.521
27	.0215	.657
28	.0272	.828
30	.0432	1.32
32	.0687	2.09
34	.109	3.33
36	.174	5.29
40	.439	13.4

Manganin $\rho = 44. \times 10^{-6}$ ohm cm

B. & S. No.	Ohms per cm	Ohms per ft.
10	.000836	.0255
12	.00133	.0405
14	.00211	.0644
16	.00336	.102
18	.00535	.163
20	.00850	.259
22	.0135	.412
24	.0215	.655
26	.0342	1.04
27	.0431	1.31
28	.0543	1.66
30	.0864	2.63
32	.137	4.19
34	.218	6.66
36	.347	10.6
40	.878	26.8

RESISTANCE OF WIRES (Continued)

B. & S. No.	Ohms per cm	Ohms per ft.	B. & S. No.	Ohms per cm	Ohms per ft.
Molybdenum $\rho = 5.7 \times 10^{-6}$ ohm cm			Monel Metal $\rho = 42. \times 10^{-6}$ ohm cm		
10	.000108	.00330	10	.000798	.0243
12	.000172	.00525	12	.00127	.0387
14	.000274	.00835	14	.00202	.0615
16	.000435	.0133	16	.00321	.0978
18	.000693	.0211	18	.00510	.156
20	.00110	.0336	20	.00811	.247
22	.00175	.0534	22	.0129	.393
24	.00278	.0849	24	.0205	.625
26	.00443	.135	26	.0326	.994
27	.00558	.170	27	.0411	1.25
28	.00704	.215	28	.0519	1.58
30	.0112	.341	30	.0825	2.51
32	.0178	.542	32	.131	4.00
34	.0283	.863	34	.209	6.36
36	.0450	1.37	36	.331	10.1
40	.114	3.47	40	.838	25.6
Nichrome $\rho = 100. \times 10^{-6}$ ohm cm			Nickel $\rho = 7.8 \times 10^{-6}$ ohm cm		
10	.00190	.0579	10	.000148	.00452
12	.00302	.0921	12	.000236	.00718
14	.00481	.146	14	.000375	.0114
16	.00764	.233	16	.000596	.0182
18	.0121	.370	18	.000948	.0289
20	.0193	.589	20	.00151	.0459
22	.0307	.936	22	.00240	.0730
24	.0489	1.49	24	.00381	.116
26	.0776	2.37	26	.00606	.185
27	.0979	2.99	27	.00764	.233
28	.123	3.76	28	.00963	.294
30	.196	5.98	30	.0153	.467
32	.312	9.52	32	.0244	.742
34	.497	15.1	34	.0387	1.18
36	.789	24.1	36	.0616	1.88
40	2.00	60.8	40	.156	4.75
Platinum $\rho = 10. \times 10^{-6}$ ohm cm			Silver (18°C) $\rho = 1.629 \times 10^{-6}$ ohm cm		
10	.000190	.00579	10	.0000310	.000944
12	.000302	.00921	12	.0000492	.00150
14	.000481	.0146	14	.0000783	.00239
16	.000764	.0233	16	.000124	.00379
18	.00121	.0370	18	.000198	.00603
20	.00193	.0589	20	.000315	.00959
22	.00307	.0936	22	.000500	.0153
24	.00489	.149	24	.000796	.0243
26	.00776	.237	26	.00126	.0386
27	.00979	.299	27	.00160	.0486
28	.0123	.376	28	.00201	.0613
30	.0196	.598	30	.00320	.0975
32	.0312	.952	32	.00509	.155
34	.0497	1.51	34	.00809	.247
36	.0789	2.41	36	.0129	.392
40	.200	6.08	40	.0325	.991

RESISTANCE OF WIRES (Continued)

B. & S. No.	Ohms per cm	Ohms per ft.	B. & S. No.	Ohms per cm	Ohms per ft.
Steel, piano wire (0°C) $\rho = 11.8 \times 10^{-6}$ ohm cm			Steel, invar (35 % Ni) $\rho = 81. \times 10^{-6}$ ohm cm		
10	.000224	.00684	10	.00154	.0469
12	.000357	.0109	12	.00245	.0746
14	.000567	.0173	14	.00389	.119
16	.000901	.0275	16	.00619	.189
18	.00143	.0437	18	.00984	.300
20	.00228	.0695	20	.0156	.477
22	.00363	.110	22	.0249	.758
24	.00576	.176	24	.0396	1.21
26	.00916	.279	26	.0629	1.92
27	.0116	.352	27	.0793	2.42
28	.0146	.444	28	.100	3.05
30	.0232	.706	30	.159	4.85
32	.0368	1.12	32	.253	7.71
34	.0586	1.79	34	.402	12.3
36	.0931	2.84	36	.639	19.5
40	.236	7.18	40	1.62	49.3
Tantalum $\rho = 15.5 \times 10^{-6}$ ohm cm			Tin $\rho = 11.5 \times 10^{-6}$ ohm cm		
10	.000295	.00898	10	.000219	.00666
12	.000468	.0143	12	.000348	.0106
14	.000745	.0227	14	.000553	.0168
16	.00118	.0361	16	.000879	.0268
18	.00188	.0574	18	.00140	.0426
20	.00299	.0913	20	.00222	.0677
22	.00476	.145	22	.00353	.108
24	.00757	.231	24	.00562	.171
26	.0120	.367	26	.00893	.272
27	.0152	.463	27	.0113	.343
28	.0191	.583	28	.0142	.433
30	.0304	.928	30	.0226	.688
32	.0484	1.47	32	.0359	1.09
34	.0770	2.35	34	.0571	1.74
36	.122	3.73	36	.0908	2.77
40	.309	9.43	40	.230	7.00
Tungsten $\rho = 5.51 \times 10^{-6}$ ohm cm			Zinc (0°C) $\rho = 5.75 \times 10^{-6}$ ohm cm		
10	.000105	.00319	10	.000109	.00333
12	.000167	.00508	12	.000174	.00530
14	.000265	.00807	14	.000276	.00842
16	.000421	.0128	16	.000439	.0134
18	.000669	.0204	18	.000699	.0213
20	.00106	.0324	20	.00111	.0339
22	.00169	.0516	22	.00177	.0538
24	.00269	.0820	24	.00281	.0856
26	.00428	.130	26	.00446	.136
27	.00540	.164	27	.00563	.172
28	.00680	.207	28	.00710	.216
30	.0108	.330	30	.0113	.344
32	.0172	.524	32	.0180	.547
34	.0274	.834	34	.0286	.870
36	.0435	1.33	36	.0454	1.38
40	.110	3.35	40	.115	3.50

FUSING CURRENTS FOR WIRES

Owing to the influence of various factors which control the rate of loss of heat energy the following values can be considered only as approximations.

Gauge No. A.W.G.	Diameter inches	Fusing current in amp.			
		Cu	Al	Fe	Fuse wire
43	0.0021	1	...	...	.....
41	.0026	...	1	...	.....
39	.0035	2	...	...	.....
38	.0040	...	2	...	.....
37	.0045	3	...	1	.....
35	.0056	4	3	...	.....
34	.0063	5	4	...	.....
33	.0071	...	...	2	.....
32	.0080	...	5	...	.....
30	.0100	10	...	3	1.7
28	.0126	15	10	...	.....
27	.0142	...	...	5	.....
26	.0159	20	15	...	.....
25	.0179	25	...	...	.....
24	.0201	30	20	10	4.9
23	.0226	35	25	...	.....
22	.0253	40	30	...	.....
21	.0285	45	35	15	.....
20	.032	60	40	...	9.0
19	.036	70	50	20	11.3
18	.040	80	60	25	13.3
17	.045	100	70	30	.....
16	.051	120	90	35	19.8
15	.057	140	100	45	.....
14	.064	160	120	50	25.4
13	.072	200	160	60	32
12	.081	225	180	70	39.1
11	.091	275	200	90	.....
10	.102	...	225	100	54.1
9	.114	...	275	120	63.1
8	.128	...	...	140	81.1
7	.144	...	...	160	90.6
6	.162	...	...	200	110.7
5	.182	...	...	225	132.1
4	.204	...	...	275	154.7

FUNDAMENTAL DATA RELATING TO SIEVES OF THE STANDARD SCREEN SCALE

From "Report of Committee on Standards," A.C.S. Year Book, 1921–1922

Sieve No.	Sieve opening, millimeters	Sieve opening, inches	Wire diameter, millimeters	Wire diameter, inches	Tolerance in average opening, per cent	Tolerance in wire diameter, per cent	Tolerance in maximum opening, per cent	Mesh per cm.	Mesh per inch
2½	8.00	0.315	1.85	0.073	1	5	10	1	2.6
3	6.72	0.265	1.65	0.065	1	5	10	1.2	3.0
3½	5.66	0.223	1.45	0.057	1	5	10	1.4	3.6
4	4.76	0.187	1.27	0.050	1	5	10	1.7	4.2
5	4.00	0.157	1.12	0.044	1	5	10	2	5.0
6	3.36	0.132	1.02	0.040	1	5	10	2.3	5.8
7	2.83	0.111	0.92	0.036	1	5	10	2.7	6.8
8	2.38	0.094	0.84	0.033	2	5	10	3	7.9
10	2.00	0.079	0.76	0.030	2	5	10	3.5	9.2
12	1.68	0.066	0.69	0.027	2	5	10	4	10.8
14	1.41	0.0557	0.61	0.024	2	5	10	5	12.5
16	1.19	0.0468	0.54	0.021	2	5	10	6	14.7
18	1.00	0.0394	0.48	0.0187	2	5	10	7	17.2
20	0.84	0.0331	0.42	0.0165	3	5	25	8	20.2
25	0.71	0.0278	0.37	0.0146	3	5	25	9	23.6
30	0.59	0.0234	0.33	0.0129	3	5	25	11	27.5
35	0.50	0.0197	0.29	0.0113	3	5	25	13	32.3
40	0.42	0.0166	0.25	0.0098	3	5	25	15	37.9
45	0.35	0.0139	0.22	0.0085	3	5	25	18	44.7
50	0.30	0.0117	0.188	0.0074	4	10	40	20	52.4
60	0.25	0.0098	0.162	0.0064	4	10	40	24	61.7
70	0.21	0.0083	0.140	0.0055	4	10	40	29	72.5
80	0.177	0.0070	0.119	0.0047	4	10	40	34	85.5
100	0.149	0.0059	0.102	0.0040	4	10	40	40	101
120	0.125	0.0049	0.086	0.0034	4	10	40	47	120
140	0.105	0.0041	0.074	0.0029	5	15	60	56	143
170	0.088	0.0035	0.063	0.0025	5	15	60	66	167
200	0.074	0.0029	0.053	0.0021	5	15	60	79	200
230	0.062	0.0025	0.046	0.0018	5	15	60	93	233
270	0.053	0.0021	0.041	0.0016	5	15	60	106	270
325	0.044	0.0017	0.036	0.0014	5	15	60	125	323

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION

Station		Latitude °	Latitude ′	Longitude °	Longitude ′	Elevation, meters	g cm/sec²
UNITED STATES							
Alaska	Fort Egbert, Eagle City	64	47.4	141	12.4	269	982.183
	Percy Islands, S. E. Alaska	54	55.8	131	35.3	4	981.524
	Point Young, S. E. Alaska	58	11.5	134	33.4	7	981.757
	Quiet Harbor, S. E. Alaska	56	14.1	132	39.6	4	981.624
	St. Michael	63	28.5	162	2.4	1	982.192
	St. Paul Island	57	7.3	170	16.6	10	981.726
Arizona	Yavapai	36	3.9	112	7.1	2179	979.192
Arkansas	Little Rock	34	45.0	92	16.4	89	979.721
California	Mount Hamilton	37	20.4	121	38.6	1282	979.660
	San Francisco	37	47.5	122	25.7	114	979.965
Colorado	Colorado Springs	38	50.7	104	49.0	1841	979.490
	Denver	39	40.6	104	56.9	1638	979.609
Connecticut	Hartford	41	44.8	72	41.8	37	980.336
Delaware	Dover	39	9.7	75	32.0	12	980.099
District of Columbia	Washington B.S.	38	56.3	77	4.0	103	980.095
	Washington U.S.C. and G.S.	38	53.2	77	0.5	14	980.112
Florida	Apalachicola	29	43.5	84	58.8	4	979.322
	Key West	24	33.6	81	48.4	1	978.970
Georgia	Atlanta	33	45.0	84	23.3	324	979.524
Idaho	Boise	43	37.2	116	12.3	821	980.212
	Sandpoint	48	16.4	116	33.3	637	980.680
Illinois	Chicago	41	47.4	87	36.1	182	980.278
	Springfield	39	47.7	89	39.5	183	980.089
Indiana	Indianapolis	39	45.9	86	8.8	217	980.090
	Terre Haute	39	28.7	87	23.8	151	980.072
Louisiana	New Orleans	29	57.0	90	4.2	2	979.324
Maine	Calais	45	11.2	67	16.9	38	980.631
Maryland	Baltimore	39	17.8	76	37.3	30	980.097
Massachusetts	Cambridge	42	22.8	71	7.8	14	980.398
	Worcester	42	16.5	71	48.5	170	980.324
Minnesota	Minneapolis	44	58.7	93	13.9	256	980.597
Missouri	Kansas City	39	5.8	94	35.4	278	979.990
	St. Louis	38	38.0	90	12.2	154	980.001

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Cont.)

Station		Latitude °	′	Longitude °	′	Elevation, meters	g cm/sec²
UNITED STATES (Continued)							
Montana	Hinsdale	48	23.8	107	5.3	661	980.739
Nevada	Goldfield	37	42.2	117	14.5	1716	979.456
New Hampshire	Lancaster	44	29.5	71	34.3	261	980.486
New Jersey	Hoboken	40	44	74	2	11	980.269
	Princeton	40	21.0	74	39.5	64	980.178
New Mexico	Las Vegas	35	35.8	105	12.1	1960	979.204
New York	Albany	42	39.1	73	46.1	61	980.344
	Ithaca	42	27.1	76	29.0	247	980.300
	New York	40	48.5	73	57.7	38	980.267
	Potsdam	44	40.1	74	58.8	130	980.571
North Carolina	Asheville	35	35.9	82	33.3	670	979.603
	Wilmington	34	14.2	77	56.6	9	979.663
North Dakota	Bismarck	46	48.5	100	47.0	516	980.625
	Pembina	48	58.1	97	14.9	243	980.917
Ohio	Cincinnati	39	8.3	84	25.3	245	980.004
	Cleveland	41	30.4	81	36.6	210	980.241
Oregon	Portland	45	31.4	122	40.7	8	980.646
Pennsylvania	Philadelphia	39	57.1	75	11.7	16	980.196
	Pittsburgh	40	27.4	80	0.6	235	980.118
	State College	40	47.9	77	51.8	358	980.124
South Carolina	Charleston	32	47.2	79	56.0	6	979.546
South Dakota	Pierre	44	21.9	100	20.8	454	980.427
Texas	Austin	30	17.2	97	44.2	189	979.283
	El Paso	31	46.3	106	29.0	1146	979.124
	Galveston	29	18.2	94	47.5	3	979.272
	Georgetown	30	38.0	97	40.1	231	979.298
	Point Isabel	26	4.7	97	12.4	8	979.076
Utah	Salt Lake City	40	46.1	111	53.8	1322	979.803
Virginia	Charlottesville	38	2.0	78	30.3	166	979.938
	Richmond	37	32.2	77	26.1	30	979.960
Washington	Seattle	47	39.6	122	18.3	58	980.733
West Virginia	Charleston	38	20.9	81	37.7	184	979.936
Wisconsin	Madison	43	4.6	89	24.0	270	980.365
Wyoming	Norris Geyser Basin	44	44.2	110	42.0	2276	979.950

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Cont.)

Station		Latitude °	Latitude ′	Longitude °	Longitude ′	Elevation, meters	g cm/sec²
CANADA							
Alberta	Banff	51	10.9	115	34.5	1376	980.753
	Calgary	51	2.7	114	3.8	1044	980.823
	Chipewyan	58	42.7	111	8.8	229	981.723
	Peace River	56	14.1	117	17.2	324	981.482
British Columbia	Liard River	59	58.7	123	47.5	160	981.790
	Revelstoke	50	59.8	118	11.8	453	980.903
	Vancouver	49	16.8	123	6.8	6	980.949
Manitoba	Winnipeg	49	54.4	97	8.0	231	980.990
New Brunswick	St. John	45	16.0	66	5.0	33	980.663
	Woodstock	46	9.0	67	34.5	56	980.699
Northwest Territory	Arctic Red River	67	26.6	133	44.2	41	982.434
	Good Hope	66	15.3	128	38.2	59	982.340
	Norman	64	54.0	125	34.2	87	982.214
	Providence	61	21.2	117	39.2	156	981.955
	Resolution	61	10.1	113	40.5	152	981.942
	Simpson	61	51.6	121	20.8	132	982.004
Nova Scotia	Halifax	44	40.8	63	33.8	9	980.574
	Sydney	46	8.4	60	11.8	12	980.731
Ontario	Kenora	49	46.0	94	30.0	330	980.974
	Kingston	44	14.6	76	28.8	79	980.530
	Ottawa	45	23.6	75	43.0	83	980.618
	Port Arthur	48	26.0	89	13.0	189	980.820
	Sault Ste. Marie	46	30.4	84	19.2	186	980.680
	Woodstock	43	8.6	80	47.0	299	980.352
Prince Edward Island	Charlottetown	46	13.9	63	7.5	8	980.733
Quebec	St. Jérôme	45	46.6	74	0.0	107	980.681
Saskatchewan	Moose Jaw	50	23.4	105	31.8	541	980.943

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Cont.)

Station		Latitude °	′	Longitude °	′	Elevation, meters	g cm/sec²
CENTRAL AND SOUTH AMERICA							
Argentina	Bahía Blanca	38	47.1S.	62	15.9	2	980.061
	Buenos Aires	34	36.5S.	58	22.2	2	979.669
Brazil	Bahia	12	58.5S.	38	31.0	4	978.331
Canal Zone	Panama	8	54.9	79	31.9	6	978.243
Chile	Valdivia	39	53.4S.	73	28.3	10	979.920
	Valparaiso	33	1.8S.	71	38.5	60	979.609
Peru	Callao	12	4.1S.	77	15.8	1	978.375
Salvador	Acajutla	13	34.7	89	50.4	12	978.303
Uruguay	Montevideo	34	54.5S.	56	12.9	4	979.772
EUROPE							
Austria	Vienna	48	12.7	16	21.5E.	183	980.860
Belgium	Brussels	50	51.0	4	22 E.	102	981.112
Denmark	Copenhagen	55	41.2	12	34.7E.	14	981.559
England	Greenwich	51	28.6	0	0.0	48	981.188
Finland	Helsingfors	60	9.7	24	57.3E.	29	981.912
France	Paris	48	50.2	2	20.3E.	61	980.943
Germany	Königsberg	54	42.8	20	29.8E.	22	981.477
	Leipzig	51	20.1	12	23.5E.	115	981.180
	Munich	48	8.7	11	36.6E.	525	980.733
Hungary	Budapest	47	29.5	19	3.6E.	108	980.852
Italy	Milan	45	28.0	9	11.5E.	141	980.569
	Rome	41	53.5	12	29.7E.	49	980.367
Netherlands	Amsterdam	52	21.9	4	54.7E.	0	981.288
Norway	Bergen	60	23.9	5	18.3E.	38	981.922
Portugal	Lisbon	38	42.5	9	11.3	75	980.088
Roumania	Bucharest	44	24.6	26	6.8E.	83	980.553
Russia and Siberia	Archangel	64	34	40	31.0E.	5	982.278
	Leningrad	59	56.5	30	17.7E.	3	981.929
	Odessa	46	26.4	30	46.4E.	43	980.769
Scotland	Glasgow	55	51.5	4	14.0	61	981.605
Spain	Barcelona	41	25.0	2	7.0E.	407	980.240

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Cont.)

Station		Latitude °	Latitude ′	Longitude °	Longitude ′	Elevation, meters	g cm/sec²
EUROPE (Continued)							
Sweden	Stockholm	59	20.6	18	3.5E.	45	981.843
Switzerland	Geneva	46	12.0	6	9.2E.	402	980.592
ASIA							
China	Hongkong	22	18.2	114	10.5E.	33	978.771
India	Madras	13	4.1	80	14.9E.	6	978.281
Japan	Tokyo	35	42.6	139	46.0E.	18	979.801
Siam	Bankok	13	43.9	100	29.4E.	7	978.278
AFRICA							
Algeria	Algiers	36	44.8	3	3 E.	213	979.905
Egypt and Anglo-Egyptian Sudan	Khartum	15	36.6	32	32.9E.	383	978.308
Liberia	Monrovia	6	19.0	10	48.8	41	978.165
Red Sea	Suez	29	56.0	32	33.4E.	3	979.307
Union of South Africa	Cape Town	33	56.1S.	18	28.7E.	11	979.657
AUSTRALIA	Melbourne	37	49.9S.	144	58.5E.	26	979.987
OCEANIC							
Atlantic Ocean and Mediterranean Sea							
Azores	Ponta Delgada	37	43.8	25	40.8	4	980.143
Bermuda	St. George	32	21	64	40	2	979.806
Canary Islands	Las Palmas	28	7.0	15	26.0	8	979.385
Greenland	Karajak Glacier	70	26.9	50	19.8	20	982.534
Iceland	Reykjavik	64	8.5	22	0.3	39	982.273
Jamaica	Kingston	17	57.7	76	47.3	2	978.591
Pacific and Indian Oceans							
Java	Batavia	6	11.0S.	106	49.8E.	7	978.178
New Zealand	Auckland	36	50.9S.	174	46.2E.	3	979.962
Philippines	Manila	14	34.7	120	38.6E.	3	978.360
Territory of Hawaii	Honolulu	21	18.1	157	51.8	6	978.946

ACCELERATION DUE TO GRAVITY AND LENGTH OF THE SECONDS PENDULUM

For Sea Level at Different Latitudes

Latitude.	g cm./sec.²	g ft./sec.²	Length in cm.	Length in ins.
0°	977.989	32.0862	99.0910	39.0121
5	8.029	.0875	.0950	.0137
10	.147	.0916	.1079	.0184
15	.339	.0977	.1265	.0261
20	.600	.1062	.1529	.0365
25	978.922	32.1168	99.1855	39.0493
30	9.295	.1290	.2234	.0642
31	.374	.1316		
32	.456	.1343		
33	.538	.1370		
34	979.622	32.1398		
35	.707	.1425	.2651	.0806
36	.793	.1454		
37	.880	.1490		
38	.963	.1511		
39	980.057	32.1540		
40	.147	.1570	.3096	.0982
41	.237	.1607		
42	.327	.1630		
43	.418	.1659		
44	980.509	32.1688		
45	.600	.1719	.3555	.1163
46	.691	.1748		
47	.782	.1778		
48	.873	.1808		
49	980.963	32.1838		
50	1.053	.1867	99.4014	39.1344
51	.143	.1896		
52	.231	.1924		
53	.318	.1954		
54	981.407	32.1983		
55	.493	.2011	.4459	.1520
56	.578	.2039		
57	.662	.2067		
58	.744	.2094		
59	981.825	32.2121		
60	.905	.2147	.4876	.1683
65	2.278	.2276	.5255	.1832
70	.600	.2375	.5581	.1960
75	.861	.2460	99.5845	39.2065
80	983.053	32.2523	.6040	.2141
85	.171	.2562	.6160	.2188
90	.210	.2575	.6200	.2204

DECLINATION OF THE SUN AND EQUATION OF TIME

Date.		Declination.	Diff. 1 day.	Equation of time.		Date.		Declination.	Diff. 1 day.	Equation of time.	
		°	°	m	s			°	°	m	s
Jan.	0	−23.1	0.11	+ 3	15	July	9	+22.4	0.15	+ 4	49
	10	−22.0	0.18	+ 7	42		19	+20.9	0.21	+ 5	58
	20	−20.2	0.25	+11	13		29	+18.8	0.26	+ 6	13
	30	−17.7	0.30	+13	32	Aug.	8	+16.2	0.30	+ 5	27
Feb.	9	−14.7	0.34	+14	27		18	+13.2	0.34	+ 3	44
	19	−11.3	0.37	+14	5		28	+ 9.8	0.36	+ 1	11
Mar.	1	− 7.6	0.38	+12	36	Sept.	7	+ 6.2	0.39	− 1	59
	11	− 3.8	0.40	+10	15		17	+ 2.3	0.39	− 5	26
	21	+ 0.2	0.39	+ 7	23		27	− 1.5	0.38	− 8	55
	31	+ 4.1	0.38	+ 4	19	Oct.	7	− 5.4	0.38	−12	4
Apr.	10	+ 7.9	0.35	+ 1	23		17	− 9.2	0.35	−14	31
	20	+11.4	0.33	− 1	5		27	−12.7	0.32	−16	0
	30	+14.7	0.29	− 2	52	Nov.	6	−15.9	0.26	−16	16
May	10	+17.6	0.23	− 3	48		16	−18.7	0.22	−15	7
	20	+19.9	0.18	− 3	45		26	−20.9	0.16	−12	36
	30	+21.7	0.12	− 2	49	Dec.	6	−22.5	0.08	− 8	54
June	9	+22.9	0.05	− 1	11		16	−23.3	0.01	− 4	17
	19	+23.4	0.01	+ 0	55		26	−23.4	0.08	+ 0	41
	29	+23.3	0.09	+ 3	2	Jan.	5	−22.6	....	+ 5	34

MEAN PLACES OF STARS

For the upper transit at Greenwich, Jan. 1, 1934

Name of star	Right ascen.			Annual var.	Declination		Annual var.
	h.	m.	s.	s.	°	′	″
α Andromedae (Alpheratz)	0	4	58.4	+ 3.0975	+28	43.8	+19.883
α Ursae Minoris (Polaris)	1	37	131.2	+32.5602	+88	57.4	+18.277
α Arietas (Hamal)	2	3	27.9	+ 3.3785	+23	9.3	+17.074
α Persei	3	19	37.9	+ 4.2756	+49	38.0	+12.910
α Tauri (Aldebaran)	4	32	9.7	+ 3.4408	+16	22.8	+ 7.332
β Orionis (Rigel)	5	11	23.8	+ 2.8822	− 8	16.5	+ 4.242
α Aurigae (Capella)	5	11	51.3	+ 4.4302	+45	56.2	+ 3.788
ε Orionis (Alnitam)	5	32	53.7	+ 3.0432	− 1	14.5	+ 2.390
β Aurigae	5	54	41.2	+ 4.4001	+44	56.6	+ 0.489
β Canis Majoris	6	19	47.5	+ 2.6411	−17	55.3	− 1.710
α Canis Majoris (Sirius)	6	42	16.3	+ 2.6434	−16	37.4	− 4.867
ε Canis Majoris (Adhara)	6	56	3.8	+ 2.3568	−28	52.8	− 4.836
α Canis Minoris (Procyon)	7	35	52.9	+ 3.1400	+ 5	23.8	− 9.158
α Hydrae (Alphard)	9	24	22.2	+ 2.9478	− 8	22.3	−15.552
α Leonis (Regulus)	10	4	53.2	+ 3.1958	+12	17.3	−17.552
α Ursae Majoris (Dubhe)	10	59	43.1	+ 3.7149	+62	6.1	−19.416
β Leonis (Denebola)	11	45	42.7	+ 3.0604	+14	56.3	−20.121
ε Ursae Majoris (Alioth)	12	51	8.9	+ 2.6434	+56	18.7	−19.552
α Virginis (Spica)	13	21	43.1	+ 3.1582	−10	49.1	−18.820
α Boötis (Arcturus)	14	12	39.1	+ 2.7350	+19	31.3	−18.783
β Ursae Minoris (Kochab)	14	50	50.9	− 0.1922	+74	25.1	−14.718
α Scorpii (Antares)	16	25	20.8	+ 3.6756	−26	17.3	− 8.082
λ Scorpii (Shaula)	17	29	6.7	+ 4.0718	−37	3.5	− 2.739
α Ophiuchi (Rasalhague)	17	31	51.4	+ 2.7834	+12	36.2	− 2.695
α Lyrae (Vega)	18	34	40.8	+ 2.0302	+38	43.2	+ 3.296
α Aquilae (Altair)	19	47	33.0	+ 2.9264	+ 8	41.5	+ 9.443
α Cygni (Deneb)	20	39	9.3	+ 2.0438	+45	2.7	+12.825
α Pisc. Austr. (Formalhaut)	22	54	0.7	+ 3.3176	−29	58.5	+19.054
α Pegasi (Markab)	23	1	28.2	+ 2.9868	+14	51.1	+19.356

APPROXIMATE CORRECTION FOR REFRACTION

For Astronomical Observations

Corresponding to temperature of 50° F., and to a barometric pressure of 29.6 inches.

(From Young's General Astronomy, by permission.)

Altitude.	Refraction.		Altitude.	Refraction.		Altitude.	Refraction.	
°	′	″	°	′	″	°	′	″
0	34	50	11	4	47.7	30	1	39.5
1	24	22	12	4	24.5	35	1	22.1
2	18	06	13	4	04.4	40	1	08.6
3	14	13	14	3	47.0	45		57.6
4	11	37	16	3	18.2	50		48.3
5	9	45	18	2	55.5	55		40.3
6	8	23	20	2	37.0	60		33.2
7	7	19	22	2	21.6	65		26.8
8	6	29	24	2	08.6	70		20.9
9	5	49	26	1	57.6	80		10.2
10	5	16	28	1	48.0	90		0.0

For every 5° F. by which the temperature is less than 50° F., add one per cent to the tabular refraction, and decrease it in the same ratio for temperatures above 50° F.

Increase the tabular refraction by three and a half per cent for every inch of barometric pressure above 29.6 inches, and decrease it in the same ratio below that point. These corrections for temperature and pressure, though only approximate, will give a result correct within 2″ except in extreme cases.

DATA IN REGARD TO THE EARTH

(Radius, U. S. C. & G. Survey.)

Equatorial radius, 6,378,388 meters, 3,963.399 miles.

Polar radius, 6,356,909 meters, 3,949.992 miles.

1° latitude at the equator = 68.70 miles.

1° latitude at the pole = 69.41 miles.

Mean density of the earth, 5.52 g/cm³ or 344.6 lb./ft.³.

Approximate mass of the earth, 6×10^{21} tons or 5.4×10^{24} kg.

Mean distance to the sun, 149,500,000 km or 92,900,000 mi.

Mean distance to the moon, 384,393 km or 238,854 mi.

DATA CONCERNING THE SOLAR SYSTEM

(Values from Young's General Astronomy, by permission.)

Name.	Mean dis. from sun, millions of miles.	Period in years.	Mean dia. in miles.	Mass, the earth = 1.	Mean density, water = 1
Mercury.....	36.0	0.24	3030	0.047	4.70
Venus........	67.2	0.62	7700	0.82	4.94
The earth....	92.9	1.00	7917.6	1.000	5.55
Mars........	141.5	1.88	4230	0.107	3.92
Jupiter.......	483.3	11.86	86500	317.7	1.32
Saturn.......	886.0	29.46	73000	94.8	0.72
Uranus.......	1781.9	84.02	31900	14.6	1.22
Neptune.....	2791.6	164.78	34800	17.0	1.11
Sun..........	....	....	866400	332000.	1.39
Moon........	....	....	2163	0.0123	3.39

METEOROLOGICAL DATA

The Atmosphere

Total mass, estimated by Elkholm:
5.2×10^{21} grams.
11.4×10^{18} pounds.
Composition:
The total volume = 1.

Substance.	Elevation.		
	Sea level.	10000 meters.	50000 meters.
Argon	0.009	0.006	0.0003
Carbon dioxide	0.0003	0.00015	0.0000
Helium	0.0000015	0.0000	0 00126
Hydrogen	0.0001	0.00035	0.136
Neon	0.000015	0.00002	0.0000
Nitrogen	0.780	0.812	0.792
Oxygen	0.210	0.182	0.070

Atmospheric Potential

The potential of the atmosphere increases with the elevation 130 to 200 volts per meter.

Velocity of Seismic Waves in the Earth's Crust

Longitudinal	4 to 14 kilometers per sec.
Transverse	3 to 10 kilometers per sec.

Angular Radius of Halos and Rainbows

Coronæ due to small water drops	1° to 10°
Small halo, due to 60° angles of ice crystals	22°
Large halo, due to 90° angles of ice crystals	46°
Rainbow, primary	41° 20′
Rainbow, secondary	52° 15′

Solar Constant

The energy falling on one sq.cm. area at normal incidence equals 1.92 small calories per minute.

PROBABLE VALUES OF THE GENERAL PHYSICAL CONSTANTS

Raymond T. Birge: The Physical Review Supplement, Vol. 1, No. 1, July, 1929.

Table A. Principal Constants and Ratios

Velocity of light	$c = (2.99796 \pm 0.00004) \times 10^{10}$ cm · sec^{-1}
Gravitation constant	$G = (6.664 \pm 0.002) \times 10^{-8}$ dyne · cm^2 · g^{-2}
Liter	$l = 1000.027 \pm 0.001$ cm^3
Volume of perfect gas (0°C, A_n)	$v_n = (22.4141 \pm 0.0008) \times 10^3$ cm^3 · mole^{-1}
Volume of perfect gas (0°C, A_{45})	$R = 22.4146 \pm 0.0008$ liter · mole^{-1}
International ohm = p abs-ohm	$p = 1.00051 \pm 0.00002$
International ampere = q abs-amp	$q = 0.99995 \pm 0.00005$
Atomic weights	O = 16.0000; H = 1.00777 ± 0.00002
	He = 4.0022 ± 0.0004; N = 14.0083 ± 0.0008
	Ag = 107.880 ± 0.001; I = 126.932 ± 0.002
	C = 12.003 ± 0.001; Ca = 40.075 ± 0.005
Normal atmosphere	$A_n = (1.013249 \pm 0.000003) \times 10^6$ dyne · cm^{-2}
45° atmosphere	$A_{45} = (1.013199 \pm 0.000003) \times 10^6$ dyne · cm^{-2}
Ice point (absolute scale)	$T_0 = 273.18 \pm 0.03$°K
Mechanical equivalent of heat	$J_{15} = 4.1852 \pm 0.0006$ abs-joule · cal$_{15}^{-1}$
Electrical equivalent of heat	$J'_{15} = 4.1835 \pm 0.0007$ int-joule · cal$_{15}^{-1}$
Faraday constant	$F = 96494 \pm 5$ int-coul · g-equiv^{-1}
	$= 96489 \pm 7$ abs-coul · g-equiv^{-1}
	$= 9648.9 \pm 0.7$ abs-em-unit · g-equiv^{-1}
	$Fc = (2.8927_0 \pm 0.0002) \times 10^{14}$ abs-es-unit · g-equiv^{-1}
Electronic charge	$e = (4.770 \pm 0.005) \times 10^{-10}$ abs-es-units
	$e/c = (1.5910_5 \pm 0.0016) \times 10^{-20}$ abs-em-units
Specific electronic charge (spectroscopic)	$e/m = (1.761 \pm 0.001) \times 10^7$ abs-em-unit · g^{-1}
	$(e/m)c = (5.279_{41} \pm 0.003) \times 10^{17}$ abs-es-unit · g^{-1}
Specific electronic charge (deflection)	$e/m = (1.769 \pm 0.002) \times 10^7$ abs-em-unit · g^{-1}
	$(e/m)c = (5.303_{39} \pm 0.006) \times 10^{17}$ abs-es-unit · g^{-1}
Planck constant	$h = (6.547 \pm 0.008) \times 10^{-27}$ erg · sec

PROBABLE VALUES OF THE GENERAL PHYSICAL CONSTANTS (Continued)

Table B. Additional Quantities Evaluated or Used in Connection with Table A

Ratio of *es* to *em* units (direct)	c'	$= (2.9979 \pm 0.0001) \times 10^{10}$ cm · sec^{-1}
Acceleration of gravity (45°)	g_{45}	$= 980.616$ cm · sec^{-2}
Acceleration of gravity (normal)	g_n	$= 980.665$ cm · sec^{-2}
Maximum density of water	$\delta_m(H_2O)$	$= 0.999973 \pm 0.000001$ g · cm^{-3}
Density of oxygen gas (0°C, A_{45})	$L(O_2)$	$= 1.428965 \pm 0.000030$ g · liter^{-1}
Factor converting oxygen (0°C, A_{45}) to ideal gas	$1 - \alpha(O_2)$	$= 1.000927 \pm 0.000030$
Density of nitrogen (0°C, A_{45})	$L(N_2)$	$= 1.25046 \pm 0.000045$ g · liter^{-1}
Factor converting nitrogen (0°C, A_{45}) to ideal gas	$1 - \alpha(N_2)$	$= 1.00043 \pm 0.00002$
Density of Hg (0°C, A_n)	D_n	$= 13.59509 \pm 0.00003$ g · cm^{-3}
International volt (= pq abs-volts)	pq	$= 1.00046 \pm 0.00005$
International joule (= pq^2 abs-joules)	pq^2	$= 1.00041 \pm 0.00010$
Electrochemical equivalent of Ag	$E(Ag)$	$= (1.11800 \pm 0.00005) \times 10^{-3}$ g · int-coul^{-1}
		$= (1.11805) \pm 0.00007) \times 10^{-3}$ g · abs-coul^{-1}
Density of calcite (20°C)	ρ	$= 2.7102 \pm 0.0004$ g · cm^{-3}
Structural constant of calcite (20°C)	$\phi(\beta)$	$= 1.09630 \pm 0.00007$
Rydberg constant for hydrogen	R_H	$= 109677.759 \pm 0.05$ cm^{-1}
Rydberg constant for ionized helium	R_{He}	$= 109722.403 \pm 0.05$ cm^{-1}
Wave-length of red Cd line (15°C, A_n)	λ_{Cd}	$= 6438.4696$ I.Å.(definition of I.Å. unit)
Rydberg constant for infinite mass	R_∞	$= 109737.42 \pm 0.06$ cm^{-1}
	cR_∞	$= (3.28988 \pm 0.00004) \times 10^{15}$ sec^{-1}
True grating space of calcite (20°C)	d'_{20}	$= (3.0283 \pm 0.0010) \times 10^{-8}$ cm
Effective grating space of calcite (20°C)	d_{20}	$= (3.0279 \pm 0.0010) \times 10^{-8}$ cm
Avogadro's number	$N_0 = Fc/e$	$= (6.064_{36} \pm 0.006) \times 10^{23}$ mole^{-1}
Gas constant per mole	$R_0 = \nu_n A_n / T_0$	$= (8.3136_0 \pm 0.0010) \times 10^7$ erg · degree^{-1} · mole^{-1}
	$R_0' = R_0/(J_{15} \times 10^7)$	$= 1.9864_3 \pm 0.0004$ cal$_{15}$ · deg^{-1} · mole^{-1}
Boltzmann constant	$k = R_0/N_0$	$= (1.3708_9 \pm 0.0014) \times 10^{-16}$ erg · deg^{-1}
Second radiation constant (exp. value)	c_2	$= 1.432 \pm 0.003$ cm · deg.
Second radiation constant (indirect)	$c_2 = hc/k$	$= 1.4317_4 \pm 0.0006$ cm · deg.
Stefan-Boltzmann constant (exp. value)	σ	$= (5.735 \pm 0.011) \times 10^{-5}$ erg · cm^{-2} · deg^{-4} · sec^{-1}
Stefan-Boltzmann constant (indirect)	$\sigma = 2\pi^5 k^4 / 15c^2h^3$	$= (5.713_9 \pm 0.006) \times 10^{-5}$ erg · cm^{-2} · deg^{-4} · sec^{-1}

Table C. Miscellaneous Derived Constants

Mass of electron (spectroscopic)	$m_0 = \dfrac{e}{c(e/m)_{sp}}$	$= (9.035_{10} \pm 0.010) \times 10^{-28}$g
Mass of electron (deflection)	$m_0 = \dfrac{e}{c(e/m)_{defl}}$	$= (8.994_{25} \pm 0.014) \times 10^{-28}$g
Atomic weight of electron (spectroscopic)	$m = F/(e/m)_{sp}$	$= (5.479_{22} \pm 0.003) \times 10^{-4}$
Atomic weight of electron (deflection)	$m = F/(e/m)_{defl}$	$= (5.454_{44} \pm 0.006) \times 10^{-4}$
Mass of atom of unit atomic weight	$M_0 = 1/N_0$	$= (1.6489_8 \pm 0.0016) \times 10^{-24}$g
Mass of hydrogen atom	$M_H = H/N_0$	$= (1.6617_9 \pm 0.0017) \times 10^{-24}$g
Number of atoms per gram of hydrogen	$1/M_H$	$= (6.017_{61} \pm 0.006) \times 10^{23}$ g^{-1}
Mass of proton	$M_P = (H - m)/N_0$	$= (1.6608_9 \pm 0.0017) \times 10^{-24}$g
Mass of α-particle	$M\alpha = (He - 2m)/N_0$	$= (6.597_{74} \pm 0.007) \times 10^{-24}$g
Charge (electrolysis) of 1 g hydrogen	$e/M_H = F/H$	$= (9574.5_1 \pm 0.7)$ abs-em-units · g^{-1}
Specific charge of proton	$e/M_P = F/(H - m)$	$= (9579.7_3 \pm 0.7)$ abs-em-units · g^{-1}
Specific charge of α-particle	$2e/M\alpha = 2F/(He - 2m)$	$= (4823.1_1 \pm 0.6)$ abs-em-units · g^{-1}
Ratio, mass H atom to mass electron (sp)	$(e/m)_{sp}/(e/M_H)$	$= 1839._{26} \pm 1$
Ratio, mass H atom to mass electron (defl.)	$(e/m)_{defl}/(e/M_H)$	$= 1847._{61} \pm 2$
Ratio, mass proton to mass electron (sp)	M_P/m_{sp}	$= 1839.26 - 1 = 1838._{26} \pm 1$
Ratio, mass proton to mass electron (defl.)	M_P/m_{defl}	$= 1847.61 - 1 = 1846._{61} \pm 2$
Energy associated with unit wave-number	$e/\nu' = hc$	$= (1.9627_{64} \pm 0.0025) \times 10^{-16}$ erg · cm
Potential (*es*) associated with unit frequency	$V/\nu = h/e$	$= (1.3725_4 \pm 0.0005) \times 10^{-17}$ erg . sec . es-unit^{-1}
Frequency associated with 1 abs-volt	$\nu/V'' = 10^8 e/hc$	$= (2.4302_5 \pm 0.0009) \times 10^{14}$ sec^{-1} · abs-volt^{-1}
Wave-number associated with 1 abs-volt	$\nu_0 = \nu'/V'' = 10^8 e/hc^2$	$= (8106._{31} \pm 3)$ cm^{-1} · abs-volt^{-1}
Wave-length associated with 1 abs-volt	$\lambda_0 = \lambda V'' = hc^2/e$	$= (12336._1 \pm 5) \times 10^{-8}$ cm · abs-volt
Energy of one-abs.-volt-electron	$h\nu/V'' = 10^8 e/c$	$= (1.5910_8 \pm 0.0016) \times 10^{-12}$ ergs
Speed of abs-volt-electron (sp)	$v_e = [2 \times 10^8(e/m_{sp})]^{1/2}$	$= (5.9346_4 \pm 0.0017) \times 10^7$ cm · sec^{-1}
Speed of abs-volt-electron (defl.)	$v_e = [2 \times 10^8(e/m)_{defl}]^{1/2}$	$= (5.9481_1 \pm 0.0034) \times 10^7$ cm · sec^{-1}
Fine structure constant	$\alpha = 2\pi e^2/hc$	$= (7.283_{64} \pm 0.006) \times 10^{-3}$
Reciprocal of fine structure constant	$1/\alpha$	$= 137.29_4 \pm 0.11$
Magnetic moment, Bohr magneton (sp)	$\mu_1 = \dfrac{h(e/m)_{sp}}{4\pi}$	$= (0.9174_{70} \pm 0.0013) \times 10^{-20}$ erg · gauss^{-1}

PROBABLE VALUES OF THE GENERAL PHYSICAL CONSTANTS (Continued)

Magnetic moment, Bohr magneton (defl.)	$\mu_1 = \dfrac{h(e/m)_{defl}}{4\pi}$	$= (0.9216_{38} \pm 0.0016) \times 10^{-20}$ erg · gauss^{-1}
Magnetic moment per mole (1 Bohr magneton per molecule) (sp)	$\mu_1 N_0$	$= 5563._{87} \pm 10$ erg · gauss^{-1} · mole^{-1}
Magnetic moment per mole (1 Bohr magneton per molecule) (defl.)	$\mu_1 N_0$	$= 5589._{14} \pm 11$ erg · gauss^{-1} · mole^{-1}
Zeeman displacement per gauss	$\Delta\nu'/H = (e/m)_{sp}/4\pi c$	$= (4.674_{33} \pm 0.003) \times 10^{-5}$ cm^{-1} · gauss^{-1}
Band spectrum constant connecting cm^{-1} and moment of inertia	$h/8\pi^2 c$	$= (27.65_{83} \pm 0.04) \times 10^{-40}$ g · cm
Atomic specific heat constant	$c_2/c = h/k$	$= (4.7757_3 \pm 0.0019) \times 10^{-11}$ sec · deg.
Reduced mass of H atom	$\mu H = R_H(m_0)_{sp}/R_\infty$	$= (9.030_{19} \pm 0.010) \times 10^{-28}$ g
Schroedinger constant for H atom	$8\pi^2 \mu H/h^2$	$= (1.663_{42} \pm 0.003) \times 10^{27}$ g · erg^{-2} · sec^{-2}
Schroedinger constant for electron	$8\pi^2(m_0)_{sp}/h^2$	$= (1.664_{32} \pm 0.003) \times 10^{27}$ g · erg^{-2} · sec^{-2}
Ionization potential for H atom	R_H/ν_0	$= 13.529_9 \pm 0.005$ abs-volt
Ionization potential for He$^+$	$4R_{He}/\nu_0$	$= 54.141_7 \pm 0.020$ abs-volt
Radius of Bohr orbit in normal hydrogen, referred to center of mass, using experimental value of R_∞	$a_0' = \alpha(1-\alpha^2)^{1/2}/4\pi R_\infty$	$= (0.5281_{69} \pm 0.0004) \times 10^{-8}$ cm
Speed of electron in normal H orbit, referred to center of mass	$v_0 = \alpha c R_H/R_\infty$	$= (2.1824_2 \pm 0.0017) \times 10^8$ cm · sec^{-1}
Hydrogen doublet constant	$\Delta\nu H = R_H \alpha^2/16$	$= 0.3636_{59} \pm 0.0006$ cm^{-1}
Compton shift at 90° (sp)	$h/m_0 c = (e/m)_{sp} h/e$	$= (0.024170_4 \pm 0.000016) \times 10^{-8}$ cm
Compton shift at 90° (defl.)	$h/m_0 c = (e/m)_{defl} h/e$	$= (0.02428_{02} \pm 0.00003) \times 10^{-8}$ cm
Wave-length of 1-abs-volt-electron	$h/[m_0(v_e)_{sp}]$	$= (12.210_0 \pm 0.006) \times 10^{-8}$ cm
Loschmidt number	$n_0 = N_0/v_n$	$= (2.705_{60} \pm 0.003) \times 10^{19}$ cm^{-3} (0°C, A_n)
Wien's displacement constant (indirect)	$A = c_2/4.9651$	$= 0.28836_1 \pm 0.00011$ cm · deg
First radiation constant	$c_1 = 8\pi hc$	$= (4.932_{96} \pm 0.006) \times 10^{-15}$ erg · cm
	or hc^2	$= (0.5884_{29} \pm 0.0008) \times 10^{-5}$ erg · cm^2 · sec^{-1}
	or $2\pi hc^2$	$= (3.697_{20} \pm 0.005) \times 10^{-5}$ erg · cm^2 · sec^{-1}
Energy per mole, equivalent to 1-abs-volt-electron per molecule	$\dfrac{F(\text{abs-coul} \cdot \text{g-equiv}^{-1})}{J_{15}(\text{abs-joule} \cdot \text{cal}_{15}^{-1})}$	$= 23054._8 \pm 4$ cal$_{15}$ · mole^{-1}
Sackur-Tetrode constant (ϵ = base of ln = 2.71828)	$S_0 = R_0' \ln [(2\pi k)^{3/2}\epsilon^{5/2}/h^3 N_0^{5/2}]$	$= -11.0533 \pm 0.0026$ cal$_{15}$ · deg^{-1} · mole^{-1}
Chemical constant (unit at. wt., pressure in atm.)	$i_0' = \frac{3}{2} \log [2\pi k^{5/3}/N_0 h^2] - \log A_n$	$= -1.5882_5 \pm 0.0004$
Multiplier of (Curie constant)$^{1/2}$ to give magnetic moment in Bohr magnetons per molecule	$\dfrac{(3k/N_0)^{1/2}}{\mu_1}$	$= 2.8384_2 \pm 0.0019$ erg$^{-1/2}$ · gauss · deg$^{-1/2}$ · mole$^{1/2}$

ABBREVIATIONS AND SYMBOLS

A.	Acre
Å	Ångström unit
A	Atomic weight. Maximum work of a thermodynamic system
A_n	Normal atmosphere
A_{45}	Atmosphere, 45° latitude
a.	Acid
a	Are
(a)	Used to indicate that electrical units are based on International ohm and International ampere as defined by silver voltameter
a	Van der Waal's pressure constant. Capillary constant
abs.	Absolute
abt.	About
a. c.	Alternating current
acet.	Acetone
acet. a.	Acetic acid
al.	Alcohol
alk.	Alkali
alt.	Altitude
amal.	Amalgam. Amalgamated
amor. or amorph.	Amorphous
amp.	Ampere
anh.	Anhydrous
antilog	Antilogarithm
ap.	Apothecaries'
appr.	Approximately
aq.	Aqua. Aqueous. Water
aq. reg.	Aqua regia
asym.	Asymmetrical
atm. or atmos.	Atmosphere (atmospheric)
At. No.	Atomic number
At. Wt.	Atomic weight
aux.	Auxiliary
Av.	Average
av. or avoir.	Avoirdupois
b	Van der Waal's volume constant
bar.	Barometer
bbl.	Barrel
bd.	Board
Bé.	Beaumé (degrees)
B. G.	Birmingham gauge (hoop and sheet)
b.h.p.	Brake horse power
bl.	Blue
blk.	Black
B. M	Board measure
b. p.	Boiling point
br.	Brown
BTU	British thermal unit
bu.	Bushel
B.W.G.	Birmingham wire gauge
bz.	Benzene
C	Centigrade
C	Concentration
c	Carat. Centi-. Cold
c	Specific heat. Heat capacity of the substance. Velocity of light in vacuo.
ca	Candle
ca.	*Circa.* About. Approximately
cal.	Calorie (gram)
cc. or c.c.	Cubic centimeter
c_p, c_v	Specific heat at constant pressure, at constant volume
C_p, C_v	Molecular heat at constant pressure, at constant volume
c. cm.	Cubic centimeter
cd.	Cord
Cent.	Centigrade
centi-	Prefix meaning 1/100
cf.	*Confer*, compare

ABBREVIATIONS AND SYMBOLS (Continued)

c.f.m.	Cubic foot per minute
cgs	Centimeter - gram - second system of units
cgse	Cgs electrostatic system
cgsm	Cgs electromagnetic system
ch.	Chain
chl	Chloroform
cir.	Circular
circum.	Circumference
cl	Centiliter
cm	Centimeter
cm^2	Square centimeter
cm^3	Cubic centimeter
c. m.	Circular mil
coef.	Coefficient
colog	Cologarithm
colorl.	Colorless
comm'l.	Commercial
conc.	Concentrated
cond.	Condensing
const.	Constant
cos	Cosine
$\cos^{-1}$	Arc or angle whose cosine is. Anti-cosine of. Inverse cosine of
cosec	Cosecant
cosh	Hyperbolic cosine
$\cosh^{-1}$	Inverse hyperbolic cosine
cot	Cotangent
$\cot^{-1}$	Arc or angle whose cotangent is . . . .
coth	Hyperbolic cotangent
$\coth^{-1}$	Inverse hyperbolic cotangent
covers	Coversed sine
c. p.	Candle power. Circular pitch. Center of pressure
cry. or cryst.	Crystalline. Crystals
csc	Cosecant
$\csc^{-1}$	Arc or angle whose cosecant is
csch	Hyperbolic cosecant
csch^{-1}	Inverse hyperbolic cosecant
CTU	Centigrade thermal unit
cu.	Cubic
cu. cm	Cubic centimeter
cu. ft.	Cubic foot
cu. in.	Cubic inch
cu. m	Cubic meter
cu. yd.	Cubic yard
cwt.	Hundredweight
cyl.	Cylinder
D	Density
d	Density. Diameter. Differential; as dx; that is the differential of x.
d	Derivative. Deci-
d.	Decomposes. Dextrorotary
d_c	Critical density
$d_{t_1}^{t_2}$	Specific gravity at temperature t_2, with reference to water at temperature t_1
da	Day
d. c.	Direct current
dec.	Decomposes
deci-	Prefix meaning 1/10
def.	Definition (s)
deg	Thermometric degree, absolute C unless contrary is indicated
deka-	Prefix meaning 10
deliq.	Deliquescent
den. or dens.	Density
dg	Decigram
diam.	Diameter
dil.	Dilute

ABBREVIATIONS AND SYMBOLS (Continued)

dissd.	Dissolved
dk	Deka-
dk.	Dark
dkg	Dekagram
dkl	Dekaliter
dkm	Dekameter
dkm^2	Square dekameter
dkm^3	Cubic dekameter
dks	Dekastere
dl	Deciliter
dm	Decimeter
dm^2	Square decimeter
dm^3	Cubic decimeter
d. p.	Diametral pitch. Double pole
dr.	Dram
dr. ap. or ʒ ap.	Dram, apothecaries'
dr. av. or ʒ av.	Dram, avoirdupois
dr. fl. or ʒ fl.	Dram, fluid
dr. t. or ʒ t.	Dram, troy
ds	Decistere
dwt.	Pennyweight
E	Electromotive force. Modulus of elasticity in tension
E_0	Mean translational energy of molecule of ideal gas at 0°C
e, or ϵ	The number 2.7182818+; the base of the Napierian or natural system of logarithms. The eccentricity of a conic section
e	Electronic charge
e. g.	*Exempli gratia*. For example
efflor.	Efflorescent
e. h. p.	Effective horse power
E. L	Elastic limit
em	Cgsm unit of quantity of electricity
emf or e. m. f.	Electromotive force
equiv	Electrochemical equivalent
es	Electrostatic or Cgse unit of quantity of electricity
etc.	*Et cetera*. And so forth
eth.	Ether
eth. acet.	Ethyl acetate
et seq.	*Et sequentes*. And the following
evap.	Evaporation
ex.	Excess
exp	Exponential function
exp.	Explodes
exsec	Exterior secant
F	Fahrenheit. Faraday
f.	From
fahr.	Fahrenheit
fath.	Fathom
feath.	Feathery
f. h. p.	Friction horse power
fir.	Firkin
fl.	Fluid
fl. dr.	Dram, fluid
fl. oz.	Ounce, fluid
fluores.	Fluorescent
fps	Foot-pound-second system of units
fpse	Foot-pound-second electrostatic system
fpsm	Foot-pound-second electromagnetic system
F. S.	Factor of safety
ft.	Foot
$ft.^2$	Square foot
$ft.^3$	Cubic foot
ft.-lb.	Foot-pound

ABBREVIATIONS AND SYMBOLS (Continued)

fur.	Furlong
G	Gravitation constant
g	Gram
g	Acceleration due to gravity
g_n	Acceleration of gravity (normal)
g_s	Standard gravity, 980.665 centimeters per second squared
g_{45}	Acceleration of gravity at latitude (45°)
gal.	Gallon
g-cal or g.-cal.	Gram-calorie
gel.	Gelatinous
gi.	Gill
glac.	Glacial
glit.	Glittering
glyc.	Glycerine
gm.	Gram
gr.	Grain
gr.	Gray
grn.	Green
gyr.	Gyration
h	Hecto-
h.	Hot
hecto-	Prefix meaning 100
h	Height. Hour
h	Planck's constant of action
ha	Hectare
hex.	Hexagonal
hg	Hectogram
hhd.	Hogshead
hl	Hectoliter
hm	Hectometer
hm^2	Square hectometer
hm^3	Cubic hectometer
hor. or horiz.	Horizontal
h.-p.	High-Pressure
HP or h. p.	Horse power
h. p.-hr	Horse power-hour
hr.	Hour
hyg.	Hygroscopic
I	Electric current
i.	Insoluble
ibid.	*Ibidem.* In the same place
i. e.	*Id est.* That is
ign.	Ignites
i. h. p	Indicated horse power
in.	Inch
$in.^2$	Square inch
$in.^3$	Cubic inch
in.	Indigo
inc.	Inclusive
in.-lb.	Inch-pound
insol.	Insoluble
Int.	International
iso.	Isotropic
isom.	Isometric
isoth.	Isothermal
J	Radiation. Mechanical equivalent of heat
J_λ	Intensity of monochromatic radiation of wave-length λ
j	Imaginary quantity $(\sqrt{-1})$
K	Karat. Kelvin, or absolute C scale of temperature
K	Constant of chemical equilibrium
k	Kilo-
k	Velocity coefficient chemical reaction
k_o	Boltzmann's gas constant
kg	Kilogram
kg-cal.	Kilogram-calorie
kg-m	Kilogram-meter
kilo-	Prefix meaning 1,000
kl	Kiloliter
km	Kilometer
km^2	Square kilometer
km^3	Cubic kilometer
kva.	Kilovolt-ampere

ABBREVIATIONS AND SYMBOLS (Continued)

kw.	Kilowatts
kw.-hr.	Kilowatt-hour
l.	Laevo-rotary. Long
l	Liter
l	Length
lat	Latitude
lb.	Pound
lb. ap.	Pound, apothecaries'
lb. av.	Pound, avoirdupois
lb. t.	Pound, troy
leaf.	Leaflets
lgr.	Ligroin
li.	Link
lim.	Limit
lin.	Linear
liq.	Liquid
ln	Natural Hyperbolic or Napierian logarithm
lng.	Long
log or log.	Logarithm
$\log_e$	Logarithm to the base *e*; natural, hyperbolic or Napierian logarithm
$\log_{10}$	Common logarithm. Logarithm to the base 10
long.	Longitude
l.-p.	low-pressure
lt.	Light
lust.	Lustrous
M.	The modulus of a system of logarithms; used especially for the modulus of the common system of logarithms, the base of which is 10. In this system it is equal to 0.4342944819+
M	Molecular weight
$M[\alpha]$	Molecular rotatory power
$M[\omega]$	Molecular magnetic rotatory power
♍	Minim or drop
m	Meter. Milli-
m	Mass. Minute
m.	Meta-
m^2	Square meter
m^3	Cubic meter
$m\mu$	Millimicron. Millimicro-
m_0	Mass of electron at low velocity
m_H	Mass of a hydrogen atom
max.	Maximum
med.	Medium
meth.	Methyl
meth. al.	Methyl alcohol
m. e. p.	Mean effective pressure
met.	Metallic
mg	Milligram
m.h.c.p.	Mean horizontal candle power
mi.	Mile
mic.	Microscopic
micro-	Prefix meaning 1/1,000,000 or 10^{-6}
micro-micro-	Prefix meaning 10^{-12}
milli-	Prefix meaning 1/1,000
milli-micro-	Prefix meaning 10^{-9}
min	Minute
min.	Minim. Minimum. Mineral
ml	Milliliter
m.l.h. c.p.	Mean lower hemispherical candle power
mm	Millimeter
mm^2	Square millimeter

ABBREVIATIONS AND SYMBOLS (Continued)

mm^3	Cubic millimeter
mmf or m.m.f.	Magnetomotive force
mol.	Molecule
Mol. Wt.	Molecular weight
monocl.	Monoclinic
m. p.	Melting point
m.s.c.p.	Mean spherical candle power
myria-	Prefix meaning 10,000 or 10^4
N	Numeric. Number (in mathematical tables)
N_o	Avogadro's number
N_∞	Rydberg's universal series constant
n	Refractive index
n.	Normal
n_o	Loschmidt's number
need.	Needles
n_a, n_k	Transport number for anion, kation
O	Atomic weight of oxygen
o	Ortho-
Obs.	Observer
octahdr.	Octahedral
oil turp.	Oil of turpentine
or.	Orange
oz.	Ounce
oz. ap. or ℥ ap.	Ounce, apothecaries'
oz. av. or ℥ av.	Ounce, avoirdupois
oz. fl. or ℥ fl.	Ounce, fluid
oz. t. or ℥ t.	Ounce, troy
P or p	Pressure
p	Para-
pa.	Pale
p. ct.	Per cent
perp.	Perpendicular
p. f.	Power factor
pk.	Peck
pl.	Plates
powd.	Powder
p_c, p_r	Critical pressure, reduced pressure
pr.	Prisms
precip. or p'p't'd.	Precipitated
p. sol.	Partly soluble
pt.	Point. Pint
purp.	Purple
pyr.	Pyridine
Q	Quantity
q	Quintal
qt.	Quart
q. v.	*Quod vide*. Which see
R	Réaumur. Radioactive mineral
R	Volume of perfect gas (O °C, A_{45}) Gas constant per mole of ideal gas. Electrical resistance.
r	Radius
r_G	Specific refractivity (Gladstone and Dale)
r_L	Specific refraction (Lorentz and Lorenz)
rac.	Racemic
rad	Radian measure of angle
rad.	Radius
rd.	Rod
reg.	Regular
rev.	Revolution
rhbdr.	Rhombohedral
rhomb.	Rhombic or orthorhombic
R.M.S.	Square root of mean square
r.p.m.	Revolutions per minute
S	Entropy
s	Stere

ABBREVIATIONS AND SYMBOLS (Continued)

s.	Scruple. Soluble
s. ap. or ℈.	Scruple, apothecaries'
s	Second
sat. or sat'd.	Saturated
sc.	Scales
S. E.	Siemens unit
sec or sec.	Second (mean solar unless contrary is stated)
sec	Secant
sec^{-1}	Arc or angle whose secant is . . . . .
sech	Hyperbolic secant
$sech^{-1}$	Inverse hyperbolic secant
segm.	Segment
sh.	Short
sin	Sine
sin^{-1}	Arc or angle whose sine is . . . .
sinh	Hyperbolic sine
$sinh^{-1}$	Inverse hyperbolic sine
sl.	Slightly
sl. sol.	Slightly soluble
sm.	Small
sol.	Solution. Soluble
soln.	Solution
sp.	Specific
specif.	Specification
sp. gr.	Specific gravity
sq.	Square
sq. ch.	Square chain
sq. ft.	Square foot
sq. in.	Square inch
sq. mi.	Square mile
sq. rd.	Square rod
sq. yd.	Square yard
std.	Standard
subl.	Sublimes
sym.	Symmetrical
T	Temperature on absolute C scale
T_c	Critical temperature absolute C
t_c	Critical temperature C (above ice point)
t	Metric ton
t.	Troy
t	Time. Temperature C (above ice point)
tab. or tabl.	Tablets
tan	Tangent
tan^{-1}	Arc or angle whose tangent is . . . .
tanh	Hyperbolic tangent
$tanh^{-1}$	Inverse hyperbolic tangent
temp.	Temperature
tetr. or tetrag.	Tetragonal
tn.	Ton
tr.	Transition
tricl.	Triclinic
trig.	Trigonal
trim.	Trimetric
T. S.	Tensile strength
Tw.°	Degrees Twaddell, hydrometer scale
ult.	Ultimate
uns.	Unsymmetrical
U. S.	United States of America. Universal system of lens apertures
V or v	Volume
v.	*Vide.* See
(v)	Indicating electrical units based on International ohm and International volt as defined by standard cell
v.	Very
V_n	Volume of perfect gas (0 °C, A_n)

ABBREVIATIONS AND SYMBOLS (Continued)

v_0	Volume per gram-mole of ideal gas at 0 °C and A_n
vel. or veloc.	Velocity
vers	Versed sine
vert	Vertical
visc.	Viscous
vol.	Volume
volt.	Volatilizes
v_c, v_r	Critical volume, reduced volume
W	Electrical resistance
w	Water
w	Wien's displacement constant
wh.	White
wt.	Weight
$\lvert x \rvert$	Absolute value of x
yd.	Yard
yel.	Yellow
yr.	Year
Z	Atomic number

α (Alpha)	Degree of dissociation. Angle of optical rotation
$[\alpha]$	Specific rotatory power
β (Beta)	Specific heat constant
γ (Gamma)	Surface tension. Ratio of c_p/c_v. Gamma magnetic units
Δ (Delta)	Diffusion coefficient. Finite difference
Δx	Increment of x
δ (Delta)	Variation; as, δx; that is, the variation of x.
ϵ (Epsilon)	Dielectric constant. Electrode potential. Base of natural logarithms.
ϵ_h, ϵ_c	Electrode potential above that of normal hydrogen. of normal calomel, electrode
η (Eta)	Viscosity
θ (Theta)	Angle (plane). Angular displacement. Temperature C above ice point.
κ (Kappa)	Susceptibility (magnetic). Electrical (volume) conductivity
Λ Lambda)	Equivalent conductivity (electrical)
λ (Lambda)	Wave-length. λ 5890 = spectral line of wave-length = 5890Å
λ_m	Wave-length of maximum monochromatic radiance of black-body at stated temperature
μ (Mu)	Permeability (magnetic). Micron, Micro-, Molecular conductivity (electrical)
$\mu\mu$	Micromicron. Micromicro-
ν (Nu)	Frequency
ν_∞	Rydberg's fundamental frequency

π (Pi)..........The number 3.14159265+; the ratio of the circumference of a circle to its diameter, of a semicircle to its radius, and of the area of a circle to the square of its radius.

Σ (Sigma)......Summation of—commonly used to indicate the sum or summation of finite differences, and nearly like $\int$.

σ (Sigma)......Stefan-Boltzmann constant

φ ....Fluidity. Angle

Ψ (Psi).........Luminous flux

Ω (Omega).....Ohm

[Ω]............Relative molecular magnetic rotatory power with reference to water

ω (Omega).....Solid angle. Angular velocity

[ω]............Specific magnetic rotatory power

$+$ ....Plus (sign of addition). Positive

$-$ ....Minus (sign of subtraction). Negative

$\pm$, ($\mp$)..........Plus or minus (Minus or plus) Positive or negative (Negative or positive)

$\times$ or $\cdot$ ....Multiplied by. Sign of multiplication

$\cdot$ ....Multiplied by

$\div$ or : ....Divided by

/ ....Divided by

= or : : ....Equals, is equal to, as

: Is to; the ratio of
: : As; equals;

Used to indicate geometrical proportion; as, $a{:}b \; :: \; c{:}d$; a is to b as c is to d; or; the ratio of a to b equals the ratio of c to d.

$\doteq$..............Is approximately equal to

$>$ ....Greater than. Above

$<$ ....Less than. Below

$\gtreqless$, ($\geqq$)........Equal to or greater than, (greater than or equal to)

$\lesseqgtr$, ($\leqq$)........Equal to or less than, (less than or equal to)

$\nless$..............Negative of $<$; $a \nless b$ denotes that a is not less than b

$\ngtr$ ....Is not greater than; $a \ngtr b$; a is not greater than b

$\ddagger$..............Is not equal to

$\neq$..............Is not equal to

$\rightarrow$ or $\doteq$ ....Approaches

$\triangleq$..............Denoting equivalence in area or volume (In geometry)

$\cong$	Approximately equal to
$\approx$	Approximately equal to
$\sim$	The difference between;—denoting a difference between two quantities without designating the greater; as, $a \sim b$
$\propto$	Varies as; is proportional to
∞	Infinity. Indefinitely great. Infinite. Soluble in all proportions
! or $\llcorner$	The continued product of numbers from one upward; the factorial; as $4! = \underline{\lvert 4} = 1 \times 2 \times 3 \times 4$
$\therefore$	Therefore. Hence. On this account
$\because$	Because. Since
....	And so on
$\equiv$	Is identical with. Is congruent with.
$\multimap$	Is a part of
$\underset{\cdot}{\sim}$ or $\backsim$	Is similar to
%	Per cent. Per Hundred
‰	Per thousand or 0.1%
$\angle$	Angle
$\llcorner$	Right angle
$\perp$	Perpendicular to
$\parallel$	Parallel to
$\bigcirc$	Circle; Circumference; 360°
$\frown$	Arc of a circle. Arc
$\triangle$	Triangle
$\square$	Square
▭	Rectangle
$\sqrt{\ }$	Square root
$\sqrt[n]{\ }$	nth root
a^n	nth power of a
$a^{\frac{1}{n}}$	The nth root of a. The root of a quantity is denoted by a fractional index at the right hand side of the quantity and above it, the denominator of the index expressing the degree of the root; as, $a^{\frac{1}{2}}$, $a^{\frac{1}{3}}$, $a^{\frac{1}{5}}$; that is, the square, cube, and fifth roots of a, respectively
( ) [ ] { }	Parentheses, brackets and braces. Quantities enclosed by them to be taken together in multiplying, dividing, etc.
$\overline{AB}$	Length of line from A to B
$f(x)$, $F(x)$ or $\phi(x)$	Functions of x

dx . . . . Differential of x

$\frac{dy}{dx}$ or $f'(x)$ . . . . . . Derivative of $y = f(x)$ with respect to x

$\frac{d^2y}{dx^2}$ or $f''(x)$ . . . Second derivative of $y = f(x)$ with respect to x

$\frac{\partial z}{\partial x}$ . . . . Partial derivative of z with respect to x

$\frac{\partial^2 z}{\partial x\,\partial y}$ . . . . Second partial derivative of z with respect to y and z

$\int$ . . . . Integral; integral of;—denoting that the following expression is to be integrated; as $\int 2xdx = x^2$; that is the integral of $2xdx$ is x^2. If integration is to be performed more than once for each time; for a number of times greater than 3, and index is commonly written at the right hand above; as $\int^m xdx^m$ that is, the mth integral of xdx^m.

$\int_b^a$ . . . . Denotes that the integral is to be taken between the value b of the variable and its value a.

II . . . . Product; the continued product of all terms such as . . . .

($\wr$) . . . . A symbol for a quantic which has no numerical coefficients; as, $(a,b,c,d,\wr\, x,y)$ which denotes the quantic $ax^3+bx^2y+cxy^2+dy^3$

° . . . . Degree (arc or temperature)

′ . . . . Minute of arc (sexagesimal). Foot.

″ . . . . Second of arc (sexagesimal). Inch.

a^1, a^2, a^3 . . . . Indices placed above and at the right hand of quantities to denote that they are raised to powers whose degree is indicated by the figure; as, a^1; that is, the first power of a; a^2, the square, or second power, of a; a^3, the cube, or third power of a; and the like. These signs are also often used to indicate the repetition of an operation; as, d^2x, d^3x, d^4x, etc., indicating that the operation of differentiation has been performed upon x two, three, four, etc., times. As used to indicate powers, they are often preceded by the negative sign to indicate the reciprocal of the corresponding power, or an inverse operation; as, a^{-1}, a^{-2}, a^{-3}, a^{-4}, etc., which are respectively equivalent to $\frac{1}{a^1}, \frac{1}{a^2}, \frac{1}{a^3}, \frac{1}{a^4}$, etc.

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No. 164 APRONS—Black Rubber. Heavier than No. 160. Our most popular number. Excellent for general use. **Grade 1230.**
Per Dozen **7.80**

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Sleeves, to match Nos. 140-146 Aprons, are long and roomy. They are made with elastic ends which insure a snug fit and yet allow them to be easily and quickly removed.

No. 161 SLEEVES—Grade 1290. Per Dozen **1.80**

No. 165 SLEEVES—Grade 1230. Also recommended for use with Aprons—**Grade 1000. Per Dozen** **1.80**

No. 169 SLEEVES—Grade 1260. Per Dozen **1.80**

No. 173 SLEEVES—Grade 1215. Per Dozen **1.80**

Rubber Tubing

Tubing designed for ordinary purposes will not serve the requirements of the laboratory. The following grades of tubing, made according to our own specifications are noted for their long wearing qualities, flexibility, and elasticity.

Grade 9910 RUBBER TUBING—White Wrapped Light Wall, carefully made of the best materials and finished in a superior manner. For general laboratory use.

Inside diam. in.	1/8	3/16	1/4	5/16	3/8
Wall, in.	1/32	3/64	1/16	5/64	3/32
Approx. ft. per lb.	65	35	24	14	10
Price per lb.	4.00	1.75	1.05	1.00	.80

Inside diam. in.	1/2	5/8	3/4	1
Wall, in.	1/8	1/8	9/64	5/32
Approx. ft. per lb.	5	4	3	2
Price per lb.	.80	.80	.80	.80

Grade 9912 RUBBER TUBING—White Wrapped Pressure Tubing, Heavy Wall, of the same composition as Grade 423. Recommended especially for burner connections.

Inside diam. in.	1/8	3/16	1/4
Wall, in.	5/64	3/32	7/64
Approx. ft. per lb.	32	16	11
Price per lb.	1.20	1.00	.80

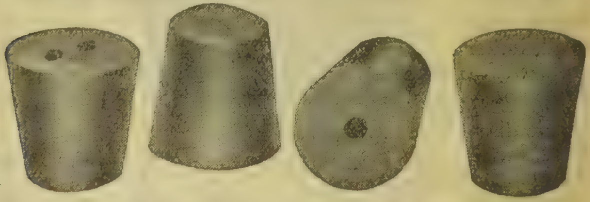
Inside diam. in.	5/16	3/8
Wall, in.	1/8	1/8
Approx. ft. per lb.	8	7
Price per lb.	.80	.80

Grade 9914 RUBBER TUBING—Pure Gum Red Antimony, of the finest selected crude rubber treated by the most improved methods.

Inside diam. in.	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$
Wall, in.	$\frac{1}{32}$	$\frac{3}{64}$	$\frac{1}{16}$
Approx. ft. per lb.	96	48	30
Price per lb.	4.80	2.40	1.45
Inside diam. in.	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$
Wall, in.	$\frac{5}{64}$	$\frac{3}{32}$	$\frac{7}{64}$
Approx. ft. per lb.	20	10	8
Price per lb.	1.20	1.00	1.00

Grade 9920 RUBBER TUBING—Black Pure Gum. The best for general laboratory use.

Inside diam. in.	$\frac{1}{8}$	$\frac{5}{32}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$
Wall, in.	$\frac{1}{32}$	$\frac{3}{64}$	$\frac{3}{64}$	$\frac{1}{16}$	$\frac{5}{64}$
Approx. ft. per lb.	130	70	57	40	25
Price per lb.	5.60	4.00	3.50	2.50	2.00
Inside diam. in.	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1
Wall, in.	$\frac{3}{32}$	$\frac{7}{64}$	$\frac{1}{8}$	$\frac{9}{64}$	$\frac{5}{32}$
Approx. ft. per lb.	18	11	8	6	5
Price per lb.	1.75	1.50	1.50	1.50	1.50



Pure Crepe Gum Rubber Stoppers

These rubbers stoppers are made from Pure Crepe Gum; full floating stock, non-blooming, and heat resisting. Have a specific gravity of .9718. Do not contain any fillers or adulterants. Based on longer life, freedom from hardening, better fit to the outlet and infrequent replacement, they represent a marked advance in the manufacture of Rubber Stoppers. A bomb test equivalent to five years exposure to atmospheric conditions, shows little or no change in quality. Manufactured in sizes 00 to 13. Compared to ordinary stoppers, you receive approximately 25% more to the pound. Upon request we will send you a table showing a complete range of sizes and the number of rubber stoppers you receive per pound, as compared to the ordinary stopper. Sample will be gladly furnished gratis.

Price — $1.00 per lb.